DIAVIK DIAMOND MINES INC.

2006 Wildlife Monitoring Report

March 2007

EXECUTIVE SUMMARY

As a requirement of the Environmental Agreement, Diavik Diamond Mines Inc. (DDMI) conducts a Wildlife Monitoring Program (WMP). The objective of the WMP is to collect information that will assist in determining if there are effects on wildlife in the study area and if these effects were accurately predicted in the Environmental Assessment. The WMP also permits the collection of data to determine the effectiveness of site-specific mitigation measures and the need for any modifications. The following report documents results collected for the 2006 Wildlife Monitoring Program for the Diavik Diamond Mine located at Lac de Gras, Northwest Territories. The data was collected according to procedures outlined in the revised 2002 Wildlife Monitoring Program. Wherever possible, comparisons to the information gathered during the previous monitoring years (2000 to 2005) and the pre-construction baseline (June 1995 to August 1997) have been included.

General observations and recommendations for possible improvement in each program are as follows:

VEGETATION/HABITAT LOSS

- Direct vegetation/habitat loss in 2006 due to the mine footprint was 0.71 km^2, which is within expected values. Total habitat loss to date from mining activities is 8.86 km^2.
- At the end of 2006, actual habitat loss for Riparian Tall Shrub (0.03 km^2) and Esker Complex (0.16 km^2) were equal to that predicted in the EA.
- As scheduled, permanent vegetation plots (PVPs) were reassessed in 2006.

BARREN-GROUND CARIBOU

- Direct summer habitat loss in 2006 from the mine footprint was 0.15 habitat units (HU's), which is within the expected amount.
- No caribou mortalities occurred due to the mine during 2006.
- The level of caribou advisory monitoring remained at "no concern" (no or fewer than 100 caribou) for 365 days during 2006.
- In 2005 and 2006, no caribou were observed within 3 km of the mine site during aerial surveys.
- DDMI is exploring options to modify the caribou aerial survey program for 2007.
- More effort is required to collect data on ground-based caribou behavioural observations in 2007. This program will focus on increasing the number of samples for caribou behaviour within the anticipated Zone of Influence (ZOI).
- DDMI will incorporate calf:cow ratio counts into the caribou monitoring program for 2007.

GRIZZLY BEAR

- Direct terrestrial habitat loss in 2006 from the mine footprint was within the expected amount at 0.43 km^2.
- Grizzly bears are still present in the Diavik wildlife study area.
- No mining-related bear mortalities, injuries or relocations occurred during 2006.

WOLVERINE

- Wolverines were present on East Island in 2006.
- No mining-related wolverine mortalities, injuries or relocations occurred during 2006.
- DDMI fulfilled its participation commitment to the DNA analysis program in 2006.
- DDMI recommends that snow track surveys be changed to randomly-selected 4 kilometer transects for the 2007 program. The number of transects required for the DDMI wildlife study area will be determined by an independent expert, with overall methods of the program being comparable to those of neighbouring developments.
- Wire fencing, mesh or other material will be evaluated and installed as skirting around south camp, where practical, to prevent wolverine access.

WASTE MANAGEMENT

- Regular inspections were conducted at the Waste Transfer Area (WTA) and Inert Landfill in 2006.
- Food and food packaging were found during 18% and 13% of inspections, respectively, at the WTA.
- Food and food packaging were found during 11% and 36% of inspections, respectively, at the inert landfill.

RAPTORS

- Raptor monitoring was performed in June and July 2006, with this being the third year DDMI conducted spring monitoring.
- During 2006, three raptor nests (two peregrine and one gyrfalcon) were productive within the Diavik study area.
- Peregrine falcons returned in 2006 and continued to nest on the high wall of the A154 pit.
- No project-related mortalities occurred during 2006.

WATERFOWL

- Habitat loss in 2006 was within the expected range and equaled 0.28 km^2 of shallow and deep water. This loss was due to construction of the A418 dike.
- Waterfowl were present at East Island Shallow Bays.
- Waterfowl are utilizing mine-altered wetlands, particularly the North Inlet.

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1. INTRODUCTION

Diavik Diamond Mines Inc. (DDMI) conducted wildlife baseline studies from 1995 to 1997. Information gathered was used to describe ecological conditions found in the Lac de Gras area in support of the Project Description and Environmental Assessment (DDMI, March 1998a, 1998b). Information was used by DDMI throughout the project design to identify mitigation measures to minimize impacts on wildlife species and to formulate predictions of the effects on wildlife due to mining activities. This information was used to develop a Wildlife Monitoring Program (WMP) for the Diavik Diamond Mine. Documents that were utilized in developing the WMP include:

- Comprehensive Study Report, The Canadian Environmental Assessment Act June 1999;
- Environmental Assessment Overview, Diavik Diamonds Project, September 1998;
- Environmental Effects Report, Wildlife, Diavik Diamonds Project, September 1998; and
- Wildlife Baseline Report, Diavik Diamonds Project, Penner and Associates, July 1998.

A Wildlife Monitoring Program (DDMI, 2002) was designed specifically to monitor and manage wildlife issues of concern identified by communities and regulatory agencies. The year 2006 was the seventh year of monitoring, and the fourth year that the complete revised WMP was initiated. Revisions to the WMP took place during meetings with the Environmental Monitoring Advisory Board (EMAB) and Environment and Natural Resources (ENR). Recommendations from the interested parties included a joint effort with BHP Billiton (BHPB) in conducting caribou and raptor monitoring. John Virgl of Golder Associates was contracted to assist in the development of the WMP and has provided expertise in data collection methods for the majority of programs to ensure similarity to other wildlife effects monitoring programs in the NWT.

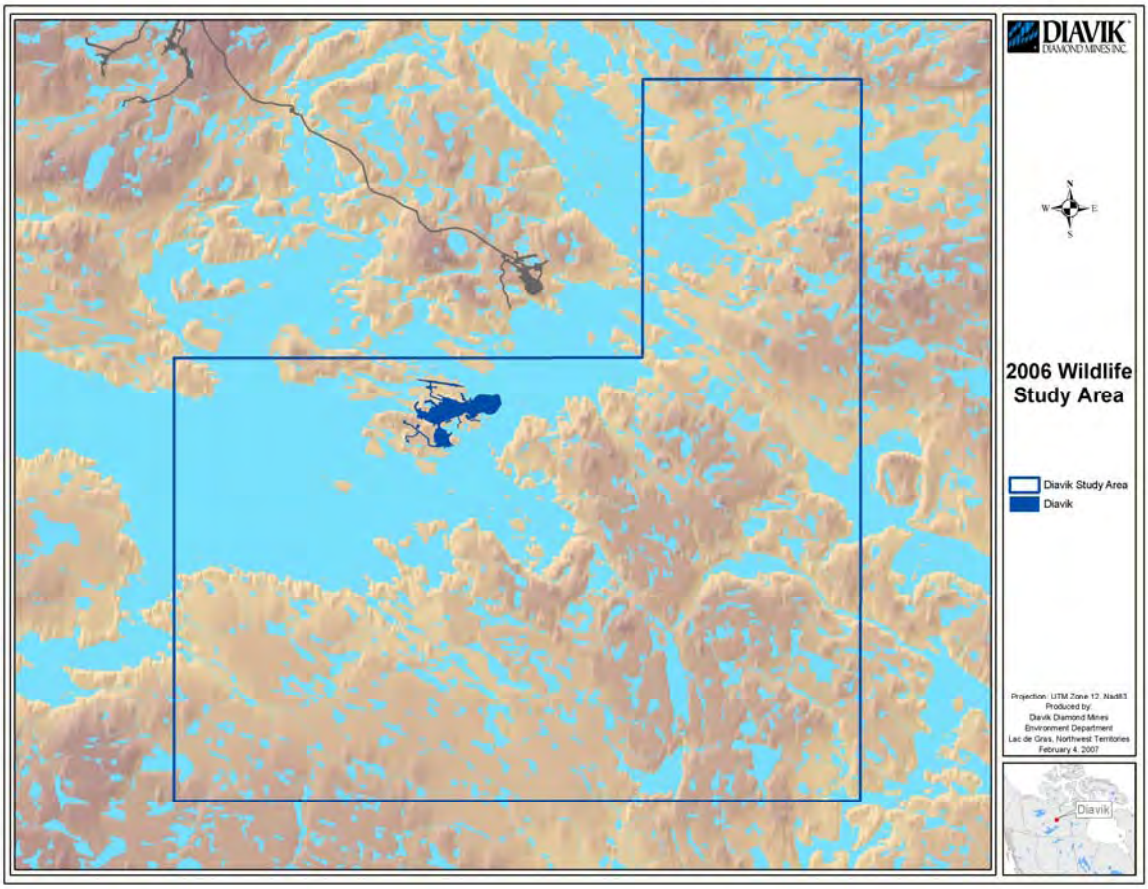
The primary objectives of the monitoring program are to:

- Collect information that will assist DDMI in determining if there are effects on wildlife and if these effects were accurately predicted in the Environmental Assessment (EA);
- Assist in determining the effectiveness of mitigation measures intended to minimize project-related effects on wildlife and whether or not these measures require modification; and
- Determine if new effects are found that were not predicted in the Environmental Assessment.

The wildlife study area (Figure 1-1) encompasses approximately 1200 square kilometers. Its boundaries are roughly: west - the southwest arm of Lac de Gras, east - Thonokeid Lake, north - the BHPB wildlife survey area and south - the north shore of MacKay Lake. An extension to the northwest was made to include the Lac du Sauvage narrows. The local study area during baseline studies (Penner, 1998) covered an area of approximately 805 square kilometers and the rationale for increasing the study area during current and future

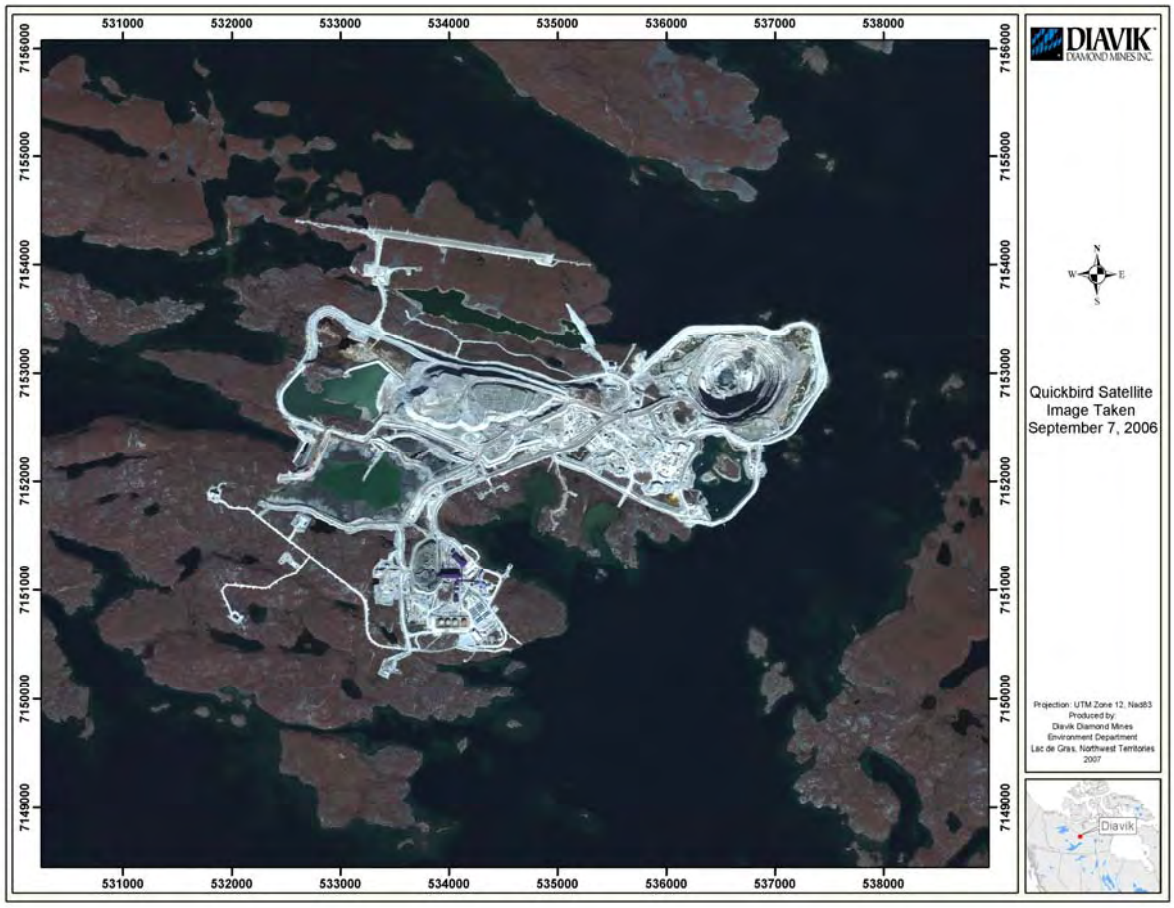
monitoring was to take into account the eastern portion of Lac du Sauvage, as this area was identified in the Wildlife Baseline Report (Penner, 1998) as an important movement corridor for caribou.

Figure 1-1 Diavik's Wildlife Study Area



The mine footprint is restricted to East Island and consists of haul roads, an airstrip, country rock piles, A154 pit, A418 dike and all mine infrastructure (Figure 1-2).

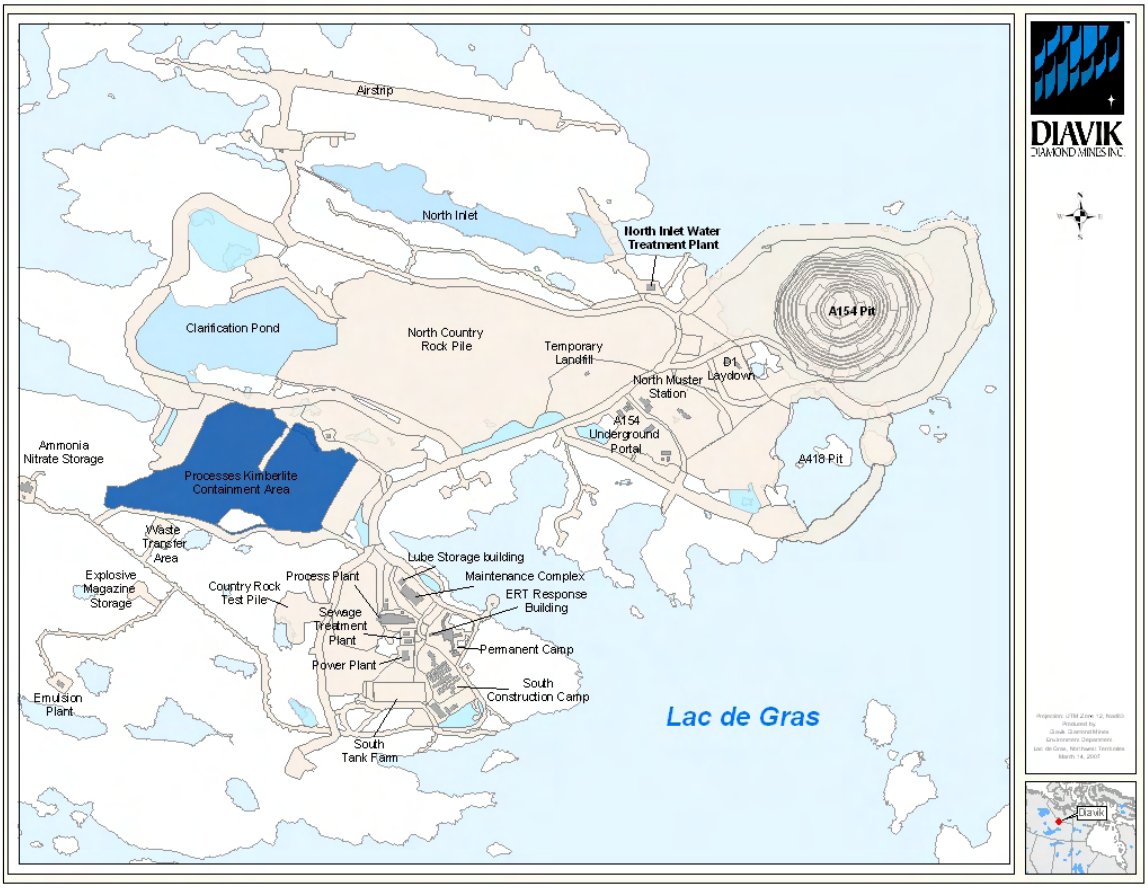
Figure 1-2 Satellite Image of East Island – 2006



During 2006, the perimeter of the A418 dike was completed and the pool was dewatered to facilitate stripping of lakebed sediments in preparation for mining. All haul roads required for mining activities to date are complete (Figure 1-3).

A number of construction projects and underground feasibility tests were conducted during 2006. Due to this increase in activity, the number of people present on East Island equaled an annual average of 716 people. The average population of the main camp accommodation was 310 people while the average for south camp accommodation was 406 people. On July 11th, 2006, East Island reached its peak population of 892 people; this consisted of 328 and 564 people in the main and south camp accommodations, respectively.

Figure 1-3 Infrastructure Present on East Island in 2006



This report is divided into nine sections that make up the core-monitoring program:

- Vegetation/Wildlife Habitat
- Caribou
- Caribou Advisory
- Caribou Mitigation Effectiveness
- Grizzly Bear
- Wolverine
- Waste Management
- Raptors
- Waterfowl

Within each section of the report, data analysis is presented that will be tracked over the life of the mine. Recommendations for enhancement to the WMP are presented at the end of each section for consideration. Based on technical experience gained throughout the baseline period and the ongoing monitoring program (in this case the 2006 program), key recommendations are described in this report and will be incorporated into the Wildlife Monitoring Program for subsequent years. The DDMI WMP will be an evolving program that

will reflect recommendations during previous years, as well as advances in project development.

Photo 1.1-1 SikSik on East Island

2. VEGETATION

2.1 VEGETATION LOSS

East Island's vegetation cover is predominantly characterized by heath tundra, heath tundra with boulders and/or bedrock and tussock/hummock habitat types. The main effect on vegetation during operations is the reduction in the geographic extent of all vegetation/land cover types due to disturbance caused by the mine and the mine infrastructure. The recovery of vegetation life would be slow, which is characteristic of arctic environments (Burt, 1997). The direct loss of vegetation/wildlife habitat due to mining activities is important as it decreases the biodiversity at the landscape, community and species level (DDMI, 1998a). This would be a direct loss of habitat utilization for wildlife, but also altered landscapes may attract certain wildlife species such as caribou that could make use of the airstrip and hauls roads for insect relief (Mueller and Gunn, 1996).

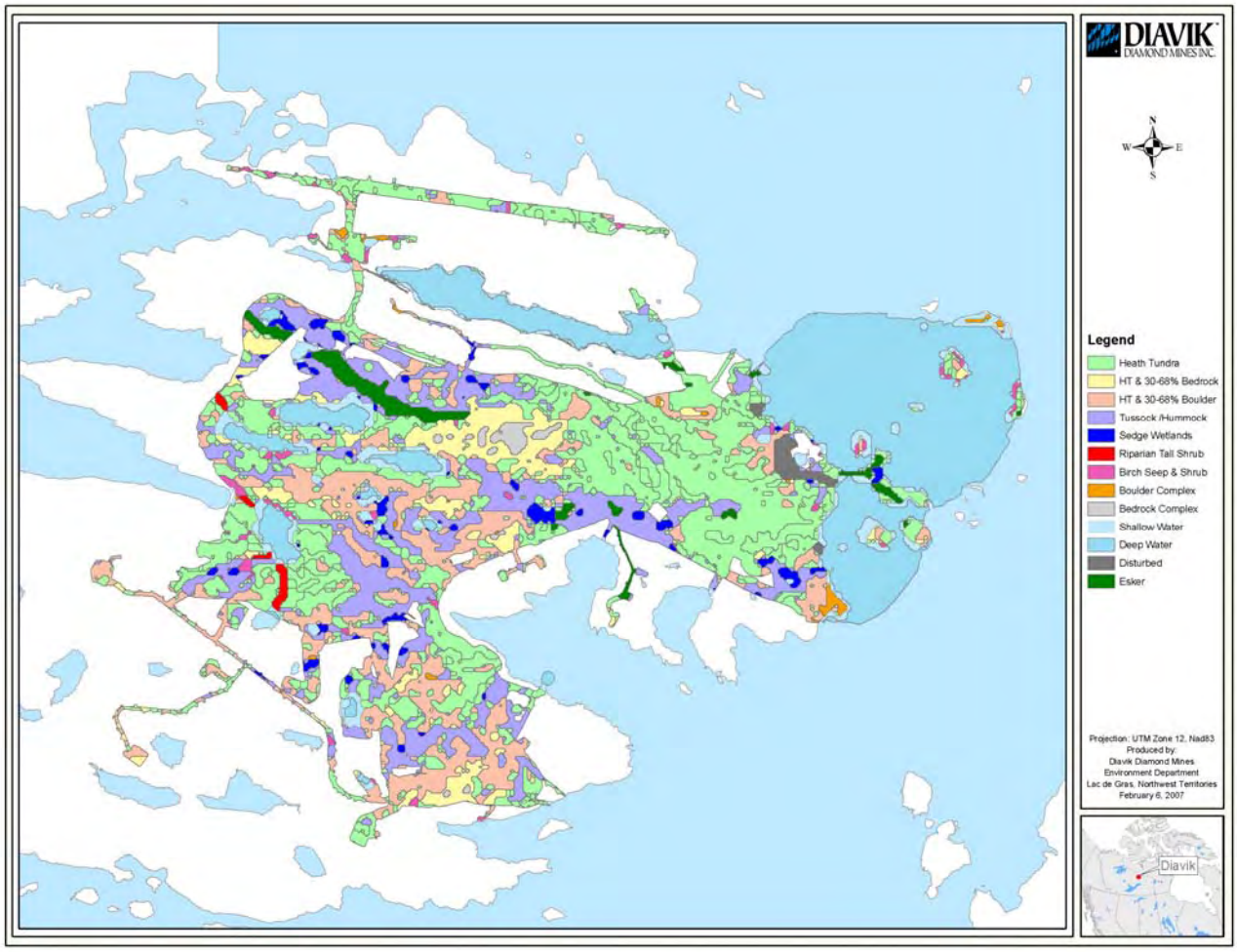
The intent for this program is to determine if vegetation loss is within the extent predicted in the Environmental Effects Report (DDMI, 1998b). The objective is:

> ***To determine if direct vegetation/habitat loss due to the mine footprint exceeds the prediction of 12.67 km^2.***

METHODS

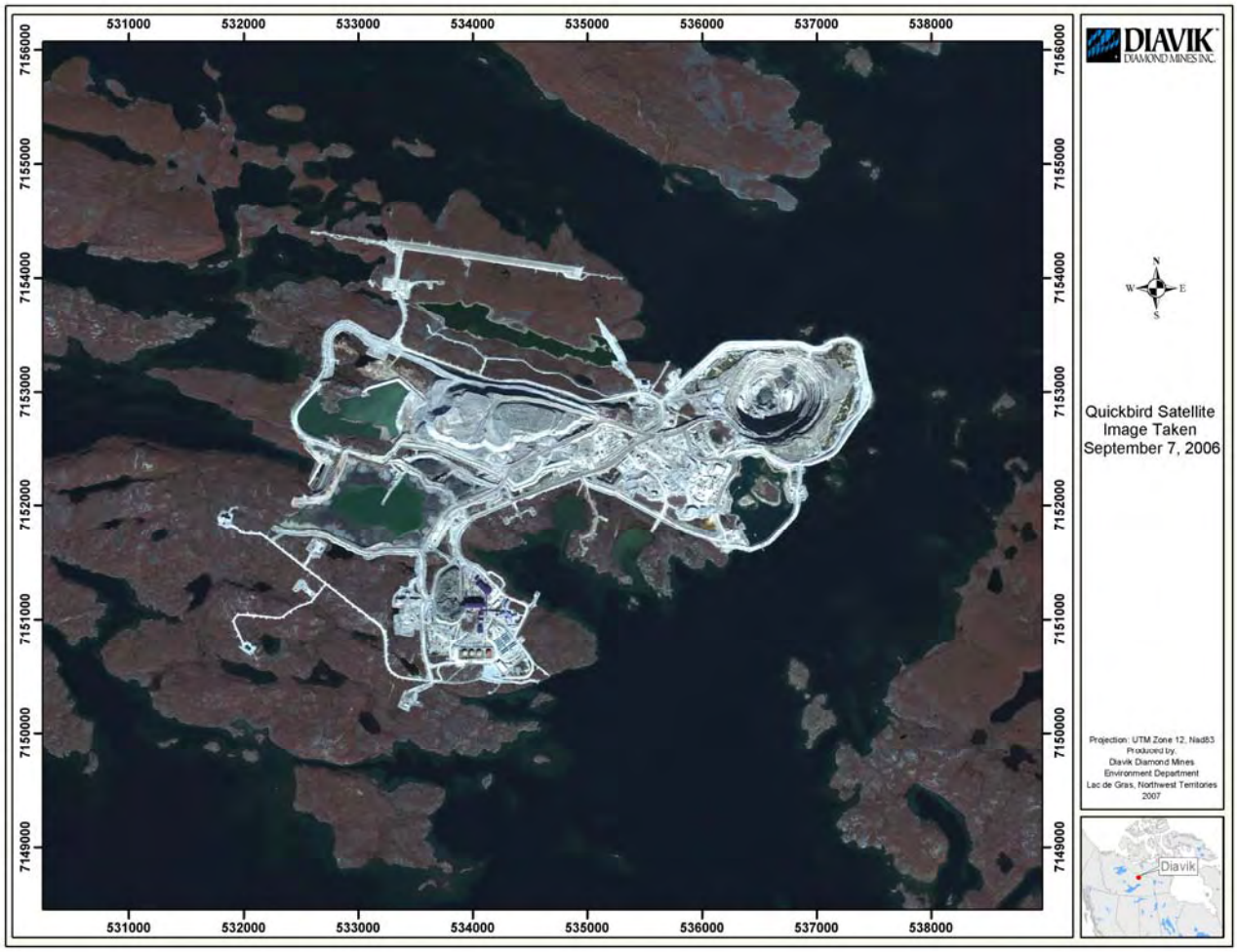
A map showing the final mine footprint (12.67 km^2) has been superimposed on the vegetation classification map used in the vegetation/land cover section of the Environmental Effects Report (DDMI, 1998b) (Figure 2.1-1). This analysis estimated the absolute and relative area of each habitat type within the final footprint. The vegetation classification map from the EER was used because the map used in the wildlife section of the EER report was created at a coarser scale (lower resolution). The vegetation map with the higher resolution allowed for a more precise estimate of the relative areas of each habitat type and is consistent with both the vegetation maps used in this report and the habitat analyses conducted since 1998.

Figure 2.1-1 Reconciliation of Predicted Total Habitat Loss on East Island, 2006



For 2000 through 2005, an Ikonos satellite image of the mine site area was obtained and used to update the area of the current mine footprint. For 2006, the same process was used; however, a higher resolution Quickbird satellite image was used to derive the mine footprint (Figure 2.1-2). This dataset was then laid over the vegetation baseline image which shows each vegetation/habitat type based on the Ecological Landscape Classification developed by ENR (Matthews *et. al* 2001). Each vegetation/habitat type that has been replaced by the mine footprint was selected and area calculations made to determine how many square kilometers of each habitat type have been replaced by the mine footprint.

Figure 2.1-2 Satellite Image of East Island - 2006



RESULTS

The mine footprint is restricted to East Island and consists of haul roads, an airstrip, country rock piles, A154 pit, A418 dike and all mine infrastructures (Figure 2.1-2). As of December 2006, a total of 8.86 km^2 of habitat has been altered due to mine footprint expansion, with construction beginning in 2000. This represents a total loss of 69.9% of the predicted mine disturbance (Figure 2.1-3). Direct habitat loss in 2006 was 0.71 km^2. Heath tundra represents the largest cumulative loss on East Island over the years (Table 2.1-1), and represents the largest predicted vegetation habitat type loss due to mining activities.

Figure 2.1-3 Type of Habitat Loss on East Island – 2000-2006

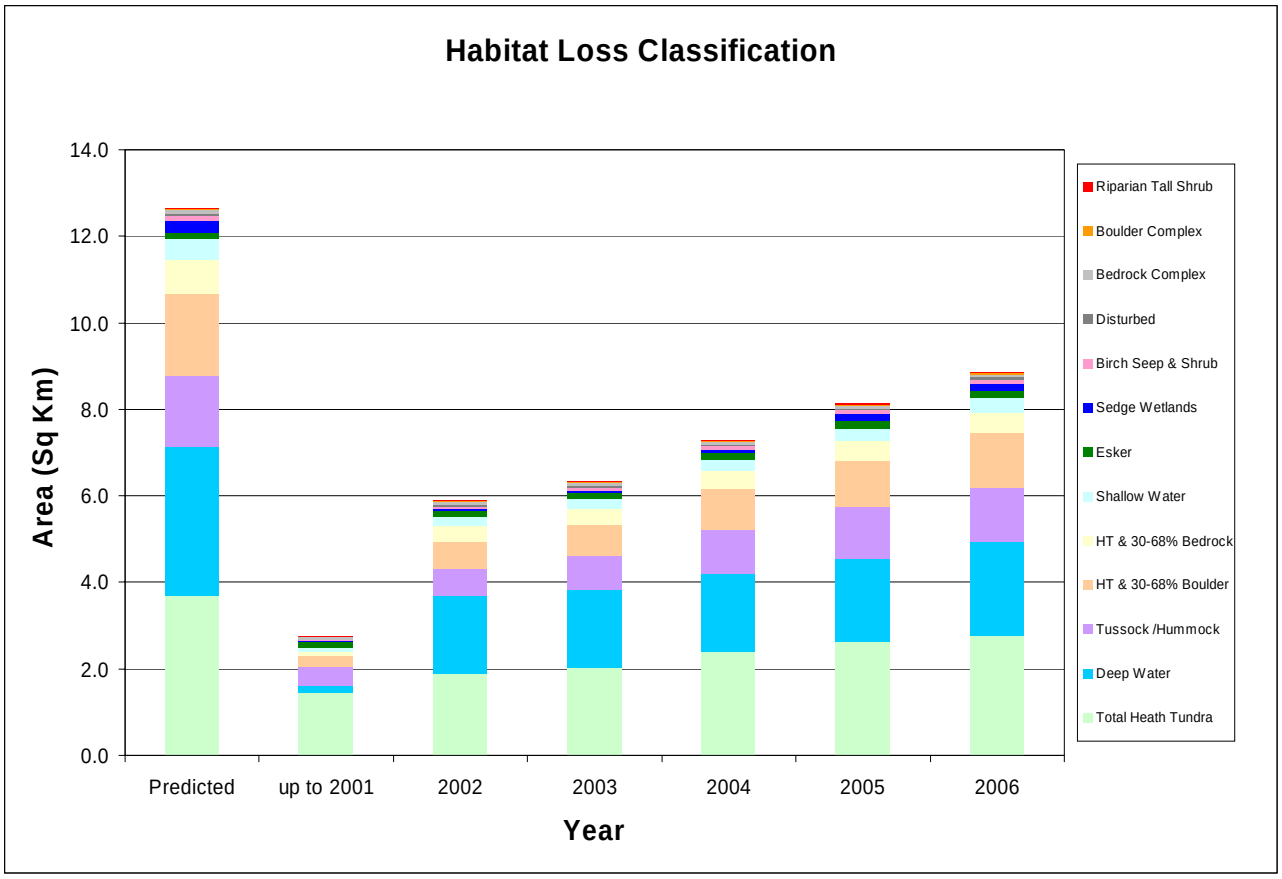


Table 2.1-1 Predicted Mine Disturbance versus Actual Mine Disturbance for All Years (2000-2006)

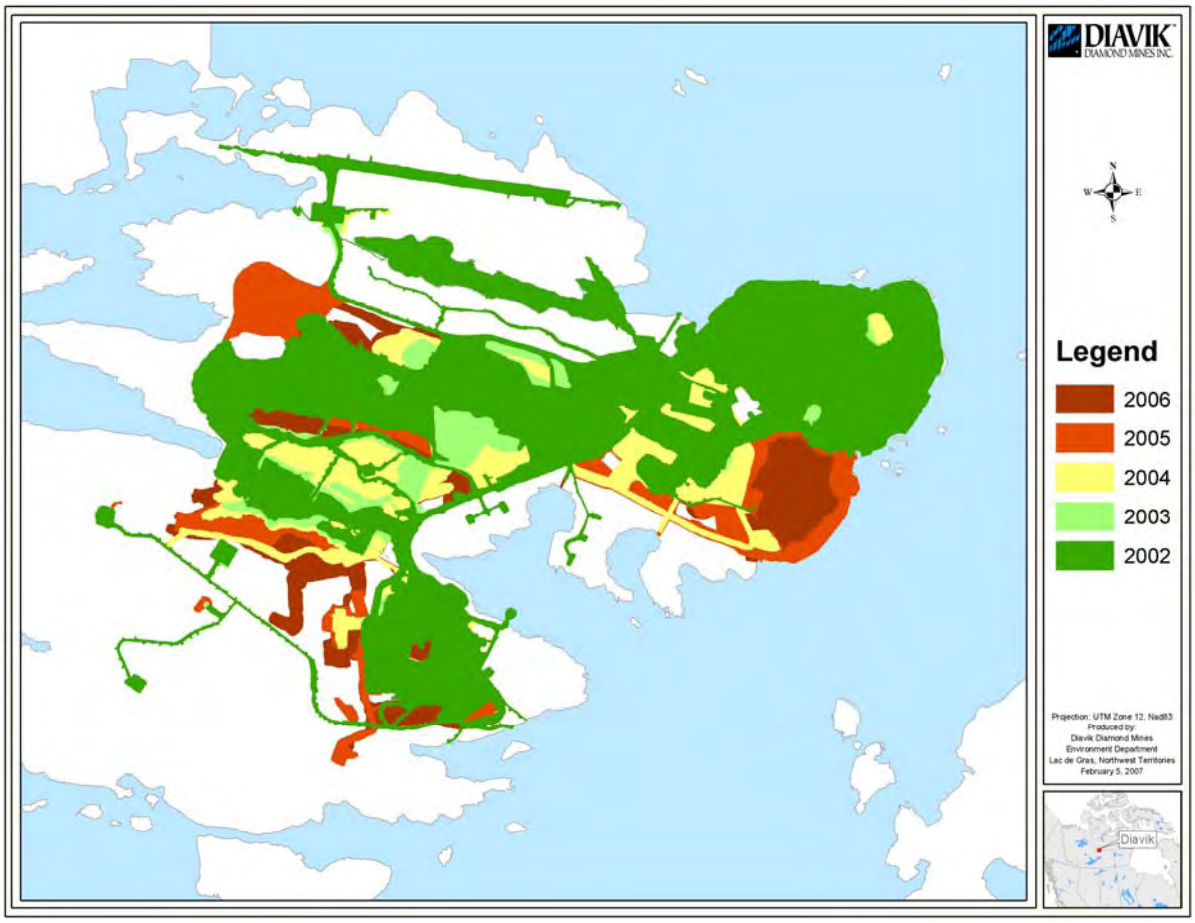
Habitat Classification	Total Area Lost to Date (km²)						Area Loss 2006	Predicted
	up to 2001	2002	2003	2004	2005	2006		
Total Heath Tundra	1.45	1.89	2.02	2.38	2.62	2.76	0.14	3.68
HT & 30-68% Bedrock	0.08	0.34	0.36	0.4	0.45	0.49	0.04	0.78
HT & 30-68% Boulder	0.26	0.64	0.73	0.96	1.07	1.24	0.17	1.89
Tussock/Hummock	0.45	0.63	0.79	1.01	1.19	1.27	0.08	1.64
Sedge Wetlands	0.02	0.03	0.04	0.09	0.16	0.16	0	0.26
Riparian Tall Shrub	0.01	0.02	0.02	0.02	0.03	0.03	0	0.03
Birch Seep & Shrub	0.03	0.05	0.06	0.08	0.08	0.09	0	0.11
Boulder Complex	0.01	0.02	0.02	0.03	0.03	0.04	0	0.05
Bedrock Complex	0.05	0.05	0.05	0.05	0.05	0.06	0	0.07
Shallow Water	0.11	0.23	0.23	0.26	0.29	0.34	0.04	0.48
Deep Water	0.15	1.8	1.81	1.82	1.93	2.17	0.24	3.46
Disturbed	0	0.05	0.05	0.05	0.05	0.05	0	0.06
Esker	0.13	0.14	0.14	0.15	0.16	0.17	0	0.16
Total	**3.12**	**5.88**	**6.32**	**7.3**	**8.15**	**8.86**	**0.71**	**12.67**

**** Any discrepancies in totals across the rows results from the rounding of numbers in annual columns for presentation purposes***

*****Values in red represent actual habitat loss equal to or exceeding that predicted***

In 2006, construction and subsequent dewatering of the A418 dike caused the greatest loss of habitat to be deep water (0.24 km^2) followed by heath tundra and boulder mix (0.17 km^2). A progression of habitat loss from the mine footprint can be seen in Figure 2.1-4.

Figure 2.1-4 Progression of Habitat Loss on East Island, 2002 – 2006



Two habitat types reached their predicted maximum for mine disturbance during 2005; riparian tall shrub (0.03 km^2) and esker complex (0.16 km^2). Vegetation loss has previously been calculated cumulatively, adding loss from the previous year to that of the current year. In 2006, vegetation loss values were re-calculated using the total area of each habitat lost, up to and including the end of the current year. By eliminating cumulatively calculated values, variance associated with rounding those individual losses is reduced. While a minor discrepancy in value for eskers occurred as a result of this calculation, this value more accurately reflects total habitat loss within the predicted mine footprint. To this end, re-calculation of esker complex loss was slightly higher than last year (0.17 km^2), and exceeds the predicted loss of 0.16 km^2, even though the mine footprint did not alter esker habitat in 2006 (Table 2.1-1).

Three land cover types that were approaching their maximums by the end of 2005 have still not met or exceeded their predicted maximums. Boulder and bedrock complexes reached a loss of 0.04 km^2 and 0.06 km^2, compared with their predicted values of 0.05 km^2 and 0.07 km^2, respectively. In addition, as the area of previous human disturbance that has been altered by the mine (0.05 km^2) is approaching the predicted value of 0.06 km^2.

Photo 2.1-1 Natural Re-vegetation of Arctic Poppies - 22 June 2006

Diavik's exploration camp is found on the north eastern shore of Lac du Sauvage. Although vegetation loss due to Diavik's exploration camp was not a component of the EA, it was included in the 2003 Wildlife Monitoring Program Report at the request of reviewers. The area of the camp previously reported (0.00051 km^2) did not change during 2006.

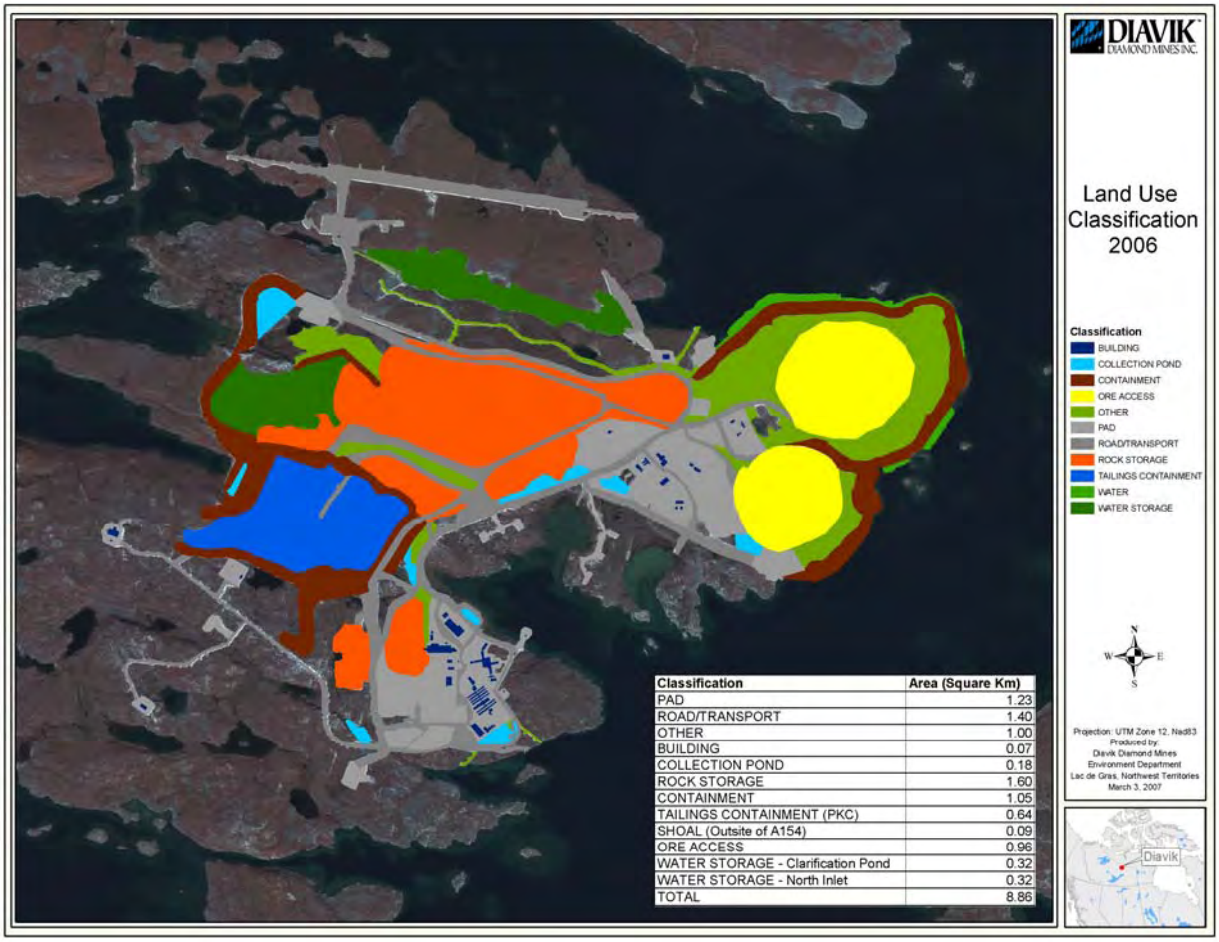
2.2 LAND USE CLASSIFICATION

DDMI began a land use classification program in 2005. All disturbed habitat was classified into categories based on current land use practices (Table 2.2-1). Land use areas correlate to vegetation loss and account for the type of infrastructure development that has occurred within the affected areas.

Table 2.2-1Total Land Use Categorized by End Use (2005 & 2006)

Category	km²	
	2005	2006
PAD	1.23	1.23
ROAD/TRANSPORT	1.25	1.40
OTHER	0.89	1.00
BUILDING	0.07	0.07
COLLECTION POND*	0.28	0.18
ROCK STORAGE	1.57	1.60
CONTAINMENT	0.84	1.05
TAILINGS CONTAINMENT (PKC)	0.62	0.64
SHOAL (Outside of A154)	0.09	0.09
ORE ACCESS	0.56	0.96
WATER STORAGE - Clarification Pond	0.42	0.32
WATER STORAGE - North Inlet	0.32	0.32
TOTAL	**8.15**	**8.86**

Figure 2.2-1 Land Use Classifications Superimposed on the Diavik Mine Satellite Image (2006)



Classification	Area (Square Km)
PAD	1.23
ROAD/TRANSPORT	1.40
OTHER	1.00
BUILDING	0.07
COLLECTION POND	0.18
ROCK STORAGE	1.60
CONTAINMENT	1.05
TAILINGS CONTAINMENT (PKC)	0.64
SHOAL (Outsite of A154)	0.09
ORE ACCESS	0.96
WATER STORAGE - Clarification Pond	0.32
WATER STORAGE - North Inlet	0.32
TOTAL	8.86

2.3 HABITAT ASSESSMENT (PERMANENT VEGETATION PLOTS)

A habitat assessment on East Island vegetation is performed to observe vegetation conditions, providing plant species identification and percent coverage in a given plot and habitat type. The analysis will be used to determine if any change is occurring in habitat communities in areas of dust deposition.

METHODS

In 2001, ten permanent vegetation plots (PVPs) were established by DDMI for habitat analysis. Nine PVPs were established on East Island; five were within heath tundra, three within wet tundra, and one on an esker. The tenth PVP was a reference (control) located on the adjacent mainland within heath tundra. The PVPs were assessed in 2001 and 2004. Following the 2004 assessment by the University of Alberta, recommendations were made to enhance data collection and analyses. The recommendations included biannual monitoring, permanent marking of plots, and the addition of reference plots and plots in

specific vegetation communities to balance the monitoring design. The majority of recommendations were accepted by DDMI and implemented for the 2006 assessment.

Since 2004, four PVPs on East Island (4, 5, 6 and 9) were lost to new mine development; three were heath tundra plots and one was a tussock-hummock plot. Five new PVPs were established on the island and included equal representation of dominant vegetation communities (Figure 2.3-1). Shrub communities were added to the habitat assessment as they were one of the dominant vegetation types on East Island. New PVPs were located on the west side of the island outside of areas included in the long-term development plan for the mine. Of the original ten PVPs there was only one reference located within heath tundra. To ensure appropriate comparison of mine plots and undisturbed plots, eight new reference PVPs were established at three locations off East Island (Figure 2.3-1). The three reference locations will be referred to as TK Camp Reference, South Reference, and West Island Reference. At each of these locations, one PVP was established in heath tundra, one in tussock-hummock and one in a shrub community (Table 2.2-1).

Figure 2.3-1 Permanent Vegetation Plots Assessed for the Diavik Mine Site – 2006

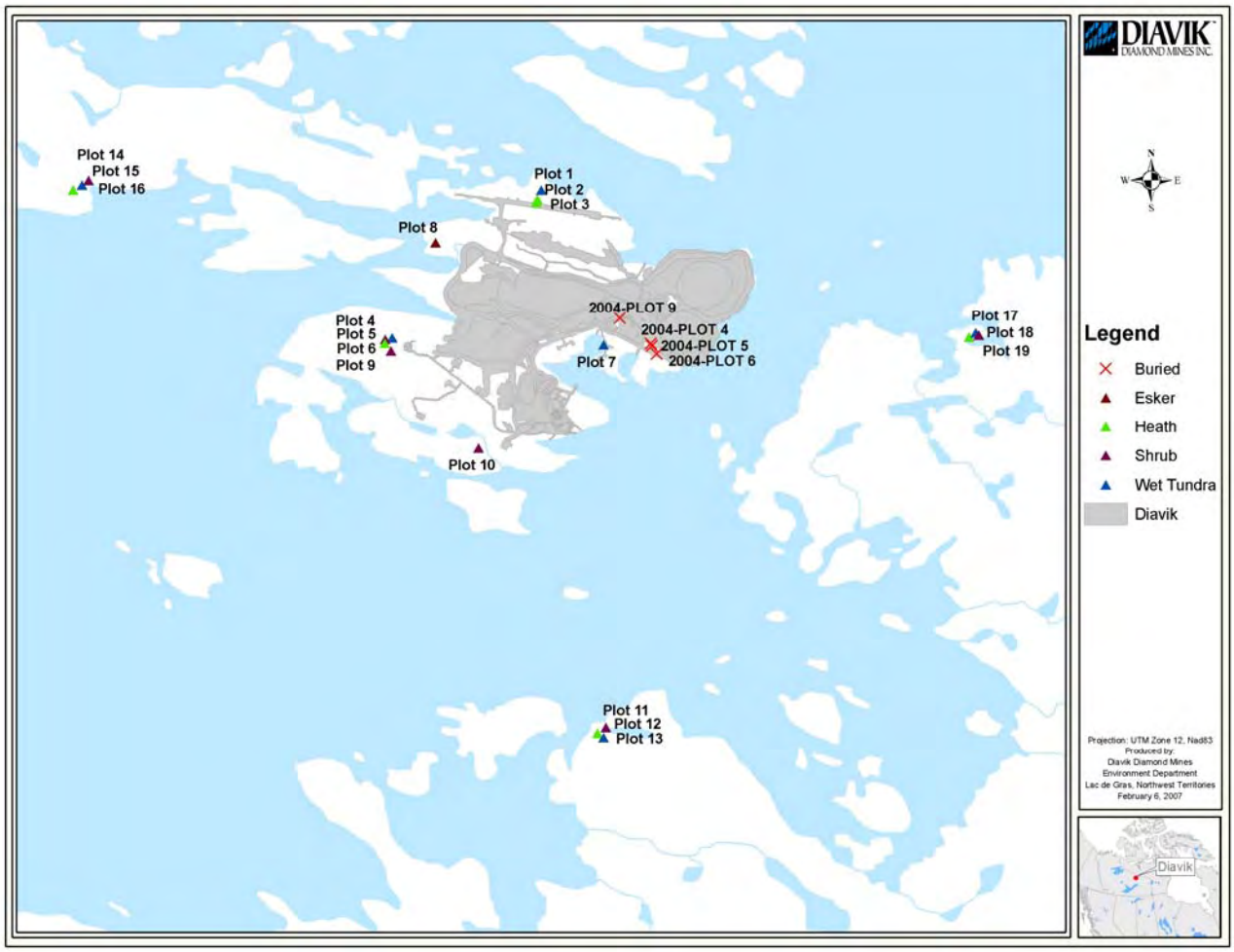


Table 2.3-1 Coordinates and Location Descriptions for PVPs

Plot No.	Community	Location	Easting	Northing
Plot 1	Heath Tundra	East Island	533933	7144275
Plot 2	Heath Tundra	East Island	533953	7154320
Plot 3	Tussock-hummock	East Island	534018	7154475
Plot 4	Tussock-hummock	East Island	531569	7152036
Plot 5	Shrub	East Island	531456	7152013
Plot 6	Heath Tundra	East Island	531451	7151948
Plot 7	Tussock-hummock	East Island	535039	7151919
Plot 8	Esker	East Island	532280	7153613
Plot 9	Shrub	East Island	531549	7151822
Plot 10	Shrub	East Island	532985	7150216
Plot 11	Heath Tundra	South Control	534939	7145517
Plot 12	Tussock-hummock	South Control	535036	7145450
Plot 13	Shrub	South Control	535079	7145615
Plot 14	Heath Tundra	West Island Control	526340	7154474
Plot 15	Tussock-hummock	West Island Control	526482	7154560
Plot 16	Shrub	West Island Control	526590	7154634
Plot 17	Heath Tundra	TK Camp Control	541033	7152048
Plot 18	Tussock-hummock	TK Camp Control	541140	7152118
Plot 19	Shrub	TK Camp Control	541192	7152078

At all new established PVPs, UTM coordinates were recorded and wooden stakes were placed in the NW and SE corners (Table 2.3-1); two marked corners are sufficient to locate plots during future monitoring. Tops of stakes, new and old, were spray painted pink to

increase ease of plot location. Previous PVPs were not remarked in 2006, therefore this is suggested for the 2008 monitoring period.

Plots were assessed 18 – 21 July 2006. Standard operating procedures developed in 2001 were followed. Each established 2 m x 2 m PVP was located by GPS and divided into four 1 m^2 quadrats with string. A 1 m^2 quadrat, divided into 100 10 cm^2 squares, was placed in the NW position. Starting with this NW quadrat and working clockwise, percent vegetation cover by species was visually assessed by Sarah Wilkinson and Bonnie Kwiatkowski (University of Alberta). Only those plants rooted in the PVPs were counted. Total vegetation cover could sum to more than 100% due to overlap in vegetation layers (e.g. shrub layer, herbaceous layer, prostrate or creeping vegetation layer). Within a vegetation layer, cover does not add to more than 100%. Samples of unidentifiable plant species were taken from outside the PVPs and stored in individually labeled plastic bags under cool conditions until a more detailed identification could be conducted. Density of non-rhizomatous or mat-forming species was recorded. Accurate densities for rhizomatous or creeping species are not possible to obtain (see Recommendations).

Ground cover was measured and included lichen, moss, bare ground, rock, litter and animal pellets. Lichen species and moss species were grouped for cover measurements; however, presence and absence data for individual lichen and moss species were recorded. Ground cover does not add to more than 100%. A digital photograph was taken of each quadrat and clearly labeled with the plot number, quadrat direction, vegetation type, and year.

Data were tested for normality and homogeneity of variance prior to statistical analyses. Only a few species, mainly those with very low abundance (<1% cover), did not meet the requirements of Levene's Test and therefore, parametric tests which were robust for heterogeneous variance were employed. Independent t-tests were performed on 2006 data to compare mine and control plots. Statistical analyses could not be conducted on 2001 and 2004 data due to the lack of references. One-way analysis of variance (ANOVA) was conducted on heath tundra and tussock-hummock data with year as a fixed factor. All analyses were conducted in SPSS 14.0 (SPSS Inc. 2005) using a significance level of 0.05.

RESULTS

In heath tundra communities, a total of 19 species were identified within mine plots and 9 species within reference plots, with an average number of species per plot of 12 and 7, respectively. Mean cover data are presented in Tables 1 and 2 (Appendix VIII). Canopy cover in both mine and reference plots was dominated by *Ledum decumbens* (northern labrador tea) and *Vaccinium vitis idaea* (mountain or bog cranberry). Terricolous (soil) lichens dominate the ground cover on and off the mine site, although it was significantly higher in reference than mine plots (19.17% vs. 6.17%, $P = 0.026$). The dominant lichens at both mine and reference sites were *Flavocetraria nivalis*, *Flavocetraria cucullata* and *Cladina* species. Lichen diversity was similar between sites and ranged from 7 to 13 species per plot. There were no other cover differences between sites.

In tussock-hummock communities, 18 species were found on the mine site and 17 in reference plots, with average plot values of 10 and 14 species, respectively. Canopy cover was dominated by *Eriophorum vaginatum* (cottongrass) and *Ledum decumbens*; ground cover was dominated by moss. *Sphagnum* species and *Aulacomnium turgidum* were the dominant mosses. Moss cover appears to be greater within mine plots in all vegetation

types compared to controls, however, results were not statistically significant (Table 2, Appendix VIII).

In shrub communities, 13 species were found on the mine site and 16 species in reference plots, with average plot values of 10 and 13 species, respectively. Canopy cover was dominated by *Betula glandulosa* (bog birch), *Vaccinium vitis idaea* and *Ledum decumbens*, while litter was the dominant ground cover. *Betula glandulosa* and *Arctostaphylos rubra* comprised the majority of the litter layer. Mine plots also had high cover of *Empetrum nigrum* (crowberry) compared to controls (Table 2, Appendix VIII). There were, however, no statistically significant differences in canopy or ground cover between sites for shrub communities.

The esker community, on the mine site, contained a total of 4 species and was dominated by *Empetrum nigrum*. Ground cover was dominated by litter. Only one plot was established on the mine site as this vegetation type is not common. The esker community had the highest amount of bare ground (8.56%) and the lowest species richness (4) when compared to heath tundra, tussock-hummock or shrub communities on or off the mine site. This is not unexpected as eskers have little soil, and therefore moisture and nutrients, to facilitate plant establishment.

Density data were collected for *Betula* (birch) and *Salix* (willow) shrub species. There was no statistically significant difference in shrub densities between the mine and reference sites. *Betula* density was greatest in reference shrub communities (15) and in wet tundra mine sites (9). Densities in other communities within references (heath 2, wet tundra 3) and mine sites (heath 3, shrub 5) were similar. Density data do not reflect the same patterns observed for *Betula* cover (see Table 2, Appendix VIII). Within reference sites, *Salix planifolia* density was greatest in wet tundra (4) and less then one individual in shrub communities. *Salix glauca* had a density of 1 in shrub communities and was not present in other reference vegetation types. Within mine sites, *Salix planifolia* had a mean density of one individual in heath and wet tundra, and *Salix glauca* a mean density of 1 in heath; these two species were not present in shrub communities.

Density counts may be redundant when cover by species is assessed, as both are measures of relative species abundance. Cover accounts for plant size as smaller plants receive less importance (cover) than larger plants, while density gives equal importance to small and large plants. Density is very sensitive to natural annual fluctuations in mortality and recruitment; while changes from year to year may be detected they may not be due to mine activities. Cover is more robust to these annual fluctuations, thus changes over time can be attributed to disturbance. Stem counts are not always accurate counts of individuals as one individual can be composed of many stems for rhizomatous, creeping or loosely tufted plant species, which are common on the tundra. Plant counts may be accurately conducted for *Betula* and *Salix* species, some forbs and bunch graminoid species.

Between years analysis of heath tundra and tussock-hummock data from the mine site indicated no significant changes in canopy cover for species that were found in all years (Table 3, Appendix VIII). A few new species were reported in 2006, where new plots were established. There was no statistically significant difference in ground cover, except for bare ground in heath ($F = 6.12$, $P = 0.016$), and differences can be explained by the methods. In 2001 a bird's eye view approach was used, thus bare ground could easily be obscured by vegetation canopy layers, whereas in 2006, ground cover was partitioned further to include

litter. These changes in methods will allow for collection of more ecologically meaningful data.

SUMMARY

There were no statistically significant differences in vegetation and ground cover between mine and reference permanent vegetation plots. Species composition was similar between mine and reference plots for each of the three plant communities assessed. Vegetation and ground cover in heath tundra and tussock-hummock communities on the mine site has not changed significantly between 2001 and 2006.

2.4 RECOMMENDATIONS FOR THE 2007 PROGRAM

Continue calculating total vegetation loss based on total area of each habitat lost, up to and including the end of the current year.

Stake plots with more durable material such as PVC piping or rebar. Staking one corner and then noting compass direction for orientation of PVP would be sufficient.

Revise Standard Operating Procedures to reflect changes in monitoring methods as discussed in this report.

Increase the number of monitoring plots in each plant community to better determine the natural variability within each community. Data from 2006 indicated that three plots are too low to determine potential effects. While dominant species are accounted for and are generally consistent within a community, the composition of less abundant species is highly variable. With such a small sample size, a difference in species composition of one plot can skew the final data and comparisons between mine and reference sites. We suggest at least 5 plots per plant community.

3. CARIBOU MONITORING

The Bathurst caribou herd is currently the largest of the four major barren-land caribou herds found on the mainland of the NWT. New estimates of the Bathurst herd suggest this herd has been in decline for the last decade at approximately five percent per year. The latest population estimate suggests that the number of females in the herd has declined from approximately 151,000 to 55,000 between 1996 and 2006 (ENR, 2006).

The Bathurst caribou utilize a migration corridor that passes through the Lac de Gras area on their way to and from their calving grounds at Bathurst Inlet (Gunn *et. al* 2002). A portion of the herd frequently forages and moves through the Lac de Gras area during the summer and fall periods, sometimes following shorelines along the lake and onto the west and east islands (DDMI, 1998b).

The Bathurst herd is the most heavily harvested of any barren-ground caribou herd in the Northwest Territories. The herd is an important food source for hunters of both western Nunavut and the communities of the western Northwest Territories. The barren-ground caribou was selected as one of the key indicator species for impact assessment because of its cultural and economic value to northern residents, ecological importance, management status, and biological vulnerability (DDMI, 1998b).

3.1 HABITAT LOSS

Habitat change on East Island has resulted from physical alteration of the landscape due to mine infrastructure. Infrastructure includes country rock piles, PKC and supporting infrastructure (i.e. camp, roads and the airstrip). The physical alteration of the landscape can have an influence on caribou as the vegetation can no longer be exploitable as a source of life basics (DDMI, 1998b).

Habitat loss on East Island is expressed in habitat units (HUs) for caribou summer habitat. A habitat unit is the product of surface area and suitability of the habitat in that area to supply food for caribou and cover for predators (DDMI, 1998b). To address how the change of habitat may affect caribou on East Island, a habitat suitability index (HSI) model was developed for DDMI during the EA by Rowell and Van Egmond (1998). The HSI model was used to determine the value of each habitat type based on the presence of important forage species for caribou and cover concealment for predators (DDMI, 1998b). Important foraging species were determined from the analysis of plant fragments found within caribou pellet samples collected in 13 randomly selected plots in the Lac de Gras area (Van Egmond and Rowell, 1997b). The results of the caribou pellet analysis were used to rank caribou food availability during the summer within each habitat type; willow (*Salix)*, lichens (*Cladonia and Cetraria*), Labrador tea (*Ledum)* and sedges (*Carex)* represented approximately 94.8% of the major plant groups identified during the pellet analysis. Therefore, habitats that contained these plant types scored the highest HSI value (DDMI, 1998b). Habitats were rated on a scale of 0 to 1 for their capability to support use for caribou, with values >0.30 regarded as highly suitable habitat and values <0.25 rated as low suitability for caribou. The area of each habitat type on East Island was multiplied by its HSI value to determine the number of foraging habitat units available to caribou.

One objective of the caribou monitoring program is to determine if direct summer habitat loss (in habitat units [HUs]) is greater than predicted. The following section summarizes

methods used and results obtained. The impact prediction in the Environmental Effects Report (DDMI, 1998b) is:

> ***At full development, direct summer habitat loss from the project is predicted to equal 2.965 habitat units (HU's).***

METHODS

The vegetation classification map used in the vegetation/land cover section of the Environmental Effects Report (DDMI, 1998b) was used to determine the loss of caribou summer habitat. This approach is similar to methods used in the Vegetation/Wildlife Habitat Loss section of this report (Section 2.1). The area (km^2) of vegetation type lost was multiplied by its habitat suitability index value (DDMI, 1998b) to determine habitat units lost (HUs).

RESULTS

Direct summer habitat loss to date from the mine totaled 2.12 habitat units (Table 3.1-1). Heath tundra, which has the highest habitat suitability rating, represents 2.76 km^2 of lost vegetation since construction began. Caribou summer habitat loss was greatest in 2001, when the majority of haul roads and laydown areas for mine infrastructure were constructed. With completion of the A418 dike construction project in 2006, habitat units lost due to mining activities this past year represent the lowest value recorded since the start of construction in 2000 (Table 3.1-1), and is equal to that lost in 2003. Overall, total direct losses for all summer habitat suitability classes for caribou are currently below that predicted in the EER.

Table 3.1-1 Predicted Area of Summer Caribou Habitat - Disturbed versus Actual Area of Summer Caribou Habitat Disturbed on East Island

Vegetation / Land Cover Type	Habitat Suitability Value	Habitat Suitability Class	Predicted Habitat Units Lost	Actual Habitat Units Lost							Total Habitat Units Lost to Date*
				2000	2001	2002	2003	2004	2005	2006	
Heath Tundra	**0.37**	High	**2.13**	0.3	0.42	0.19	0.09	0.23	0.14	0.12	**1.49**
Heath Boulder	**0.4**										
Tall Shrub	**0.46**										
Bedrock	**0.27**	Moderate	**0.63**	0.07	0.12	0.07	0.05	0.08	0.08	0.02	**0.5**
Tussock / Hummock	**0.3**										
Sedge Meadow	**0.28**										
Esker	**0.3**										
Birch Seep	**0.11**	Low	**0.2**	0.02	0.05	0.02	0.01	0.01	0.01	0.01	**0.13**
Boulder Field	**0.21**										
Heath Bedrock	**0.23**										

Totals may vary slightly due to rounding of values for reporting purposes.

3.2 ZONE OF INFLUENCE

Mining activities have the potential to decrease the use of habitat adjacent to human developments for caribou due to behavioural disturbance (Diavik Diamond Mines Inc. [DDMI], 1998b). Miller and Gunn (1979) explained the expression of disturbance in relation to wildlife as "the phenomenon, which resulted from the introduction of unfamiliar stimuli into an animal's environment brought about by the presence of human activities". Zones of Influence (ZOI) were established during Diavik's Wildlife Environmental Effects Report (EER) to ensure a conservative approach in the assessment of the possible impacts from human activity on caribou. The ZOI were based on literature and the experience of barren-ground caribou biologists.

Information collected on the activity of caribou, as part of DDMI's Wildlife Monitoring Program, is used to determine whether a change in behaviour is detected in relation to distance from mining activities. Aerial surveys (see Section 3.2.1) provide a quick "snap-shot" of caribou behaviour. In addition, scan sampling is conducted on East Island where the foraging behaviour of animals may be influenced by mining activities. Observations are also made on the mainland ("control site"), to determine whether or not "changes in behaviour were a response to human activity" (Gunn, 1983).

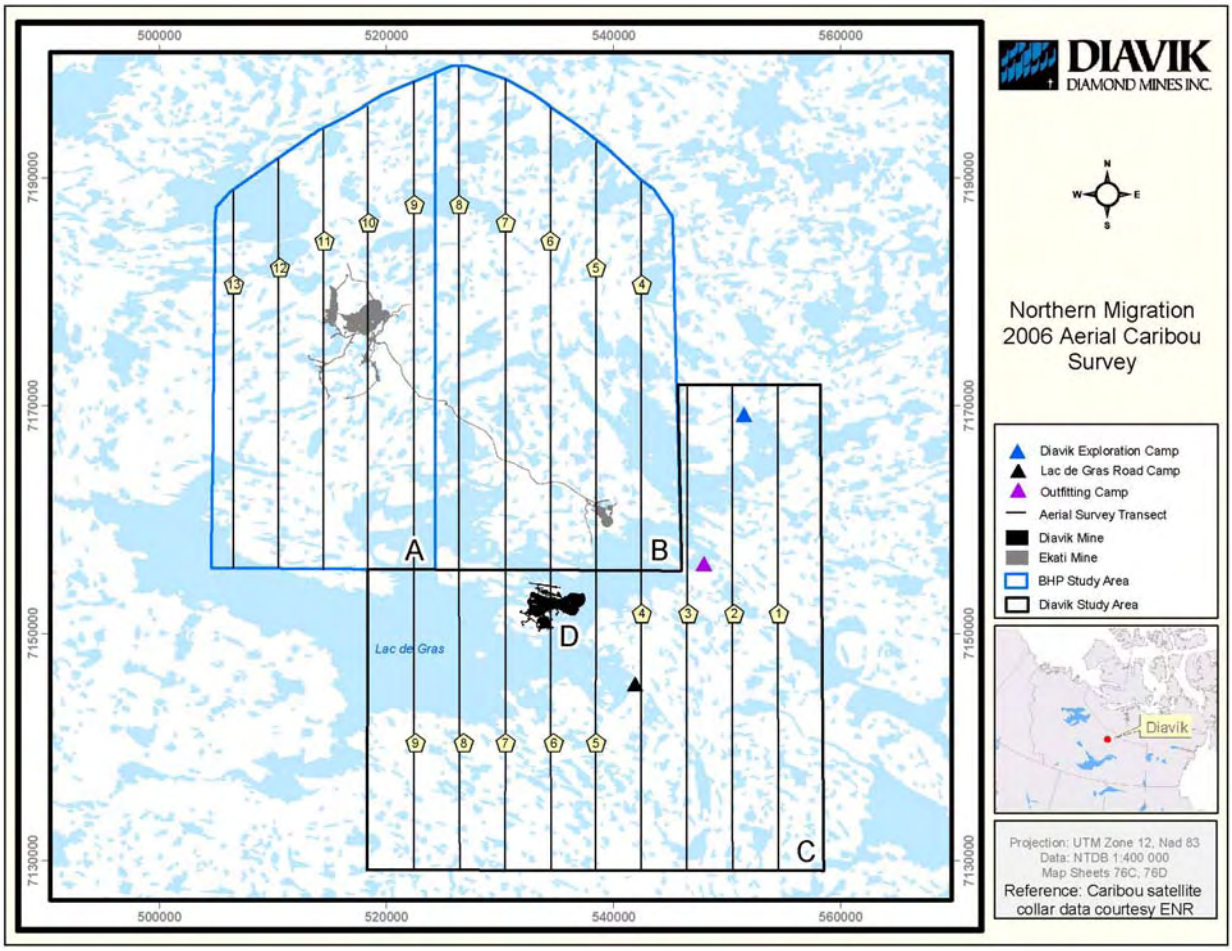
The objective for this program is to determine if the ZOI from mining activities is greater or less than predicted. The following section summarizes the methods used and results obtained from aerial surveys. The impact prediction found in the EER (Wildlife, 1998) is:

> ***The zone of influence from project-related activities would be within 3 km to 7 km.***

3.2.1 Methods

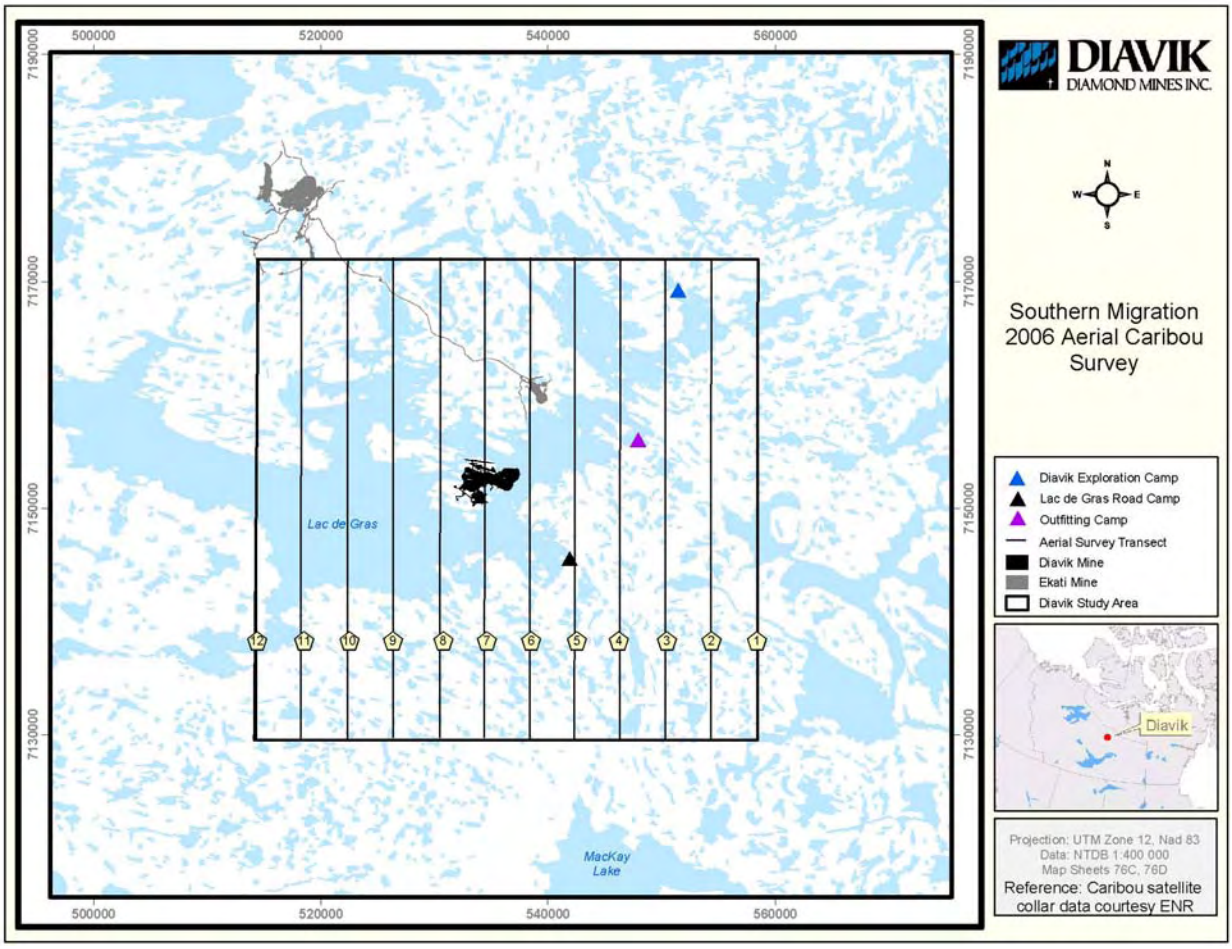
From 2002 through 2005, DDMI and BHP Billiton (BHPB) completed weekly aerial surveys, when weather permitted, within a study area that covered the two mine sites (Figure 3.2.1-1). Surveys were typically completed from late April through October to collect information on caribou numbers, habitat type associated with the caribou groups, and the dominant activity of caribou with respect to distance from the Diavik mine site. Observations were separated into the northern (spring) and southern (post-calving) migration periods. The northern migration includes all observations before June 30, and the southern migration includes observations following June 30. Thirteen transects were spaced 4 km apart, and the observation width along transects was 1200 m, which generated 30% coverage of the study area (Figure 3.2.1-1). All transects were surveyed, except for mid-June to mid-July, when every second transect was flown to coincide with fewer numbers of caribou within the study area. A helicopter was used and all surveys were completed at 120 m to 180 m above ground level (agl) at a speed of 145 km to 160 km per hour.

Figure 3.2.1-1 Aerial Survey Transects for Caribou Effects Monitoring During Northern Migration



From May 1 to June 24, 2006, (northern migration) five aerial surveys were completed using the same protocols and study area (Figure 3.2.1-1). However, BHPB has adopted new study designs and protocols for caribou aerial surveys, which currently excludes surveys during the northern migration period. In addition, the size of the study area, distance between transects, and timing of surveys also changed for the southern migration period. Subsequently, DDMI modified the previous study area to continue to capture information on caribou distribution and behaviour around the mine site during the 2006 southern migration. The western boundary of the previous study area was extended 4 km, and the western and eastern boundaries were included as survey transects (Figure 3.2.1-2). Thus, a total of 12 transects, spaced 4 km apart, were flown once per week from July 1 to November 11, when weather permitted (n = 17 surveys).

Figure 3.2.1-2 Aerial Survey Transects for Caribou Effects Monitoring During Southern Migration



Habitat type associated with the caribou groups was recorded. During the northern migration, habitat was classified as heath tundra/snow-covered tundra, frozen lakes, sedge wetland and other (esker, disturbed, boulders, and bedrock). During the southern migration, habitat classifications included heath tundra, esker, sedge wetland, riparian shrub and other (water, bedrock, disturbed, and boulder).

Analysis of caribou behaviour was classified as feeding/resting (bedded, feeding, or standing) or moving (running, walking, or trotting) for each migration period (northern and southern), and all observations were classified based on location relative to the mine site ($\leq$3 km and >3 km). Data collected for observations of caribou behaviour greater than 3 km from site only include observations made within the Diavik wildlife study area.

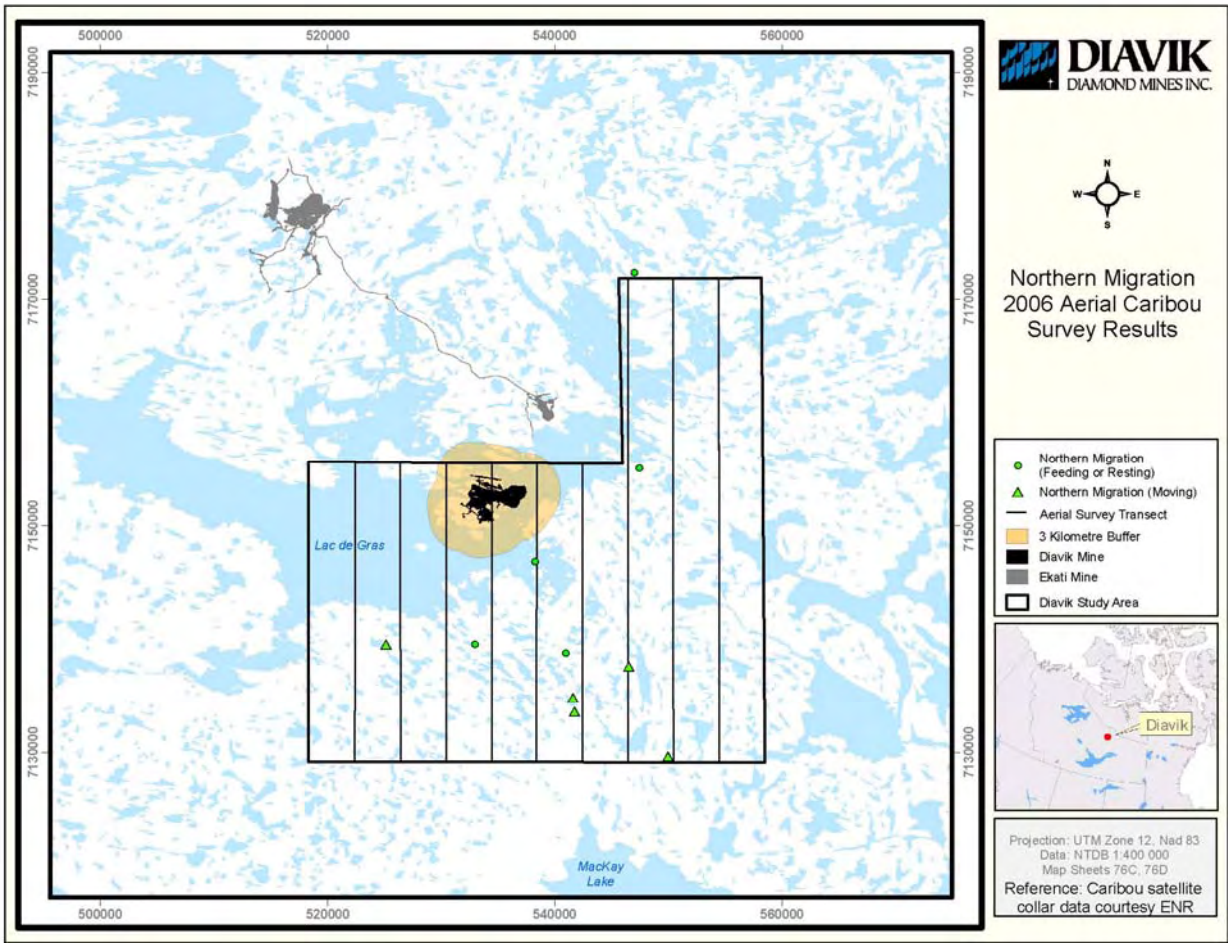
RESULTS

3.2.1.1 Northern Migration

Similar to 2005, no caribou were observed during the 2006 northern migration within the predicted 3 km ZOI around the DDMI site (Figure 3.2.2.1-1). Since 2002, five groups of caribou have been observed within the predicted ZOI; three groups in 2002, one group in 2003, and one group in 2004. None of these groups were recorded as moving, thus 100% of the groups observed within 3 km of the mine between 2002 and 2004 were feeding, standing, or bedded (Figure 3.2.2.1-2).

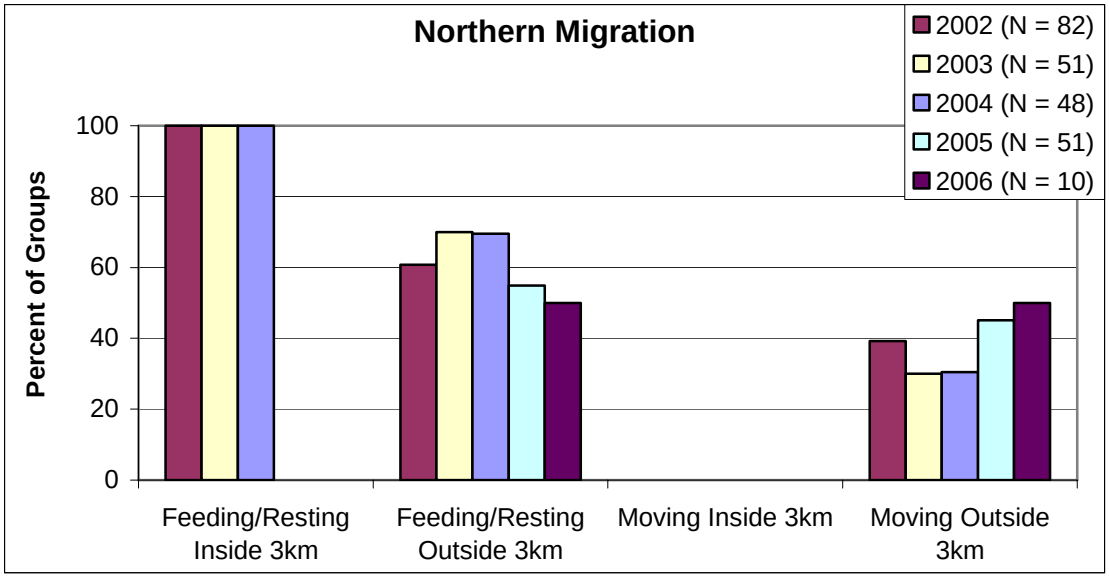
The number of caribou groups observed outside the minimum ZOI (*i.e.*, 3 km) in 2006 was also low (Figure 3.2.2.1-1). Ten groups were observed within the Diavik study area during the northern migration. Five groups were feeding and resting, and five groups were moving (Figure 3.2.2.1-2). Since 2002, the average (calculated as geometric mean) proportion of caribou groups observed feeding and resting greater than 3 km from the mine was 60.7% (n = 241), and has ranged from 50% to 70%. In contrast, about 40% of caribou groups were walking, trotting, or running when initially observed from the helicopter.

Figure 3.2.2.1-1 Distribution and Behaviour of Caribou within the DDMI Study Area Based on Aerial Survey Data - 2006 Northern Migration



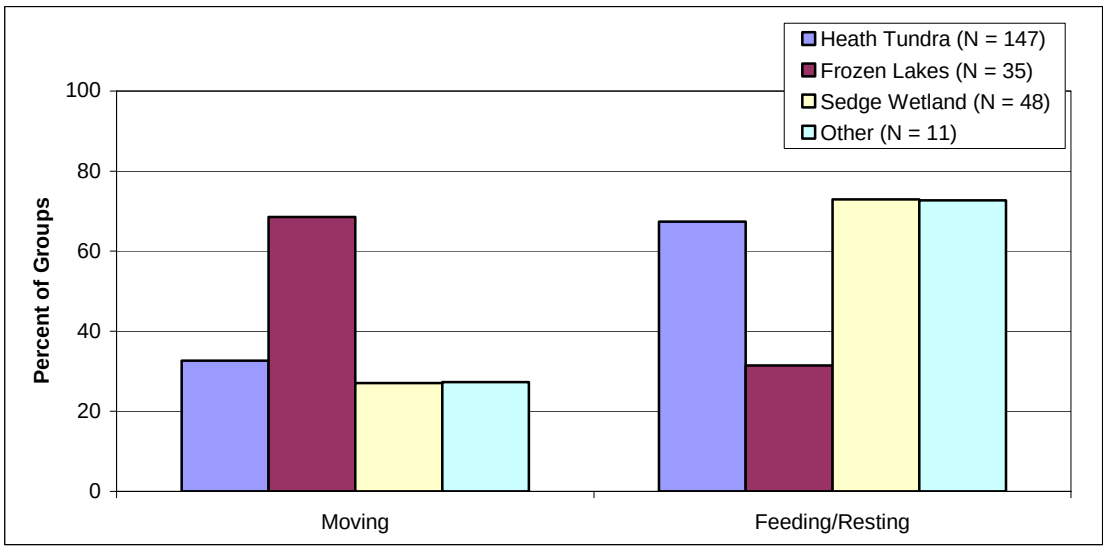
Diavik Diamond Mines Inc.

Figure 3.2.2.1-2 Behaviour of Caribou Based on Aerial Survey Data Within and Greater than 3 kilometres of the Diavik Site - 2002 to 2006 Northern Migration



After pooling the data from 2002 through 2006, the behaviour of caribou groups appeared to be influenced by habitat during the northern migration. For example, 70% of caribou groups observed on frozen lakes were moving, while 70% to 75% of groups located on heath tundra, sedge wetland or other terrestrial habitat were feeding, standing, or bedded (Figure 3.2.2.1-3).

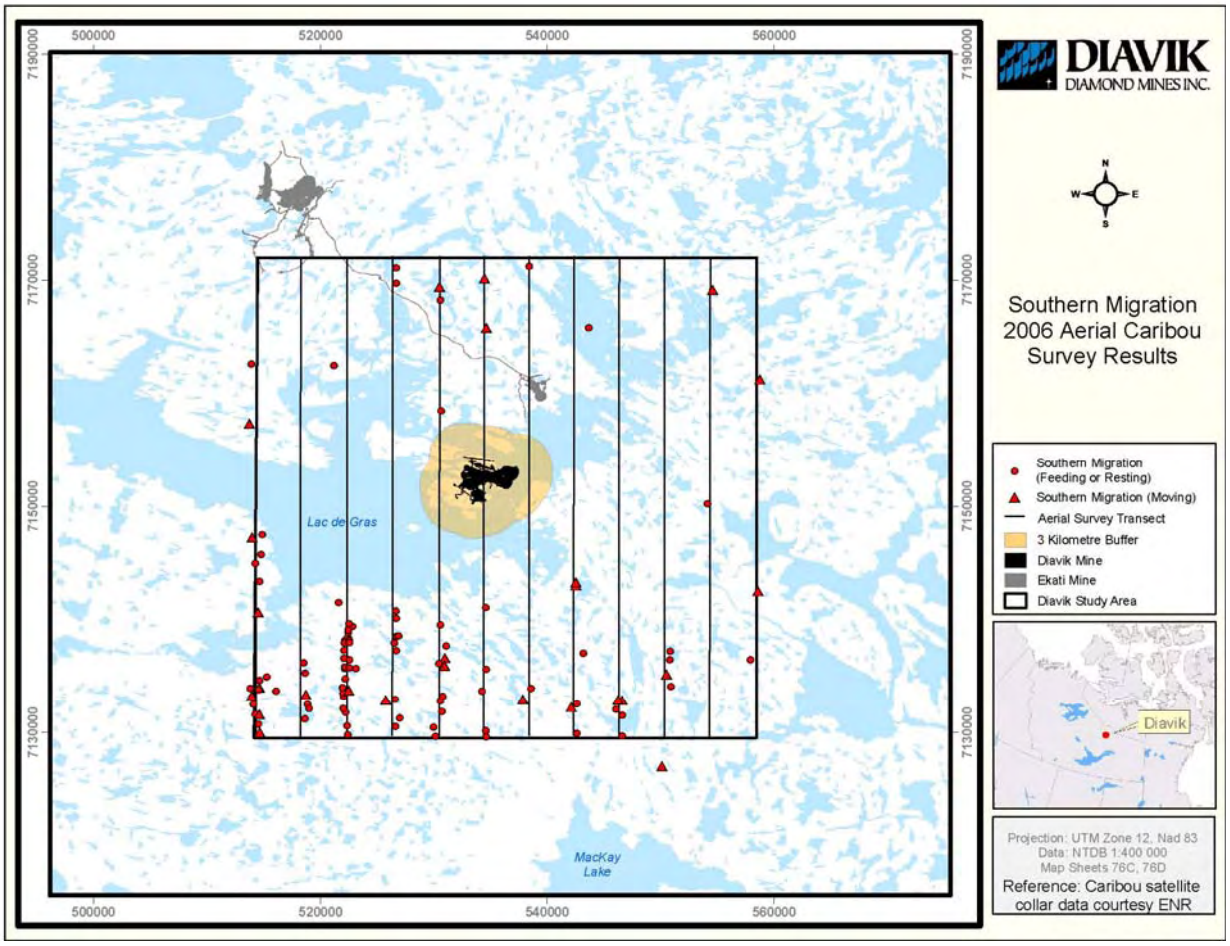
Figure 3.2.2.1-3 Behaviour of Caribou among Habitats Within the Diavik Study Area - Northern Migration, 2002 to 2006



3.2.1.2 Southern Migration

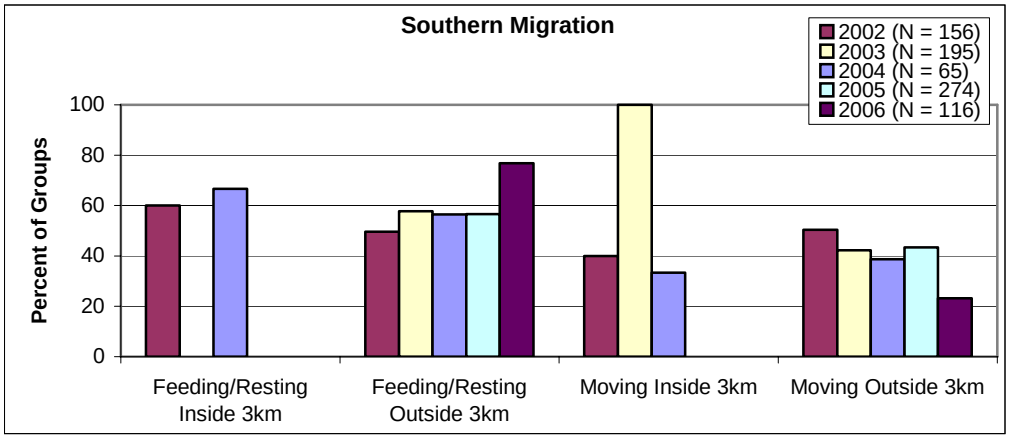
Similar to the northern migration, no caribou were observed within 3 km of the mine site during the southern migration (Figure 3.2.2.2-1). Since 2002, nine groups of caribou have been observed within the 3 km ZOI; three in 2004, one in 2003, and five in 2002. Of these nine groups, 44% were recorded as moving, and 56% were recorded as feeding or resting.

Figure 3.2.2.2-1 Distribution and Behaviour of Caribou within the DDMI Study Area Based on Aerial Survey Data - 2006 Southern Migration



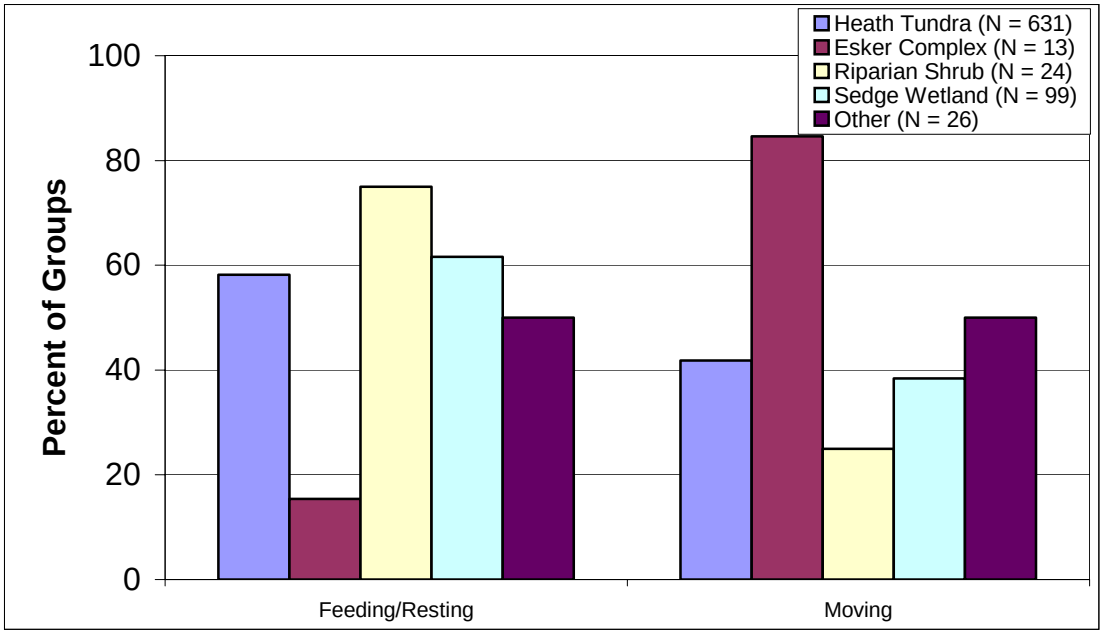
In 2006, the number of caribou groups observed greater than 3 km from the mine (n = 116 groups) was less than in 2005 (n = 274), 2003 (n = 195), and 2002 (n = 156). Since 2002, the mean proportion of groups exhibiting feeding and resting behaviour, greater than 3 km from the mine, was 59.0% (n = 794) and has ranged from 50% to 77% (Figure 3.2.2.2-2). Similar to the northern migration, approximately 40% of caribou groups were moving when first spotted from the helicopter during 2002 through 2006.

Figure 3.2.2.2-2 Behaviour of Caribou Based on Aerial Survey Data Within and Greater than 3 kilometers of the Diavik Site - 2002 to 2006 Southern Migration



After pooling data across years, point observations of caribou group behaviour also were strongly associated with habitat during the southern migration. For example, 62% and 75% of groups observed in sedge wetland and riparian shrub habitat were feeding or resting, respectively, while 15% of caribou groups on eskers were feeding or resting (Figure 3.2.2.2-3). Similarly, the proportion of groups feeding and resting in heath tundra was higher than the fraction of groups observed walking, trotting, or running. In the other habitats, the chances of observing groups resting versus moving were similar.

Figure 3.2.2.2-3 Behaviour of Caribou Among Habitats Within the Diavik Study Area - Southern Migration, 2002 to 2006



3.2.1.3 Summary

In summary, 14 caribou groups have been located within 3 km of the mine site during aerial surveys from 2002 through 2006. Five groups were observed during the northern migration and nine during the southern migration. The small number of groups observed within 3 km of the mine prevents statistical comparisons of point observations of caribou behaviour with groups greater than 3 km from the mine. For the 2008 annual report, impact predictions relating to the ZOI will be more fully tested through a comprehensive analysis of regional caribou data (*e.g.*, Golder, 2005).

Since 2002, the average proportion of caribou groups observed feeding or resting greater than 3 km from the mine was 61% (range = 50% to 70%) during the northern migration and 59% (range = 50% to 77%) during the southern migration. Although these values largely ignore the influence of habitat, weather, and mine-related factors on caribou behaviour, the data do show that, on average, approximately 60% of caribou observed during aerial surveys were feeding or resting at the time of detection. Similar to the Appendix included in the 2004 annual report (Golder, 2005), the comprehensive analysis in 2008 will include the influence of factors such as habitat, weather, and insect activity levels on caribou behaviour.

The low number of caribou traveling through the study area during the past three to four years has limited the opportunity to study caribou behaviour on the ground through scanning observations. During 2003, 2004, and 2005, ground observations of caribou behaviour were successfully completed for 12, 14, and 5 caribou groups, respectively, including five control groups within the Diavik study area. No caribou scanning observations were recorded in 2006. DDMI acknowledges that more effort must be expended at obtaining ground-based behavioural observations of caribou at various distances from the mine site.

3.3 DISTRIBUTION OF MOVEMENT

Due to construction of mining areas, infrastructure, roads, and the airstrip, a deflection of caribou movements may be associated with mining activities (DDMI, 1998b). A friction model was developed by Wierzchowski *et al.* (1998) as one tool to evaluate the possible effects of mining activities on caribou distribution in the Lac de Gras area. The friction model was used to calculate pathways of least resistance for caribou during pre-development, development, and post-closure, based on the degree of friction of the landscape. The model allowed Diavik to make general predictions about the effect of the mine on the distribution of caribou movement (DDMI, 2002). Data collection to fully test the accuracy of the model is beyond the scope of this program and would require killing caribou to measure empty body weight, which was used as an input and output variable in the friction model. Therefore, information collected from aerial surveys and caribou collar locations will be used to examine the distribution of caribou within the wildlife study area. These observations are then compared with predicted trends in movement.

The following section describes the methods used and results obtained from aerial surveys and information provided by caribou collar locations supplied by Environment and Natural Resources (ENR). The impact prediction found in the EER (DDMI, 1998) is:

During the northern (spring) migration, caribou would be deflected west of East Island and during the southern migration (fall), caribou would move around the east side of Lac de Gras.

METHODS

Aerial survey areas and methods are described in Section 3.2.1 and Appendix I. For the northern migration, aerial survey information was broken down across sectors within the regional study area (Figure 3.2.1-1). The BHPB survey area was separated into two sectors (A and B), as it was apparent that these were natural geographic areas of caribou movement within the Lac de Gras area (Golder, 2004). Sector C consists of the Diavik wildlife study area and sector D contains East Island where the Diavik mine is located. Information was evaluated to provide metrics such as first and last date observed, maximum number, total number, and density of caribou within each of the sectors. Density of caribou was calculated as the number of caribou per survey per survey area. During the northern migration, the survey area contained all habitat types including frozen lakes (Table 3.3.1-1). An important reminder while reading this section is that total number of caribou observed (actual caribou counted) will be reported throughout this portion of the report.

Table 3.3.1-1 Areas (km^2) Surveyed During the Northern Migration - 2006

Sector	Northern Migration (km^2)
A	229.8
B	239.6
C	332.9
D	6.5

For the southern migration, data were compiled for the entire study area (Figure 3.2.1-2) because surveys were not completed in sectors A and B (see Section 3.2.1). Deep water was excluded from the estimated survey area (412.1 km^2), and density was compared to annual estimates from sector C for 2002 through 2005 (surveyed area for sector C = 221.0 km^2; DDMI, 2006).

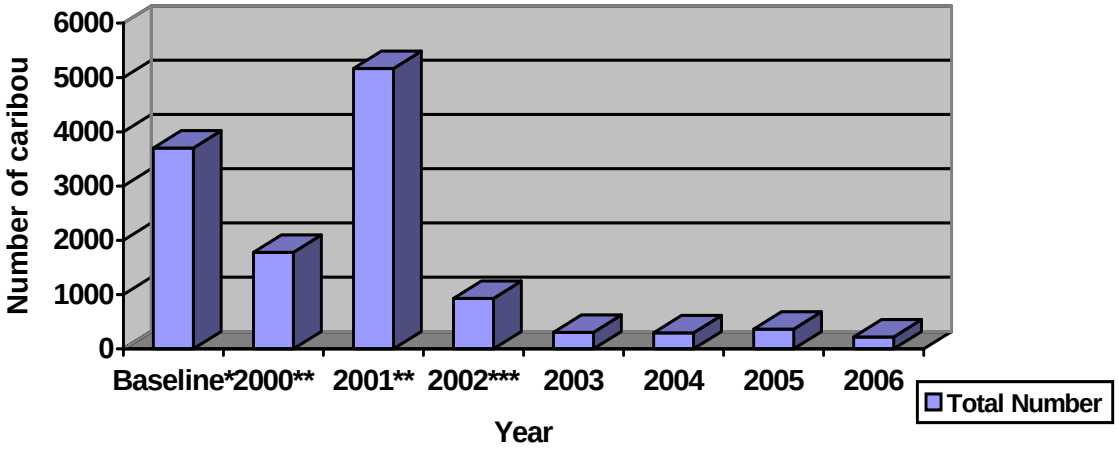
ENR provided weekly data on the geographic location of collared cows and this information was used to show general locations of the Bathurst caribou herd during migration periods (Gunn *et al.*, 2002). Movements of collared Bathurst caribou during the 2006 northern and southern migrations are included in this report. Historical data for 2002 to 2005 caribou collar locations can be found in DDMI (2006) and Golder (2005).

RESULTS

Although differences exist in aerial survey methods used throughout baseline (Penner, 1998), construction and post-construction, general observations can be made. In 2006, 218 caribou were observed in the Diavik wildlife study area during the northern

migration, similar to the numbers observed from 2003 through 2005. In contrast, approximately 6000 animals were observed during the northern migration in 1996, and an estimated 5000 caribou were counted in 2001 (Figure 3.3.2-1). A similar number of animals were estimated in 1997 (1400 caribou), 2000 (1700 caribou) and 2002 (979 caribou). No caribou were observed on the East Island during the northern migration period in 2006, or in 2001, 2004, and 2005.

Figure 3.3.2-1 Total Number of Caribou in the DDMI Wildlife Study Area - Northern Migration



*Baseline observations, 1996-1997. Consists of mean numbers on east and west islands (Penner, 1998).

**Caribou numbers based on East Island ground counts and aerial survey observations.

***Caribou numbers based on weekly aerial surveys of Diavik's wildlife study area (2002-present).

The total number and average density of caribou during the northern migration in 2006 was higher in sectors A and C than B and D (Table 3.3.2-1). The variance in density estimates was high for sectors A through C, and was associated with the low frequency of caribou observed across surveys. For example, caribou were observed during one of five surveys in sector A, and two of five surveys in sectors B and C (Table 3.3.2-1). The date that caribou were first sighted was the same for sectors A through C, and no caribou were observed in sector D (East Island). For sectors A and C, the date of the first sighting of caribou in the regional study area occurred two weeks later in 2005 and 2006 than in 2004 and 2002, but at a similar time to that observed in 2003.

Table 3.3.2-1 Caribou Observations within Sectors (A-D) During the Northern Migration - 2006

	Northern Migration (n = 5 surveys)			
	A	**B**	**C**	**D**
Survey Date Caribou First Observed	14 May	14 May	14 May	-
Survey Date Caribou Last Observed	14 May	27 May	27 May	-
Maximum Caribou Observed in Single Survey (survey date)	132 (14 May)	11 (27 May)	49 (27 May)	0 -

Total Caribou Observed in Sector	132	12	74	0
Number of Surveys in Which Caribou were Observed	1	2	2	0
Mean $\pm$ 1SD Caribou / Survey / km^2	0.06 $\pm$ 0.19	0.01 $\pm$ 0.02	0.02 $\pm$ 0.05	0.00 $\pm$ 0.00

Observed patterns of caribou numbers and density across sectors in 2006 were similar to the results from 2002 through 2005 (Figure 3.3.2-2). The exception was in 2004, which suggested that the observed number of caribou was higher in sector B than in sector A. Data from satellite-collared caribou suggested that females in the Bathurst herd traveled east of the study during the 2006 northern migration (Figure 3.3.2-3).

Figure 3.3.2-2 Total Number of Caribou Observed in Each Sector - Northern Migration

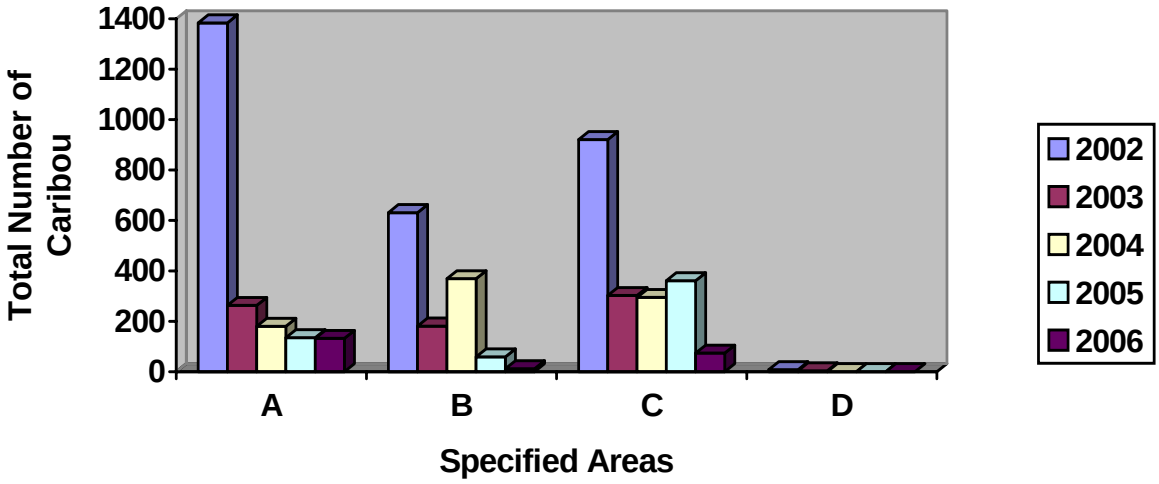
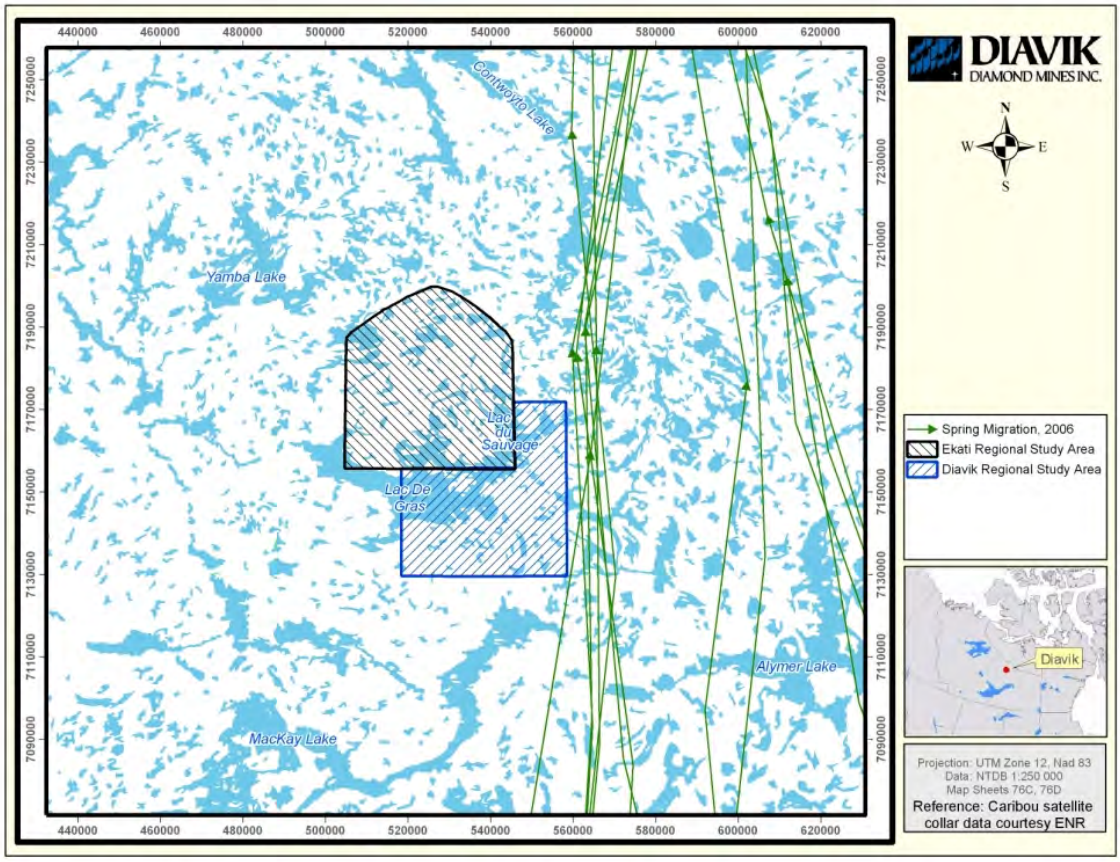
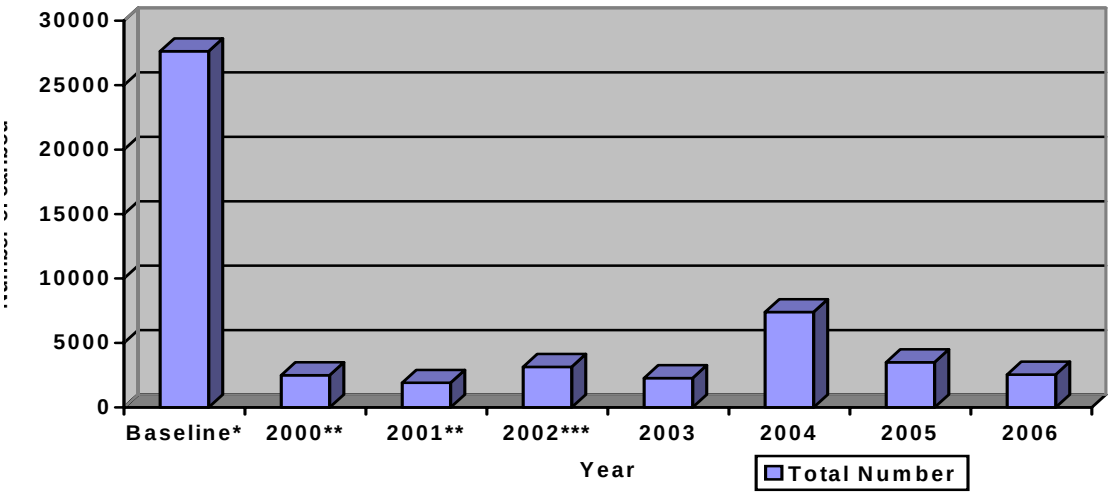


Figure 3.3.2-3 Caribou Collar Locations during the Northern Migration - 2006



During the southern migration in 2006, approximately 2120 caribou were observed in the Diavik wildlife study area, which is similar to the number of caribou observed from 2000 through 2003, and in 2005 (Figure 3.3.2-4). During 2004, 7399 caribou were observed within the DDMI study area, with the greater part of this value (7,000) being from two observations during one survey (Table 3.3.2-2). In contrast, an annual average of approximately 27,000 caribou was observed during three years of baseline studies (Figure 3.3.2-4).

Figure 3.3.2-4 Total Number of Caribou in the Diavik Wildlife Study Area - Southern Migration



*Ba

seline observations (1995-1997). Consists of mean numbers on the east and west islands of Lac de Gras (Penner, 1998)

***Caribou numbers based on East Island ground counts and aerial survey observations.*

****Caribou numbers based on weekly aerial surveys of Diavik's wildlife study area (2002–present).*

The date that caribou were first sighted in the Diavik study area (sector C) has decreased by approximately two to three weeks in 2005 and 2006 relative to 2002 through 2004 (Table 3.3.2-2). Although the date that caribou were last observed in the study area was much later in 2006 than previous years, the data are biased as surveys in 2006 were continued for approximately five to six weeks longer relative to 2002 through 2005. With the exception of 2004, the number and density of caribou in the study area during the southern migration has been similar among years (Table 3.3.2-1). Similarly, the frequency of observing caribou during the surveys was relatively consistent among years, and ranged from 64% in 2004 to 79% in 2005. In 2006, 71% of the surveys detected caribou, while caribou were observed in 73% and 75% of the surveys in 2002 and 2003, respectively.

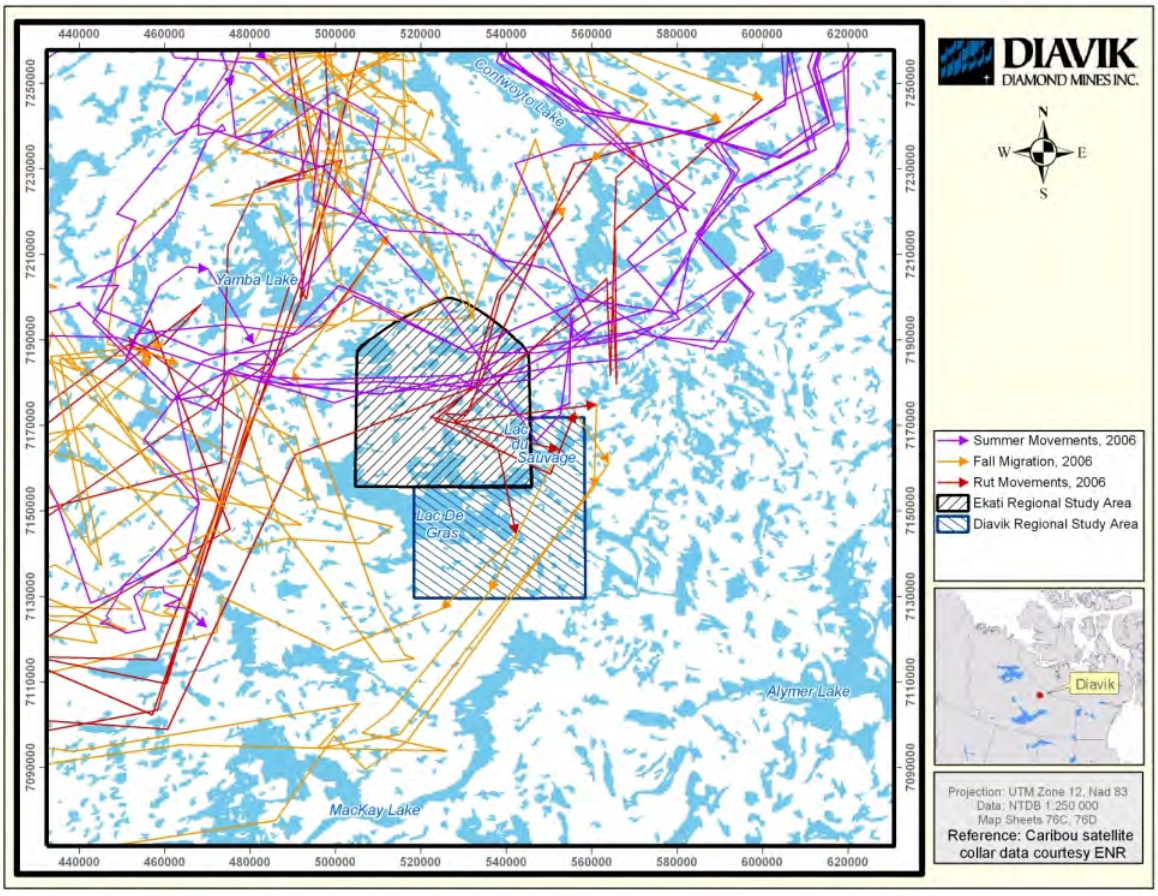
Table 3.3.2-2 Caribou Observations within the Diavik Study Area (Sector C) During the Southern Migration, 2002 - 2006

	2002 (n = 11)	2003 (n = 12)	2004 (n = 14)	2005 (n = 14)	2006 (n =17)
Survey Date Caribou First Observed	26 July	25 July	18 July	2 July	8 July
Survey Date Caribou Last Observed	23 Sept	19 Sept	25 Sept	24 Sept	04 Nov
Maximum Caribou Observed in Single Survey (survey date)	2340 (26 July)	1660 (01 Aug)	7000 (23 July)	500 (30 July)	1351 (16 Sept)
Total Caribou Observed in Sector	3088	2280	7399	3507	2120
Number of Surveys in which Caribou were Observed	8	9	9	11	12
Mean $\pm$ 1SD Caribou / Survey / km^2	1.3 ± 3.1	0.86 ± 2.15	3.04 ± 9.51	1.13 ± 1.73	0.41 ± 1.06

n = number of surveys

Data from satellite-collared animals suggests that cows in the Bathurst herd traveled through the southern portion of the study area during the fall migration period (Figure 3.3.2-5). The distribution of caribou groups observed during aerial surveys also indicated that most groups were recorded south of Lac de Gras (Figure 3.2.2.2-1). A comprehensive analysis also showed that from 2002 to 2004, the majority of collared caribou traveled adjacent to or through the southeast corner of the study area (Golder, 2005). Data collected for the southern migration appears to agree with the impact prediction found in the EER (DDMI, 1998), stating that caribou would travel east of the mine site during the southern migration.

Figure 3.3.2- Caribou Collar Locations during the Southern Migration – 2006



SUMMARY

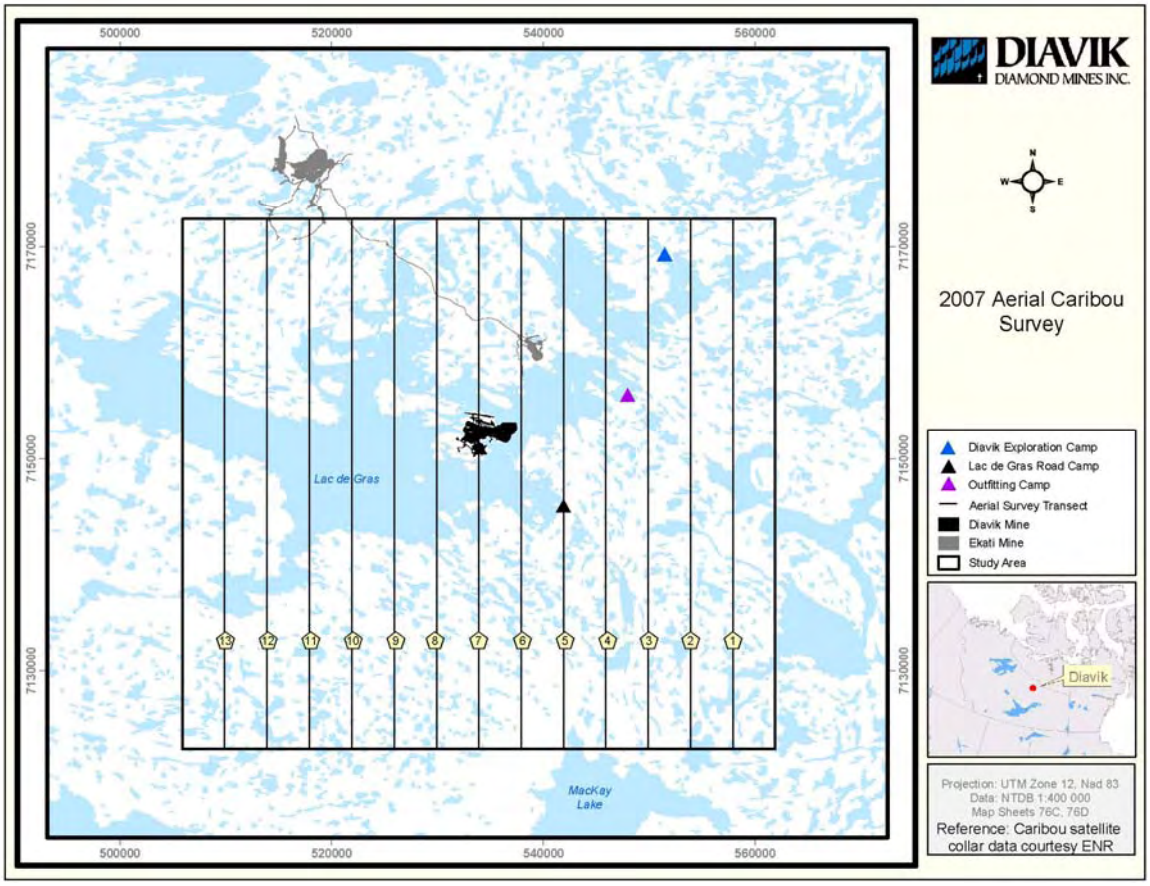
The number of caribou observed within the Diavik wildlife study area was higher during baseline (1996 to 1997) than from 2000 through 2006, especially during the southern migration. However, data from 2002 to 2006 (aerial surveys) show relatively constant numbers, with the exception of 2004 when approximately twice the number of animals were recorded. The particular factors associated with this pattern are not known, but are likely associated with changes in aerial survey methods, variables influencing the geographic distribution of caribou within their annual home range, and changes in population size. For example, recent information collected by ENR (2006) suggests that the number of females in the Bathurst herd has decreased by approximately 63% since 1996. Some studies have shown that long-term changes in habitat condition, and caribou foraging and movement patterns can be associated with periodic range shifts and large fluctuations in population size (Messier *et al.*, 1988; Ferguson *et al.*, 2001). Thus, there are a number of factors that can affect the annual distribution and movement of caribou across their home range, which can create year-to-year changes in the abundance of animals in the study area, and other local areas (*e.g.*, communities) within the Slave Geological Province.

Relative to 2002 through 2004, the timing of the first caribou sighted in the study area during the southern migration decreased by approximately two to three weeks in 2005 and 2006. Explanations for this pattern are not currently known. One possibility may be related to changes in herd size and number of calves produced, and the associated changes in behaviour of females. Hypothetically, as the absolute number of calves produced decreases, synchronicity in parturition date may increase and enable lactating females to spend less time on the calving grounds where predator density is likely higher relative to other areas of the home range. Although birth synchrony is an adaptation to decrease predation rate on calves, independent of population size, leaving the calving grounds sooner may increase calf survival when annual calf production is lower relative to other years. Alternately, temporal changes in occurrence of caribou in the study area also may be related to food quality and quantity on the calving grounds and summer range, or random variation in the timing of herd movements and distribution.

During southern migrations from 2002 to 2005, the number and mean density of caribou was highest in sector C. In particular, the location of caribou groups observed during aerial surveys showed that most of the largest groups were observed in the southeast corner (sector C) of the regional study area (DDMI, 2006). These data are supported by the migration paths of collared caribou which showed that from 2002 to 2005, the majority of collared animals traveled through or adjacent to the eastern portion of the regional study area during the early part of the southern migration (Golder, 2005). Results from 2006 also showed a correlation between the distribution of caribou observed in the study area and the movement of satellite-collared animals. This information supports the prediction that caribou would travel east of the mine site during the southern migration (DDMI, 1998).

Golder (2005) completed a comprehensive analysis of the caribou data from 1998 through 2004 within the regional study area for the Diavik and Ekati mines. The results indicated that the estimated ZOI on the probability of caribou occurrence around the Diavik mine ranged from 22 km to 26 km for the northern and southern migration periods. In response to this information, DDMI is proposing a new study area (56 km wide x 50 km long) for caribou monitoring, which is over twice as large as the previous study area. The northern boundary has not changed, but the southern boundary extends to the far north shore of MacKay Lake (Figure 3.3.3-1). The eastern and western boundaries have been expanded to include most of Lac de Gras and Lac du Sauvage. The survey area consists of 13 transects oriented in a north-south direction, and the distance between transects is 4 km resulting in 30% coverage of the study area.

Figure 3.3.3-1 Proposed Expanded Study Area for Caribou



Specific data collection protocols will remain consistent with previous methods. However, through the process of adaptive monitoring and management, the timing and number of surveys completed likely will be revised to better reflect project and regional requirements. Any changes will be discussed with the Environmental Monitoring Advisory Board and other stakeholders. For example, the number of calves and cows in a group could be recorded during the southern migration. Information on calf:cow ratios will provide regional estimates of calf recruitment rate, which can be combined with recruitment rates from other regions on the Bathurst range to better understand this important attribute of the herd's demography.

3.4 MORTALITY

Mineral development in the Bathurst caribou herd range has caused concerns about increased mortality, which include: ground-vehicle collisions, collisions with aircraft and accidental losses associated with caribou moving in hazardous areas around mining activities (DDMI, 1998b). Mitigation measures have been developed that are designed to reduce the potential for mortalities such as, wildlife have the "right of way" on all haul roads, suspension of blasts when caribou are within the "safe zone" of the blast, and the

caribou traffic advisory. The objective for this program is to determine if the number of caribou deaths or injuries associated with DDMI mining activities is greater than predicted. The following section summarizes methods applied and the results produced from incident reporting and road observations. The impact prediction in the Environmental Effects Report (DDMI, 1998b) is:

Project-related mortality is expected to be low.

METHODS

Project related caribou mortalities are monitored in a number of ways. All personnel undergo environmental orientation where it is stipulated that should a wildlife incident occur, an incident report is to be completed. Numerous environmental data collection programs occur on East Island such as water quality sampling and dust and vegetation monitoring programs; any caribou mortalities located during these sampling events are investigated by Environment personnel. Weekly caribou aerial surveys also provide information on observed mortalities.

RESULTS

No project-related caribou mortalities or injuries occurred on East Island in 2006.

Table 3.4 Caribou Mortalities on East Island

	Baseline*	2000	2001	2002	2003	2004	2005	2006
Natural Caribou Mortalities on East Island	8	7	1	1	0	2	0	**0**
Project-related Mortalities	0	0	0	0	0	1	0	**0**

Includes data from 1995-1997

3.5 RECOMMENDATIONS FOR THE 2007 PROGRAM

DDMI is exploring options to modify the caribou aerial survey program for 2007, and has proposed a survey area that is two times larger than the current area. DDMI will incorporate calf:cow ratio counts into the caribou monitoring program for 2007. More effort is required to collect data on ground-based caribou behavioural observations in 2007. This program will focus on increasing the number of samples for caribou behaviour within the anticipated ZOI.

4. CARIBOU ADVISORY MONITORING

The objective of the Caribou Advisory Monitoring program is to make certain that workers are aware of the approximate numbers of caribou on or near East Island. This raises general awareness and ensures employees are alert of the likelihood that mitigation measures could be triggered. The number of animals on the island and in specific areas dictates mitigation measures to be undertaken (e.g. haul road closure, speed reduction).

METHODS

Various methods were used to determine whether or not animals were present in the vicinity of East Island; these included reports from pilots, reports from workers, Environment department road surveys on East Island and utilizing the satellite collar locations provided by Environment and Natural Resources (ENR). If animals were reported in the general area, ground surveys were initiated. Ground based surveys are completed by searchers counting caribou from vehicles along the haul roads twice per day and documenting approximate numbers.

RESULTS

During 2006, the caribou traffic advisory remained at “No Concern” for 365 days, as caribou numbers on the island did not exceed 100 at any given time.

When small numbers of caribou were noted in areas in the vicinity of haul roads, an announcement was made on radio Channel 7 to notify all users of the haul road as to their presence and location.

4.1 RECOMMENDATIONS FOR THE 2007 PROGRAM

There are no recommendations for this program.

5. CARIBOU MITIGATION EFFECTIVENESS MONITORING

Caribou mitigation effectiveness monitoring allows DDMI to evaluate whether or not mitigation measures are effective in preventing adverse impacts to wildlife. Mitigation monitoring allows DDMI to confirm their effectiveness and identify where adjustments in operating strategies are required. Monitoring investigations will determine if herding procedures are successful, if winter road alignment diverts caribou away from East Island, and if there is preferential use of areas impacted by dust (DDMI, 2002). A number of monitoring tasks were not initiated in 2006 as caribou were not in the vicinity of project infrastructure such as country rock stockpile ramps and dike landing areas.

5.1 CARIBOU HERDING

While on the island, caribou movements were monitored so that project personnel were aware of their presence and relative location. Of particular importance from a safety perspective (both human and animal), caribou movements in the vicinity of the airstrip and blast areas were tracked. When caribou were sighted adjacent to potentially hazardous locations in association with the airstrip and blast areas, DDMI implemented its standard operating procedure (SOP) for caribou herding (Appendix I).

METHODS

The method used to move caribou away from hazardous areas consisted of the slow advancement of personnel behind the caribou, encouraging the movement of the animals in a safe direction.

RESULTS

DDMI's Caribou Herding SOP was not employed during 2006 as caribou did not frequent the project area.

5.2 USE OF DUST DEPOSITION AREAS

Dust deposition can influence vegetation vigour, snowmelt rates, and changes in vegetation community structure. As a result, caribou may be attracted to these areas (Gunn, 1998). Dust from Diavik's mining activities is monitored and information on this year's program can be found in the Dust Deposition Monitoring Program 2005 Annual Report (DDMI, 2006).

An additional study titled, "Dust Distribution and Monitoring Using Lichens as Bioindicators" is also currently being undertaken through Diavik, in conjunction with the University of Alberta. The research objectives of this study are to:

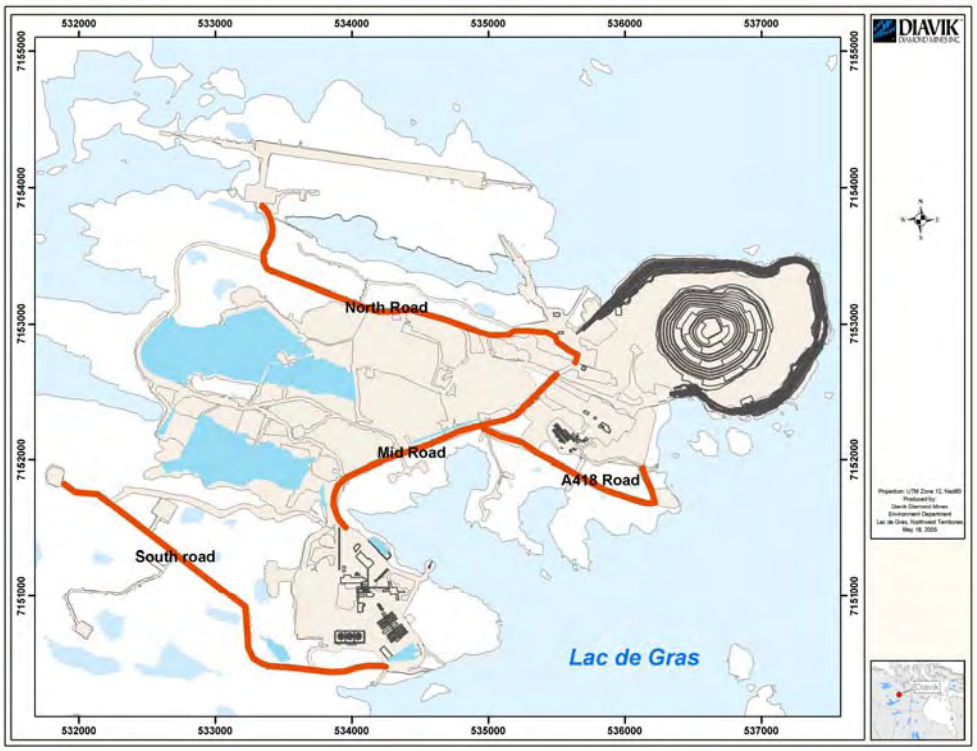
- Determine concentration of known airborne contaminants in lichen tissue at pre-established distances from dust sources at the mine site;
- Determine if there is a correlation between distance from the mine and lichen tissue concentration of airborne contaminants;
- Quantify differences in bioaccumulation of contaminants among selected lichen species so that the most appropriate species can be selected to use as bioindicators;

- Determine if there is a correlation between contaminant concentrations in lichen tissue and lichen and native plant abundances, composition and species diversity; and,
- Provide scientifically based recommendations for the effective use of lichens as bioindicators of airborne contaminants from mining activities.

METHODS

Road observations were conducted twice a week from April to October to determine if caribou were utilizing areas adjacent to haul roads. These roads are chosen to represent the greatest degree of dust deposition. Information collected includes number of caribou encountered at various distances (on road, <50 m of road, 50-200 m of road and greater than 200 m from the road), dominant behaviour of group, group size and group composition (Appendix II). East Island was divided up into four haul road sections (Figure 5.2-1) for a total of 9.8 kilometers of roads surveyed.

Figure 5.2-1 Caribou Road Observation Locations



RESULTS

Caribou road surveys were conducted on 38 occasions between 1 May and 5 October 2006. No caribou were observed during any of the surveys.

5.3 RECOMMENDATIONS FOR THE 2007 PROGRAM

Observations for mitigation effectiveness will continue to be conducted when caribou are present on East Island. A dust deposition research program for vegetation on East Island will continue during 2007.

6. GRIZZLY BEAR MONITORING

The barren-ground grizzly bear ranges throughout most of the Northwest Territories. Under Federal SARA legislation, it is considered a 'Species of Special Concern', as assessed by the Committee on the Status of Endangered Species (COSEWIC 2002).

Actions are currently being taken to revise the listing of grizzly bears under the federal Species at Risk Act (SARA) legislation from Schedule 3 to Schedule 1, thereby providing protection afforded by the Act. The consultation period between various governments and wildlife co-management boards has been extended to further satisfy requirements to incorporate the best available community knowledge and aboriginal traditional knowledge. The timeline for the extended consultation period is currently unknown; however upon completion the species listing may be revised (SARA Public Registry 2007).

Grizzly bears have low population densities, low reproductive rates and are sensitive to human activity (DDMI, 1998b). The barren-ground grizzly bears of the NWT are unique, as they "have not been subjected to the exploitation and habitat changes" and "have remained relatively undisturbed from human activity" (McLoughlin et al. 1999). As such, the grizzly bear is considered 'sensitive' in the Northwest Territories (RWED, 2000).

Impacts to grizzly bears from mining may occur through direct mortality, habitat suitability reduction and direct habitat loss. The focus of the monitoring program is to determine direct habitat loss, level of grizzly bear activity, zone of influence of mining activities and if project related mortalities have occurred.

6.1 HABITAT LOSS

Grizzly bears use a wide variety of vegetation and habitats types. Studies of grizzly bears in the Northwest Territories have led to an understanding of their seasonal habitat preferences (McLoughlin et al. 2002a). Loss of habitat may result in negative effects on grizzly bears; for that reason analysis has been conducted to determine if habitat loss is significantly different from the prediction (DDMI 1998b), which is:

> ***At full development, direct terrestrial habitat loss from the project is predicted to be 8.67 km^2.***

METHODS

Methods used to determine grizzly bear habitat loss are similar to that described in the Vegetation section (Section 2.1).

RESULTS

Cumulative grizzly bear habitat loss on East Island due to mining related activities was 6.31 km^2 (Table 6.1-1). This loss represents a value up to December 2006 and includes losses from 2000 through to 2005. The wildlife study area (Figure 1.1-1) is approximately 1200 km^2 (including shallow and deep water) and a loss of 6.31 km^2 represents a loss of 0.53% of habitat available in the wildlife study area. Grizzly bear home ranges, as determined by McLoughlin et al. (2003), are 2100 km^2 for females and

7245 km^2 for males. Within the context of these home range sizes, this represent a loss of 0.30% and 0.09% of an individual female or male home range, respectively. East Island encompasses approximately 20 km^2 of terrestrial habitat; a loss of 6.31 km^2 indicates a loss of 31.6% of available habitat. Based on McLouhglin et al. (2002b), 23 of 56 grizzly bear dens were located in heath tundra habitat and, currently, the Diavik mine footprint has altered 2.76 km^2 of this habitat type.

Table 6.1-1 Predicted versus Actual Grizzly Bear Habitat Loss on East Island

Vegetation/Land Cover Type	Predicted Area Lost (km^2)	Area Lost (km^2) 2000	Area Lost (km^2) 2001	Area Lost (km^2) 2002	Area Lost (km^2) 2003	Area Lost (km^2) 2004	Area Lost (km^2) 2005	Area Lost (km^2) 2006	Total Area Lost (km^2)
Heath tundra	**3.68**	0.65	0.80	0.41	0.14	0.37	0.24	**0.14**	**2.76**
Heath boulder	**1.89**	0.15	0.30	0.19	0.08	0.23	0.11	**0.17**	**1.24**
Tall Shrub	**0.03**	0.01	0.00	0.01	0.00	0.00	0.01	**0.00**	**0.03**
Bedrock	**0.07**	0.02	0.03	0.01	0.00	0.00	0.00	**0.00**	**0.06**
Tussock hummock	**1.64**	0.19	0.26	0.19	0.15	0.22	0.18	**0.08**	**1.27**
Sedge Wetland	**0.26**	0.02	0.00	0.02	0.01	0.04	0.07	**0.00**	**0.16**
Esker	**0.16**	0.13	0.00	0.00	0.00	0.00	0.03	**0.00**	**0.17**
Birch seep	**0.11**	0.01	0.02	0.02	0.01	0.02	0.00	**0.00**	**0.09**
Boulder field	**0.05**	0.01	0.01	0.01	0.00	0.01	0.00	**0.00**	**0.04**
Heath bedrock	**0.78**	0.06	0.20	0.08	0.03	0.04	0.05	**0.04**	**0.49**
Total	**8.67**	**1.25**	**1.62**	**0.94**	**0.42**	**0.93**	**0.69**	**0.43**	**6.31**

Discrepencies in totals across the rows results from the rounding of numbers in annual columns for presentation purposes
****Values in red represent actual habitat loss equal to that predicted***

6.2 PRESENCE

Mining activities can impact the presence of grizzly bears due to disturbance and habitat loss (DDMI, 1998b). Vegetation loss and changes to caribou distribution from mining activities may also impact the presence of grizzly bears (Gau and Case, 1999). Consequently, monitoring was conducted to determine if mining activities influence the presence of grizzly bears in the study area. The predicted effect is:

> ***Mine development is not predicted to influence the presence of grizzly bears in the area.***

METHODS

Based on diet selection (Gau et al. 2002) and seasonally preferred habitats (McLoughlin et al. 2002a), the presence of bear sign within and adjacent to seasonal high quality habitats (sedge wetland in June and riparian shrub in August) was used as an index of habitat utilization by grizzly bears within the Diavik study area (Appendix I).

A total of 36 plots were randomly selected within the study area, consisting of a 500 m by 500 m area and comprised of at least 25% of either sedge wetland or riparian shrub habitats (Figure 6.2-1). Sedge wetland plots were surveyed in early July, while riparian shrub plots were surveyed in early August. Each plot was searched for bear sign for approximately one hour by two observers. All bear sign (dens, diggings, tracks, scat, hair and kill sites) were documented. Only sign determined to have been left in this year (i.e. since spring den emergence) were included in the analysis. Plots with a bear present were considered to contain fresh sign, but not surveyed. This represented the fourth full year of data collection, as only a limited number of plots were surveyed in 2002.

In addition, incidental observations of grizzly bears on East Island and within the DDMI wildlife study area were recorded and used as a measure of grizzly bear presence within the study area.

HABITAT SURVEY RESULTS

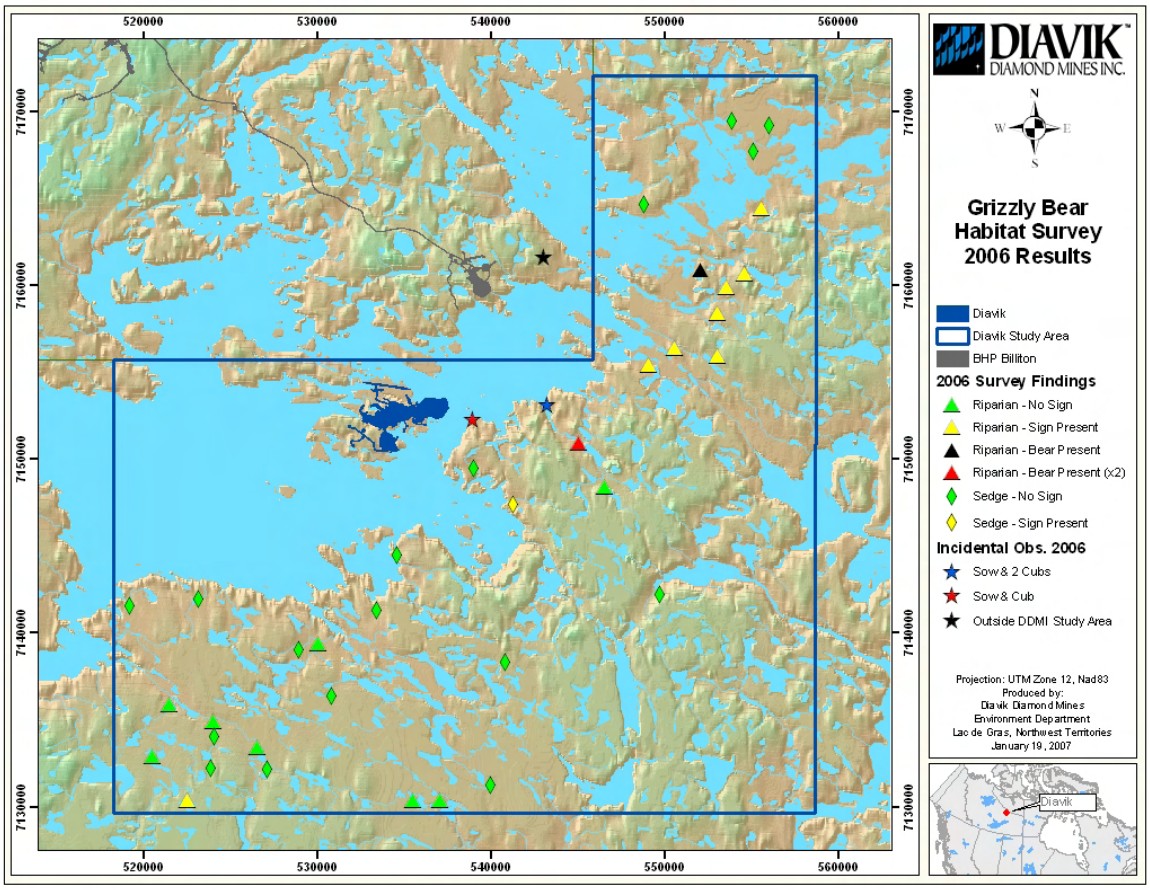
Eighteen sedge wetland habitat plots were surveyed for sign of grizzly bear presence from 7-10 July 2006. One sedge wetland plot (S06) contained sign, fresh tracks and a dig (Table 6.2-1), indicating bears had been present in 5% of sedge wetland plots surveyed this year (Figure 6.2-1).

Grizzly bear sign surveys in eighteen riparian habitat plots were conducted from 11-14 August 2006. Grizzly bear sign in riparian habitat was confirmed in 55% of the plots surveyed (Figure 6.2-1). Confirmation was obtained through the presence of a single bear at one plot (R02), a sow and cub at a second plot (R09), and numerous fresh digs and scat (Table 6.2-1).

Table 6.2-1Grizzly Bear Sign Observations in Survey Plots, 2002 to 2006

	2002	**2003**		**2004**		**2005**		**2006**	
	Riparian	Riparian	Sedge	Riparian	Sedge	Riparian	Sedge	**Riparian**	**Sedge**
# of Plots Surveyed	(8)	(18)	(17)	(18)	(18)	(17)	(18)	**(18)**	**(18)**
Bed	0	3	2	0	0	0	0	**0**	**0**
Den	0	0	0	0	0	0	1	**0**	**0**
Dig	2	11	6	3	8	1	1	**11**	**1**
Track	0	6	3	0	3	1	1	**0**	**1**
Scat	0	2	0	3	1	8	0	**9**	**0**
Hair	0	2	0	0	0	0	0	**0**	**0**
Kill Site	0	1	0	2	1	2	0	**0**	**0**
Bears Present	1	1	1	1	0	0	3	**3**	**0**
Total	**3**	**26**	**12**	**9**	**13**	**12**	**6**	**23**	**2**

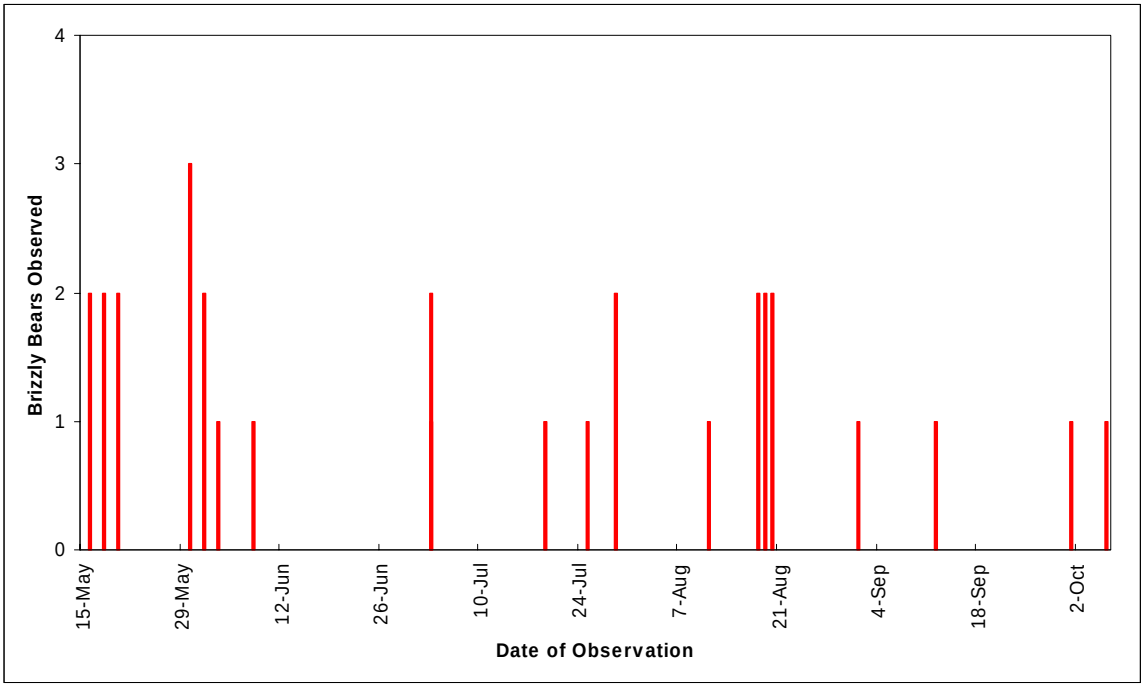
Figure 6.2-1 Grizzly Habitat Survey Results and Incidental Observations 2006



INCIDENTAL OBSERVATION RESULTS

Grizzly bear incidental observations on East Island totaled 21 occasions, with 33 individual bears recorded by Environment personnel during 2006 (Appendix IV). The number of on-island observations is almost half that of last year where 60 animals were recorded on 43 occasions in 2005. It is important to note however that the actual number of bears on site is unknown, as clearly the same bear(s) were observed on several occasions.

Figure 6.2-2 Frequency of Incidental Observations – Grizzly Bears on East Island



East Island incidental bear observations occurred on 20 separate days, with the first bear sighting on 16 May, and the last recorded observation 6 October (Figure 6.2-2). More than half of the observations included multiple bears, with the majority of these sightings involving a single sow and cub pair (Appendix IV). There was one occasion on 30 May where three bears, a sow and two cubs, were observed on East Island. In general, the residency time of any one bear on East Island was fairly short, as deterrents were used to remove bears from the island in many cases.

The 2006 caribou migration differed from years past. The timing of the herd moving through the Diavik study area was later in the fall/winter and the number of caribou observed also decreased. This could be a contributing factor to the decrease in bear activity on East Island, given that caribou are a valued prey species for grizzly bears.

There was also a significant increase in air traffic at the Diavik site in 2006, due to re-supply issues resulting from a short winter road season. However, numerous bears were observed at or near the airstrip, and observations from Environment staff noted that these bears reacted very little to aircraft movement. As an example, on 19 July 2006, a bear was spotted at the west PKC dam. Environment staff deterred the bear using a vehicle until the bear settled at the east end of the airstrip, which is out of range for vehicles. Due to air traffic, Environment was unable to continue bear deterrent activities for approximately 2 hours, but stayed in the area to observe the bear to ensure that it was not put in a dangerous situation with aircraft. During this time, 2 Hercules aircraft landed and departed, as did a 737. The bear showed little reaction to the Hercules, merely raising its head. At the sound of the jet landing and taking off, the bear got up and briefly walked around, only to lay back down again. The continued presence of bears near the airstrip, paired with behavioural observations such as the one outlined here, does not appear to support a decrease in bear activity due to air traffic.

Outside of East Island observations and sightings recording during caribou aerial surveys, two additional incidental grizzly observations were recorded within the DDMI wildlife study area during 2006 (Figure 6.2-1). The first recorded observation was on 8 May, when a den (Photo 6.2-1) was discovered approximately 8 km east of the Diavik mine site. A sow and two cubs, aged 2-3 years, were observed in the immediate vicinity of the den (Photo 6.2-2). The second recorded observation was of a grizzly sow and cub traveling southeast on the ice of Lac de Gras. This sighting occurred on 9 June 2006, approximately 4 km east of the Diavik mine site (Figure 6.2-1).

Outside of the wildlife study area, two additional bears were recorded by Diavik personnel; details on these sightings have been included for information purposes. The first was a single grizzly reported by a DDMI geological crew approximately 12 km north east of Diavik on 24 July. The second, also a single bear, was recorded by DDMI Environment 50 km north of Diavik during a raptor survey on 24 July.

Photo 6.2-1 Grizzly Bear Den, 08 May 2006

Photo 6.2-2 Grizzly Sow and Two Cubs 08 May 2006

CONCLUSION

The results generated by conducting grizzly bear sedge wetland and riparian shrub habitat surveys in 2006 provide evidence to suggest that grizzly bears continue to be present and maintain active home ranges within the DDMI wildlife study area. While incidental observations of grizzly bears in the area decreased from last year, these recordings also provide evidence to support continued activity of grizzly bears in the study area. The decrease in incidental observations is most likely linked to the change in caribou distribution experienced in the Slave Geological Province during 2006. While an increase in air traffic could have also contributed to this phenomenon, observations of bear behaviour in proximity to multiple flights do not appear to support this hypothesis.

6.3 ZONE OF INFLUENCE

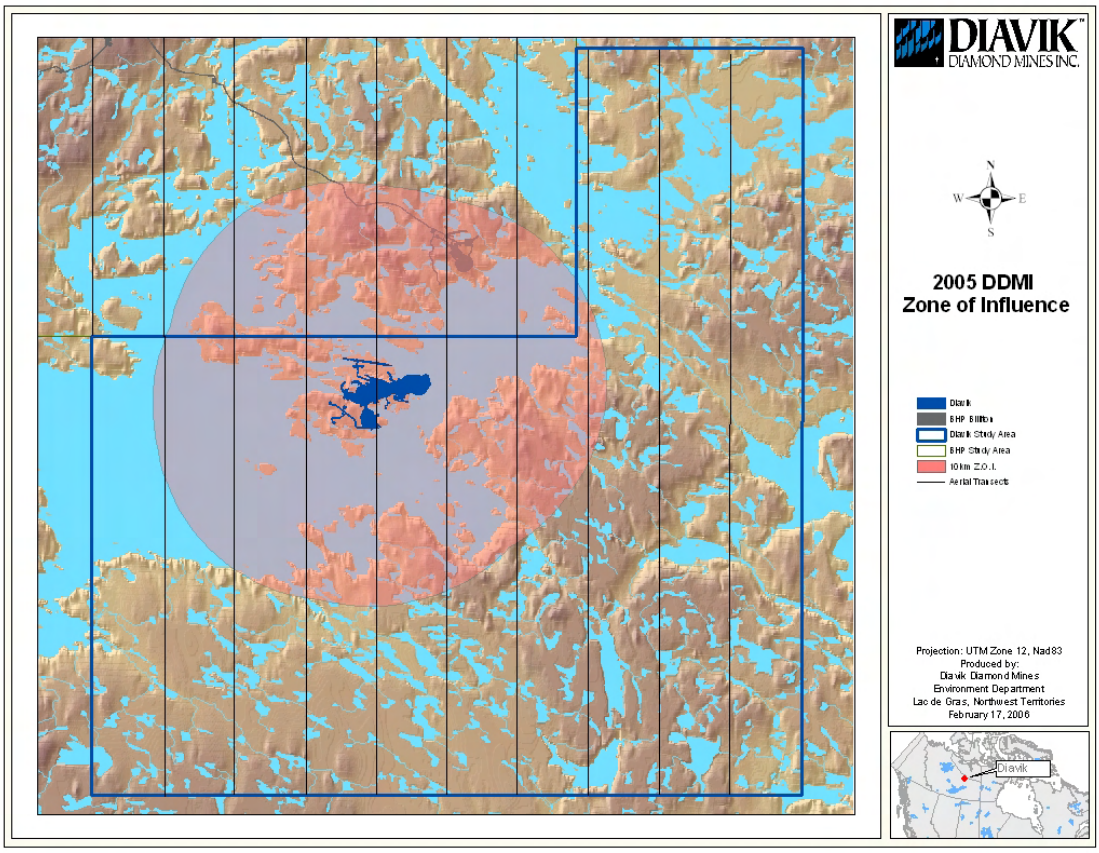
Mining activities may cause behavioural disturbances, which could result in the spatial and temporal displacement of an animal from otherwise useful habitat (DDMI, 1998b). The effects of disturbance may cause bears to become displaced or habituated to industrial activities. Information is limited on zone of influence (ZOI) for bears in response to mining activities, but Harding and Nagy (1980) reported disrupted bear foraging activities up to 4 km from industrial sites. The predicted effect is:

> ***The maximum zone of influence from mining activities is predicted to be 10 km.***

METHODS

The presence of grizzly bears surrounding the Diavik site was monitored at 36 plots, described above. In addition, while conducting weekly caribou aerial surveys, all observations of grizzly bears within the predicted zone of influence (<10 km) and outside of the predicted zone of influence (>10 km) were documented. The number of bears per transect area surveyed were determined for the Diavik wildlife study area (Table 6.3-1). Density of grizzly bears within the zone of influence was calculated using the sum of length of transects multiplied by the area surveyed (1.2 kilometer observation width during aerial surveys) within the highlighted area in Figure 6.3-1, which extends into the BHPB wildlife study area. Determining the density of bears outside the zone of influence was calculated using survey transects present within the Diavik wildlife study area, without the addition of transects in the BHPB study area. The area surveyed within 10 kilometers is 166.2 km^2 where the area surveyed greater than 10 kilometers is 226.1 km^2.

Figure 6.3-1 Predicted Maximum Zone of Influence for Grizzly Bears

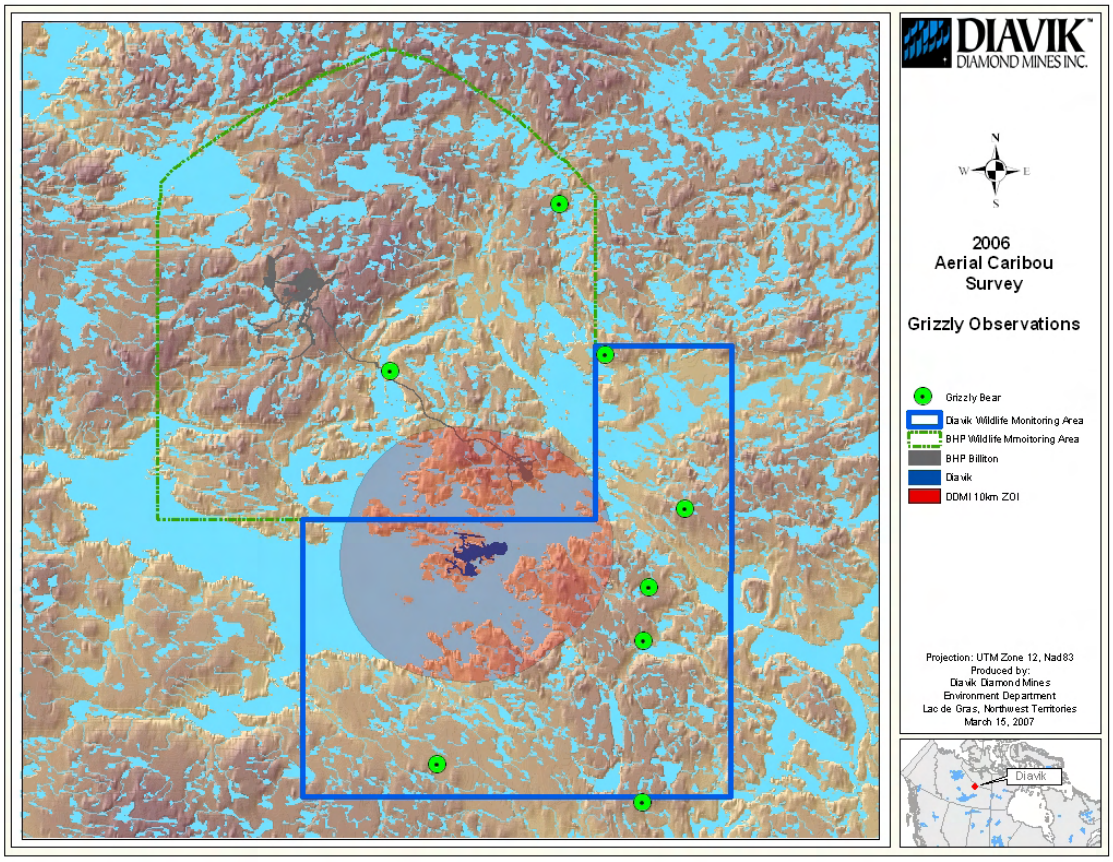


RESULTS

Habitat surveys did not detect any effect of distance from the mine on the chance of finding grizzly bear sign. This indicates that a zone of influence may not exist within the study area. However, these results are currently based on only five years of data. In addition, all plots are located between 3 and 30 km from the mine. Thus, a small zone of influence (limited to East Island) or very large zone of influence (greater than the study area) would not be detected. For the 2008 annual report, impact predictions relating to the ZOI will be more fully tested through a comprehensive analysis of regional grizzly bear data (e.g., Golder, 2005).

During the aerial caribou surveys for 2006, eight grizzly bears were observed (Figure 6.3-2), five of which were within the DDMI wildlife study area. Of the three remaining, two were in the BHP-Billiton wildlife monitoring area, while the other was just outside the southern boundary of the Diavik wildlife monitoring area.

Figure 6.3-2 Grizzly bears observed within and outside the Diavik zone of influence, 2006.



Weekly aerial surveys were conducted from April to November and observations of grizzly bears in the study area were recorded (Table 6.3-1 and Figure 6.3-2). Densities of bears within the zone of influence and outside the ZOI, but within the Diavik study, area were calculated as 0.000 and 0.022, respectively. This is the first year since aerial surveys began (2002) to that no grizzly observations were recorded inside the 10 km zone of influence.

Table 6.3-1 Aerial Survey Observations of Grizzly Bears in the DDMI Wildlife Study Area

	2002		2003		2004		2005		2006	
	Inside ZOI	Outside ZOI	Inside ZOI	Outside ZOI	Inside ZOI	Outside ZOI	Inside ZOI	Outside ZOI	Inside ZOI	Outside ZOI
# of Observations	1	6	2	11	4	7	6	4	**0**	**5**
Transect Area Surveyed (km2)	166.2	226.1	166.2	226.1	166.2	226.1	166.2	226.1	**166.2**	**226.1**
# Observations / Area Surveyed	0.006	0.027	0.012	0.049	0.024	0.031	0.036	0.018	**0.000**	**0.022**

ZOI is 10 km; inside ZOI is <10km and outside ZOI is >10km.
****Values represent only those observations within the DDMI study area.***

6.4 MORTALITY

Despite mitigative measures, mine activities may lead to grizzly bear mortalities, injuries or relocations from year to year. The specific impact prediction in the Environmental Effects Report (DDMI, 1998b) is:

> ***Mortalities associated with mining activities are predicted to be 0.12 to 0.24 bears per year.***

METHODS

Project related incidents and mortalities are reported to environment staff for documentation.

RESULTS

No grizzly bear injuries, mortalities or relocations occurred during 2006 (Table 6.4-1).

Table 6.4-1 Grizzly Bear Statistics for all Monitoring Years

	2000	2001	2002	2003	2004	2005	2006
Days with Bear Visitation on East Island	15	14	5	15	24	34	**20**
Days Deterrent Actions were Utilized	10	8	2	6	20	23	**8**
Grizzly Relocations	0	1	0	1	0	0	**0**
Mine-related Grizzly Mortalities	0	0	0	0	1	0	**0**

A total of 21 observations of grizzly bears (33 bears in total) were made on East Island in 2006. These occurred on 20 separate days between 16 May and 6 October. Deterrent actions, primarily consisting of pen launched bear bangers and 12 gauge cracker shells, were utilized on eight occasions to ensure the protection of people and property by moving the bears off to a safe distance (Appendix IV). During three of the deterrent events, a helicopter was utilized to coax the bears away from site infrastructure.

Although there is some interaction between the Diavik Diamond Mine and surrounding grizzly bears, every effort is made to immediately report and deter any animals that come into contact with the mine site. Bear awareness sessions continue to help raise employees awareness and response, and contributed to the timely reporting of bears approaching site. This, in turn, minimizes unwanted interactions.

Construction began at the Diavik Diamond Mine site in the year 2000. The calculated mine mortality rate over the past seven years is 0.14, which falls within the range predicted during the environmental assessment.

6.5 RECOMMENDATIONS FOR THE 2007 PROGRAM

It is recommended that the DDMI Environment Department continue to facilitate bear awareness training sessions, for all site employees and contractors.

7. WOLVERINE MONITORING

Wolverines are year round residents in the Lac de Gras area (DDMI, 1998b) and the western population is listed as a species of 'Special Concern' by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC, 2005).

Actions are currently being taken to revise the listing of wolverine under the federal Species at Risk Act (SARA) legislation from Schedule 3 to Schedule 1, thereby providing protection under the Act. The consultation period between various governments and wildlife co-management boards has been extended to further satisfy requirements to incorporate the best available community knowledge and aboriginal traditional knowledge. The timeline for the extended consultation period is currently unknown; however, upon completion the species listing may be revised (SARA Public Registry 2007).

The Government of the Northwest Territories (GNWT) is in the process of approving SARA for the NWT that would specifically account for species within the territory. Should this be established, it would supersede the federal legislation. The GNWT lists the status of wolverines as secure (RWED, 2000), and it is believed that populations within the Slave Geological Province (SGP) are healthy (Mulders, 2000).

Wolverine home ranges have been estimated at 126 km^2 for adult females and 404 km^2 for adult males (Mulders, 2000). The feeding behaviour of wolverine may result in their attraction to camps and habituation if they receive a food reward (Penner, 1998). This potential has been demonstrated during baseline and initial construction in the Diavik area.

7.1 PRESENCE

The objective for this program is to determine if mining activities are influencing the presence of wolverines in the study area. The impact prediction is stated as:

> ***The mine is not predicted to cause a measurable shift in the presence of wolverines in the study area.***

METHODS

Wolverine presence around the Diavik Diamond Mine is regularly monitored in three ways: snow track surveys, incidental observations on East Island and sightings during weekly aerial caribou surveys.

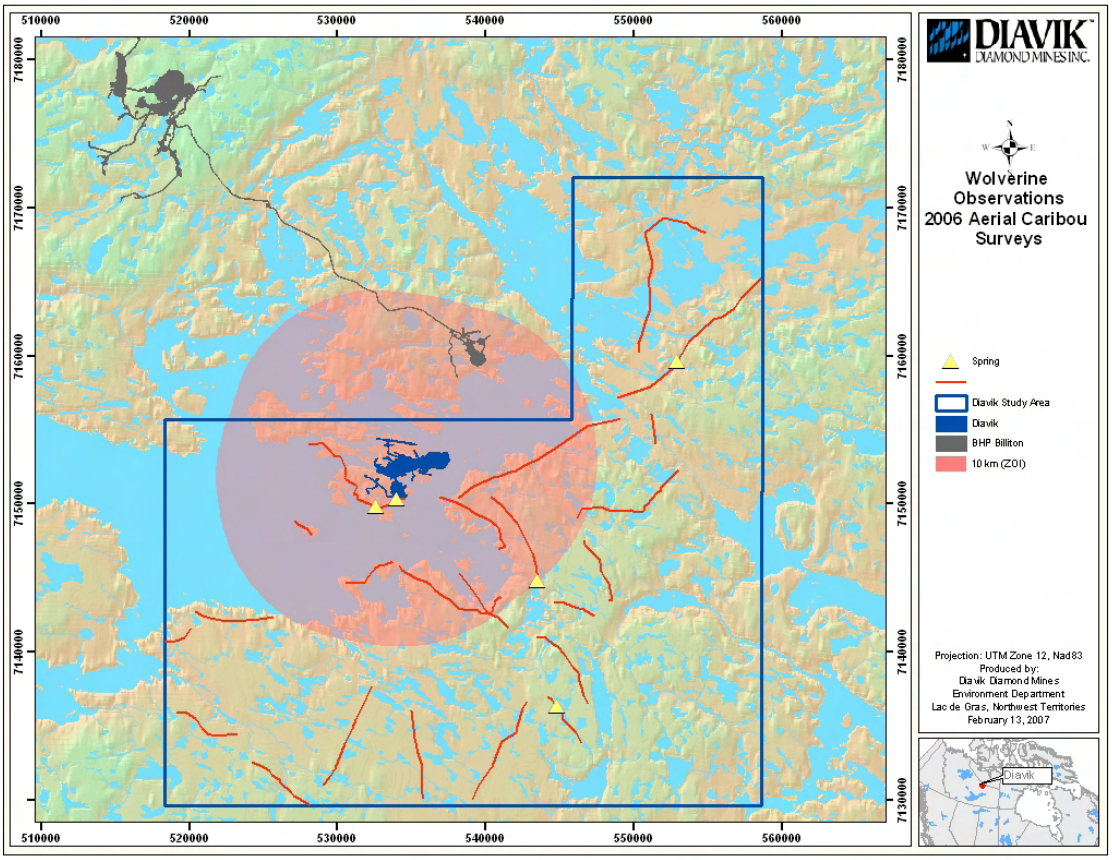
Wolverine snow track surveys are conducted by snowmobile along 23 transects, totaling 148 kilometers in length (Figure 7.1-1). Each transect is driven once by snowmobile in both April and December of each year, and all wolverine tracks and other sign (digs and dens) are recorded. The snow track surveys began in 2003, and have been conducted with the assistance of community members from Kugluktuk.

DDMI representatives record all sightings of wolverines on East Island, and summarize observations of wolverine during caribou aerial surveys.

SNOW TRACKING RESULTS

Spring wolverine snow track surveys were conducted on 28 March to 1 April 2006. A total of 148 kilometers, divided into 23 transects, were surveyed. In all, 5 separate occurrences of wolverine sign (4 sets of tracks, 1 of scat), were recorded on 4 transects surveyed (Figure 7.1-1). This resulted in an index of 0.03 wolverine sign per kilometer, which was down from previous years (Table 7.1-1). Adverse snow conditions are known to significantly influence snow tracking efficiency; however, observers noted that the snow conditions during the 2006 spring survey were excellent, very light snow every day, minimizing the potential for inaccurate counts. No incidental observations of wolverine were made during the spring survey.

Figure 7.1-1 Results form Snow tracking Surveys 2006



Winter wolverine snow track surveys began 7 December 2006. Unfortunately, unfavorable snow tracking conditions and inclement weather resulted in cancellation of the winter survey on 14 December. While 12 transects were surveyed, the data are not included in this report due to the inability for meaningful comparison to previous surveys. Snow tracking conditions were recorded as extremely poor, primarily due to recent white out's (12 and 23 November), which resulted in most of the snow being blown off open lakes and tundra, and deposited in sheltered bowls and sporadic snow drifts (Photo 7.1-1). Bare ice and exposed tundra made snowmobile travel and track recognition very difficult. Temperature extremes also led to concern for personnel and equipment safety, which ultimately resulted in the cancellation of the winter snow tracking surveys.

Photo 7.1-1 Poor Wolverine Snow Tracking Conditions 7 December, 2006

Photo 7.1-2 Wolverine Tracks Observed 8 December 2006

Table 7.1-1Wolverine Track Index and Mean Days Following Snow, 2003 to 2006

	Spring 2003	Spring 2004	Winter 2004	Spring 2005	Winter 2005	Spring 2006
Tracks Encountered	13	16	12	7	16	5
Track Index (Tracks/km)	0.09	0.11	0.08	0.05	0.11	0.03
Mean Days Since Snow	2	4	4	7.5	2	1

Using a 10 km zone of influence around the Diavik mine site (Figure 7.1-1), a proximity analysis of total wolverine track densities for 2006 show an index of 0.16 wolverine tracks per kilometer for all transects located within 10 km versus an index of 0.07 for those transects outside the 10 km zone (Table 7.1-2). Analysis of the probability of occurrence of wolverine tracks also showed that likelihood of detecting a wolverine track increased decreasing distance from the mine (Appendix VII). As with previous years, the majority of the tracks encountered were located immediately southeast of the Diavik mine site. Bobby Algona of Kugluktuk, who provides traditional knowledge and expertise with regards to wolverines, had previously identified this particular portion of the DDMI study area as ideal wolverine habitat due to the frequent presence of boulder fields and cliffs.

Table 7.1-2 Proximity Analysis of 2006 Wolverine Snow Tracking Results

Transects	Spring Track Index
Inside 10 km Zone *(a,b,c,d,e,i,j,n)*	0.06
Outside 10 km Zone *(f,g,h,k,l,m,o,p,q,r,s,t,u,v,w)*	0.02

INCIDENTAL OBSERVATIONS

Incidental observations of wolverine on or around East Island were reported to and recorded by Environment personnel on 31 occasions in 2006 (Appendix V). Of these observations, seven were associated with the waste transfer area where site waste material is reduced, incinerated, or packaged and stored for shipment off site. Inspections of this area occur every two days to ensure proper waste handling and disposal procedures, and to verify that practices are being utilized to minimize wildlife attraction. The total number of incidental observations was down from the previous year, when a wolverine took up residence under the south camp buildings and

contributed greatly to the 41 observations made in 2005 (Table 7.1-3). The majority of animals recorded this year appeared to be passing through or around the site. Deterrent actions were utilized to move wolverines away from site developments on two occasions in 2006 (Appendix V).

Photo 7.1-3 Incidental Wolverine Observation, February 2006

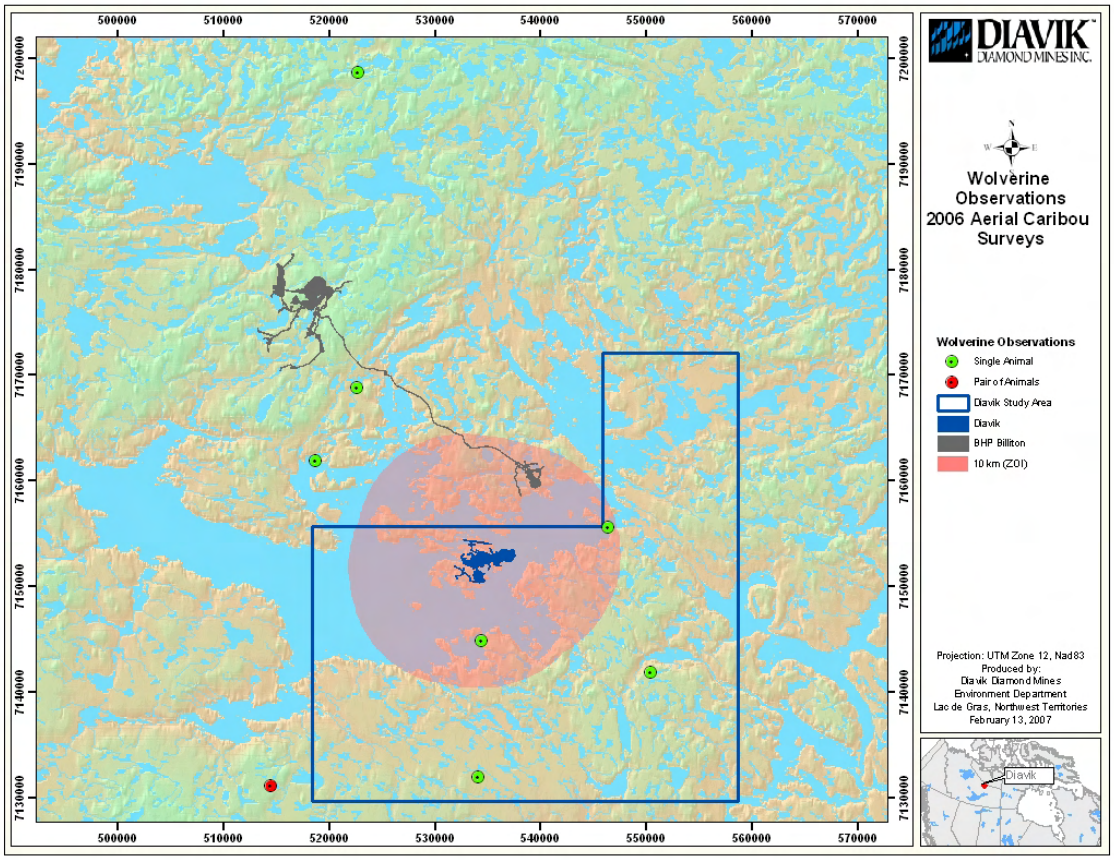
Table 7.1-3 Wolverine Sighting on East Island, Baseline to Present

	Base -line	2000	2001	2002	2003	2004	2005	2006
Days with Wolverine Visitation on East Island	82*	25	36	4	38	14	43	**31**
Days Deterrent Actions were Utilized	N/A**	9	10	0	1	1	5	**2**
Wolverine Relocations	1	0	2	0	0	0	0	**0**
Mine-related Wolverine Mortalities	1	0	1	0	0	0	0	**0**

27 / year **Unknown - Baseline Includes wolverine occurrences recorded at three different camps (i.e. Diavik, Kennecott, and/or Echo Bay Road Camps).

An additional nine wolverines were observed during the weekly aerial caribou surveys conducted in 2006. Four individual animals were spotted by observers within the DDMI wildlife monitoring area, and another five animals (three individuals and one pair) were recorded outside the Diavik area (Figure 7.1-2).

Figure 7.1-2 Wolverine Observations from Aerial Caribou Surveys, 2006



DISCUSSION

Results generated from wolverine snow tracking surveys, aerial caribou observation and on-site incidental wolverine observations in 2006 provide evidence to suggest wolverine continue to be present and maintain active home ranges within the DDMI wildlife study area.

7.2 DNA STUDY

In 2005, Diavik participated in a multi-party study coordinated by Environment & Natural Resources designed to monitor wolverine abundance across broad landscapes using genetic analysis. In April 2006, Diavik again participated in the wolverine DNA study, fulfilling our two year commitment to this program. The results for the genetic analysis program conducted at Diavik have been statistically analyzed in “A Comparison of Effects Monitoring Methods for Wolverine at the Diavik Diamond Mine” (DDMI 2007). The analysis and resultant recommendations are included in Appendix VII of this report.

The results from the data collected across the Slave Geologic Province will also be presented in a separate report that will incorporate wolverine genetic data from three mining companies, local outfitting companies and the Daring Lake Tundra Research Station, operated by ENR.

7.3 MORTALITY

Mortalities can occur if wolverines become habituated to mining activities resulting from efforts to locate food (DDMI, 1998b). Diligent waste management (Section 8.0), strictly enforced speed limits, and immediate reporting of wildlife sightings on East Island have limited mortalities of wolverine during the operational period of the Diavik mine. The prediction made during the environmental assessment was:

> ***Mining related mortalities, if they occur, are not expected to alter wolverine population parameters in the Lac de Gras area.***

To date, efforts have been focused on minimizing mining related mortalities to prevent any changes to wolverine population parameters.

METHODS

Project related incidents that may occur are reported to Environment personnel through incident reports submitted by mine staff. The Environment department follows up on any incident and completes the necessary documentation. This information is tabulated and provided for annual comparisons.

RESULTS

One project related incident involving wolverine occurred in 2006 (Appendix VI). A wolverine was found trapped inside an open, empty oil tote at the Waste Transfer Area on 3 March. Environment personnel responded immediately and were successful in safely freeing the wolverine from the tote. The wolverine did not appear to have sustained any injuries in the incident, and measures were immediately taken to prevent future similar occurrences.

No injuries, mortalities or relocations of wolverine occurred as a result of mining activities on East Island in 2006 (Table 7.1-3). Since 2000, two wolverines have been relocated, and a single mortality occurred at the DDMI mine site.

7.4 RECOMMENDATIONS FOR THE 2007 PROGRAM

Wolverine snow track surveys will continue to include traditional knowledge on the movements and approximate numbers of wolverines within the study area.

Diavik is evaluating a change in monitoring procedure for the wolverine track surveys in order to provide more statistically reliable data.

Diavik's two year commitment to the wolverine DNA study has been fulfilled. No further sample collection will occur until such time as the analysis and recommendations are discussed and agreed upon.

8. WASTE MONITORING

DDMI is committed to taking all the necessary steps to ensure that the collection, storage, transportation and disposal of all wastes generated by the project are being conducted in a safe, efficient and environmentally compliant manner. The DDMI Waste Management Plan, an integral part of Diavik Diamond Mines' Environmental Management System, focuses on minimizing the generation of wastes at points of use, optimizing the usage of materials before disposal and facilitating the collection and processing of wastes with the least adverse effects on the physical and biological conditions at site.

Along with the ideals of the four R's embodied in the Waste Management Plan, namely reduction, recovery, reuse and recycling, there are several mitigation measures to prevent and reduce adverse impacts on wildlife. These measures include, but are not limited to, incineration of all food wastes, categorical segregation of all non-food waste for storage and subsequent removal from site, and on-site disposal. All of these methods are designed to minimize wildlife attraction to the site.

Incineration, segregation and storage of waste takes place at the DDMI Waste Transfer Area (WTA) which was established to ensure proper handling and storage of waste on site. The facility is located on the south side of the Processed Kimberlite Containment (PKC) area. The WTA is approximately 130 X 130 meters (m), and is surrounded by a gated, 3 meter high chain link fence erected to control wind transportation of any litter and minimize wildlife intrusion. Contained within the WTA are two incinerators for food waste, a burn pit for non-toxic/non-food contaminated burnable material, a contaminated soils containment area, a treated sewage containment area, as well as sea cans, sheds, and storage areas for drums, crates, bins and totes. The majority of wastes are inventoried and stored at the WTA while awaiting backhaul on the winter ice road.

On-site disposal of non-burnable wastes such as steel, plastics and glass currently occurs at the inert landfill located within the Type 3 waste rock pile. These materials are covered with waste rock on a regular basis to prevent wildlife attraction.

DDMI Environment personnel conduct inspections of the WTA and landfill every second day from January to December. The inspections are conducted to ensure all waste segregation, storage and disposal procedures set out in the DDMI Waste Management Plan are being followed, thereby preventing the attraction of wildlife and protecting environmental integrity. Environment personnel record all occurrences of improperly disposed waste materials which attract wildlife, as well as all wildlife sign and observations. Any infractions are reported to waste management personnel for immediate rectification.

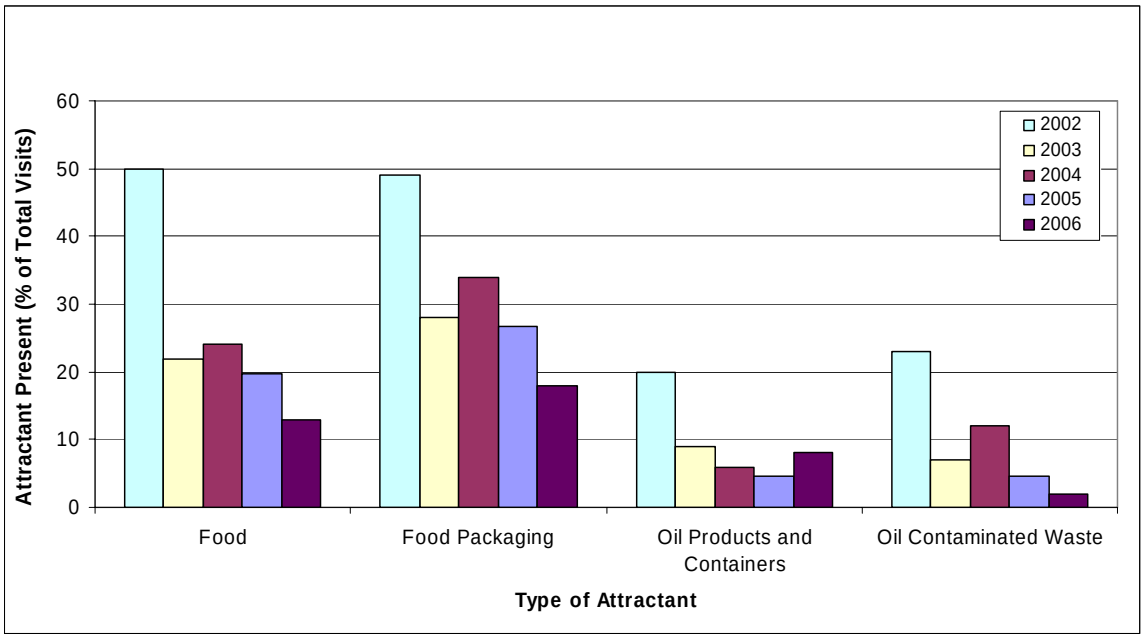
METHODS

In 2006, inspections of the Waste Transfer Area and landfill were conducted every two days beginning 2 January and ending 31 December. Inspections consisted of Environment personnel walking the area of the waste transfer and landfill, where safe to do so, and documenting the type and number of attractants found, as well as wildlife species or fresh sign that were present during the survey.

RESULTS

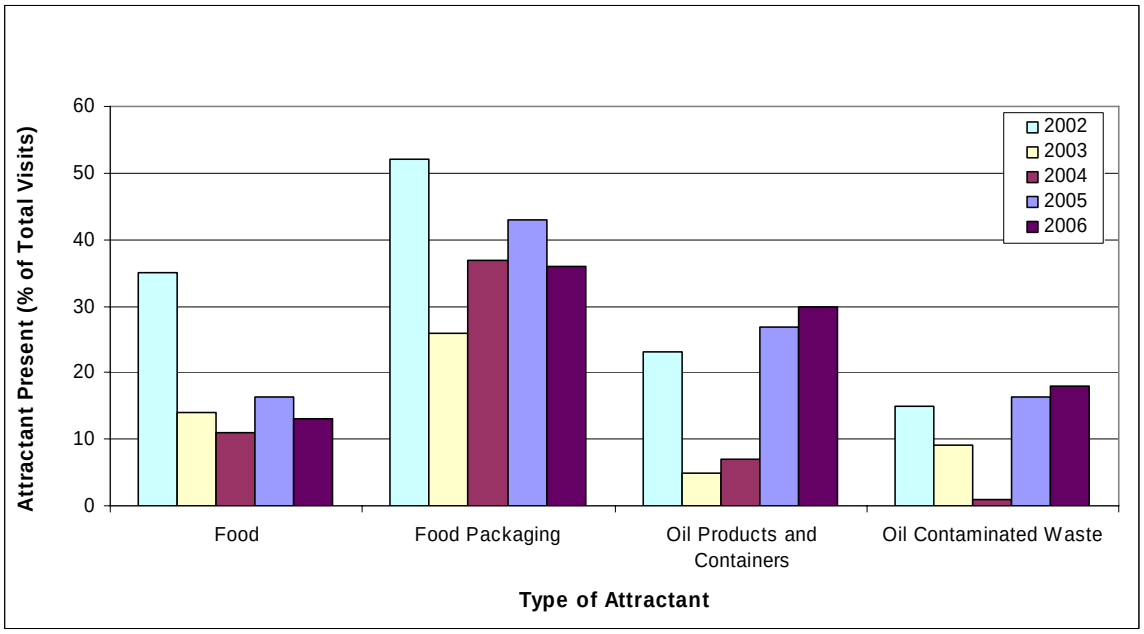
Potential wildlife attractants (such as food and oil) were found at the Waste Transfer Area on 37.9% of the 174 inspections during 2006. Food packaging and food waste were the most commonly observed attractants, with findings during 13% and 18% percent of all inspections, respectively (Figure 8.2-1).

Figure 8.2-1 Percentage of Total Inspections Identifying Attractants at the Waste Transfer Area 2002-2006



Attractants were found on 69.5% of 174 inspections of the inert landfill. Again, food packaging was the most commonly found attractant, having been observed during 36% of all inspections (Figure 8.2-2). However, the occurrences of oil products and containers, and oil-contaminated waste were still higher than previous years. While these values did not surpass those of food packaging, this is the second year where observations of oil wastes exceeded that for food in the landfill.

Figure 8.2-2 Percentage of Total Inspections Identifying Attractants at the Inert Landfill 2002-2006



Wildlife was observed on 33.9% of the inspections of the waste transfer area, and on 8.6% of the inspections at the landfill. Similar to previous years, foxes were the most frequently observed wildlife in these two areas, followed by ravens and gulls (Table 8.2-1).

Wildlife sign was found on 31.9% of visits to the waste transfer area, and 33.9% of visits to the landfill. The most commonly observed sign, as with previous years, belonged to foxes (Table 8.2-1). There was one occasion where wolf sign (tracks), were recorded in the vicinity of the landfill.

Table 8.2-1Occurrences of Wildlife or Wildlife Sign during Waste Inspections

	WTA (174 visits)		Landfill (174 visits)	
	Wildlife	**Wildlife Sign**	**Wildlife**	**Wildlife Sign**
Gull	14	0	3	0
Raven	13	2	2	2
Fox	32	49	4	58
Hare	0	0	0	0
Ground Squirrel	0	0	0	0
Wolverine	3	7	0	0
Wolf	0	0	0	1
Grizzly Bear	0	0	0	0

DISCUSSION

The DDMI Waste Management Plan outlines the practices in place to ensure that materials which may act as wildlife attractants are routed toward the Waste Transfer

Area for incineration or storage. To this end, occasional observations identifying attractants can be expected and should not present a problem if incineration is prompt.

The continued occurrence of wildlife and wildlife sign at the Waste Transfer Area indicated that mitigation measures, such as fencing, require improvement. Efforts undertaken to reduce the occurrence of wildlife in the WTA included patching fence damage, as well as repairing the gate assembly, and reviewing waste handling and storage procedures with WTA personnel.

The total number of observations for each type of waste occurring within the WTA has shown an overall decreasing trend since 2002 when data collection began. The exceptions to this trend occurred in 2004 for three of the four categories, as well as for oil products and containers this year. This trend helps to show that improvements in employee education and waste tracking are contributing to achieving a reduction in improper waste segregation.

However, the continued presence of attractants at the inert landfill indicates that waste management practices require further improvement in this area. The location of the landfill within the waste rock pile, combined with frequent turnovers, appears to limit wildlife from accessing the area. The low frequency of wildlife and wildlife sign observations indicate that efficient turnover rates are successful at helping to minimize wildlife visits to this area.

Consideration must also be given to the size of the workforce during 2006. The average number of people present on East Island over the course of the year exceeded that for 2005. With this growth in the resident population, presence of attractants did not significantly increase, and in some cases decreased, from previous years.

The increase in oil products, containers and oil contaminated waste at the landfill was likely due to increased construction activity that began in 2005. Improper segregation and uncontrolled dumping was found to be occurring from several contractors when construction first began. Environment personnel, in conjunction with waste management staff, quickly identified problem areas and began conducting extensive waste management awareness sessions with all contractors and DDMI employees to resolve the problem. Additionally, waste collection bins were numbered and inspected prior to pick up to facilitate communication between waste management staff and Environment, and to address issues within various departments. This process is ongoing.

Overall, procedures and mitigation measures currently in place have been relatively successful at minimizing wildlife interactions. While foxes, ravens and gulls appear to be frequenting the WTA and landfill areas, these animals are natural scavengers. The relatively low number of observations suggests that these individuals may be attracted to the area; however they are not sustained by the attractants they may find.

8.1 RECOMMENDATIONS FOR THE 2007 PROGRAM

The continued presence of attractants in the inert landfill indicates a need for additional environmental awareness sessions. Environment personnel will continue to provide a dynamic workforce with information on ramifications due to improper waste management, such as human safety issues related to carnivore problems.

Regular inspections (every second day) at the WTA and landfill will continue, as this has proven successful in the prompt discovery and resolution of potential concerns. DDMI

Environment is working to initiate a better waste tracking system with our waste management contractor, some elements of which have already been implemented.

DDMI is currently investigating the potential to install a gate at the landfill to further reduce opportunities for uncontrolled dumping.

9. RAPTOR MONITORING

9.1 PRESENCE AND DISTRIBUTION

The peregrine falcon and gyrfalcon were selected as key species because of their special management status, biological vulnerability to disturbance and that they are known to nest regularly in the Lac de Gras area (DDMI, 1998b). The peregrine falcon (*Falco peregrinus tundrius*) is listed under Schedule 3 of the Species at Risk Act as a "Species of Special Concern", as designated by the Committee of the Status of Endangered Wildlife in Canada (COSEWIC, 1992). A Species of Special Concern is defined as a wildlife species that may become a threatened or endangered species because of a combination of biological characteristics and identified threats.

As the last date of assessment for the *tundrius* sub-species was April 1992, the species is currently under re-assessment, with a draft report under review (COSEWIC, 2007).

Habitat loss, sensory disturbance, and impacts to prey populations may influence raptors nesting in the Lac de Gras area. The impact predictions for raptors are that:

> ***Disturbance from the mine and the associated zone of influence is not predicted to result in measurable impacts to the distribution of raptors in the study area.***
>
> ***The mine is not predicted to cause a measurable change in raptor presence in the study area.***

Other raptors present in the study area include rough-legged hawks, snowy owls, and short-eared owls. However, these species are uncommon, and their presence from year to year is unpredictable. Falcons are thereby used to monitor impacts to raptors.

METHODS

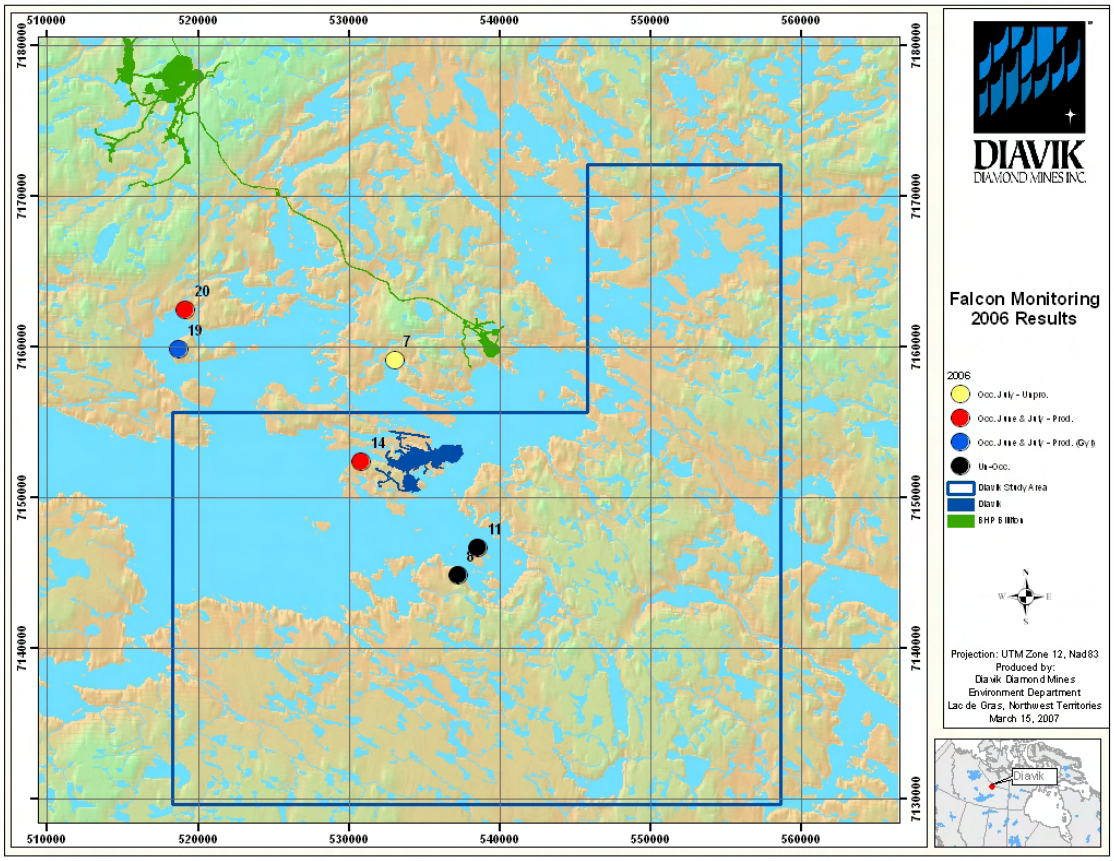
Falcon nesting sites were visited on 5 June and 24 July 2006, in cooperation with ENR and BHP Billiton Diamonds Inc., and included nest sites in the Daring Lake Tundra Research Station, Ekati™ Diamond Mine, and Diavik Diamond Mine wildlife study areas. The falcon monitoring results from Daring Lake are presented here as control data from an undisturbed area. Previously identified potential nesting sites were visited by helicopter to determine if nesting sites were occupied, and to count any young in the nest (Figure 9.1-1). Minimal time was spent in the vicinity of the sites to reduce disturbance.

2006 marked the third year the spring survey of falcon sites was added to the monitoring program. The purpose is to include those nests which are occupied in spring but fail before the July chick count. The reasoning for this is that following arrival at the breeding grounds, falcons must locate and defend a suitable cliff for nesting, attract a mate, contend with unpredictable weather and occasional storms, and assess the availability of prey in that year. Any one of these may influence the choice, or the option, of breeding in that year. As such, this is also the most vulnerable period for falcons, and the time when breeding attempts are most likely to fail. DDMI has therefore added a spring survey to the falcon monitoring program to account for this sensitive time of year.

RESULTS

Six known nesting sites in the Diavik wildlife study area were each surveyed twice during 2006. During the spring occupancy survey conducted on 5 June, three of the six sites were occupied (14, 19 and 20); two of the nests (19 & 20) contained incubating females so the number of eggs could not be determined. Nest site 14 was occupied by one female but no eggs were observed. The productivity survey was completed on 24 July, and found four nest sites occupied (7, 14, 19 and 20), two of which were confirmed productive. Site 14 contained 3 chicks approximately 21 days old and site 20 contained 4 young approximately 18 days old. Site 19 contained a gyrfalcon, whose chicks had likely fledged by the time of the survey, due to different phenology than that of peregrine falcons. Site 7 was unproductive (Table 9.1-1).

Figure 9.1-1 Falcon Nest Site Locations



Productivity was within the range recorded in the Diavik wildlife study area since 2000, as was occupancy. Historically, the number of occupied sites in the study area has ranged from one to five, and never more than two have been productive (Table 9.1-1). Chick production in the past has ranged from zero to five. During 2006, a total of 7 chicks were recorded, making this the most successful year for chick production recorded since data collection began in 2000. Occupancy and production in the Diavik wildlife study area during 2006 were found to be similar to that found in the undisturbed Daring Lake area (Table 9.1-1).

The observations made in 2006 are consistent with those made in previous years. Although occupancy in the Diavik area was slightly higher than that found at Daring Lake, the study areas had an equal number of productive sites with similar chick counts.

Table 9.1-1 Falcon nest occupancy and production at Diavik and Daring Lake, 2000 to 2006

	Diavik	Daring	Diavik	Daring	Diavik	Daring	Diavik	Daring	Diavik	Daring	Diavik	Daring	Diavik	Daring
	2000		2001		2002		2003		2004*		2005*		2006*	
Total Sites	6	-	6	13	6	18	6	10	6	10	6	10	6	10
Occupied	2	-	2	2	4	10	1	5	5	5	4	4	2	2
Productive	2	-	0	1	1	9	0	3	1	1	0	1	2	2
Total Young	5	-	0	3	3	15	0	4	2	1	0	3	7	8

Daring Lake data originates from the Daring Lake research station (S. Matthews, personal communication, ENR). Diavik data includes spring and summer monitoring data.

The occupancy of falcon nest sites has changed little since studies began in 1995 (Table 9.1-2). Sites 11 and 14 have been the most commonly used sites since monitoring began in 1995, this being the first year in which site 11 was unoccupied and unproductive. While site 7 has now been in use on three occasions, it previously had not been occupied until the spring of 2004. While this site was not productive this year, the return of a falcon for a third year in a row is encouraging. Sites 11, 14, 19, and 20 have all been used both before and following construction.

Table 9.1-2 History of Activity at Falcon Nests Surrounding Diavik, 1995 to 2006

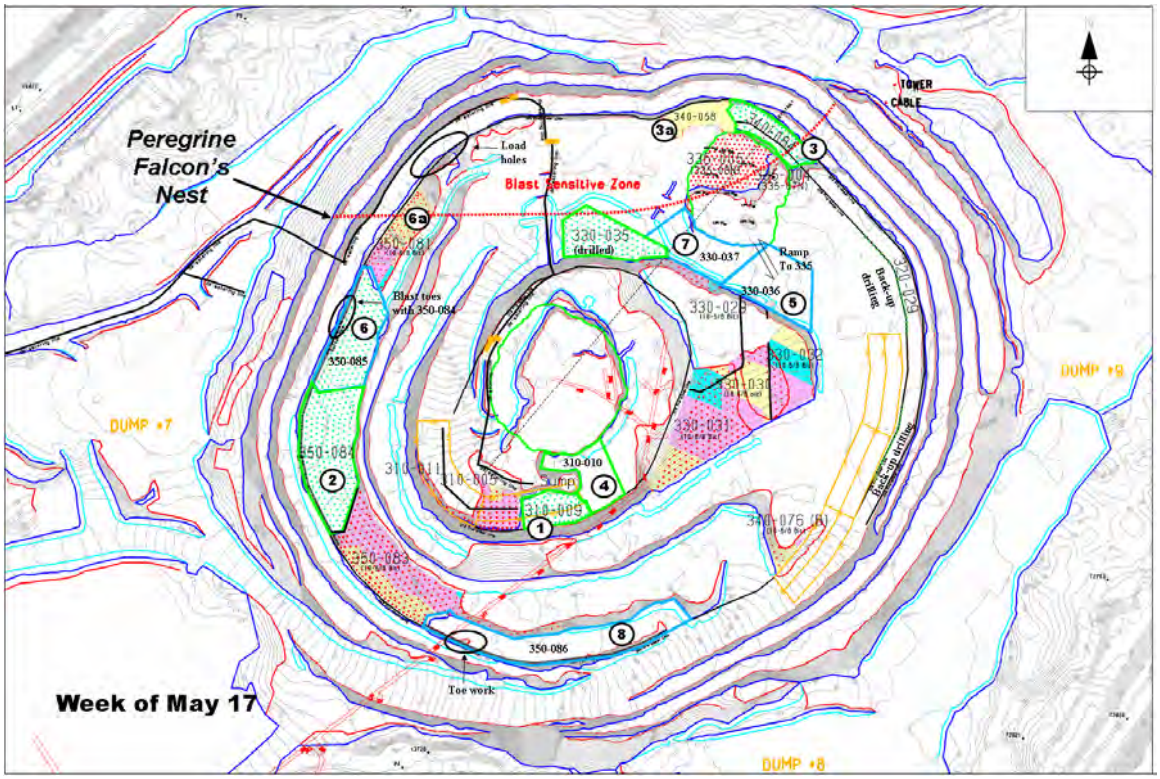
Nest Site	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
7	No	No	No	-	-	No	No	No	No	Yes	Yes	Yes (July only)
8	No	No	No	-	-	No	No	No	No	Yes (June only)	No	No
11	Yes	Yes	Yes	-	-	Yes	Yes	Yes	Yes	Yes	Yes (July only)	No
14	No	No	Yes	-	-	Yes	No	Yes	No	Yes	Yes	Yes
19	Yes	No	No	-	-	No	No	Yes	No	Yes (July only)	No	Yes
20	Yes	No	No	-	-	No	Yes	Yes	No	Yes	Yes	Yes

Falcon production is known to be seasonally variable, highly dependent upon small mammal and bird populations, availability of suitable nesting habitat and weather events. As such, annual changes in falcon occupancy or productivity are unlikely to be sensitive indicators of disturbance. Rather, impacts from mining would probably be manifest in gradual decline in falcon occupancy or productivity over several years or with proximity to the mine. An alternative scenario is that falcon productivity and occupancy are only affected by human disturbance in years when natural environmental factors are limiting the falcon's ability to breed.

In 2006, falcon productivity was within normal range throughout the Slave Geological Province, as evidenced by similar productivity and occupancy rates at the Diavik and Daring Lake study areas. It is normal for some falcon nests to be active most years, while others are only used in unusually good years.

Not included in the monitoring data presented above is the presence of a nesting pair of peregrine falcons in the A154 pit. Falcons were first confirmed to have established a nest on the west highwall of the pit on 19 May 2005. This area was adjacent to a blast sensitive zone in the pit, thereby limiting exposure of the falcons to blasts. A map showing the location of the nest is provided in Figure 9.1-2, and it was located in the same area as in 2005. This nesting site had previously been discussed with ENR and it was agreed at that time that, given the blast plans and location of the nest, no deterrent actions would be taken as these could possibly have increased the risk of the falcons moving to a more active area of the pit. Instead, DDMI would continue to monitor the nest throughout the season.

Figure 9.1-2 Location of Peregrine falcon nest in A154 pit, 2006



Due to the location of the nest, it was unsafe to attempt to view the nest from above and difficult to see into the nest from below. Environment staff usually monitored the nest from below or from across the dike using binoculars or a spotting scope. The falcons were observed on numerous occasions. Of particular interest, the breeding pair was often seen being harassed by a rough-legged hawk between the dates of 3 – 10 June 2006.

Two adults and one juvenile falcon were observed near the pit on numerous occasions, with the first confirmed sighting of the juvenile on 27 August. On this date, climbers contracted to scale the pit walls were accessing a bench known to be near the nest site. While they were setting up their equipment, the juvenile falcon perched on a nearby rock face (Photo 9.1-1). The last confirmed sighting of the occurred on 29 September.

Photo 9.1-1 Juvenile peregrine falcon sighting in A154 pit, 27 August 2006

This is the third occurrence of falcons successfully nesting in the A154 pit at Diavik. Similar events have also occurred at two open pits and other structures at the nearby Ekati mine (BHPB 2003). Further events such as these are expected at Diavik, particularly given falcon fidelity to nesting sites.

9.2 MORTALITY

The objective for this program is to determine the number of raptors killed or injured due to DDMI mining-related activities. The following section summarizes methods used and results produced from incident reporting. The impact prediction in the Environmental Effects Report (DDMI, 1998b) is:

> ***The mine is not predicted to cause a measurable change in raptor presence in the study area.***

METHODS

Project related incidents that may occur are reported to Environment personnel through incident reports submitted by mine staff. The Environment department follows up on any incident and completes the necessary documentation. This information is tabulated and provided for annual comparisons.

RESULTS

There were no falcon injuries or mortalities at the Diavik site during 2006.

9.3 RECOMMENDATIONS FOR THE 2007 PROGRAM

Recommendations for 2007 are to continue the spring occupancy and summer productivity surveys, in conjunction with BHPB and ENR. DDMI will also continue to be diligent for falcons nesting in the A154 pit, or other areas that may present a hazard.

10. WATERFOWL MONITORING

The Diavik site lies along the western arctic feeding ground for migratory birds known as the central flyway (Penner, 1998). Migratory birds often stop or "stage" to feed in the Lac de Gras area before moving on to their nesting grounds in the high arctic. Diavik's surveys include both natural (shallow bays) and man-made (mine-altered) wetlands in an effort to provide a clear picture of potential impacts of mining activities on waterfowl.

In the East Island area, shallow bays, melt-water ponds and shoreline leads have been identified as important areas for migrant waterfowl (DDMI, 1998b) as they provide habitat requisites such as open water. The shallow bays consist of a combination of mudflats and sedge bands, which are proximate to open water and upland vegetation, providing ideal habitat for shorebirds (Van Egmond *et al*. 1997a). Mining activities may artificially produce early open water due to dust deposition and the associated increased rate of snowmelt. This, in turn, may attract migrating waterfowl. DDMI monitors the shallow bays of East Island to determine if there is a change in the number and species of waterfowl present.

Artificially created water habitat is also monitored to ascertain the level of use by waterfowl in those created habitats. Habitat loss (shallow and deep water) due to mining activities is also monitored to determine if more or less habitat is lost than predicted.

10.1 HABITAT LOSS

The objective is to determine if direct habitat loss is greater than predicted. The following section summarizes the methods used and results obtained from satellite imagery. As a result of mining activities, habitat loss will occur and it has been predicted that:

> ***At full development, direct aquatic habitat loss from the project is predicted to be 3.94 km^2.***

METHODS

The vegetation classification map used in the vegetation/land cover section of the Environmental Effects Report (DDMI, 1998b) was used to determine the loss of waterfowl habitat (see Section 2.1).

RESULTS

Habitat loss is defined as the loss of habitat utilized by waterfowl in the East Island area. In 2006, a total of 0.28 km^2 of shallow and deep water was lost, primarily as a result of construction of the A418 dike. It was predicted that 3.94 km^2 would be lost as a result of the mine (DDMI, 1998b). In total, 2.51 km^2 has been lost up to December 2006 (Table 10.1-1).

Table 10.1-1 Predicted Versus Actual Direct Waterfowl Habitat Loss on East Island - 2006

Wetland Type	Predicted Area lost (km^2)	Actual Area Lost (km^2)						Total Area Lost (km^2)
		up to 2001	2002	2003	2004	2005	2006	
Shallow water: <2 m	0.48	0.11	0.12	0.01	0.03	0.03	0.04	**0.34***
Deep water: >2 m	3.46	0.15	1.66	0.01	0.01	0.12	0.24	**2.17***
Total area	**3.94**	**0.26**	**1.78**	**0.02**	**0.04**	**0.15**	**0.28**	**2.51***

Discrepancies in totals across the rows results from the rounding of numbers in annual columns for presentation purposes

10.2 PRESENCE

The objective for this component is to determine if disturbance from the mine is impacting the presence of waterfowl species. Disturbance may result from habitat loss, altered drainage patterns, dust fall, noise from mining activities and human presence (DDMI, 1998b). The following section summarizes the methods used and results obtained from yearly surveys of East Island shallow bays and mine altered water bodies. This monitoring program will determine if conditions are different than the predicted impact:

> ***The mine is not predicted to cause a measurable change in waterfowl presence in the study area.***

METHODS

East Island shallow bays (Figure 10.2-1) and mine-altered water bodies (Figure 10.2-2) were surveyed for waterfowl presence daily from 17 May to 20 June. Waterfowl surveys were initiated a full week ahead of previous years due to the availability of open water as a result of an early melting season in 2006. After this initial five week period, areas were monitored once per week until 18 October 2006. Survey frequency was greater in the spring to coincide with migratory bird utilization of the study area. The mine-altered waterfowl survey methods (Appendix I) were modified in 2005 to point observations from shore, with the aid of binoculars. Due to potential safety hazards associated with increased construction activity in the vicinity of many mine-altered water bodies, point observations were again utilized in 2006. Shallow bay surveys continued to be conducted by Environment personnel walking the perimeter of the bays. All birds observed were identified in accordance with specific characteristics outlined in Petersons Field Guide to Western Birds (3rd Edition, 1990) and, counted and recorded. For analytical simplicity, species observations were categorized into groups, based upon easily identifiable characteristics and similarities, such as fowl-like birds and dabbling ducks. The waterfowl presence section of this report summarizes staging waterfowl groups; specifically, shorebirds, geese, dabbling and diving ducks from both the shallow

bays and mine-altered water bodies. A complete species list by category has been included (Appendix I).

Figure 10.2-1 East Island Shallow Bay Monitoring Locations

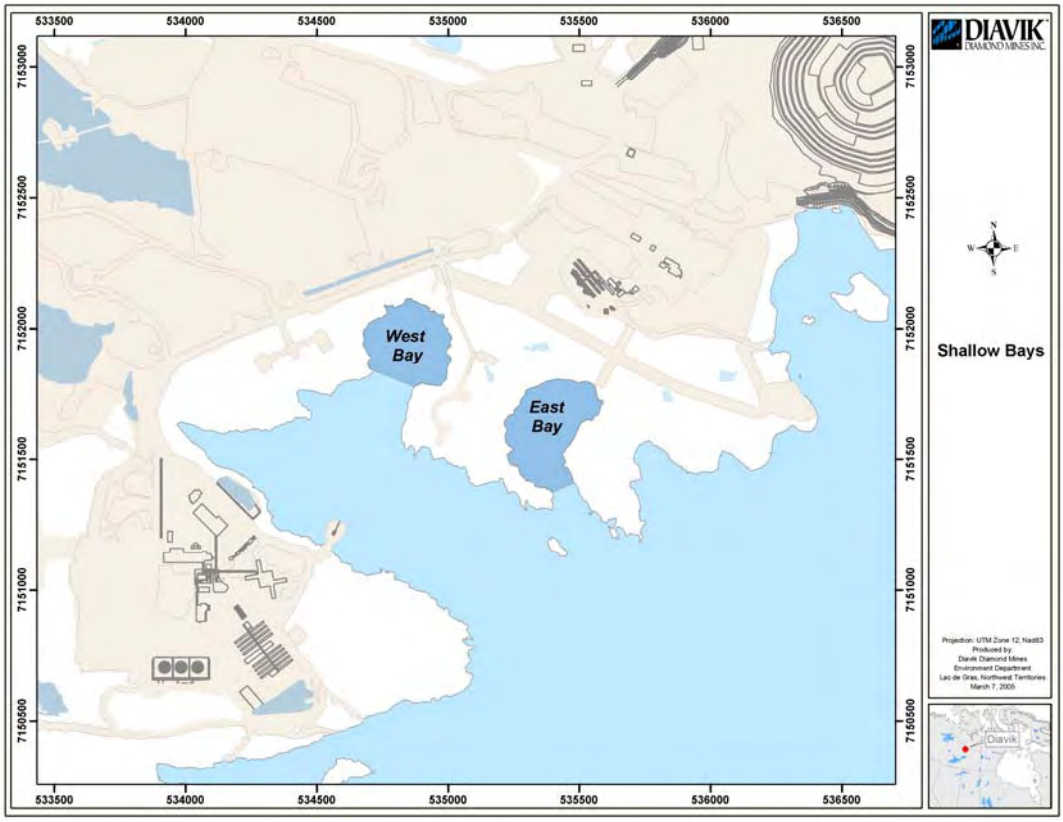
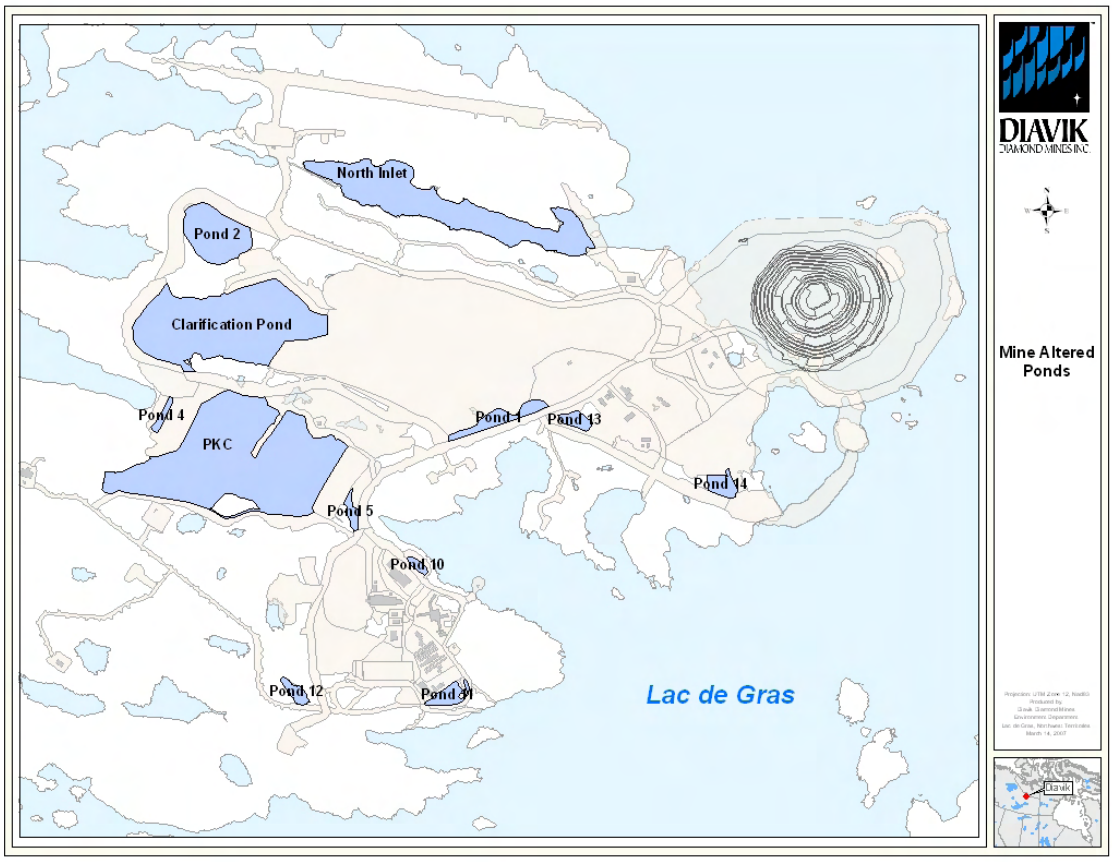


Figure 10.2-2 Mine Altered Waters on East Island 2006



RESULTS

In 2006, 12 species of shorebirds were recorded as present during waterfowl monitoring surveys (Table 10.2-1). The semipalmated plover, semipalmated sandpiper, least sandpiper, and baird's sandpiper continue to be the only shorebird species present during all years of monitoring. Spotted sandpipers, which had not been observed previously on site, were recorded several times in 2006, as was the long billed dowitcher following a four year absence. Conversely, the common snipe has not been observed since baseline and 2000. .

Table 10.2-1 Shorebird Species Present (√) or Absent (X) on East Island for All Monitoring Years

Species	Baseline (1995-1997)	2000	2001	2002	2003	2004	2005	2006
Semipalmated Plover	✓	✓	✓	✓	✓	✓	✓	✓
Black-bellied Plover	×	×	×	×	×	✓	✓	×
Lesser Golden Plover	✓	✓	✓	✓	×	×	✓	×
Semipalmated	✓	✓	✓	✓	✓	✓	✓	✓

Species	Baseline (1995-1997)	2000	2001	2002	2003	2004	2005	2006
Sandpiper								
Least Sandpiper	✓	✓	✓	✓	✓	✓	✓	✓
White-rumped Sandpiper	✓	✓	✓	✓	×	✓	✓	✓
Baird's Sandpiper	✓	✓	✓	✓	✓	✓	✓	✓
Pectoral Sandpiper	✓	✓	×	✓	×	×	×	×
Stilt Sandpiper	✓	✓	✓	✓	×	×	✓	×
Dunlin	✓	✓	×	✓	×	✓	×	✓
Sandhill Crane	×	×	×	×	×	✓	✓	✓
Sanderling	✓	✓	✓	×	×	×	×	×
Red-necked Phalarope	✓	✓	✓	✓	✓	×	✓	✓
Common Snipe	✓	✓	×	×	×	×	×	×
Ruddy Turnstone	×	✓	×	✓	×	×	✓	✓
Long billed Dowitcher	×	×	✓	×	×	×	×	✓
Spotted Sandpiper	×	×	×	×	×	×	×	✓

In 2006, a total of 781 shorebirds were observed during waterfowl and mine altered water body surveys (Table 10.2-2). While the total number of shorebirds in 2006 decreased from 2005, when 888 shorebirds were recorded, only 230 unidentified shorebirds were recorded in 2006 as opposed to the 493 unidentified in 2005, due to continued training and increased proficiency in identification procedures.

The semipalmated sandpiper was the most common species of shorebird observed in 2006, comprising 30% of total shorebird observations. The dunlin, lesser yellowlegs and ruddy turnstone were the least commonly observed shorebird species in 2006 with only a single individual recorded for each species.

Table 10.2-2 Waterfowl Survey Shorebird Observations - 2006

Species	Observations
Bairds Sandpiper	23
Dunlin	1
Long Billed Dowitcher	10
Least Sandpiper	72
Lesser Yellowlegs	1
Red Necked Phalarope	18
Ruddy Turnstone	1
Sandhill Crane	2
Semipalmated Plover	142

Species	Observations
Semipalmated Sandpiper	237
Spotted Sandpiper	30
White Rumped Sandpiper	14
Shorebird spp.	230
Total	**781**

Two species of birds were identified and confirmed present in the geese category during 2006 waterfowl monitoring surveys (Table 10.2-3). The total number of birds observed in this category during 2006 (309) was less than in 2005 (596). The greater white-fronted goose was the more common of the two species observed with 79% of all goose observations (Table 10.2-4). Both of these two species have been present during all years of monitoring. There were no recorded observations of tundra swan or snow goose during the 2006 surveys, however, two birds were recorded as goose species. as the observers could not determine their species but were confident they belonged in this category.

Table 10.2-3 Geese Species Present (√) or Absent (X) on East Island for All Monitoring Years

Species	Baseline (1995-1997)	2000	2001	2002	2003	2004	2005	2006
Canada Goose	✓	✓	✓	✓	✓	✓	✓	✓
Greater White-fronted Goose	✓	✓	✓	✓	✓	✓	✓	✓
Snow goose	✓	×	✓	✓	×	✓	✓	×
Tundra Swan	✓	✓	×	×	×	×	✓	×

Table 10.2-4 Waterfowl Survey Goose Observations - 2006

Species	Observations
Canada Goose	63
Greater White-fronted Goose	244
Goose species	2
Total	**309**

Three species of dabbling ducks were confirmed present during the 2006 waterfowl monitoring surveys (Table 10.2-5). Northern pintail have been present consistently since baseline, while the American green-winged teal, which had been absent from 2002 to 2004 was recorded again for the second straight year. The American wigeon which had not been observed since 2001 was observed on multiple occasions in 2006. Mallard ducks, present during baseline but not observed for the last four years were again absent during monitoring surveys in 2006.

Table 10.2-5 Dabbling Duck Species Present (√) or Absent (X) on East Island for All Monitoring Years

Species	Baseline (1995-1997)	2000	2001	2002	2003	2004	2005	2006
Northern Pintail	✓	✓	✓	✓	✓	✓	✓	✓
Mallard	✓	×	×	✓	×	×	×	×
American Wigeon	✓	×	✓	×	×	×	×	✓
American Green-winged Teal	✓	✓	✓	×	×	×	✓	✓

Northern pintail continue to be the most abundant dabbling duck observed with 92% of all dabbling duck observations in 2006, while the American green-winged teal accounted for 6% and the American wigeon rounding out the remaining 2% (Table 10.2-6). The total number of dabbling ducks recorded in 2006 (n = 363 ducks) was down from the 507 observed in 2005, however, the ratio between the species was very similar with northern pintail and American green-winged teals comprising 93% and 7% respectively, of the 2005 observations. All unidentified duck observations were grouped with diving ducks as has been done consistently since baseline.

Table 10.2-6 Waterfowl Survey Dabbling Duck Observations - 2006

Species	Observations
American Green-winged Teal	23
Northern Pintail	333
American Wigeon	7
Total	**363**

Nine bird species were categorized as belonging to the diving duck category during the 2006 shallow bay and mine altered water body monitoring programs (Table 10.2-7). Four of the nine species observed, specifically the Pacific loon, yellow billed loon, lesser scaup and the common merganser were not recorded during previous years. The only species of diving ducks not observed in 2006 were the scoters (black and surf) which have not been regularly observed in the past. Long tailed ducks (formerly oldsquaw) are the only species of diving duck to be observed consistently over all monitoring years.

Table 10.2-7 Diving Duck Species Present (√) or Absent (X) on East Island for All Monitoring Years

Species	Baseline (1995-1997)	2000	2001	2002	2003	2004	2005	2006
Long Tailed Duck (Oldsquaw)	✓	✓	✓	✓	✓	✓	✓	✓
Greater Scaup	✓	✓	✓	×	✓	×	✓	✓
Black Scoter	✓	×	×	×	×	×	✓	×
Surf Scoter	×	×	×	×	×	✓	×	×
Red-breasted Merganser	✓	✓	✓	×	✓	×	✓	✓
Common Loon	✓	×	×	✓	✓	×	✓	✓
Red-throated Loon	✓	✓	✓	×	×	×	✓	✓
Pacific Loon	×	×	×	×	×	×	×	✓
Yellow Billed Loon	×	×	×	×	×	×	×	✓
Lesser Scaup	×	×	×	×	×	×	×	✓
Common Merganser	×	×	×	×	×	×	×	✓

In total, 531 birds were grouped into the diving duck category, including those duck–like birds that were unidentified, which accounted for 46% of the observations (Table 10.2-7). Similar to previous years, long tailed ducks were the most commonly identified species, with 35% of the diving duck observations.

Table 10.2-8 Waterfowl Survey Diving Duck Observations - 2006

Species	Observations
Long Tailed Duck	183
Greater Scaup	52
Lesser Scaup	6
Common Loon	1
Red Throated Loon	15
Pacific Loon	13
Yellow Billed Loon	3
Red Breasted Merganser	6
Common Merganser	7
Loon species	6
Merganser species	3
Duck species	236
Total	**531**

Disturbance as a result of mine activities appears to be very minimal with regards to impacts on waterfowl presence at the Diavik mine site. Four species of diving ducks (common merganser, lesser scaup, Pacific loon, and yellow billed loon), and one species of shorebird (spotted sandpiper) identified in 2006 had not been recorded during past surveys. The American wigeon, a dabbling duck, and the long billed dowitcher, a shorebird, were both identified as present in 2006 following four year absences.

10.3 HABITAT UTILIZATION

DDMI's water management system includes several engineered, lined ponds to collect site run off water. There are 12 mine-altered water bodies to date, each of which has the potential to provide suitable habitat for migratory birds. Specific water bodies included in surveys are the north inlet, processed kimberlite containment area, the clarification pond, and collection ponds 1, 4, 5, 10, 11 and 12 (Figure 10.2-1). Collection ponds 2, 13, and 14 were constructed and incorporated into the monitoring program during 2005. The area previously designated as the sedimentation pond was removed from the monitoring program in 2006 as it was reclaimed by the waste rock pile.

As part of the water management system, the water within the north inlet was lowered and thus exposed "new" shoreline habitat that may potentially be used by waterfowl and shorebirds. The processed kimberlite containment (PKC) area was constructed in 2002, and waters that could potentially be used by waterfowl are stored in this area for use within the diamond process plant. Use of these areas will be monitored by DDMI to determine the extent to which early open water or vegetation growth may attract waterfowl. This data can then be compared to that of East Island's shallow bays, which have not been significantly altered by mine activities.

The objective is to determine if waterfowl are using mine-altered waters, thereby determining if:

> ***Early open water or early vegetation growth might attract waterfowl during spring migration.***

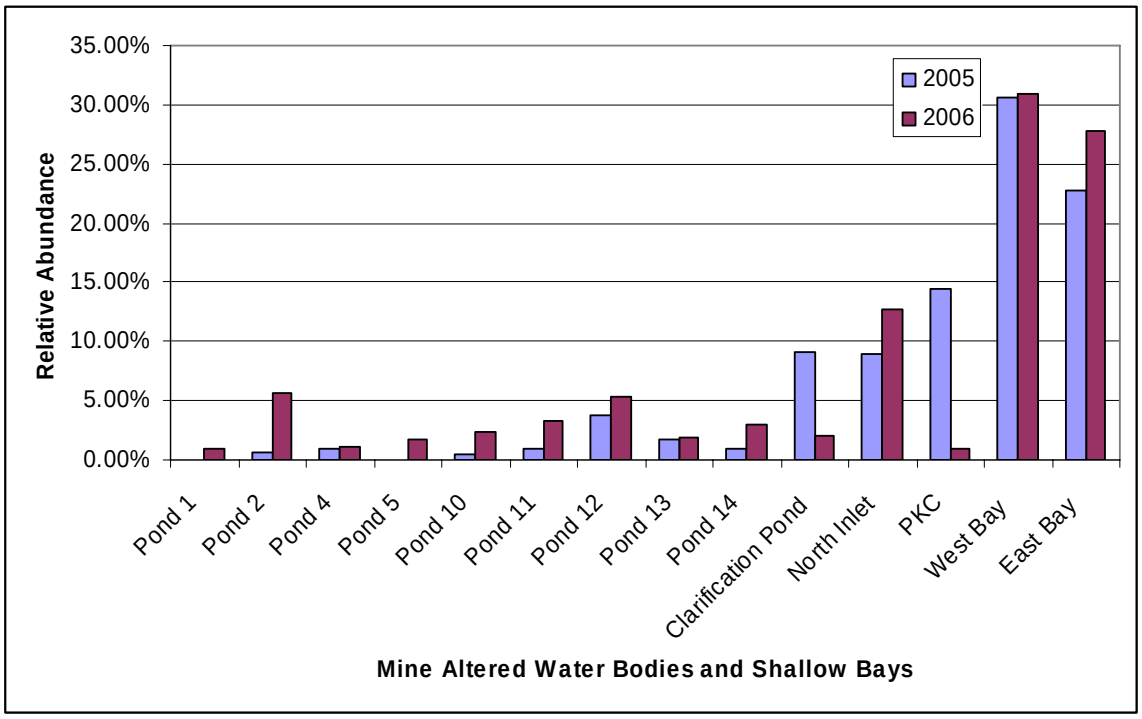
METHODS

Mine-altered water bodies and East Island shallow bays were surveyed daily from 15 May to 20 June then weekly until 18 October. In accordance with the 2006 DDMI waterfowl survey methods (Appendix I), Environment personnel walked the perimeters of the shallow bays and scanned mine altered water bodies and shoreline perimeters with binoculars, to identify and record all bird observations.

RESULTS

Monitoring surveys conducted on the shallow bays and mine altered water bodies of the Diavik mine site resulted in a total of 3041 birds recorded including all passerines, birds of prey and seabirds. The west and east shallow bays accounted for 31% (940) and 28% (846) of all observations, respectively, while all mine-altered water bodies combined accounted for the remaining 41% (1255) of observations (Figure 10.3-1). While the total numbers are down slightly from 2005 when 3406 birds were recorded, the distribution amongst the locations is similar.

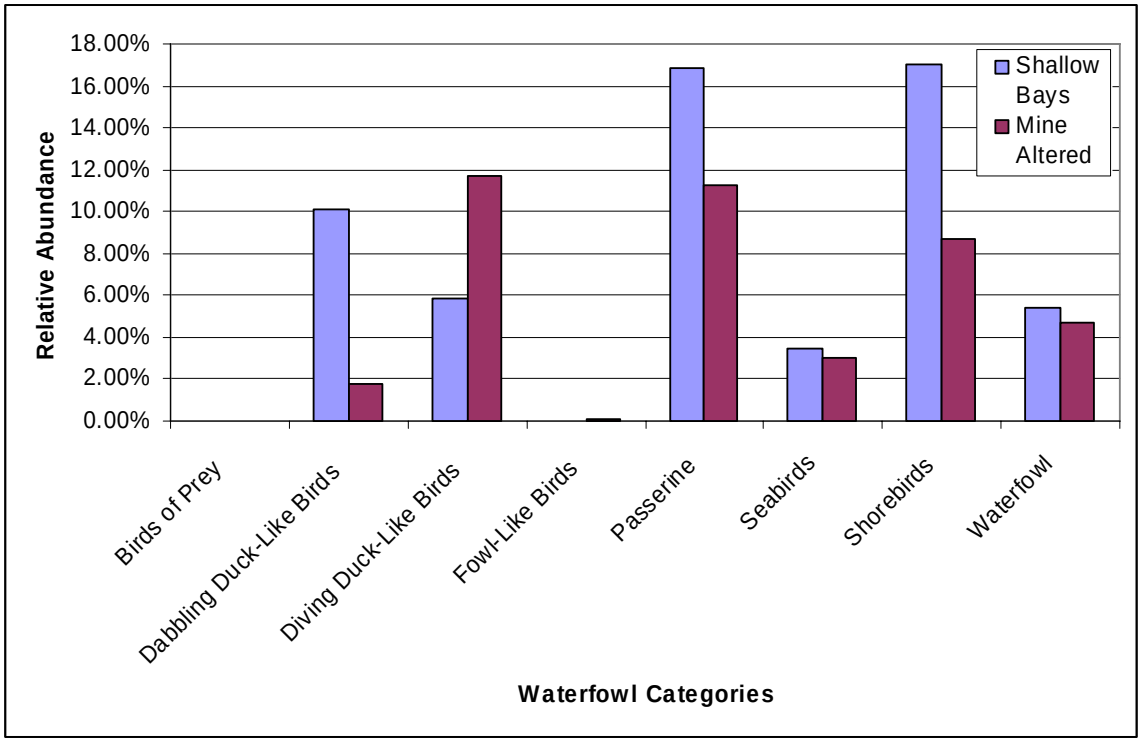
Figure 10.3-1 Relative Abundance of Observations by Habitat Area



In 2006 the majority of observations in mine-altered water bodies occurred at the North Inlet (Figure 10.3-1). All areas surveyed, with the exception of the PKC and clarification pond showed an increase in the number of birds recorded. This could indicate habitat preference, but consideration must be given to the possibility of disturbance avoidance. For example, the lower numbers in the PKC and clarification may be a result of increased construction activity in these areas with the expansion of the Type 3 rock pile to encompass the former sedimentation pond area, and the raising of the PKC perimeter dams, both of which were ongoing projects in 2006.

A comparative analysis of relative abundance of waterfowl monitoring categories, between shallow bays and mine-altered water bodies, clearly depicts several habitat preferences (Figure 10.3-2). Shorebirds, dabbling ducks, and passerines show an affinity to the shallow bays which are surrounded by grass and sedge wetland habitat, ideal for resting, nesting and feeding. The mine-altered water bodies generally have bedrock and boulder perimeters with crevices and outcrops that are attractive nesting grounds for many species of duck, in particular diving ducks which show a preference for these mine-altered water bodies, which is also likely due to the increased depth of the water compared with the shallow bays.

Figure 10.3-2 Relative Abundance of Waterfowl – Shallow Bays vs. Mine-altered Water Bodies, 2006



10.4 MORTALITY

The objective of avian mortality monitoring is to determine the number of mine-related mortalities, should they occur. The following section summarizes methods used and results obtained from incident reporting. The specific impact prediction in the Environmental Effects Report (DDMI, 1998b) is:

Mining related mortalities, if they occur, are expected to be low.

METHODS

Project related incidents (deaths caused by mining activities such as collisions with vehicles or power lines, or blasts) are reported to environment personnel for follow up, and all necessary documentation completed. This information is tabulated and provided for annual comparisons should future mortalities occur.

RESULTS

In 2006, the DDMI environment department recorded 11 avian mortalities between 6 April and 24 December. Six of these incidents involved rock ptarmigan which had been killed by inadvertently flying into closed overhead doors, or moving vehicles. On one occasion a duck was killed when it flew into an oncoming haul truck. Two ravens were found dead on site, one of which was found to have succumbed to starvation as a result of a blockage of ingested plastic, the other was believed to have been killed from a fall from its nest. A red throated loon died when it became entangled in gill nets during the 2006 A418 fishout. A lapland longspur was found dead, but the cause was unknown.

10.5 RECOMMENDATIONS FOR THE 2007 PROGRAM

Increase bird identification training for Environment personnel to further reduce the occurrences of observations classified as unidentifiable.

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APPENDIX I

STANDARD OPERATING PROCEDURES FOR WILDLIFE

1 OBJECTIVE/PURPOSE

This Standard Operating Procedure (SOP) provides design consideration measures that will protect wildlife during blasting activities at the Diavik mine site. The protective measures are intended to minimize the behavioral responses, blockages or deflection of movements in wildlife from noise and motion stimuli associated with blasting.

2 RESPONSIBILITIES

It is the responsibility of Contractors and Diavik staff performing blasting activities to be aware of this procedure and to follow it to ensure minimal disruption of wildlife due to blasting activities.

It is the responsibility of the Environmental Coordinators, Environmental Technicians, contractors, researchers and students, and any other members of the Environment Team to understand and follow this Standard Operating Procedure. In particular, Environment personnel may be required to conduct regular inspections of blasting activities or monitoring to recommend refinements in capacity or duration of blasting so as to minimize the effects of blasting on wildlife in the vicinity.

3 PROCEDURE

3.1 General

Blasting, excavation and other activities will be suspended when caribou or other animals (i.e. grizzly bears, raptors) are in the vicinity of blasting sites and near possible thin ice conditions whenever possible. In particular, this is important during fall freeze-up. In the case of caribou, blasting can then continue when the animals have been herded away appropriately as per SOPENV-WILD-16 (Caribou Herding).

Blasting will be suspended if there are caribou or other large mammals within the “safe zone” of the blasting area. This safe zone is determined as per the Blasting/Explosives Management Plan. The zone will be determined according to the type of explosives being discharged, the size of the blast and the location. Site Environment personnel will utilize appropriate herding techniques to remove animals from hazardous areas (SOP – Caribou Herding)

4 RELATED FORMS/DOCUMENTS

- SOPENV-WILD-16 – Caribou Herding

Revision History

Revision	Description	Prepared By	Date
00	Initial Release		June 2001
01	Updated	S. Oystryk	February 2005
02	Updated – review date	C. English	October 2006

1 OBJECTIVE/PURPOSE

This Standard Operating Procedure (SOP) provides measures that will protect wildlife from road and air traffic at the Diavik mine site. Road traffic during the operational phase includes haul trucks, service and employee transport vehicles.

2 RESPONSIBILITIES

Everyone traveling on roads at the Diavik site shares responsibility for following this procedure; in particular:

1. Contractors and Diavik employees operating vehicles and heavy equipment at site
2. Pilots operating aircraft and/or helicopters
3. Environmental personnel during wildlife monitoring tasks

3 PROCEDURE

3.1 Road Traffic

- All vehicles are to be restricted to designated roads and prepared work areas within the designed footprint of the mine.
- Recreational use of off-road vehicles is to be prohibited to prevent damage to vegetation to the shoreline buffer and residual habitat patches within the mine footprint.
- Wildlife, particularly caribou, is to have the right-of-way when crossing or attempting to cross roads and other operational areas. Traffic speeds are to be reduced to 30 km/hr when wildlife is near roads.
- Site Environment personnel will provide the following levels of notification to the Mine Manager. As well, color codes will be posted that describe caribou advisories:

  "No Concern" (Green) – issued when no caribou or fewer than 100 are present on the east island.

  "Caribou Advisory" (Yellow) - issued when there are between 100 and 1000 caribou present on the east island.

  "Caribou Alert" (Red) - issued when there are over 1000 caribou on the east island.

  "Thin Ice Period-Late Fall" (Red X) - issued when there are over 100 caribou on the east island.

- General information with respect to caribou in the vicinity of the site will be provided on a centrally located Notice Board that will indicate, by color code, varying levels of notification.

- Construction and operation activities will be designed for flexibility and will be adjusted when caribou occur on or near the east island - particularly when caribou occur within the mine footprint. This may entail temporary delays or suspension of localized activities or suspending/rerouting traffic or other recommended measures as are deemed necessary by Environmental Personnel to protect caribou from harassment and injury.
- The following levels of thresholds and action are recommended:

COLOR:	
RED X	Traffic, construction and operations activities will be stopped or carefully controlled when >100 caribou are present on the east island.
RED	Traffic, construction and operations activities will be stopped or carefully controlled when > 1000 caribou (i.e., a large herd) are present on the east island.
YELLOW	Traffic, construction and operations activities will be carefully controlled when 100 to 1000 caribou (i.e., small herds) are present on the east island.
GREEN	Traffic speeds should be able to be maintained.

- Options for careful control of road traffic, construction and operations may include but not be limited to:
    - limiting non-essential or maintenance traffic and activities
    - convoy or re-route traffic
    - alternate closure and opening of roads and activity areas
    - temporary road closures and short periods of suspended operations
- Restrictions for traffic and other Project activities will remain in effect until caribou monitoring demonstrates the risks of caribou interactions are reduced according to established thresholds
- Dust control measures will be applied as necessary throughout the year (see SOPENV-WILD-08, Dust Control).
- Traffic may be temporarily suspended or carefully controlled when large groups of caribou are near roads, or in hazardous terrain. Herding techniques will be implemented to move caribou away (SOPENV-WILD-16, Caribou Herding).

3.2 Air Traffic

- Caribou will be herded off the runway prior to aircraft landings and takeoffs. Herding techniques to be implemented are described in SOPENV-WILD-16, Caribou Herding.

- Helicopter over flights are to maintain a minimum altitude of >300 m AGL, whenever possible.
- Aircraft traffic will be restricted within 500 m of known raptor nest sites during active reproductive periods, whenever possible.
- Helicopter use near important waterfowl and shorebird staging areas, active raptor nest sites and caribou water crossings should be restricted.
- Helicopter harassment of wildlife, especially grizzly bear, caribou, wolves and wolverine must be avoided, consistent with the GNWT Wildlife Act.

4 RELATED FORMS/DOCUMENTS

- SOPENV-WILD-08, Dust Control
- SOPENV-WILD-16, Caribou Herding

Revision History

Revision	Description	Prepared By	Date
00	Initial Release		2001
01	Updated	S. Oystryk	February 2005
02	Reviewed	C. English	October 2006

1 OBJECTIVE/PURPOSE

This Standard Operating Procedure (SOP) provides direction with regard to measures that will protect wildlife during the development of roads at the Diavik mine site. There are three types of roads at the Project Site: haul roads for mining haul truck traffic; service roads to provide vehicle access to all parts of the Project; and an access road for the winter ice road. The protective measures described in this SOP are intended to minimize the effects from the construction and maintenance of roads.

2 RESPONSIBILITIES

This document is applicable to:

- Contractors constructing or maintaining roads at the Project Site;
- Diavik Site Manager for maintenance;
- Senior Environmental Coordinator for inclusion in wildlife monitoring tasks; and
- Environment Personnel for conducting wildlife protection procedures, including:

    - regular inspections of road construction and maintenance activities;
    - monitoring for efficiency; and
    - monitoring to recommend refinements in the location, construction and maintenance of roads during construction and operation of the mine

3 PROCEDURE

3.1 General

Potential effects on wildlife that may be caused by road construction and maintenance include:

- habitat change and generation of dust, noise and motion from large equipment;
- sensory stimuli causing a behavioral response in wildlife; and
- physical barriers, deflecting or blocking wildlife movements

In order to minimize these effects, the following procedures may be implemented:

Perimeter Roads

- The perimeter road and country rock storage should avoid physical alteration of the east island raptor cliff nesting site and two productive sedge ponds to protect habitat and reduce behavioral disturbance.

- Roads should be constructed to minimize barrier effects to caribou and other wildlife movements. Design features include: low height (< 1 m) except where roads may be designed to deflect caribou; no rock berms or use of large boulders on side slopes; and road shoulders with gradual slopes (3:1) composed of small rock substrate, unless otherwise required for mine safety (under Mines Safety Act).

- If the perimeter road layout causes constriction or funneling points at boulder fields, the fields may have to be covered with a finer-grained fill to facilitate caribou passage.

Ice Roads

- Ice roads on Lac de Gras should be designed and maintained to function to deflect caribou away from East Island and mining operations.

- Ice roads on Lac de Gras are to be maintained to minimize disruption of caribou passage during spring migration and include breaks in high snow berms.

Revision History

Revision	Description	Prepared By	Date
00	Initial Release		June 2001
01	Updated	S. Oystryk	February 2005
02	Reviewed	C. English	October 2006

1 OBJECTIVE/PURPOSE

This Standard Operating Procedure (SOP) provides guidelines and design consideration measures that will protect wildlife along pipeline and power line developments at the Diavik mine site. Pipelines may act as physical barriers, blocking or deflecting movements of wildlife, and power lines pose a mortality risk to birds and may cause behavioral disturbance in caribou.

2 RESPONSIBILITIES

This SOP is applicable to:

- Contractors constructing pipelines and power lines at the Project Site
- Site Services contractors for maintenance
- Environmental Personnel for conducting wildlife protection procedures, including:
  - regular inspections
  - wildlife monitoring

3 PROCEDURE

3.1 Management Strategy

The goal is to minimize the occurrence of bird electrocution and collisions with powerlines and pipelines acting as physical barriers, blocking or deflecting movements of wildlife. In order to fulfill this strategy, the following should occur:

- Design the pipeline and utility corridor, poles and lines following the mitigation recommendations. Incorporate remedial action by installing warning devices on the power lines closest to the shallow bays.
- Monitor the pipeline and utility corridor and identify problem areas including areas of concentrated bird strikes or electrocutions and construction of nests on poles.

3.2 Design Considerations for Power Lines

Electrocution

- The key to reducing bird electrocutions is to increase the distance between phase conductors, and phase conductors and ground wires, so that simultaneous touching of these parts is impossible.

Recommended Designs and Modifications (from Bevanger 1994, Postovit and Postovit 1987)

- Separate phase wires and phase and ground wires by 152 cm. This distance is based on skin to skin contact with two wires by an eagle. Separation can be achieved by:

  - lowering cross-arms
  - extending pole tops
  - removal of ground wire
  - place the ground wire underground
  - modify the ground wire with gaps to prevent current flow except for sudden charges (e.g. lightning strikes)
- Use insulated phase conductors, and all other live parts, which will have the same effect as separation of live structures
- Use an armless pole design
- Avoid pole-mounted transformers, which usually have short phase-phase and phase-ground distances. Locate the transformer on the ground in a closed building if possible.
- Install hanging insulators, so that the phase conductor is located below the cross-arm. Electrocution would be avoided as birds would perch on the cross-arm above the phase conductor
- Use wood or other non-conductive material in the cross-arms. This option may not be feasible where the need for earthing is great
- Manage bird perching by:
  - installing elevated perches
  - blocking hazardous perch sites with perching guards

Collision

Consideration should be given to the location of the route, and it should be located in road corridors unless impractical. High activity areas such as staging or feeding sites should be avoided, particularly if the utility corridor is adjacent to a road where vehicle traffic could flush birds into the wires. On the Diavik site, the highest-use sites by birds are the shallow bays.

Recommended Designs and Modifications (from Bevanger 1994, Postovit and Postovit 1987)

- Use a flat line configuration (e.g. H frame) instead of a vertical line configuration (e.g. delta, stack)
- Group multiple lines in a common corridor, so that visibility of lines is improved and a smaller area is occupied. Preferably place wires at the same height.
- Use aerial bundled cables which are more bulky and visible.
- Use thicker ground wires.
- Mark phase and/or ground wires with warning devices placed at short distances (e.g. 5 m):
  a) Physical enlargements - e.g. spiral vibration dampers which are made of polyvinyl chloride plastic (112-125 cm length) and twisted around wires (Brown and Drewien 1995). Markers colored bright yellow may enhance visibility, as the avian eye is most sensitive to yellow-green color, and yellow is also very reflective in low light conditions (Brown and Drewien 1995). Other marker types include: bird flight

diverters, spheres, hanging plates, balloons and plastic strips. Technical problems associated with line markers include: icing, acting as wind catchers and causes line stress and tension leading to breaks.

b) Cover wires with colored plastic sheaths or paint wires.

c) Use silhouette or predator scaring methods.

d) Use of low-intensity light.

e) Use acoustical scaring devices. This method may be less effective in areas which are subject to intense noise disturbance.

Poor weather and light conditions reduce the mitigation effectiveness of some wire marking devices, particularly those based on increasing line visibility. Warning devices may also reduce the rate of bird electrocution.

3.3 Design Considerations for Pipe Lines

Pipelines transport a variety of fluids at the mine site, including domestic water supply, sanitary waste water, drainage water from operations area and mine pits, and slurry from processed kimberlite. Pipelines are installed above-ground, insulated and will vary in height. Pipelines may act as physical barriers, blocking or deflecting movements of wildlife. Recommended design considerations for pipelines include:

- Above-ground pipelines should be installed to minimize barrier effects to caribou passage. Heights of single pipelines are installed below 0.5 m (top of pipe) or above 2.0 m (bottom of pipe). Pipelines within the 0.5 to 2.0 m range and all multiple pipelines below 0.5 m should be furnished with granular ramps at least 20 m wide and spaced strategic locations.
- Ramps are to be added when wildlife monitoring identifies specific needs to enhance caribou movements.

Revision History

Revision	Description	Prepared By	Date
00	Initial Release		2001
01	Updated	S. Oystryk	February 2005
02	Updated – review date	C. English	October 2006

1 OBJECTIVE/PURPOSE

This Standard Operating Procedure (SOP) provides identification and mitigation measures to be adopted by contractors and Diavik personnel to mitigate the effects of airborne dust along the haul roads, at the mine site, and at the airstrip. The potential impact of excess dust levels at the Diavik operations include decreased visibility and safety concerns, dust levels which are in excess of environmental and occupational guidelines, and effects to wildlife and habitat by deposition to land and water.

2 RESPONSIBILITIES

The dust control procedures are applicable to the Environment Department and other operations personnel that have joint responsibility for the identification and mitigation of excess dust. Specific tasks will include identifying excess dust levels, coordinating the overall dust control activities, identifying potential environmental and safety concerns arising from excess dust at the site, ensuring that dust control practices are being maintained, and keeping records of the maintenance activities implemented at the site.

Diavik employees, Environment staff, haul truck drivers and the Mine Supervisor will be jointly responsible for the identification of excess dust levels along the roads. It will then be the responsibility of the Mine and/or Site Services Superintendents to coordinate the mitigation measures, depending on the areas of responsibility.

3 PROCEDURE

3.1 Identification of Excess Dust Conditions

The following steps will be taken by contractors and Diavik personnel to ensure that excess dust emissions are identified and as a result, the overall ecological objectives with respect to dust are achieved.

- Site Services and Mine Operations should be cognizant of dust levels in and around the mine and site. In particular, they should be aware of:

  - The presence of heavy, visible dust clouds over the mining area (feedback from the operators of the haul trucks and other heavy equipment should be gathered throughout the shift).

  - Sudden changes in wind conditions, or prolonged periods with high winds which can cause dust release episodes.

- Haul truck operators should be looking for the presence of large dust clouds in the wake of other haul trucks, along the haul routes and in the vicinity of the active mine area.

Dust clouds which obscure the visibility behind the haul trucks represent a safety hazard as well as an environmental concern. If dust clouds are observed, the shift supervisor should be notified.

- During high wind periods, Environment personnel should ensure that clouds of dust are not being released from the exposed areas at the mine site, along the haul roads and at the airstrip. High winds will tend to whip loose material into the air resulting in decreased visibility, which represents a safety concern.

3.2 Dust Suppression/Control Measures

Near the Active Mine Area

- If vehicle activity or wind-blown dust from the exposed haul routes is the cause, water should be applied as a dust suppressant.

- During extreme weather conditions (e.g. wind storms) it may not be practicable to mitigate excess dust levels. In these conditions, consideration may be given to curtail or cease construction or mining operations for the time that the conditions persist.

- Crushing operations should involve a wet process, once temperatures are above freezing, or the operation should be enclosed in a building to prevent dust dispersal.

Along Haul Roads

- During non-freezing conditions, water should be applied to the haul roads by mine operations personnel. This water should be applied in the following manner:

    - water should be applied to the traveled section of the haul route using a standard water truck equipped with a spray bar

    - water should be added in sufficient amounts to wet the surface of the roadway, but excess water will cause puddles and should be avoided

- During freezing conditions, water cannot be applied to the roadways for safety purposes. During the winter months, snow accumulations will usually be sufficient to prevent excess dust releases. If excess dust is noted in the winter, this is typically the result of spillage from the haul trucks landing on the road surface. To remedy this, the following steps can be taken:

    - Increase awareness of mine operators to ensure that the haul trucks do not get over-filled

- Mine Operations personnel can grade the surface of the haul routes to remove any excess material

- The surface of the roadways should be inspected periodically by Mine Operations personnel and graded if there is evidence of potholes or excess fine material on the surface.

Around Camp

- During non-freezing conditions, water should be applied as a dust suppressant to roads around the camp. See above (Along Haul Roads) for proper application. Site Services personnel are responsible for watering and maintaining roads around the camp site.

At the Airstrip

- The use of dust suppressant has been approved for the airstrip. This suppressant (EK35) should be applied progressively as a way to test performance. In the initial phase, EK35 will be applied to high-traffic areas subject to jet and prop wash. This includes the apron, parking lot, taxi strip and helipad. The suppressant will be mixed in to crushed rock and packed down. Should the product prove effective in these areas, application to the airstrip will be evaluated.

- In subsequent years, topical applications of the product will be of lesser volume than that required in the first year. All applications should be performed during warm, dry weather.

3.3 Record Keeping

The record keeping tasks associated with the dust control program are important to Diavik operations as they demonstrate compliance with the good environmental practices at the facility and provide indications of areas where the operations could be improved in order to mitigate environmental impacts and minimize safety concerns. Records should be maintained for the remedial actions taken to address excess dust levels. The amount of water used in dust suppression efforts must also be recorded and reported to the Wek'èezhìi Land and Water Board in the monthly and annual reports.

Revision History

Revision	Description	Prepared By	Date
00	Initial Release		June 2001
01	Updated	S. Oystryk	February 2005
02	Minor amendments	S. Golding	March 30, 2006
03	Updated – review date, responsibilities, airstrip, camp	C. English	October 2006

1 OBJECTIVE/PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide supervisors and workers with a method to prevent wildlife-human interactions and outline safe procedures regarding hunting, trapping, feeding and fishing at the project site.

2 RESPONSIBILITIES

It is the superintendent's responsibility to ensure that the supervisors, tradesman, operators and workers are trained and understands this procedure.

It is the supervisors, tradesman, operators and workers responsibility to follow this procedure.

3 PROCEDURE

3.1 General

It is not permitted to bring on site or have in your possession any firearm or weapon of any kind. This includes:

- Rifles
- Shotguns
- Hand guns
- Bow and arrows
- Cross Bows or Arrows
- Sling Shots
- Knives (with 4 inch blade or longer)

Firearms and ammunition used for the protection of workers from dangerous animals will be kept securely locked away and will only be used by authorized personnel.

It is not permitted to bring any type of animal trap to any project site.

There is to be absolutely no feeding of wildlife on the project site; this will result in immediate dismissal.

HUNTING OR TRAPPING OF ANY WILDLIFE IS NOT PERMITTED ON THE PROJECT SITE

FISHING IS NOT PERMITTED ON THE PROJECT SITE

Any sightings of dangerous animals are to be reported to your Supervisor, other workers in the area, Security (Ch. 2) and the Environment Department (Radio Channel #6 or 766-5420).

4 EQUIPMENT

- None required

5 RELATED FORMS/DOCUMENTS

- None

Revision History

Revision	Description	Prepared By	Date
00	Initial Release	C. English	30 June 2005
01	Updated – Security as contact for sightings, review date	C. English	October 2006

1 OBJECTIVE/PURPOSE

This Standard Operating Procedure (SOP) provides guidelines on procedures to follow when conducting aerial surveys for caribou to determine the relative abundance, distribution, dominant behaviours, group composition and activity of caribou with respect to the mine site. It also allows for collection of incidental observations of other wildlife.

2 RESPONSIBILITIES

It is the Senior Environmental Coordinator's responsibility to ensure that all members of the Environment Team are trained in, and understand, this Standard Operating Procedure (SOP).

It is the responsibility of the Environmental Coordinators, Environmental Technicians, contractors, researchers and students, and any other members of the Environment Team to follow this Standard Operating Procedure.

3 PROCEDURE

3.1 Field Procedures

Surveys will be flown once per week from late April through to early October, with only the even-numbered transects being flown between 5 June and 10 July when caribou are at the calving grounds. The first survey should occur prior to caribou moving through the study area while the last should occur during the post-migration period. Initial dates for northern migration and final dates for the post-southern migration surveys will remain flexible in response to current data from satellite-collared caribou delivered by the department of Environment & Natural Resources (ENR) and local observations of caribou in the area.

Systematic surveys with a transect width of 1.2 km (600m/2000 feet on each side of helicopter) will be used to estimate the number of animals in the study area. To ensure that observations are restricted to within the 600-metre boundary, marks must be made on the side windows of the helicopter. Before the survey begins, the pilot is asked to fly to 180 meters (590 ft) and hover with the helicopter perpendicular to the runway with two one thousand foot markers on either side of the helicopter. The observers then mark the side windows with a horizontal line, which lines up with the second one thousand foot marker. The mark is then used as an observation boundary. Only caribou observed beneath the line will be recorded as on transect. The distance between transects will be 4km.

A helicopter will be used for all surveys. In addition to the pilot, a navigator in the front seat will use a 1:250,000 scale map to plot and follow a predetermined flight path, and record all observations of wildlife by observation number. The navigator will also record all pertinent data including the GPS location, distance & direction of caribou from recorded waypoint, group size

and composition, dominant behavior, direction if moving and habitat type (see descriptor codes on page 3).

To ensure consistency in survey methods two observers will observe from the rear of the helicopter. Neither the pilot nor navigator will be permitted to help observe. When caribou are observed, the observer will call "mark" so the navigator can immediately mark and save a waypoint. Then the observer will call out the number of caribou, composition (male, female, or calf), distance from the helicopter, activity, direction if moving and habitat type. Caribou observed beyond the transect width or outside of the study area during turns at the end of each transect can be noted on the sheet, but no GPS waypoint should be taken. If the pilot is speaking on the radio, the observer may tap the navigator/recorder on the shoulder and s/he will know to mark a waypoint. Details can be gathered once the pilot is off the radio. Never speak over the pilot while s/he is communicating with the airport and/or other aircraft.

Surveys will be conducted from 110-130 meters (360-430 ft) above ground level (AGL), at a speed of 145-160 kilometers per hour (90-99 mph). Surveys range from 4-8 hours and extend slightly beyond the DDMI study area. Please refer to the attached map. Caribou activity budgets are to be performed concurrently with the aerial survey. Once the aerial survey is complete, the pilot will fly back to the area the caribou were seen and drop crews on the ground to conduct activity budgets (SOPENV-WILD-15, Caribou Scanning).

Incidental observations of other species will be made, but there will be no excessive deviation from the flight path in connection with such observations. Incidental observations of grizzly bear (and dens), wolves (and dens), wolverines, black bears, raptors (and nest sites), muskoxen and moose will be recorded on aerial survey datasheets. These observations will later be recorded as 'incidental observations'.

Local weather conditions resulting in poor visibility during surveys may result in temporary deviation from these protocols.

3.2 Data

The following information will be recorded for caribou observations:

- GPS location, using hand held GPS or helicopter GPS
- Distance of location from helicopter
- Habitat type
- Number of caribou
- Dominant composition of caribou (nursery or non-nursery)
- Dominant behavior (activity) of group
- Direction of caribou movement, if moving
- Locations of tracks/trails, direction of travel or orientation of tracks/trails
- Observation of any other wildlife, den locations or raptor nest sites

If surveys detected no caribou, then "0" or "no observations" should be entered on the data sheet and in the database for that date.

A running tally of helicopter hours and fuel use will be kept and reported on the datasheet. Additionally, a signed copy of the helicopter receipt should be kept in the Helicopter Logbook.

3.3 Analysis and Reporting

Data collected will be transferred to the DDMI database. This data will be checked for omissions and/or errors to ensure accurate data entry.

Analyses will take into consideration the relative value of habitat and topography to caribou in addition to distance to mine elements.

For each migration period, a field report of total numbers of caribou and other wildlife seen will be prepared.

3.4 Descriptors & Codes

Vegetation/Habitat Classifications for the Lac de Gras Area
Used for Caribou Survey

Adapted from Matthews, Epp and Smith, 2001

Heath Tundra (*HT*)

Heath Tundra (<30% Rock) This class of heath tundra is a closed mat plant community that grows on moderate to well drained soils, covering most of the upland areas. Plants generally belong to the heath family, the Ericaceae. The vegetation layer forms a mat of low shrubs dominated by dwarf birch and Labrador tea. Other common plant species include lingonberry, blueberry, crowberry, alpine milkvetch (*Astragalus alpinus*) and alpine azalea (*Loiseleuria procumbens*). Herb and moss layers are not well developed. Typical lichens include several species of Cetraria, Cladina, Cladonia and others. As a closed mat community, vegetation covers at least 70 percent of the surface of the ground.

Heath/Bedrock (30-80% Bedrock) Where heath tundra thins and bedrock outcrops are exposed, vegetation is discontinuous and is best described as open mat heath tundra. This class of heath tundra is easily distinguished on satellite imagery due to the presence of bedrock, reduced vegetative cover and therefore a distinctive highly reflective spectral signature. Plant species are typical heath species described above.

Heath/Boulders (30-80% Boulders) Heath with boulder fields is also an open mat plant community class. It can be distinguished from the heath/bedrock class because of the spectral differences between bedrock and boulders. Textural differences between boulders and bedrock are significant from an image analysis perspective. Differences in lichen composition and cover on boulders and bedrock outcrops also contribute to the identification of these separate classes.

Boulder Association (*BO*) (>80% Boulders)

Heath with boulder fields is also an open mat plant community class. It can be distinguished from the heath/bedrock class because of the spectral differences between bedrock and boulders. Textural differences between boulders and bedrock are significant from an image analysis perspective. Differences in lichen composition and cover on boulders and bedrock

outcrops also contribute to the identification of these separate classes.

Large areas of boulder fields exist in the central part of the study area and are found to a lesser extent in other areas. Boulder associations include boulder outcrops, boulder streams and drainages, as well as glacial eratics. This land cover type supports very little plant growth. Boulders, however, support a variety of rock lichens. Crustose lichens which are common include *Umbilicaria* spp. (rock tripe), *Xanthoria elegans* (orange rock lichen), *Rizocarpon geographicum* (green map lichen), *Parmeliopsis ambigua* (green starburst lichen), and others.

Bedrock Association (*BE*) (>80% Bedrock)

Exposed bedrock supports very little vegetative cover. These areas are generally wind swept and moisture free. Early colonisers such as crustose lichens are common, but vegetative coverage is highly variable and favours protected areas, crevices and depressions where growth can be initiated. Cover types having discontinuous vegetation, such as described above, may be confused with other cover types because substrate such as bedrock or boulders dominates the reflectances of the vegetation that is present.

Esker Complex (*EC*)

Eskers provide significant topographic relief to a gently rolling tundra landscape. These linear structures of sand and gravel, formed by glacial rivers, can run for hundreds of kilometres and reach 30 m in height. Eskers support a number of plant communities and are important habitat for wildlife. They are used as travel corridors by caribou, grizzly bears, wolves and other wildlife. The ice-free substrate of sand and gravel provides excellent den sites where digging is relatively easy. Eskers, being a complex of plant communities, can be difficult to classify using computer classifiers. Esker tops are wind- swept and, therefore, accumulate very little snow during the winter.

Sedge Wetland (*SW*)

Sedge Wetland Wetland complexes are typically wet sedge meadows and other sedge associations of non-tussock plant species. Sedge species such as *Carex aquatilis* and *C. bigelowii*, and cotton grass (*Eriophorum angustifolium*) are the dominant vegetation types. Plant species occupy wet, low lying sites where standing water is present throughout much of the growing season. The substrate is usually organic or silty soils.

Tussock/Hummock (Sedge Association) Plants belonging to the sedge family (*Cyperaceae*) are also dominant in this vegetation unit. Tussock cotton grasses such as *Eriophorum vaginatum* and *E. russeolum* are common. These sites are drier and less frequently flooded than sedge wetlands. Tussocks produce hummocks or mounds of 0.4 to 1 m in diameter. Hummocks are typically composed of old tussocks invaded by bog rosemary (*Andromeda polifolia*), cloudberry (*Rubus chamaemorus*), Labrador tea (*Ledum decumbens*), blueberry (*Vaccinium* spp.), and cranberry (*Vaccinium vitis-idaea*). Sphagnum moss typically occupies the troughs between hummocks. Dwarf birch (*Betula* spp.) and willow (*Salix* spp.) tend to become established on the older hummocks (Diavik Diamond Mines Inc. 1998). Sedge wetlands and Tussock/Hummock vegetation provide important foraging areas for barren-ground caribou

Riparian Shrub (*RS*)

Riparian Tall Shrub This riparian association follows active stream courses, usually with a cobble or boulder substrate. Riparian tall shrub appears as linear plant associations of birch, willow and alder. Tall shrubs such as diamond-leaved willow (Salix planifolia) and green alder (Alnus crispa) can reach heights up to 4 m. Black spruce may also be associated with this community, particularly in some southern parts of the study area. Understory plant species include dwarf raspberry, dwarf marsh violet, cloudberry, grasses, sedges, club mosses and common horsetail. This vegetation unit is one of the most productive in the

Birch Seep This vegetation unit occurs in areas of active water seepage through boulder fields and boulder streams. Birch (Betula spp.) is the dominant vegetation, which commonly reaches a height of 1 m. Diamond-leaved willow is also present in smaller amounts. Blue joint (Calamagrostis canadensis) and water sedge (Carex aquatilis) are common plant species occurring in the understory along with crowberry (Empitrum nigrum), Labrador tea (Ledum decumbens), and mosses.

Spruce Forest (*SF*) The treeline lies in an area of transition between the tundra and boreal forest to the south. Boreal forest species become more common with the presence of dwarf white spruce (*Picea glauca*) and black spruce (*Picea mariana*). The northern limit of black spruce generally falls short of white spruce in this part of the Northwest Territories (Porsild and Cody 1980). Both species grow in lowland, sheltered areas such as river valleys, where soil moisture is abundant. The forest in this region is typically clumped with outliers in this predominantly tundra landscape. In some areas, spruce-lichen woodland exists in more favourable habitats.

Disturbed Site (*DS*) A habitat that has been altered by human development. This includes roads, pits airstrips and other portions of the mine footprint

Ice (*IC*) Frozen lakes

Lake (*LA*) Lake

Snow covered Tundra (*ST*) *(NEW in 2005)* This vegetation unit only includes Heath Tundra (HT) and Sedge Wetlands (SW) that may be indistinguishable when covered in snow. This code should not be necessary for other habitat types, such as Boulder (BO) and Bedrock (BE) Associations.

Group Composition

Code	Descriptor
F	**Females:** Have a dark vulva fur patch below tail and anus; cow antlers are relatively small and spindly, 9-20 inches long or 23-50 cm tall; weigh between 150 and 300 pounds; have hard antlers all winter and drop them pre-calving (June) and then start re-growing antlers in June; about 4 ft to shoulder, or 1.2 m; 2 and 3 year old caribou will be hard to distinguish from adult females without seeing vulva patch
M	**Males:** No dark vulva patch; white fur from tail to underside; have a vivid white belly (less visible on females) and a pronounced white-ish to gray main; bull antlers are branched, semi-palmated, and have flattened brow tines 20-62 inches or 52-158 cm tall; weight 275 to 600 pounds; drop antlers late October and re-grow them starting in June; don't have antlers during the spring Northern migration; about 4.5 ft and taller (140-150 cm)
C	**Calves:** brown; very small; shoulder height is less than 70 cm around 2 ft; always with cow in first year
Y	**Yearling:** Smaller than full grown cows but larger than calves; shoulder height is approximately 1 meter or 3 ft.; solid light gray colour - adults have more distinct white and beige colour; yearling's antlers would be stubs (not over 6 inches)
F/C	Females with calf/calves
F/M	Females & males
F/M/C	Females, males, calves

Monthly Patterns

Apr/May: Large bulls will be antlerless (note: "bald" has been used in the past by some to refer to genetically antlerless) in March/April, with new antlers starting to form in May. By late May with thick beams 6-12" long. Younger bulls may carry hard antlers through most of April, then start regrowing antlers in May. Cows will mostly remain antlered. Calves will shed spike antlers in April and will start growing in May. Barren cows will also shed antlers in April and start growing in May. Some calves stay behind when bands head out to calving grounds, but many calves go with the bands.

June: Cow/calf pairs obvious. Larger bulls have up to 30-60 cm of heavy-beamed antlers. Pregnant cows will have nubs by mid-June, non-pregnant cows, yearlings and young bulls will all have some (10-30 cm) antler growth.

July: Large bulls will have obvious large antlers – big beams and points developing. Young bulls less so. Cows have antlers in velvet as well. Calves obvious (small, reddish). Yearlings will appear small bodied with relatively short faces.

Aug/Sept: Mature bulls will have large mature antlers, cow antlers will be fully formed. Calves usually have spikes only. Yearlings small bodied with shorter faces, with less developed antlers. Need to see vulva patch to ID yearlings to sex (yes – can use the angle of the antlers to help if viewing from the front, but really should see vulva patch to be sure.)

Activity

Code	Descriptor
A	Alert
B	Bedded
F	Feeding
B/F	Bedded/Feeding
R	Running
S	Standing
Sw	Swimming
T	Trotting
W	Walking

4 EQUIPMENT

- Binoculars
- GPS unit & spare batteries
- Maps
- Datasheet, including codes
- Survival gear

5 RELATED FORMS/DOCUMENTS

- Aircraft SOP (SOPENV-EQUIP-01)
- Caribou Scanning SOP (SOPENV-WILD-15)
- Caribou Aerial Survey Form (FORM-ENV-WILD-04)
- Caribou Scanning Observations (Activity Budget) Form (FORM-ENV-WILD-05)

Revision History

Revision	Description	Prepared By	Date
00	Initial Release		March 2003
01	Updated	R. Eskelson/ S. Oystryk	March 2005
02	Updated	C. English	11 February 2006
03	Updated – omitted BHP-B's role, added caribou scan requirements	C. English	12 October 2006

1 OBJECTIVE/PURPOSE

This Standard Operating Procedure (SOP) provides the procedures to follow when environment staff are recording the number of times individual caribou or groups of caribou are encountered during weekly monitoring. The objective of this component of the monitoring program is to determine if caribou are attracted to dust deposition sites.

2 RESPONSIBILITIES

It is the Senior Environmental Coordinator's responsibility to ensure that all members of the Environment Team are trained in, and understand, this Standard Operating Procedure (SOP).

It is the responsibility of the Environmental Coordinators, Environmental Technicians, contractors, researchers and students, and any other members of the Environment Team to follow this Standard Operating Procedure.

3 PROCEDURE

3.1 Field Procedures

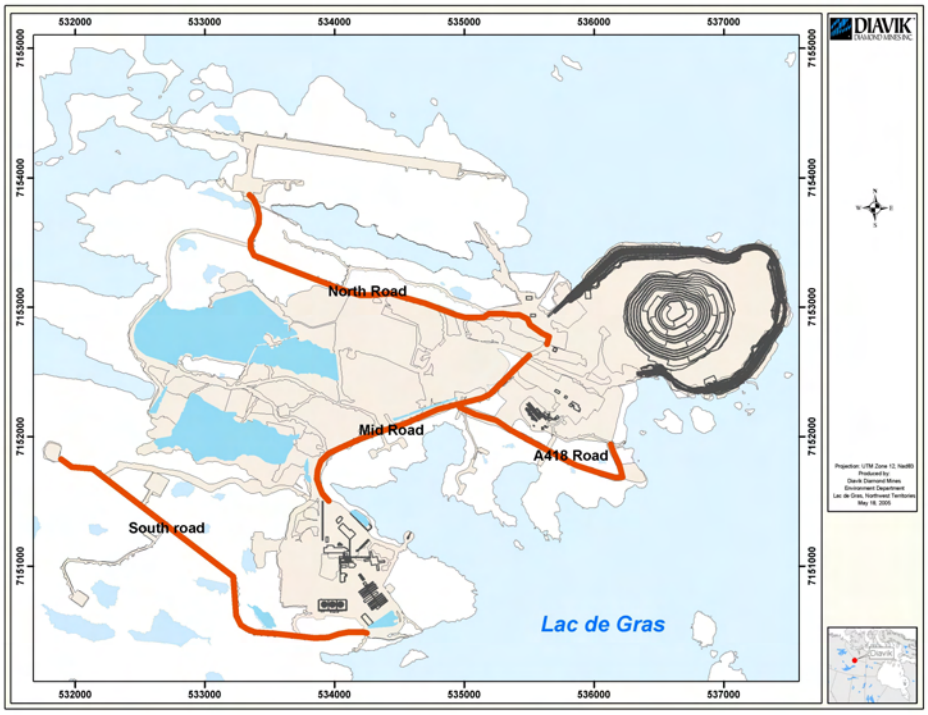
This monitoring is carried out between April 15 and October 15 or until caribou are no longer within the area.

Caribou road observations are performed twice each week. Data sheets should accompany personnel during the monitoring. Four roads are surveyed during the work: the south haul road, airport road, the road to A418 and the road to the waste transfer area. Field staff will set the odometer to zero at the start of each road, as indicated on the attached map. Staff will drive the entire distance of the road while scanning for caribou, and mark the total distance travelled (as indicated on the odometer) on the field sheet.

Field staff will record the number of groups of caribou encountered within different distance categories (i.e., on the road, within 50 m of the edge of the road, 50 – 200 m from the edge of the road and >200 m from the side of the road). Other information recorded will include: group size, dominant behaviour of the group and group composition (see codes in the next section).

If no caribou are encountered during the trip, then enter a "0" (or no caribou) under the heading "group size", still recording the distance travelled and date. The survey will be conducted on one leg of the trip only, i.e. caribou will only be counted once while driving in one direction along each road.

Figure 1: Map of Roads for Caribou Observations



3.2 Descriptor Codes

Composition Codes	
F	females
M	males
C	calf
Y	yearling
F/C	females and calves
F/M	females and males
F/M/C	females, males, calves

Activity Codes	
A	Alert
B	Bedded
F	Feeding
R	Running
S	Standing
T	Trotting
W	Walking

3.3 Analysis and Reporting

Data sheets will be checked for omissions and/or errors on the same day as the survey. A report on the number of caribou encountered per distance traveled must be prepared.

4 EQUIPMENT

- Binoculars
- Data sheets
- Map

5 RELATED DOCUMENTS

- Caribou Road Observations-Vehicle Encounters – FORM-ENV-WILD-03

Revision History

Revision	Description	Prepared By	Date
00	Initial Release		March 2003
01	Updated	R. Eskelson/ S. Oystryk	March 2005
02	Updated	C. English	June 2005
03	Updated – Related documents, review date, purpose	C. English	October 2006

1 OBJECTIVE/PURPOSE

This Standard Operating Procedure (SOP) provides guidelines on procedures to follow when processed kimberlite containment areas (PKC) and rock piles are monitored for caribou. The purpose of this procedure is to determine if caribou utilize the PKC and rock piles. This information can help to determine if caribou drink from or get trapped in the PKC, or use the rock piles for insect relief.

2 RESPONSIBILITIES

It is the Senior Environmental Coordinator's responsibility to ensure that all members of the Environment Team are trained in, and understand, this Standard Operating Procedure (SOP).

It is the responsibility of the Environmental Coordinators, Environmental Technicians, contractors, researchers and students, and any other members of the Environment Team to follow this Standard Operating Procedure.

3 PROCEDURE

3.1 Field Procedures

Monitoring will be conducted twice per week from May to October.

A truck with Diavik environmental personnel will travel the roads adjacent to the PKC area and the road up to the rock piles while scanning for caribou. Fixed observation points that provide a clear view of the PKC area and tops of the rock piles can be used. Observations of caribou behaviour will be recorded, including group size, location, route travelled (if observed), and behaviour. Specific observations of caribou drinking from or becoming stuck in the PKC should be noted.

If caribou are detected, a rough drawing of the area and the animals location should be included on the data sheet. If caribou are found to be drinking from or stuck within the PKC, herding or rescue attempts may be required; notify the Senior Environmental Coordinator immediately.

If surveys detected no caribou, then "no observations" should be entered on the data sheet and in the database for that date.

3.2 Analysis and Reporting

Data sheets will be transferred to a database on the same day when possible. Data sheets and the database will also be checked for omissions and/or errors at the end of shift by an alternate to ensure accurate data entry.

Observations will be summarized in the annual report and if it is discovered that the PKC or rock piles pose a risk for caribou, possible mitigation strategies will be presented and discussed.

4 EQUIPMENT

- Data sheets
- Binoculars

5 RELATED DOCUMENTS

- Caribou-PKC/Rock Pile Interaction Datasheet – FORM-ENV-WILD-09

Revision History

Revision	Description	Prepared By	Date
00	Initial Release		March 2003
01	Updated	R. Eskelson/ S. Oystryk	March 2005
02	Updated	C. English	June 2006
03	Updated – title, review date, related documents	C. English	October 2006

1 OBJECTIVE/PURPOSE

This Standard Operating Procedure (SOP) provides guidelines on procedures to follow when gathering information regarding activity budgets/caribou scans (i.e. time spent feeding, resting, walking, running) of caribou exposed to the mine site and on control sites.

2 RESPONSIBILITIES

It is the Senior Environmental Coordinator's responsibility to ensure that all members of the Environment Team are trained in, and understand, this Standard Operating Procedure (SOP).

It is the responsibility of the Environmental Coordinators, Environmental Technicians, contractors, researchers and students, and any other members of the Environment Team to follow this Standard Operating Procedure.

3 PROCEDURE

3.1 Field Procedures

Scan Sampling of Caribou Groups

Scan sampling of caribou groups or individuals will be used to monitor caribou behaviour as a function of distance from the mine. The method to be used is adapted from Curatolo and Murphy (1983), and will involve two observers. Individual caribou activities will be recorded as feeding, bedded, standing, alert, walking, trotting, or running. Individuals will be classified as feeding when they are actually foraging or searching for food (i.e., walking with head down).

GPS location will be recorded, and observations will be conducted during the spring, summer, and autumn. Group composition will be classified (see descriptor codes below), and the number of animals in the group will be recorded. Thus, the response variable is caribou behaviour, while the potential stressors include distance from mine, season, and group composition. In order to control for the effects of habitat and insect harassment, all observations will be performed within one habitat type (tundra with < 30% bedrock or boulders) and the level of insect harassment will be recorded.

The group will be scanned every 8 minutes for a minimum of 4 observations and a maximum of 8. For each scan, the number of animals exhibiting each type of behaviour will be recorded. Here, the unit of replication is the individual group. We anticipate obtaining 10 - 15 replicates for each level within the treatment effects. Given that there are a total of 12 levels within treatments (2 sites, 3 seasons, and 2 group composition categories), the maximum number of hours required to obtain 15 full replicates (i.e., 64 minutes for each group) is 192 hrs. However,

it is believed that the replicates can be obtained in less time. Surveys should be evenly distributed between island and mainland locations.

Response to Specific Stressors

For all caribou groups, instantaneous observations will be used to assess the response of caribou to different potential stressors as a function of distance. These observations will occur during scan sampling, and consequently, no increase in observation time will be required. In the event that a stressor is introduced during scan sampling, the observers will note the time (in the comments box) and record the response of caribou to stressors will as "no reaction" or "exhibiting a reaction" (i.e., alert posture, walking or running away from disturbance; see data sheet). The reaction of the majority of the group will be used in selecting the category. Estimated distance (m) from the stressor will also be recorded. Stressors include type of aircraft, type of vehicle, and blasts from pits.

The observers will then wait until the animals resume previous behaviour (1 – 2 minutes), and begin scanning observations again.

For the scan observations, weather conditions such as wind speed and direction, temperature, and type of precipitation will be documented. Level of insect harassment will be recorded separately for mosquitoes/black flies and for bot/warble flies. Bot and warble flies will be recorded simply as being present or absent during the observation period, based on observed reaction of caribou (sudden bolting, aberrant running, or rigid standing).

3.2 Analysis and Reporting

A report will should be prepared and provide a summary of the number of replicates for each of the treatments (season, site, group composition) for each of the 2 tasks obtained for each migration period. Data sheets will be transferred to a database on the same day when possible. Data sheets and the database will also be checked for omissions and/or errors at the end of shift by an alternate to ensure accurate data entry.

3.3 Descriptor Codes

Habitat Codes	
BE	Bedrock (>80%)
BO	Boulders (>80%)
EC	Esker Complex
HT	Heath Tundra
RB	Riparian Birch
RS	Riparian Shrub
SW	Sedge Wetland
SF	Spruce Forest
SF/BE	Spruce Forest/Bed Rock
SW/HT	Wetland/Heath Tundra

HT/BE	Heath Tundra/Bedrock
HT/BO	Heath Tundra/Boulders
LA	Lake
IC	Ice

Composition Codes	
F	females
M	males
C	calf
Y	yearling
F/C	females and calves
F/M	females and males
F/M/C	females, males, calves

Activity Codes	
A	Alert
B	Bedded
F	Feeding
R	Running
S	Standing
T	Trotting
W	Walking

4 EQUIPMENT

- Binoculars
- Watches, stopwatches
- Field notebook, datasheets and pencils

Revision History

Revision	Description	Prepared By	Date
00	Initial Release		March 2003
01	Updated	R. Eskelson/ S. Oystryk	March 2005
02	Updated – review date	C. English	October 2006

1 OBJECTIVE/PURPOSE

This Standard Operating Procedure (SOP) provides guidelines to follow when surveying habitat within the Diavik wildlife study area for grizzly bear sign. Presence of bear sign will be used as an index of habitat utilization by grizzly bears. The purpose of this procedure is to determine the potential long-term influence of the mine on habitat use by grizzly bears within the study area.

2 RESPONSIBILITIES

It is the Senior Environmental Coordinator's responsibility to ensure that all members of the Environment Team are trained in, and understand, this Standard Operating Procedure (SOP).

It is the responsibility of the Environmental Coordinators, Environmental Technicians, contractors, researchers and students, and any other members of the Environment Team to follow this Standard Operating Procedure.

3 PROCEDURE

3.1 General

This study is carried out twice per year – once in July and once in August. July surveys are conducted in sedge wetland habitats, whereas August surveys are conducted in riparian shrub habitats. These habitat types are considered high quality bear habitat, based on seasonal grizzly bear preference.

3.2 Field Procedures

Eighteen polygons will be sampled during each of the spring and summer surveys. Sample sites will be uniquely identified, located on a map and GPS co-ordinates will be recorded. This ensures that the same polygons are sampled during subsequent years.

Each polygon will encompass of a 500 m x 500 m area and comprise a minimum of 25% of the preferred habitat type(s).

Safety is of primary importance. Before surveying any polygon, especially riparian shrub habitat, fly over the area closely to check for bears in the area. If a bear is present within the polygon, this will be considered as fresh bear sign and the polygon will not be sampled that day. If a bear is within 5 km of the polygon or a fresh kill is observed in the area, move on to survey another site, and try to return to the previous site before the seasonal program is complete (i.e., do not entirely abandon the site). If the bear persists in the area over the course of several days, record this information on the field sheet and abandon efforts to survey the area.

Observers will initiate the search for bear sign from the centre of each polygon, as provided by pre-determined UTM co-ordinates. If the centre point falls within open water, begin searching from the nearest shoreline.

Field crews will consist of 3 personnel; 2 roving observers with land-based and sign recognition experience, and one stationary patrol that must remain vigilant toward potential bear encounters at all times. Upon landing, a survey route is discussed and each of the 2 observers will begin surveying in opposite directions and meet back toward the center point and patrol.

The polygon represents the initial point of the survey, but searching should not necessarily be restricted to the area of the polygon and should include an approximate 1-km buffer from the initial starting point. The idea is to obtain coarse-scaled information on the presence/absence of grizzly bear activity within and adjacent to each polygon. For example, if an esker is located within 1 km of the polygon, observers should include the esker in their search area.

The duration of each search within and adjacent to the polygon will be standardized to one hour.

Sign includes attributes such as dens, diggings, tracks, scat, hair and kill sites/feeding evidence. If sign is detected, the number of independent sign is to be recorded. A narrative description of the type of sign will be recorded on the data sheet, including age of sign and description of surrounding habitat. One data sheet will be used for each sample polygon and 'no observations' will be recorded where no sign is evident in the survey.

Upon return to the office, field sheets will be checked for omissions and errors that same day.

4 EQUIPMENT

- Maps identifying seasonal polygon locations
- Binoculars
- Field sheets/logbook
- Camera
- Bear spray, bangers and flares
- GPS
- Paper envelopes for hair samples
- Satellite phone
- Radio with fully-charged, spare battery programmed with the helicopter channel
- Summer survival gear

5 RELATED FORMS/DOCUMENTS

- Grizzly Bear Habitat Activity Survey – FORM-ENV-WILD-06
- SOP – Aircraft – SOPENV-EQUIP-01
- SOP – Wildlife Monitoring Programs - SOPENV-WILD-18
- Diavik's Wildlife Monitoring Program

Revision History

Revision	Description	Prepared By	Date
00	Initial Release	C. English	30 June 2005
01	Updated - review date	C. English	October 2006

1 OBJECTIVE/PURPOSE

This Standard Operating Procedure (SOP) provides guidelines on procedures to follow when carrying out wolverine snow track surveys. Monitoring for these surveys generally takes place twice per year.

2 RESPONSIBILITIES

It is the Senior Environmental Coordinator's responsibility to ensure that all members of the Environment Team are trained in, and understand, this Standard Operating Procedure (SOP).

It is the responsibility of the Environmental Coordinators, Environmental Technicians, contractors, researchers and students, and any other members of the Environment Team to follow this Standard Operating Procedure.

3 PROCEDURE

3.1 Field Procedures

Surveys will be conducted two times, once in the early spring (end of March or early April) and once in early winter (late November to early December) by snowmobile. Surveys are best conducted 2 – 6 days after a snowfall. Personnel will follow each transect from start to finish, ensuring to closely follow the GPS waypoints provided for each transect. The snowmobile must be driven slowly to ensure that all wolverine tracks are recorded.

The observer will record the start and end time of each transect. In addition, the distance travelled for each transect will be recorded from the odometer on the snow machine.

For each wolverine track observation, record:

- observation number
- number of wolverines (sex, if possible)
- direction of travel (N, S, E, W)
- UTM coordinates

An elder generally comes to site to help out with this survey. Since this program began, Bobby Algona of Kugluktuk has participated in the survey and provided his observations from the program. This participation is extremely valuable and should be maintained.

3.2 Analysis and Reporting

Upon return from the field, technicians will check their data sheets and maps for completeness and accuracy and will submit them for data entry. If an elder from one of the communities helps out on the survey, that person should be interviewed after the survey to obtain the overall number of wolverines they feel are present, based on tracks sighted, and any other key observations that they noticed should be recorded. A summary of the information collected will be completed for inclusion in the annual report.

4 EQUIPMENT

- Binoculars, GPS (and spare batteries)
- Field notebook and pencil
- Compass
- Winter Survival gear and equipment
- Radio and charged, spare batteries

5 RELATED FORMS/DOCUMENTS

- Snowmobile SOP (SOPENV-EQUIP-04)

Revision History

Revision	Description	Prepared By	Date
00	Initial Release		2001
01	Updated	R. Eskelson/ S. Oystryk	March 2005
02	Updated – Aboriginal participation, timing, review date	C. English	October 2006

1 OBJECTIVE/PURPOSE

The Standard Operating Procedure (SOP) outlined below discusses the procedure for conducting wolverine post surveys. These surveys help to determine the potential long-term influence of the mine on habitat use by wolverines within the study area. This survey incorporates a DNA sampling protocol to monitor relative wolverine abundance and populations across large landscapes. In practical terms, this methodology also provides an opportunity to potentially document the mortality of "resident" wolverines by sport or northern hunters in adjacent areas, document the return of relocated wolverines to Regional Study Areas (RSAs), and compare densities with other areas.

2 RESPONSIBILITIES

It is the Senior Environmental Coordinator's responsibility to ensure that all members of the Environment Team are trained in, and understand, this Standard Operating Procedure (SOP).

It is the responsibility of the Environmental Coordinators, Environmental Technicians, contractors, researchers and students, and any other members of the Environment Team to follow this Standard Operating Procedure.

3 PROCEDURE

3.1 Field Procedures

The survey is to be carried out in early April by snowmobile. Lure stations combined with hair snares for DNA profiling will be placed three kilometres apart as shown on the map in Figure 1, provided by the department of Environment and Natural Resources (ENR). 141 Spruce posts (4"x 4" x 5' in length) will be erected across the study area.

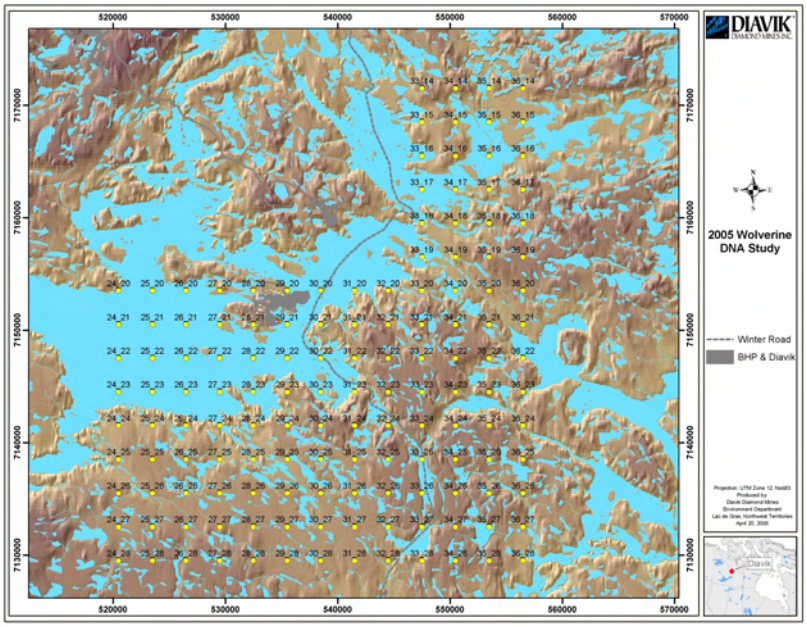


Figure 1: Identification of wolverine post locations

Prior to deploying posts, each post will be spiral-wrapped in double-stranded barbed wire, intended to snag small clumps of hair, from approximately 1 ft. from the bottom up to the very top. The barbed wire is secured by u-nails, and two opposing u-nails will also need to be inserted on the top of the post.

Also prior to post deployment, preparation of baits and lures will be required. A drum containing bait and lures is stored beside the winter road at Reference Island to reduce attractant potential at the main camp. Lures will be made using two different colours of 2" x 4" pieces of felt. One colour will be smeared with beaver castor and the other with long-range scent using a kitchen knife or syringe. Only a small amount of the product is required on each felt. Once product has been applied, roll the felt up and secure a piece of 12" wire around the middle of the felt by wrapping the wire around it a few times. Due to the strong odour associated with these lures, they will need to be prepared & stored outside at the storage drum. The bait used is small chunks of caribou meat, which also require a piece of 12" wire to be threaded through and secured to the meat.

During post deployment, a toboggan with the posts, stands, bolts and tools will be required. During the first year of the study, trucks can be used to cache posts beside the winter road along each pre-determined transect. During subsequent years, posts may be cached at various locations along each transect. Either way, ensure you are carrying spare posts, stands and bolts at all times.

Upon arrival at each station during deployment, one person will assemble the post/stands while the other digs out an x-shaped hole in the snow approximately 12" wide and 3' long for

placement of the stand. Place the assembled post into the hole and backfill with extra snow, ensuring the snow is hard-packed and the post stable.

Each station will be baited with a small portion of caribou meat and two commercially prepared lures. These are secured to the two u-nails on top of each post. See Figure 2. Note the set-up time and coordinates of each post on the datasheet (FORM-ENV-WILD-17), and any problems that may have been encountered during set up (e.g. true coordinate was in middle of winter road, so post moved to nearest location adjacent to the road).

Figure 2: Assembled post

After a period of 10 days, posts will be checked for hair snags. Ensure that posts are checked in the same order as they were deployed. Any wolverine hair identified is to be collected using tweezers or needle-nose pliers and put into labelled envelopes. The following data will need to be noted: date, time, location, side of the post (1, 2, 3 or 4, as per Figure 3) and height from the ground from which the hair was collected (A, B or C, Figure 3). Wind direction and speed will need to be recorded on the datasheet, and changes in direction or speed throughout the day need to be noted as it could result in loss of hair samples. Also note any wildlife sign at the base of the posts including scat, tracks, urine, etc. Again, spare posts, stands, bolts, lures and bait will need to be carried in case anything requires replacement. Any replacements also need to be recorded on the datasheet.

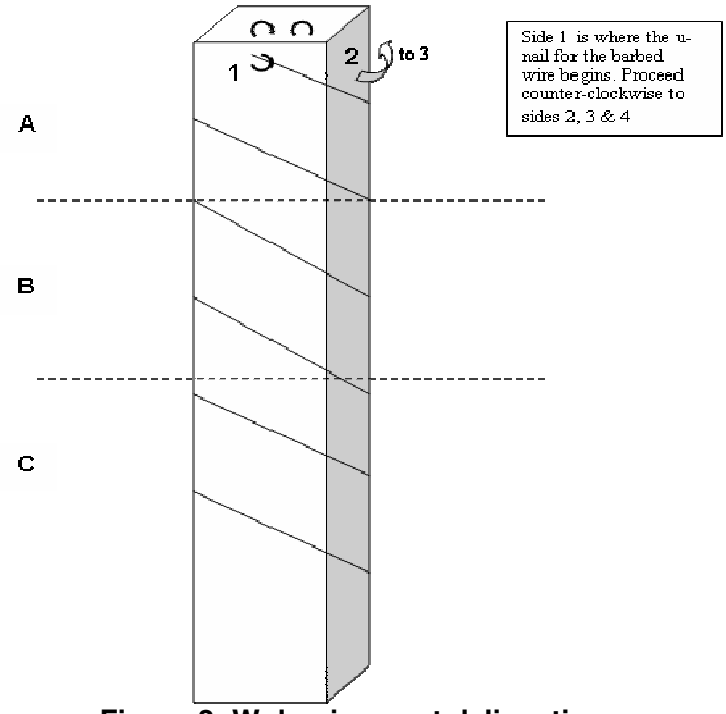


Figure 3: Wolverine post delineations

Another 10 days after the first round of hair collection, posts will again be checked for hair snags. The same procedure will be followed for this session as is outlined above. The exception to this is that posts will be dismantled after hair has been collected. The post will need to be dug out from the snow and baits and lures will need to be removed and collected for incineration. Depending on the year, posts will either be cached along each transect, or collected and brought back to Reference Island for storage. If cached, ensure posts are on land and at a high point to try and reduce the amount of snow cover on each cache. Record the coordinates of each cache on the datasheet. If posts are being brought back to Reference, they can be collected along each transect and deposited at the junction of the winter road for later retrieval by truck, or taken straight to the island. Posts do not have to have the stand removed for caching.

Once back in the office, hair samples collected should be stored in a box on the desk. Samples obtained should be reconciled against field sheets and recorded on to an Excel file outlining all of the samples obtained. Once this has been completed, they will be forwarded to ENR staff in Yellowknife for shipment to the genetics lab in Nelson, BC for DNA extraction and analysis.

Data sheets will be checked for omissions and/or errors on the same day as the survey. A summary log will be maintained outlining dates each station was completed and observations relating to each specific station.

ENR will assist in the cataloguing and shipment of hair samples for genetic analysis.

3.2 Field Safety

Each field crew will consist of 2 people and full survival gear must be carried with each team.

A satellite phone must be carried; preferably by each team, but at a minimum by crews deploying posts at the far northern and southern portions of the study area, as radio contact is variable or non-existent in these locations. Radio or phone check-ins with main camp must occur every two hours.

When preparing lures in the field, ensure you are aware of your surroundings. Continuously scan for approaching wildlife and re-seal the drum containing bait & lures during your work and prior to departing the area.

3.3 Contacts

Robert Mulders, Wildlife Biologist, Environment & Natural Resources, Robert_mulders@gov.nt.ca, phone: (867) 920-6315

David Paetkau, President, Wildlife Genetics International, dpaetkau@wildlifegenetics.ca, phone: (250) 352-3563

4 EQUIPMENT

To expedite a smooth transition & maintain consistency of this program, ENR will provide participating mining companies with the required sampling materials (hair snagging posts, bait and lures). ENR will also provide mining companies with field training to ensure that the deployment of hair snagging posts and hair collection techniques are standardized.

- Maps with wolverine post locations
- Datasheets & pencils
- GPS with extra batteries and pre-programmed post coordinates
- Bear bangers
- Felt
- Thin wire, cut into 12” long pieces
- Caribou meat
- Knives, saws
- Paper envelopes for hair samples (second & third sessions)
- Tweezers, needle-nose pliers, Leatherman
- Hammer & socket wrench that fits large bolt in base
- Shovel
- Spare bolts, stands & posts

- Lures (two types) & bait
- Survival bags & personal gear
- Camera
- Snowmobiles, toboggans & helmets
- Spare fuel & oil for snowmobiles
- Radio and extra batteries
- Satellite phone

5 RELATED FORMS/DOCUMENTS

- Wolverine DNA Sample Collection Datasheet – FORM-ENV-WILD-17

Revision History

Revision	Description	Prepared By	Date
00	Initial Release	C. English	05 February 2006
01	Updated – cache locations, review date	C. English	October 2006

1 OBJECTIVE/PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide direction for monitoring the Waste Transfer Area (WTA) and the Landfill for both attractants to wildlife and wildlife that may visit these sites. Wildlife can potentially be very dangerous by becoming habituated to human activity. This situation can pose a threat to the safety of both the personnel on site and to the animal itself.

2 RESPONSIBILITIES

It is the Senior Environmental Coordinator's responsibility to ensure that all members of the Environment Team are trained in, and understand, this Standard Operating Procedure (SOP).

It is the responsibility of the Environmental Coordinators, Environmental Technicians, contractors, researchers and students, and any other members of the Environment Team to follow this Standard Operating Procedure.

3 PROCEDURE

3.1 General

Monitoring will be conducted 2-3 times per week during the entire year. Surveys to monitor the landfill site will include a systematic survey on foot of the entire landfill site and waste transfer area. Consecutive surveys should be alternated between morning and afternoon. The following information will be recorded on the Waste Transfer Area/Landfill Monitoring Data Sheet (FORM-ENV-WILD-07):

- time of start, finish and duration of survey
- the presence of any possible attractants to the site (i.e. edible items, oil products)
- observations of wildlife at the site (all species including bears, wolves, wolverines, foxes, caribou, hares, and birds)
- any fresh sign of wildlife use of the site (i.e. tracks, scats, etc.)

If surveys detected no sign of wildlife, then "no observations" should be entered on the data sheet and in the database for that date. All applicable fields must be filled out.

3.2 Analysis and Reporting

Constant analysis of the data obtained will be performed to ensure early detection of any problems that may develop with respect to wildlife use of the landfill site.

Data sheets will be checked for omissions and/or errors on the same day as each survey.

Data sheets will be transferred to a data base each week. A report will be prepared and will provide a summary of the information collected.

4 EQUIPMENT

- Data sheets
- Binoculars

5 RELATED DOCUMENTS

- Landfill Monitoring Datasheet (FORM-ENV-WILD-07)

Revision History

Revision	Description	Prepared By	Date
00	Initial Release		March 2003
01	Updated	R. Eskelson/ S. Oystryk	March 2005
02	Updated – related documents, review date	C. English	October 2006

1 OBJECTIVE/PURPOSE

This Standard Operating Procedure (SOP) provides guidelines to follow when monitoring waterfowl, shorebirds and other aquatic birds at the Diavik mine site. The purpose of this monitoring is to document general observations/occurrences of waterfowl, loons and shorebirds during spring migration & breeding season to determine any changes in habitat use. This monitoring is carried out at two shallow bays and all mine-altered water bodies (i.e. PKC, north inlet and drainage ponds).

2 RESPONSIBILITIES

It is the Senior Environmental Coordinator's responsibility to ensure that all members of the Environment Team are trained in, and understand, this Standard Operating Procedure (SOP). It is the responsibility of the Environmental Coordinators, Environmental Technicians, contractors, researchers and students, and any other members of the Environment Team to follow this Standard Operating Procedure.

3 PROCEDURE

3.1 General

Shallow Bays (2) are monitored every day in the morning, from May 25th to June 20th, then weekly until October 15th.

Mine altered wetlands are monitored daily from May 15th to June 20th, then weekly until October 15th.

3.2 Field Procedure

Surveys are to be completed in the morning, at approximately the same time every day. The perimeter of each shallow bay is walked each day it is surveyed.

Mine-altered water bodies will be monitored from a single point on shore using binoculars. A minimum of 5 minutes should be spent at each water body in order to determine if waterfowl are present in the area.

Personnel should ensure they have binoculars, a bird book and a camera with them during the work to assist in identifications. Wherever possible, all efforts should be made to identify the species sighted.

For their own safety, personnel should ensure they scan the area for bears prior to & during monitoring. If a bear is seen in the area, the survey will be delayed or cancelled.

Data to be recorded is as follows:

- Dates and times of surveys;
- Survey personnel
- Survey site (i.e. east and west bays, North Inlet, PKC or drainage ponds)
- All bird species, activities and numbers
- Weather
- Percent open water

Incidental observations such as nest locations or habitat use should be documented with coordinates of nest, number of eggs or chicks and habitat type.

Upon return from the field, technicians will check their data sheets for accuracy and will submit them for data entry. Should the individual have had problems identifying any species in the field, a brief discussion should be held with individuals in the office and alternative identification sources should be referenced, such as other bird books and the internet.

4 EQUIPMENT REQUIRED

- Binoculars
- Peterson's Field Guide to Western Birds
- Field sheets/logbook
- Camera
- Bear bangers
- GPS

5 RELATED FORMS/DOCUMENTS

- Diavik's Wildlife Monitoring Program
- Shallow Bay Waterfowl Datasheet - FORM-ENV-WILD-10
- Mine Altered Waterfowl Datasheet - FORM-ENV-WILD-11
- Peterson's Field Guide to Western Birds

Revision History

Revision	Description	Prepared By	Date
00	Initial Release		2001
01	Updated		March 2003
02	Updated	R. Eskelson/ S. Oystryk	May 2005
03	Updated	C. English	February 2006
04	Updated – review date	C. English	October 2006

Bird Species of Lac de Gras

Waterfowl	
BLBR	Black Brant
CAGO	Canada Goose
DAGO	Dark Goose
SPGO	Goose spp.
GWFG	Greater White Fronted Goose
BLGO	Lesser Snow Goose (black)
LSGO	Lesser Snow Goose (white)
TUSW	Tundra Swan
TRSW	Trumpeter Swan
Duck-like Birds (dabbling)	
AGWT	American Green Winged Teal
NOPI	Northern Pintail
SPDU	Duck spp.
Duck-like birds (diving)	
BLSC	Black Scoter
COLO	Common Loon
COME	Common Merganser
GRSC	Greater Scaup
LESC	Lesser Scaup
SPLO	Loon spp.
SPME	Merganser spp.
OLDS	Oldsquaw (now called Long-tailed duck)
PALO	Pacific Loon
RBME	Red Breasted Merganser
RNGR	Red Necked Grebe
SUSC	Surf Scoter
YBLO	Yellow Billed Loon
RTLO	Red Throated Loon
MALD	Mallard
AMWI	American Wigeon
WWSC	White-winged Scoter
HOGR	Horned Grebe
Shorebirds (wading)	
BASA	Baird's Sandpiper
BBPL	Black Bellied Plover
COSN	Common Snipe
DUNL	Dunlin
LESA	Least Sandpiper
LEGP	Lesser Golden Plover (now called American Golden Plover)
SPPL	Plovers spp.
LEYE	Lesser Yellowlegs
LBDO	Long Billed Dowitcher
PESA	Pectoral Sandpiper
RNPH	Red Necked Phalarope
RUTS	Ruddy Turnstone
SACR	Sandhill Crane

Seabirds, Gulls etc.(aerialists)	
ARTE	Arctic Tern
GLGU	Glaucus Gull
HERG	Herring Gull
LTJA	Long Tailed Jaeger
PAJA	Parasitic Jaeger
POJA	Pomarine Jaeger
BOGU	Bonapartes Gull
THGU	Thayers Gull
BASW	Barn Swallow
SAGU	Sabines Gull
UNGU	Unidentified Gull
Passerine (perching)	
AMPI	American Pipit
AMRO	American Robin
ATSP	American Tree Sparrow
CORA	Common Raven
CORE	Common Redpoll
GCTH	Gray Cheeked Thrush
HASP	Harris' Sparrow
HORE	Hoary Redpoll
HOLA	Horned Lark
LALO	Lapland Longspur
PASS	Passerimiformes spp.
SPRE	Redpoll spp.
SAVS	Savannah Sparrow
SNBU	Snow Bunting
WCSP	White Crowned Sparrow
YWAR	Yellow Warbler
DEJU	Dark-eyed Junco (state coloured form)
Fowl-like Birds	
SPPT	Ptarmigan spp.
ROPT	Rock Ptarmigan
WIPT	Willow Ptarmigan
Birds of Prey	
BAEA	Bald Eagle
SPFA	Falcon spp.
GOEA	Golden Eagle
GYRI	Gyrfalcon
NOHA	Northern Harrier
PEIA	Peregrine Falcon
SPRA	Raptor spp.
RLHA	Rough Legged Hawk

SEPL	Semipalmated Plover
SESA	Semipalmated Sandpiper
UNSA	Unidentified Sandpiper
SPSH	Shorebird spp.
STSA	Stilted Sandpiper
WRSA	White Rumped Sandpiper
RUTU	Ruddy Turnstone
SPSP	Spotted Sandpiper
HDGW	Hudsonian Godwit
SADL	Sanderling
BBSP	Buff-breasted Sandpiper

SEOW	Short Eared Owl
SNOW	Snowy Owl
Activity Codes	
Fe	Feeding
Sw	Swimming
Pe	Perched
Fo	Fly-Over
Td	Territorial Display
Fl	Flush
Wa	Walking
Al	Alert
St	Standing
No Obs	No Observations

1 OBJECTIVE/PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide the methods for conducting raptor surveys, in an effort to monitor the nesting success of peregrine falcons and other raptors. Surveys are also undertaken to monitor whether mining activity is disturbing nesting raptors.

2 RESPONSIBILITIES

It is the Senior Environmental Coordinator's responsibility to ensure that all members of the Environment Team are trained in, and understand, this Standard Operating Procedure (SOP).

It is the responsibility of the Environmental Coordinators, Environmental Technicians, contractors, researchers and students, and any other members of the Environment Team to follow this Standard Operating Procedure.

3 PROCEDURE

3.1 Field Procedures

The raptor survey will be conducted once during spring (June) to determine nest occupancy, and once in the summer (usually July) to detect productivity rates of each nest. These surveys are typically done in conjunction with BHPB and ENR, Wildlife and Fisheries Division. During the spring, DDMI and BHPB sites are checked. During the summer, DDMI, BHPB and Daring Lake Tundra Research Stations (the control site) are all surveyed. The survey crew consists of one member each from DDMI, BHPB and ENR.

The methodology for this type of raptor survey involves a "Look-See" method where observers use a helicopter to fly adjacent to the nest site to determine whether or not birds are occupying the area, and to count the number of eggs or young raptors if they are present.

The location of nest sites will be documented using a GPS. Proof of nest success would include finding a nest containing eggs (spring) or young (summer).

For each nest site, one data sheet will be used to record information from each survey.

3.2 Analysis and Reporting

Upon returning to camp, field data will be summarized and transcribed onto the computer in the wildlife database. The information collected will be summarized in the annual wildlife monitoring program report.

4 EQUIPMENT

Binoculars
GPS/Map
Coordinates of known nest sites
Raptor datasheets and pencil
Bird Identification book

5 RELATED FORMS/DOCUMENTS

- Aircraft SOP (SOPENV-EQUIP-01)
- Raptor Survey Datasheet (FORM-ENV-WILD-08)

Revision History

Revision	Description	Prepared By	Date
00	Initial Release		March 2003
01	Updated	S. Oystryk	February 2005
02	Updated – methodology, participants	C. English	October 2006

1 OBJECTIVE/PURPOSE

The Standard Operating Procedure listed below outlines the field working procedures required when conducting various wildlife monitoring programs at Diavik.

2 RESPONSIBILITIES

It is the Senior Environmental Coordinator's responsibility to ensure that all members of the Environment Team are trained in, and understand, this Standard Operating Procedure (SOP).

It is the responsibility of the Environmental Coordinators, Environmental Technicians, contractors, researchers and students, and any other members of the Environment Team to follow this Standard Operating Procedure.

3 PROCEDURE

3.1 Waterfowl

- Make sure you have enough field sheets and pencils for recording findings
- Complete a thorough scan of the area before leaving the vehicle to avoid surprise encounters with wildlife. Continue scanning the area while in the field.
- Ensure proper clothing is worn for the environmental conditions (i.e. rain gear, rubber boots, toque)
- Take binoculars with you to assist in observations, as well as a Bird Identification guide
- Waterfowl monitoring is conducted at the double bays and all mine altered wetlands.
- Be sure to have a charged radio and extra battery
- If working off site personnel must always work in pairs.
- Plan your route to minimize risk of injury and impact on tundra vegetation.

3.2 Caribou

- Majority of caribou surveys are conducted from a vehicle or a helicopter
- Road observations are conducted along the four main roads (airport, south haul road, A418 and south perimeter)
- Be sure to dress appropriately for the climatic conditions
- Ensure all survival gear is in the truck and helicopter
- Carry a charged radio and extra battery
- Record all observations and behaviors on field sheets
- Ensure you have an air horn and/or bear bangers if doing off-site scans

3.3 Grizzly Habitat

- Grizzly Habitat surveys are conducted on foot.

- Complete a thorough scan of the area (approx. 1km swathe) before leaving the helicopter to avoid surprise encounters with wildlife. Continue scanning the area while in the field.
- A third person remains in the centre of the polygon to continually survey the area for wildlife
- Be sure to dress appropriately for the climatic conditions
- Ensure all survival gear is in the truck and helicopter
- Ensure each individual carries an air horn or bear banger and bear spray
- Carry a charged radio and extra battery
- Record all observations and behaviors on field sheets

3.4 Wolverine Snow Tracking & DNA Posts

- Wolverine Snow Tracking surveys are conducted by snowmobile (minimum of two)
- Be sure to dress appropriately for the climatic conditions
- Ensure all survival gear is accessible at all times
- Carry a charged radio and extra battery
- Record all observations and behaviors on field sheets

3.5 Raptor

- Raptor surveys are conducted by helicopter in conjunction with ENR and BHPBilliton staff
- Be sure to dress appropriately for the climatic conditions
- Ensure all survival gear is accessible at all times
- Carry a charged radio and extra battery
- Record all observations and behaviors on field sheets

3.6 Boats

- Always wear a PFD within 3 m of the water and when on the boat
- Wear or take a floater suit with you
- Bring a copy of the shoal map for the area and use extreme caution in unfamiliar areas
- Stock a tent and survival gear in the jet boat for the summer (under the bow)
- Ensure the boat you are using contains a boat safety kit, fire extinguishers, rope, anchors and fuel (mixed gas for the lunds)
- An extra jerry can of straight gas should be carried in the jet boat at all times
- Return to site as quickly as possible if the weather starts to change

3.7 General

- Be sure to let someone know where, how long and why you are going somewhere. Leave a map on the coordinators desk in the office.
- Check in every two hours while you are in the field. Check-ins can be done with other Environment staff or the Safety department.
- Notify the department with which you have been checking in once you are back on site.

- If there are carnivores on the island or in the area, carry appropriate deterrent gear (bangers, bear spray, air horns, etc.)
- Always work in pairs and don't venture off alone without notifying someone
- Pack enough equipment for the tasks as well as some back ups if possible
- Pre-scan areas where you will be working away from roads and vehicles for any wildlife before heading out.
- Have appropriate clothing and spare gear if you are out for an extended period of time
- Carry emergency rations and survival gear when applicable
- Carry the portable satellite phone with you for work farther afield.

Revision History

Revision	Description	Prepared By	Date
00	Initial Release		December 2002
01	Updated	R. Eskelson/ S. Oystryk	March 2005
02	Updated – boats, gear, review date	C. English	October 2006

1 OBJECTIVE/PURPOSE

This Standard Operating Procedure (SOP) presents the methods for dealing with nuisance and problem wildlife at the Diavik site. The procedure is essential for human safety in relation to risk or danger from wildlife and for the protection of vulnerable wildlife species. It outlines options for dealing with nuisance wildlife, particularly problem bears, and for documenting and reporting all wildlife incidents.

2 RESPONSIBILITIES

It is the Senior Environmental Coordinator's responsibility to ensure that all members of the Environment Team are trained in, and understand, this Standard Operating Procedure (SOP).

It is the responsibility of the Environmental Coordinators, Environmental Technicians, contractors, researchers and students, and any other members of the Environment Team to follow this Standard Operating Procedure.

In addition, the following people have responsibilities:

- Environment Manager or alternate - communications and critical decisions for dealing with nuisance and problem wildlife
- Health and Safety Manager - to ensure effectiveness of emergency measures for wildlife and worker safety
- Employees and Contractors - to adhere to specified mitigation measures and reporting of the occurrence of grizzly bears and other problem wildlife

3 PROCEDURE

3.1 General

Occasional visitations by grizzly bears, wolverine, wolves and foxes to the Project site are anticipated. Worker safety is a priority, and there will be situations when management action will be required to deter, relocate and, as a last resort, kill an animal.

3.2 Grizzly Bears

Grizzly bears are found throughout the Lac de Gras area and will occasionally visit the east island from May to October. In order to prevent the attraction of grizzly bears and other scavengers to the site, the proper storage of food, incineration of food waste, and prohibiting / inspection for litter will take place. The policy that prohibits feeding of wildlife will be strictly enforced, with zero-tolerance for non compliance.

Carrion, especially caribou carcasses in the vicinity of the camp from either natural (except caribou killed by grizzly bears) or project-related mortality sources are to be quickly disposed of by incineration or removed from the island by helicopter, boat or snowmobile. Grizzly-killed caribou carcasses will not be removed until the grizzly bear has completed feeding on the carcass, unless the carcass is within an active work area. In such cases, the carcass will be removed in a manner (e.g., dragging) so that the bear can relocate the carcass.

Environment Department personnel will conduct regular compliance audits to ensure prevention of grizzly bear attractants.

There is a well-defined process to follow for taking steps if a bear is observed at the mine site. This process, as well as a description of the remedial actions (such as deterrence, relocation or destruction), are found in the "Problem Bears" SOP (SOPENV-WILD-01). That specific SOP must be consulted in the event of a bear occurrence, as this SOP only provides general background and prevention information.

3.3 Carnivores

Wolverines, foxes and occasionally wolves will visit the Diavik mine site in search of food or shelter. Nuisance carnivores may pose a safety risk for employees through aggressive attacks, causing injury, and transmission of disease.

Deterrence of Problem Carnivores

Preventing the attraction of carnivores through proper food storage, garbage disposal and camp maintenance is the most economical and effective way of preventing problems.

Relocation of Problem Carnivores

- Because of its vulnerable national status, only problem wolverines will be subject to relocation efforts. Problem foxes and wolves will be destroyed under special permit and permission from ENR, or by ENR themselves.
- Relocation of a problem wolverine involves capture with a culvert trap, possible immobilization with drugs for tagging or attaching a radio collar, and transport by ground or air to a distant area (i.e. >200 km).
- Ideally, the relocated wolverine will stay in the new area and cease to be a problem. However, relocation is not always effective. Wolverines can also travel great distances and may return to their original home range.
- Relocation of wolverines will be recommended to Diavik Environment Manager and Wildlife and Fisheries Division only when deterrence has not been effective
- Wolverine relocations, which involve immobilization with drugs, will only be undertaken by Wildlife and Fisheries Division, ENR with the full cooperation and assistance of the Diavik Environmental Staff.

Destruction of Problem Carnivores

Destruction of a problem carnivore will be used as a last resort, in the event that deterrence procedures are not effective, or if a relocated wolverine returns to the Diavik site.

The destruction of a problem carnivore will require the following actions:

- The completion of an Environmental Incident Investigation Report, detailing the nature of the control action, consultations with management and Wildlife and Fisheries Division, ENR;
- Submission of the Environmental Incident Investigation Report to the Diavik Environmental Manager. A formal, more detailed incident report is also issued to Wildlife and Fisheries Division, ENR; and,
- A write-up as an appendix to the annual wildlife monitoring report.

3.4 Caribou

During mid-summer, caribou seek relief from mosquitoes and flies on bare or unvegetated areas, exposed ridges, and shorelines of lakes and rivers. Caribou may frequent man-made structures, such as roads and airstrips, because they provide similar habitat. This could result in collisions which may compromise worker safety and cause damage to equipment, as well as injury or death for the animal.

Detailed procedures on caribou herding in the case of caribou presence on site can be found in the Standard Operating Procedure on Caribou Herding (SOPENV-WILD-16).

3.5 Birds and Small Mammals

Birds and small mammals may be viewed as pests or irritations, but will not usually pose a direct threat to worker safety. Some species of birds may be attracted to infrastructure for roosting, nesting and potentially for food sources (i.e., food scraps and garbage). Indirect effects of bird and mammal activity, such as obstruction of power lines and equipment with nests, or damage to cables and other synthetic materials by chewing, may cause temporary stoppages of work or minor property damage.

Action to resolve nuisance birds or small mammals may include:

- relocation of a nest to an alternate nearby location;
- alteration of a nesting structure to prevent further nesting;
- destruction of a nest and alteration of nesting structure to prevent further nesting;
- live-trapping and release of problem animal off the east island; and,
- destruction of problem animal.

All incidents and actions taken regarding nuisance birds and small mammals will be documented in weekly reports to the Diavik Environment Manager and in the annual wildlife report.

4 RELATED FORMS/DOCUMENTS

- Problem Bears SOP (SOPENV-WILD-01)
- Caribou Herding SOP (SOPENV-WILD-16)
- Environmental Incident Investigation Report SOP (SOPENV-REG-01)
- Environmental Incident Investigation Report FORM (FORMENV-REG-01)

Revision History

Revision	Description	Prepared By	Date
00	Initial Release		2001
01	Updated	R. Eskelson/ S. Oystryk	March 2005
02	Updated – ENR references, review date	C. English	October 2006

1 OBJECTIVE/PURPOSE

This Standard Operating Procedure (SOP) provides guidance for dealing with situations where Security employees at the Diavik Mine site encounter a situation where wildlife becomes a problem. This is a general procedure, and other SOPs provide further detail for specific types of wildlife or situations.

2 RESPONSIBILITIES

It is the responsibility of the Environment Department to ensure that Security employees are aware of this SOP and understand it. It is the responsibility of Security employees and supervisors to follow this procedure in any situation where wildlife is a problem or causes concerns about worker safety at the mine site.

Environment Staff will notify the Security supervisor of who to contact after hours during each rotational change. The best way to notify environment after hours is by telephone. Environment staff do not generally carry a radio after hours.

3 PROCEDURE

3.1 General

Preventing the attraction of carnivores through proper food storage, garbage disposal and camp maintenance is the most effective way of avoiding problem carnivores. Management action will be carried out if carnivores pose a threat to people and/or property.

Occasional visitations by grizzly bears, wolverine, wolves and foxes to the Project site are anticipated. Carnivores must be deterred from the project site. Worker safety is a priority, and there will be situations when management action will be required.

Should there be a time when Environment staff is not available, Security staff possess bear bangers and training to use them. Their initial response may be required until such time as Environment staff become available.

3.2 Carnivore Deterrence

Carnivore deterrence refers to a method or device, either physical or chemical designed to chase the animal away. This could involve one or a combination of the following approved and recommended methods by ENR:

- Bear Bangers
- Noise crackers and Flares
- Use of Vehicles

When using methods of deterrence, you have to remember to think the situation through. Remember the following points:

- No shooting of bear bangers towards buildings or fuel sources.
- Ensure that the bear bangers land between you and the bear – you don't want to scare the animal towards you. If you are going to use air horns – direct the air horn towards the animal.
- If you want to move the bear to the right, shoot the banger so it fires to the left of the bear. Vehicles may be used to move bears but ensure that you are thoroughly thinking the situation through – you do not want to scare a bear under a building.
- If you move the animal, ensure that you observe the direction of movement so that you are aware of where it is going – it may just be moving to another attractant source and will require further deterrence.
- Ensure that you are aggressively deterring the animal, but do not unnecessarily harass it (i.e. watch for heat stroke or extreme body stress).

If the situation becomes threatening to property or human life, immediately notify the Environment Department.

Document all deterrent actions taken by your department and fill out an Environmental Incident Investigation form (General and Wildlife sections) and forward to the Environment Department (see SOPENV-REG-01 for guidance on completing this form).

If all actions fail to deter the animal, notify Environment Department who will assess the situation and take further action if required.

4 RELATED FORMS/DOCUMENTS

- SOP - Environmental Incident Investigation (SOPENV-REG-01)
- Environmental Incident Investigation form (FORMENV-REG-01)

Revision History

Revision	Description	Prepared By	Date
00	Initial Release		May 2001
01	Updated	R. Eskelson/ S. Oystryk	March 2005
02	Updated	C. English	June 2006

1 OBJECTIVE/PURPOSE

This Standard Operating Procedure provides guidelines on procedures to follow when bears are reported on site. This procedure applies to all DDMI personnel, contractors, and visitors to the site. Occasional visitations by grizzly bears to the project site are anticipated but the bears must be deterred from the area. Worker safety is a priority, and there will be situations when management action will be required.

2 RESPONSIBILITIES

All supervisors and contractors are responsible to manage the risks of the jobs performed during reports of bears on site. If conditions warrant work restrictions, the supervisor is responsible to initiate the appropriate actions.

No supervisor or crew is allowed to or expected to work in conditions where the presence of a bear on site would put them at risk of injury.

Jobs shall proceed appropriately depending on the area and type of work being performed where the bear has been reported. Certain activities may require being placed on hold or re-scheduling.

3 PROCEDURE

3.1 General

The table below outlines the steps to be taken if a bear is observed on site.

STEPS	DESCRIPTION	RESPONSIBLE PARTY
Notify Security & Environment	• Security & Environment Departments are to be notified when a bear is observed on site. • To report to security contact radio channel 2 (24 hrs). To report to Environment contact radio channel 6 (7am to 7pm). The following information will be determined: • Person reporting bear sighting • Contact information for person reporting bear sighting (i.e. radio channel)	Personnel Reporting Bear Sighting

STEPS	DESCRIPTION	RESPONSIBLE PARTY
Security to Notify Environment	• Number of bears • Last known location • Does anyone have a visual of the animal (maintain visual from a safe distance, if possible, until environment arrives) • Are there workers in the area and how many Security is to contact Environment on channel 6 (7 am to 7 pm), or in their rooms after 7 pm. Contact order for Environment staff: • Environmental Technician • Environmental Coordinator • Senior Environmental Coordinator Security will relay all information to Environment. Further contact with Security will occur on radio channel 2	Security

STEPS	DESCRIPTION	RESPONSIBLE PARTY
Security to Issue Bear Advisory or Bear Alert	Security will issue either a Bear Advisory or Bear Alert. **Bear Advisory (Bear on Island, but not near work areas or accommodations)**. - Security will notify all personnel of the bears location using radio alert channel 16. - A bear advisory will continue to be called every 2 hrs, for a maximum of 6 hours, i.e. three times, unless Security is otherwise notified by Environment to continue the alert. **Bear Alert (Bear in local area, work areas, and/or accommodations area).** - Security will notify all personnel of the bears location using radio alert channel 16. - The walkway between south camp and the main accommodations will be closed. - The walking trail, if in operation, will be swept by Security to collect anyone using the trail. If an alert occurs during shift change, Security will determine the need for buses to move personnel.	Security
Monitor Radio	All supervisors are responsible to monitor the radio for changes or updates on the bear's movement on site. Supervisors are responsible to account for and notify their staff. If necessary, supervisors are responsible to restrict work in certain areas, depending on the bears location.	All Supervisors
Criteria for Lifting Bear Advisory	• The advisory will stay in effect for a maximum of 6 continuous hours, unless the Environment department notifies Security to continue.	Security & Environment Departments
Criteria for Lifting Bear Alert	• Once Environment has notified Security that the bear has been removed from site, Security can then issue a site-wide all-clear. If the bear is moved off from site, but remains on the island at a distance where deterrent actions are no longer effective, the bear alert will be reduced to an advisory.	Security Control

STEPS	DESCRIPTION	RESPONSIBLE PARTY
Notification	• Security Control shall notify all employees that the alert has been lifted using radio channel 16.	Security Control

3.2 Remedial Action for Problem Bears

Preventing the attraction of bears through proper food storage, garbage disposal and camp maintenance is the most effective way of avoiding problem bears, and problem carnivores in general. Management action will be carried out if bears or other carnivores pose a threat to people and/or property.

Occasional visitations by grizzly bears to the project site are anticipated and must be deterred from the area. Worker safety is a priority, and there will be situations when management action will be required. Procedures for dealing with problem wildlife are listed below.

Diavik Senior Environmental Coordinator and the Environmental Coordinator will work with Wildlife and Fisheries Division, ENR, GNWT to deal with problem grizzly bears at site. There is a hierarchy of options for control of a grizzly bear that poses a nuisance or danger to human safety; the three levels of increased effort to deal with a problem grizzly bear are:

- Level I: Grizzly Bear Deterrence
- Level II: Grizzly Bear Relocation
- Level III: Grizzly Bear Destruction

The Senior Environmental Coordinator and Environmental Coordinator will maintain effective communication with Wildlife and Fisheries Division in reporting problem bears and in evaluating options for problem bear control.

Level I: Grizzly Bear Deterrence

A method or device, either physical or chemical, designed to chase the animal away. This could involve one or a combination of the following approved and recommended methods by ENR:

- Bear Bangers
- Noise crackers and flares
- Rubber bullets
- Use of vehicles and aircraft
- Pepper spray

An individual using methods of deterrence must properly assess the situation that they are in. The following points must be considered:

- No shooting of a bear banger towards buildings or fuel sources

- Ensure that the bear banger is shot between you and the bear so that the animal is not scared towards you. If using an air horn, ensure that it is directed towards the bear.
- Vehicles are an acceptable method of deterring bears; however, ensure that the animal is moved away from project activities and not scared towards camp infrastructure or toward unsuspecting people.
- Increase the level of deterrent accordingly, based on the bears behaviour: air horns, vehicles & their horns, bear bangers, cracker shells/flares, rubber bullets, helicopter.
- If a helicopter is available on or near the project, it may be required to deter the bear off the island if other methods of deterrents are unsuccessful. Ideally, an attempt should be made to move the bear onto the small islands, west of the airstrip - thereby encouraging the bear to move off East Island onto the mainland. **Note:** This method of deterrence can only be conducted by the DDMI Environment department.
- Documentation of all deterrent actions must be completed.

If using a helicopter to deter a bear, one Environment employee should be in the aircraft with the pilot, or on the ground directing the pilot with a visual of the bear. The pilot should:

  - Stress the bear as little as possible. A stressed bear running for a distance can overheat and die.
  - Keep the helicopter well back from the bear. The minimum distance between the helicopter and the bear is 100 m (320 ft) back and 30 m (100 ft) up from the ground.
  - Keep the bear in visual contact. This should be done by taking the helicopter to a higher altitude rather than getting closer than the minimum distance.
  - Only get close enough to the bear to make it move, not fly over it. A bear moving at a 'fast walk' can cover a lot of ground quickly and efficiently; there is no need to run the bear.
  - DO NOT push a bear for more than 10 minutes or 3 km (2.2 miles).

Level II: Grizzly Bear Relocation

The following outlines procedures and rationale that will be considered if a situation arises where a grizzly bear has to be relocated off East Island:

- When a grizzly bear cannot be deterred off East Island using the methods described above, it may be necessary to relocate the bear from the project site. Relocation of a bear can only be done with recommendation from DDMI Environment department to mine management and ENR wildlife officials.
- ENR wildlife officers will be flown up to the project site to undertake the bear capture. Usually relocation involves capturing a bear using immobilization drugs fired from a helicopter and transporting the bear by air to an area away from people (i.e. the south mainland).
- A report outlining the actions taken to relocate the bear will be completed by DDMI Environment. This report will be filed for incorporation into the annual wildlife monitoring program report.

Level III: Grizzly Bear Destruction

The destruction of a grizzly bear will only be implemented as a last resort deterrence method if all the above methods have failed. A decision to destroy a bear will come directly from ENR wildlife officials upon recommendation and discussions with designated biologists and DDMI Environment personnel. Wildlife and Fisheries Division, ENR will be consulted and requested to remove a persistent, problem grizzly bear that is not an immediate danger to worker safety. However, if an emergency arises where there is direct danger to an individual then it may be necessary to destroy a bear immediately.

Only Environment personnel with a valid Possession and Acquisition License to handle firearms can destroy a grizzly bear. In order to do this, direct permission must be obtained from ENR using their 24-hr emergency contact phone number: (867) 873-7181.

If this situation occurs, a detailed incident report must be prepared and submitted to ENR officials. This report would also be included as an appendix in the annual wildlife monitoring report.

3.3 Contractor Responsibility

Bear sightings should be reported immediately to DDMI Environment personnel. If a sighting has occurred during night shift hours, the occurrence should be reported to Security. Security will contact Environment personnel in their rooms during the night. Environment personnel will maintain constant visual monitoring of the bear and take action as necessary to ensure the safety of all workers.

All personnel in the vicinity of the animal will be notified by the Security department. It is also the responsibility of the supervisors of an area to notify their workers and provide a safe shelter for them (i.e. vehicles, trailers etc.) while the bear is present in that location.

In order for the Environment department to successfully deter the animal, it requires full cooperation from all site employees and contractors. Individuals are requested to stay away from the area where the bear is present as well as to stay away from the area that the bear is anticipated being moved to.

4 RELATED FORMS/DOCUMENTS

- Wildlife Deterrent Report Form template (FORM-ENV-WILD-01)
- Aircraft SOP (SOPENV-EQUIP-01)

Revision History

Revision	Description	Prepared By	Date
00	Initial Release		2001
01	Updated	S. Oystryk	February 2005
02	Updated	C. English	June 2006

1 OBJECTIVE/PURPOSE

This Standard Operating Procedure (SOP) provides guidelines to follow when moving caribou from the dikes surrounding mine pits, airstrip and other hazardous areas at the Diavik mine site. The intent of caribou herding is to encourage caribou to leave known and potentially hazardous sites and situations for their protection, using procedures that will not harass or cause adverse behavioral responses by caribou that may lead to impacts through aggravated stress or injury.

2 RESPONSIBILITIES

It is the Senior Environmental Coordinator's responsibility to ensure that all members of the Environment Team are trained in, and understand, this Standard Operating Procedure (SOP). It is the responsibility of the Environmental Coordinators, Environmental Technicians, contractors, researchers and students, and any other members of the Environment Team to follow this Standard Operating Procedure.

In addition, the following personnel have responsibilities:

- Diavik Site Manager and Managers of Construction Contractors for cooperation in caribou herding procedures
- The drivers of all vehicles and other site personnel with radio contact to report presence of caribou on the east island or within the mine footprint
- Helicopter and/or fixed wing pilots with radio contact to report presence of caribou on the east island or within the mine footprint

3 PROCEDURE

3.1 General

The caribou herding procedures are to be applied under three specific locations and circumstances, or where Environmental site personnel identify additional hazard areas or situations during ongoing monitoring and inspections.

Dikes

The caribou herding procedures are to be applied when caribou move onto the dikes of mine pits, either traveling over land or by swimming to the dike, and where they are vulnerable to:

- injury from flying rock during blasting operations
- severe behavioral response to blasting or other operational sensory stimuli
- entrapment on the dike, hazardous terrain and behavioral response to sensory stimuli from construction or operational activities

Any number of caribou present on the mining dikes will trigger caribou herding action. This threshold is established to prevent injury from flying rock and disturbance from severe adverse response to blasting.

- Caribou herding on dikes and confined corridors will use a combination of a small truck and/or foot patrol as most appropriate to the local situation and terrain. The direction of herding will depend on their location on the dike or confined space relative to the escape routes to the shoreline buffer. The shortest escape route may not always be the most appropriate route.

- Maintain the necessary radio communication with blasting supervisor, for timing of the herding and personnel safety. Maintain the necessary radio communication with construction and site manager to facilitate any modification of traffic, and construction or operational activities where required to allow caribou escape to a shoreline buffer as planned in the previous step, and to announce the "All-Clear" at the completion of caribou herding procedures.

- Herding by vehicle and on foot will entail approaching caribou at a slow speed (i.e., < 5 km/hr for vehicles) and stopping when caribou show an alarmed response. When caribou stall, the patrol will slowly move forward to initiate a further alarmed response. Observation of caribou behavior will provide cues on when to proceed. Herding should never stimulate a Very Alarmed-Panic Escape Response.

Constricted Corridors

The caribou herding procedures are to be applied when caribou are trapped in hazardous and constricted spaces such as corridors within the mine footprint where they are vulnerable to collisions with vehicles and severe behavioral response to sensory stimuli associated with vehicles and employee activities.

The criteria to trigger herding of caribou in confined corridor or other hazardous sites are dependent on a combination of factors. Good judgment is required to avoid disturbance and caribou injury, but the following should be considered: number of caribou present, distance of caribou from roads or other stimuli, the nature of the confining feature, the effectiveness of traffic control, duration of entrapment, and behavioral response by caribou in the confined space.

The steps for undertaking herding procedures in constricted corridors are the same as outlined in the section on Dikes, above.

Airstrip

The caribou herding procedures are to be applied when caribou are on or near the airstrip or at the water crossing west of the airstrip during aircraft landing or take-off where they are

vulnerable to collisions with aircraft or severe behavioral response to sensory stimuli associated with aircraft during landing or take-off.

Any number of caribou present on the airstrip or located within 100 m of the airstrip will trigger caribou herding action. This threshold is established to prevent any potential for caribou-aircraft collisions.

- A small truck will be used for patrol, and, if necessary, to move caribou off the airstrip. Vehicle patrols should proceed from east to west to encourage caribou to move to escape routes leading to the west island and to avoid herding the caribou to active construction and mining operations. Maintain communication with air traffic control. Vehicles can travel at normal site speed limits unless caribou are visible.

- When caribou are present on the airstrip, the vehicle will approach caribou at a slow speed (i.e., < 5 km/hr) and stop when caribou show an alarmed response. During airstrip patrols, the herder should wait no longer than 3 minutes for caribou to begin moving off the airstrip, before continuing the herding procedure. If the caribou stall, the patrol may slowly move forward to initiate an alarmed response. If caribou travel along the airstrip ahead of the patrol, the vehicle may proceed to move caribou from the airstrip surface.

- In the event that a herd of caribou remains within 100 m of the airstrip and exhibits behavior for returning or crossing the airstrip, the patrol may need to park at a push-out of the airstrip from where the patrol may proceed to continue the herding on foot.

Other Hazards or Entrapment Sites

The caribou herding procedures are to be applied when caribou are trapped in hazardous and constricted spaces and situations that are identified by Environmental site personnel during ongoing monitoring and inspections. These spaces and situations may include:

- caribou trapped within the area of infrastructure and above-ground pipelines
- prolonged caribou entrapment in the area near the shallow bays
- caribou presence or entrapment on the islands adjacent to the mine pits during the brief period of thin ice hazard in October

3.2 Caribou Advisories

The Caribou Monitoring Program will assemble information on caribou occurrence in the region, when caribou are near or approaching the Project site and when caribou are on the east island. The Monitoring Program will provide the following notifications:

No Concern (Green): The notification issued to Diavik Site Managers and Site Contractor Managers that no caribou or fewer than 100 caribou are present on the east island.

Caribou Advisory (Yellow): The notification issued to Diavik Site Manager and Site Contractor Managers that between 100 and 1000 caribou are present on the east island. Temporary road closure or various management actions may be required, technical procedures may be implemented, including modification, careful control or stoppage of traffic, construction and operation activities.

Caribou Alert (Red): The notification issued to Diavik Site Managers and Site Contractor Managers that over 1000 caribou are present on the east island. Temporary road closure or management actions may be required; technical procedures may be implemented, including modification, careful stoppage of traffic, construction and operation activities.

Thin Ice Period - Late Fall (Red X): The notification issued to Diavik Site Managers and Site Contractor Managers that in late fall, over 100 caribou are present on the east island. This is the most critical time at the project site as there is a potential for environmental stimulus to potentially herd animals onto thin ice conditions. Procedures required for implementation may include modification, careful control or stoppage of traffic, construction and operational activities depending on the number, herd sizes, location and/or movements of caribou.

3.3 Determining Caribou Hazards

When caribou are present on the east island, Environment site personnel or other designated personnel (i.e. contractors or site services) are responsible for conducting the following searches and communications:

1. Conduct a search of the airstrip and immediate vicinity of the airstrip for caribou 15 minutes prior to aircraft landing and immediately prior to aircraft take-off. Maintain radio contact with airport terminal operator and security personnel if they are able to search the airstrip and immediate vicinity for caribou prior to aircraft landing and immediately prior to take-off.

2. Conduct a search of mine dikes and areas in the vicinity of the mine for caribou presence prior to blasting. If caribou are present near the access to the dikes, the caribou will either be observed to ensure they do not cross onto the dike or herded away.

3. Maintain radio communication with security personnel, truck drivers, contractors, helicopter pilots and other site operators to receive reports of caribou on the dikes and confined road corridors. Verify reports of caribou to determine numbers and appropriate management action.

4. Maintain communication and radio contact as necessary with Construction Manager, Diavik Site Manager and/or air traffic controller as necessary to implement

adjustments to vehicle traffic, construction and operations activities and/or aircraft traffic to expedite the herding of caribou from hazard sites.

4 RELATED FORMS/DOCUMENTS

- SOP – Caribou Scanning (SOPENV-WILD-15)
- SOP – Caribou Road Observations (SOPENV-WILD-13)
- SOP – Caribou Monitoring in the PKC/Rock Piles (SOPENV-WILD-14)

Revision History

Revision	Description	Prepared By	Date
00	Initial Release		2001
01	Updated	S. Oystryk	February 2005
02	Updated – related forms, review date	C. English	October 2006

1 OBJECTIVE/PURPOSE

This Standard Operating Procedure (SOP) has been developed to provide guidance when dealing with and reporting a suspected rabid animal. Rabies is a deadly viral disease that can affect warm-blooded animals, including humans. Proper precautions must be taken when handling such animals, whether alive or dead.

2 RESPONSIBILITIES

It is the Senior Environmental Coordinator's responsibility to ensure that all members of the Environment Team are trained in, and understand, this Standard Operating Procedure (SOP).

It is the responsibility of the Environmental Coordinators, Environmental Technicians, contractors, researchers and students, and any other members of the Environment Team to follow this Standard Operating Procedure.

3 PROCEDURE

3.1 Rabies

The main carrier of rabies in the Northwest Territories is the fox, and although rabies is widespread in the fox population it has also been identified in lemmings, wolves, caribou and polar bears.

Transmission of the rabies virus is shed in the saliva of infected animals. It is transmitted primarily through bite wounds or contact of infected saliva with scratches or skin wounds. It can also be transmitted through mucous membranes.

Animals infected with rabies often act differently than normal. A shy animal may become friendly or a friendly animal may become timid. Animals may also become very bold and aggressive, and may experience partial paralysis. However, it can be difficult to distinguish between a tame or injured animal and a rabid animal.

The feeding of animals is extremely dangerous and is strictly prohibited at the Diavik mine site.

The incubation period, which is the time between exposure to the virus and clinical disease, may be from two weeks to many months. Its length depends on a number of factors, including the strain of rabies, and the location of the bite.

The wound or exposed surface should be washed immediately with soap and water and any clothing that may have been contaminated should be removed. There is no rabies vaccine on site, so medical evacuation to Yellowknife will be required. As long as you seek treatment promptly following exposure to a rabid animal, the disease can be prevented.

3.2 Handling a Live Animal Suspected Of Having Rabies

Staff on site should stay away from all wild animals, particularly any animal that is sick or acting strangely. Environment should be notified as soon as an animal suspected of having rabies is identified.

Without coming into contact with the infected animal, Environment staff will try to monitor the animal and keep track of its location. The Environment department will consult with ENR to determine the best approach in dealing with the animal. If it is necessary to capture the animal, extreme caution will be taken when handling the trapped animal. Thick gloves, a long-sleeved shirt, long pants and coveralls will be worn.

3.3 Handling the Carcass of an Animal Suspected of Having Rabies

If a dead animal is to be shipped out and tested for rabies, follow these safety guidelines:

- Wear gloves, a long-sleeved shirt, long pants and coveralls.
- Take two new clean garbage bags and put one inside the other. Turn them inside out over your hands and arms.
- Move the bag around the dead animal until the animal is in the bag.
- Take extreme caution that you do not get saliva from the animal on to your skin.
- Tie the bag closed and attach a label with the date and description of where the animal was found.
- Keep the animal cool but do not freeze it (approximately 2-4°C).

3.4 Reporting

Wildlife Officers with ENR must be contacted and advised if it is suspected that an animal frequenting site is rabid. After discussions with the wildlife officer, it will be decided whether or not to destroy the animal and send the remains in for testing, or to bring up an officer to assess the situation before taking further action.

Diavik's internal reporting procedure includes an Environmental Incident Investigation Report form with a specific section to address wildlife-related issues. In a situation where rabies is suspected, this form must be filled out and submitted to the Environment Department as per the associated SOP as soon as possible. Photographs should be taken and attached to the form for future reference.

If the animal is shipped out for a necropsy, a follow-up report will come from ENR, Wildlife and Fisheries Division. Receipt of this report should be documented and attached to the completed Environmental Incident Investigation Report form.

4 EQUIPMENT

- Traps, if necessary
- Thick gloves
- Garbage bags
- Camera

5 RELATED FORMS/DOCUMENTS

- SOP – Environmental Incident Investigation (SOPENV-REG-01)
- Environmental Incident Investigation Report FORM (FORMENV-REG-01)

Revision History

Revision	Description	Prepared By	Date
00	Initial Release		2001
01	Updated	S. Oystryk	February 2005
02	Updated – ENR references, review date	C. English	October 2006

1 OBJECTIVE/PURPOSE

The purpose of this procedure is to outline a wildlife reporting protocol to regulators. It is important to establish clear and consistent lines of communication between Diavik employees and staff of the North Slave Regional Office of the department of Environment & Natural Resources.

2 RESPONSIBILITIES

It is the Senior Environmental Coordinator's responsibility to ensure that all members of the Environment Team are trained in, and understand, this Standard Operating Procedure (SOP).

It is the responsibility of the Senior Environmental Coordinators to follow Section 3.1 of this Standard Operating Procedure.

It is the responsibility of the Senior Environmental Coordinators, Environmental Coordinators, Environmental Technicians, contractors, researchers and students, and any other members of the Environment Team to follow Section 3.2 of this Standard Operating Procedure.

3 PROCEDURE

3.1 General Wildlife Updates

During the winter months, the Sr. Environmental Coordinator will send an e-mail to ENR staff every two weeks with a general update of wildlife activities on site. This would include carnivore sightings, fox activity and any injured animals on site. During summer months, a weekly e-mail should be sent for the same purpose outlining bear activity & deterrent actions, caribou numbers and any herding activities that may have occurred, wolverine presence, fox activity and any injured animals identified. This e-mail should be sent to the Manager, Wildlife & Environment and the Senior Wildlife Officer.

Should a major issue arise that relates to wildlife, ENR staff must be contacted immediately. The 24-hr Wildlife Emergency phone number is (867) 873-7181. This would include threats to human safety from wildlife, potentially diseased animals, carnivores having gained access to buildings, aggressive or critically injured wildlife, and any other activities that may pose a threat to employees at the camp. It is important to have collected as much information relating to the issue as possible, in order to provide the officer a clear understanding of the risks.

3.2 Wildlife Mortalities

The following are instances where mortalities must be reported immediately, in accordance with ENR's "Wildlife Sampling Guidelines for Exploration Camps and Mines". Anytime that:

- a bear is found dead
- a muskox is found dead
- a bird of prey (Eagle, falcon, hawk, owl) is found dead
- two or more animals of the same species are found dead within half a kilometer of each other
- a bear, muskox, caribou, wolf, wolverine, fox or bird of prey is found dead within 1 kilometer of any human activity

Use the 24-hr Wildlife Emergency Line to report mortalities. Again, it is imperative to have as much information as possible to forward on to the officer on duty.

Prior to moving or inspecting the animal, ensure the following photographs are taken:

- General area, showing where the animal is laying
- Four photographs of the animal. One from each side, the head and the tail
- Anything unusual
- Obvious injuries or marks
- If applicable, the piece of equipment that was involved in the incident

Upon initial inspection, the following information should be collected and an Environmental Incident Investigation Report Form (FORM-ENV-REG-01) completed:

- Location of animal, including coordinates & general description
- Time
- Date
- Estimate of how long it has been dead
- Any other animals or animal sign of any species within the general area
- Probable or known cause of death
- Weather conditions
- Behaviour of animal prior to incident (from discussions with personnel involved, if applicable)

Once the inspection has been completed, it will be necessary to collect and dispose of the animal. Personnel handling the wildlife will require gloves and safety glasses at all times. If the animal is thought to be diseased, remove the head and package it in a designated canister for shipment to the ENR North Slave Regional Office. If the cause of death is not obvious and the animals body is relatively intact (i.e. not eaten), ship the carcass to ENR North Slave Regional Office for a histology. Both these types of samples will need to be kept frozen, during shipping as well, and all applicable documentation completed for the Transportation of Dangerous Goods. Before destroying any wildlife, always contact ENR Wildlife Officers for permission. Generally speaking, if a grizzly bear is destroyed, the animal will be skinned and dissected, with the carcass incinerated on site, but be sure to discuss specific requirements of each incident with ENR officials. The hide (including head & paws intact) should be wrapped in a tarp, placed in a drum with ice packs and shipped to the ENR North Slave Regional Office, with all applicable documentation. Ensure that notice is provided to ENR staff once the drum has been shipped.

After all information has been collected, a follow-up report to the ENR Manager, Wildlife and Environment will be required. This report would include photos and a detailed description of the incident, including any pertinent history associated with that particular animal. Notification of the mortality must also be distributed within DDMI to the Manager, Environment; Vice President, Technical Services; Northern Affairs Manager; Manager, Sustainable Development and Executive Director, EMAB (emab1@arcticdata.ca), as well as all other Environment staff.

4 EQUIPMENT

GPS
Camera
Field logbook
Knife
Garbage bags
Gloves & safety glasses

5 RELATED FORMS/DOCUMENTS

- Environmental Incident Investigation Report Form (FORM-ENV-REG-01)

Revision History

Revision	Description	Prepared By	Date
00	Initial Release	C. English	February 2006
01	Updated	C. English	June 2006
02	Updated – reporting frequency, review date	C. English	October 2006

APPENDIX II

CARIBOU ROAD OBSERVATIONS

Date	Observers	Road	Number	Composition	Encounter Distance	Behavior
1-May-06	KC	A418 Road	0	No Observations		
1-May-06	KC	Mid Road	0	No Observations		
1-May-06	KC	North Road	0	No Observations		
1-May-06	KC	South Road	0	No Observations		
4-May-06	CM/SB	A418 Road	0	No Observations		
4-May-06	CM/SB	Mid Road	0	No Observations		
4-May-06	CM/SB	North Road	0	No Observations		
4-May-06	CM/SB	South Road	0	No Observations		
8-May-06	CM	A418 Road	0	No Observations		
8-May-06	CM	Mid Road	0	No Observations		
8-May-06	CM	North Road	0	No Observations		
8-May-06	CM	South Road	0	No Observations		
11-May-06	CM	A418 Road	0	No Observations		
11-May-06	CM	Mid Road	0	No Observations		
11-May-06	CM	North Road	0	No Observations		
11-May-06	CM	South Road	0	No Observations		
15-May-06	CM	A418 Road	0	No Observations		
15-May-06	CM	Mid Road	0	No Observations		
15-May-06	CM	North Road	0	No Observations		
15-May-06	CM	South Road	0	No Observations		
18-May-06	KC/HG/HS	A418 Road	0	No Observations		
18-May-06	KC/HG/HS	Mid Road	0	No Observations		
18-May-06	KC/HG/HS	North Road	0	No Observations		
18-May-06	KC/HG/HS	South Road	0	No Observations		
22-May-06	KC/HG	A418 Road	0	No Observations		
22-May-06	KC/HG	Mid Road	0	No Observations		
22-May-06	KC/HG	North Road	0	No Observations		
22-May-06	KC/HG	South Road	0	No Observations		
25-May-06	JG/HG/HS	A418 Road	0	No Observations		
25-May-06	JG/HG/HS	Mid Road	0	No Observations		
25-May-06	JG/HG/HS	North Road	0	No Observations		
25-May-06	JG/HG/HS	South Road	0	No Observations		
29-May-06	HG	A418 Road	0	No Observations		
29-May-06	HG	Mid Road	0	No Observations		
29-May-06	HG	North Road	0	No Observations		
29-May-06	HG	South Road	0	No Observations		
2-Jun-06	CM/MC	A418 Road	0	No Observations		
2-Jun-06	CM/MC	Mid Road	0	No Observations		
2-Jun-06	CM/MC	North Road	0	No Observations		
2-Jun-06	CM/MC	South Road	0	No Observations		
5-Jun-06	CM/MC	A418 Road	0	No Observations		
5-Jun-06	CM/MC	Mid Road	0	No Observations		
5-Jun-06	CM/MC	North Road	0	No Observations		
5-Jun-06	CM/MC	South Road	0	No Observations		
8-Jun-06	CM/MC	A418 Road	0	No Observations		
8-Jun-06	CM/MC	Mid Road	0	No Observations		
8-Jun-06	MC/CM	North Road	0	No Observations		
8-Jun-06	CM/MC	South Road	0	No Observations		

12-Jun-06	MC/CM	A418 Road	0	No Observations		
12-Jun-06	MC	Mid Road	0	No Observations		
12-Jun-06	MC	North Road	0	No Observations		
12-Jun-06	MC	South Road	0	No Observations		
15-Jun-06	HG	A418 Road	0	No Observations		
15-Jun-06	HG	Mid Road	0	No Observations		
15-Jun-06	HG	North Road	0	No Observations		
15-Jun-06	HG	South Road	0	No Observations		
19-Jun-06	HS/HG	A418 Road	0	No Observations		
19-Jun-06	HS/HG	Mid Road	0	No Observations		
19-Jun-06	HS/HG	North Road	0	No Observations		
19-Jun-06	HS/HG	South Road	0	No Observations		
23-Jun-06	HG	A418 Road	0	No Observations		
23-Jun-06	HG	Mid Road	0	No Observations		
23-Jun-06	HG	North Road	0	No Observations		
23-Jun-06	HG	South Road	0	No Observations		
30-Jun-06	HG	A418 Road	0	No Observations		
30-Jun-06	HG	Mid Road	0	No Observations		
30-Jun-06	HG	North Road	0	No Observations		
30-Jun-06	HG	South Road	0	No Observations		
4-Jul-06	MC, HG	A418 Road	0	No Observations		
4-Jul-06	MC, HG	Mid Road	0	No Observations		
4-Jul-06	MC, HG	North Road	0	No Observations		
4-Jul-06	MC, HG	South Road	0	No Observations		
6-Jul-06	SB	A418 Road	0	No Observations		
6-Jul-06	SB	Mid Road	0	No Observations		
6-Jul-06	SB	North Road	0	No Observations		
6-Jul-06	SB	South Road	0	No Observations		
10-Jul-06	SM	A418 Road	0	No Observations		
10-Jul-06	SM	Mid Road	0	No Observations		
10-Jul-06	SM	North Road	0	No Observations		
10-Jul-06	SM	South Road	0	No Observations		
17-Jul-06	JG	A418 Road	0	No Observations		
17-Jul-06	JG	Mid Road	0	No Observations		
17-Jul-06	JG	North Road	0	No Observations		
17-Jul-06	JG	South Road	0	No Observations		
20-Jul-06	HS, HG	A418 Road	0	No Observations		
20-Jul-06	HS, HG	Mid Road	0	No Observations		
20-Jul-06	HS, HG	North Road	0	No Observations		
20-Jul-06	HS, HG	South Road	0	No Observations		
24-Jul-06	JG	A418 Road	0	No Observations		
24-Jul-06	JG	Mid Road	0	No Observations		
24-Jul-06	JG	South Road	0	No Observations		
24-Jul-06	JG	South Road	0	No Observations		
27-Jul-06	RB/MC	A418 Road	0	No Observations		
27-Jul-06	RB/MC	Mid Road	0	No Observations		
27-Jul-06	RB/MC	North Road	0	No Observations		
27-Jul-06	RB/MC	South Road	0	No Observations		
31-Jul-06	MC	A418 Road	0	No Observations		

31-Jul-06	MC	Mid Road	0	No Observations		
31-Jul-06	MC	North Road	0	No Observations		
31-Jul-06	MC	South Road	0	No Observations		
7-Aug-06	MC/SM	A418 Road	0	No Observations		
7-Aug-06	MC/SM	Mid Road	0	No Observations		
7-Aug-06	MC/SM	North Road	0	No Observations		
7-Aug-06	MC/SM	North Road	0	No Observations		
10-Aug-06	JG	A418 Road	0	No Observations		
10-Aug-06	JG	Mid Road	0	No Observations		
10-Aug-06	JG	North Road	0	No Observations		
10-Aug-06	JG	South Road	0	No Observations		
14-Aug-06	JG	A418 Road	0	No Observations		
14-Aug-06	JG	Mid Road	0	No Observations		
14-Aug-06	JG	North Road	0	No Observations		
14-Aug-06	JG	South Road	0	No Observations		
24-Aug-06	MC/RB	A418 Road	0	No Observations		
24-Aug-06	MC/RB	Mid Road	0	No Observations		
24-Aug-06	MC/RB	North Road	0	No Observations		
24-Aug-06	MC/RB	South Road	0	No Observations		
28-Aug-06	MC/RB	A418 Road	0	No Observations		
28-Aug-06	MC/RB	Mid Road	0	No Observations		
28-Aug-06	MC/RB	North Road	0	No Observations		
28-Aug-06	MC/RB	South Road	0	No Observations		
31-Aug-06	SM	A418 Road	0	No Observations		
31-Aug-06	SM	Mid Road	0	No Observations		
31-Aug-06	SM	North Road	0	No Observations		
31-Aug-06	SM	South Road	0	No Observations		
4-Sep-06	SB/SM	A418 Road	0	No Observations		
4-Sep-06	SB/SM	Mid Road	0	No Observations		
4-Sep-06	SB/SM	North Road	0	No Observations		
4-Sep-06	SB/SM	South Road	0	No Observations		
8-Sep-06	JG	A418 Road	0	No Observations		
8-Sep-06	JG	Mid Road	0	No Observations		
8-Sep-06	JG	North Road	0	No Observations		
8-Sep-06	JG	South Road	0	No Observations		
11-Sep-06	JG	A418 Road	0	No Observations		
11-Sep-06	JG	Mid Road	0	No Observations		
11-Sep-06	CM	North Road	0	No Observations		
11-Sep-06	JG	South Road	0	No Observations		
21-Sep-06	CM	A418 Road	0	No Observations		
21-Sep-06	CM	Mid Road	0	No Observations		
21-Sep-06	CM	North Road	0	No Observations		
21-Sep-06	CM	South Road	0	No Observations		
25-Sep-06	HG	A418 Road	0	No Observations		
25-Sep-06	HG	Mid Road	0	No Observations		
25-Sep-06	HG	North Road	0	No Observations		
25-Sep-06	HG	South Road	0	No Observations		
28-Sep-06	CM	A418 Road	0	No Observations		
28-Sep-06	CM	Mid Road	0	No Observations		

28-Sep-06	CM	North Road	0	No Observations		
28-Sep-06	CM	South Road	0	No Observations		
5-Oct-06	JG	A418 Road	0	No Observations		
5-Oct-06	JG	Mid Road	0	No Observations		
5-Oct-06	JG	North Road	0	No Observations		
5-Oct-06	JG	South Road	0	No Observations		

APPENDIX III

CARIBOU PKC / ROCK QUARRY / ROCK PILE OBSERVATIONS

Date	Observers	Location	Number	Composition	Behaviour	Description of Interaction
4-May-06	CM/SB	PKC	0	No Observations		
4-May-06	CM/SB	Quarry	0	No Observations		
8-May-06	CM	PKC	0	No Observations		
8-May-06	CM	Quarry	0	No Observations		
11-May-06	CM	PKC	0	No Observations		
11-May-06	CM	Quarry	0	No Observations		
15-May-06	CM	PKC	0	No Observations		
15-May-06	CM	Quarry	0	No Observations		
18-May-06	KC/HG/HS	Country Rock	0	No Observations		
18-May-06	KC/HG/HS	PKC	0	No Observations		
22-May-06	KC/Hg	Country Rock	0	No Observations		
22-May-06	KC/HG	PKC	0	No Observations		
29-May-06	HG	PKC	0	No Observations		
29-May-06	HG	Quarry	0	No Observations		
2-Jun-06	CN/MC	PKC	0	No Observations		
2-Jun-06	CM/MC	Quarry	0	No Observations		
5-Jun-06	CM/MC	PKC	0	No Observations		
5-Jun-06	CM/MC	Quarry	0	No Observations		
8-Jun-06	CM/MC	PKC	0	No Observations		
8-Jun-06	CM/MC	Quarry	0	No Observations		
12-Jun-06	CM/MC	PKC	0	No Observations		
12-Jun-06	CM/MC	Quarry	0	No Observations		
15-Jun-06	HG	PKC	0	No Observations		
15-Jun-06	HG	Quarry	0	No Observations		
19-Jun-06	HG/HS	PKC	0	No Observations		
19-Jun-06	HG/HS	Quarry	0	No Observations		
23-Jun-06	HS,HG	Country Rock	0	No Observations		
23-Jun-06	HG/HS	PKC	0	No Observations		
23-Jun-06	HS,HG	PKC	0	No Observations		
23-Jun-06	HG/HS	Quarry	0	No Observations		
30-Jun-06	HG	PKC	0	No Observations		
30-Jun-06	HG	Quarry	0	No Observations		
4-Jul-06	MC, HG	PKC	0	No Observations		
4-Jul-06	MC, HG	Quarry	0	No Observations		
6-Jul-06	SB	Country Rock	0	No Observations		
6-Jul-06	SB	PKC	0	No Observations		
10-Jul-06	SM	PKC	0	No Observations		
10-Jul-06	SM	ROCK PILE	0	No Observations		
17-Jul-06	JG	PKC	0	No Observations		
17-Jul-06	JG	Quarry	0	No Observations		
20-Jul-06	HS/HG	PKC	0	No Observations		
20-Jul-06	HS/HG	Quarry	0	No Observations		
24-Jul-06	JG	PKC	0	No Observations		
24-Jul-06	JG	Quarry	0	No Observations		
27-Jul-06	RB/MC	PKC	0	No Observations		

27-Jul-06	CM	Quarry	0	No Observations		
31-Jul-06	CM	PKC	0	No Observations		
31-Jul-06	CM	Quarry	0	No Observations		
7-Aug-06	MC/SM	PKC	0	No Observations		
7-Aug-06	MC/SM	Rock Pile	0	No Observations		
10-Aug-06	JG	PKC	0	No Observations		
10-Aug-06	JG	Quarry	0	No Observations		
14-Aug-06	JG	PKC	0	No Observations		
14-Aug-06	JG	Quarry	0	No Observations		
24-Aug-06	MC/RB	Country Rock	0	No Observations		
24-Aug-06	MC/RB	PKC	0	No Observations		
24-Aug-06	MC/RB	PKC	0	No Observations		
24-Aug-06	CM	Quarry	0	No Observations		
28-Aug-06	MC/RB	PKC	0	No Observations		
28-Aug-06	CE	Quarry	0	No Observations		
31-Aug-06	SM	Country Rock	0	No Observations		
31-Aug-06	SM	PKC	0	No Observations		
4-Sep-06	SM/SB	Country Rock	0	No Observations		
4-Sep-06	SB/SM	PKC	0	No Observations		
8-Sep-06	JG	Country Rock	0	No Observations		
8-Sep-06	JG	PKC	0	No Observations		
11-Sep-06	JG	PKC	0	No Observations		
11-Sep-06	JG	Quarry	0	No Observations		
21-Sep-06	CM	PKC	0	No Observations		
21-Sep-06	CM	Quarry	0	No Observations		
25-Sep-06	HG	PKC	0	No Observations		
25-Sep-06	HG	Quarry	0	No Observations		
28-Sep-06	CM	PKC	0	No Observations		
28-Sep-06	CM	Quarry	0	No Observations		
5-Oct-06	JG	PKC	0	No Observations		
5-Oct-06	JG	Quarry	0	No Observations		

APPENDIX IV

GRIZZLY BEAR INCIDENTAL OBSERVATIONS ON EAST ISLAND

Date	Number of Animals	Color, Size, Markings of Animal	Location	Advisory Issued	Attractant Present	Corrective Measures Taken	Action Taken (Deterrents Used)	Comments
16-May-06	2	Sow & Cub	North West of Airport	Bear Alert	None	N/A	No Deterrent Action	Bears moved NW to West Island
18-May-06	2	Sow (Blonde/dark hind Quarters) & Cub (1st Year/blonde)	Emulsion & WTA	Bear Advisory	None	N/A	No Deterrent Action	Bears monitored for 20 Min. until out of site, Area monitored for additional 1 hour.
20-May-06	2	Unknown	AN Storage	Bear Advisory	None	N/A	No Deterrent Action	Unable to Locate Bears
30-May-06	3	Sow & 2 Cubs (Pics Available)	Airport/Helipad	Bear Advisory	None	N/A	Deterrent Action - 5 12ga Cracker Shells	Bears crossed ice heading East.
1-Jun-06	2	Sow & Cub (1st Year)	West of Airstrip	Bear Alert	None	N/A	No Deterrent Action	Bears moved off
3-Jun-06	1	Male	West of Airstrip	No Advisory Issued	None	N/A	No Deterrent Action	Bear on ice moving West
8-Jun-06	1	Adult Male (Blonde), Pics Available	Shallow Bays	Bear Alert	None	N/A	No Deterrent Action	Bear moved to mainland south shore of LDG
3-Jul-06	1	Unknown	Airport/Helipad	No Advisory Issued	Unknown	N/A	No Deterrent Action	Not Immediately Reported to Env.
3-Jul-06	2	Sow & Cub (Pics Available)	WTA/PKC	Bear Advisory/Bear Alert	None	Review Safety Procedures/Bear Alert&Advisory Procedures with LDG Employees	Deterrent Action - 4 Bear Bangers	Bears moved NW away from infrastructure
19-Jul-06	1	Sex Unknown (Pic Available)	West PKC Dam/Clarification Pond	Bear Alert	None	N/A	Deterrent Action - 3 Bear Bangers/Helicopter	Bear moved North into LDG, swam to

								mainland.
25-Jul-06	1	Adult Male (Blonde) (Injured rear right leg, visible limp)	AN Storage	Bear Alert	None	N/A	No Deterrent Action	Bear moved off to west
29-Jul-06	2	Sow & Cub (Pics Available)	Helipad/North Inlet	Bear Alert	None	N/A	Deterrent Action - 2 Bear Bangers/Heilicopter	Bears moved across runway into LDG, swam to mainland
11-Aug-06	1	Unknown	West PKC	Bear Alert	None	N/A	Deterrent Action - 3 Bear Bangers	Dear moved West towards West Island
18-Aug-06	2	Sow & Cub (1st Year)	South Camp	Bear Alert/Bear Advisory	South Camp Kitchen - Odor	None Taken	No Deterrent Action	Unable to locate bears - last seen around A21 area
19-Aug-06	2	Sow & Cub (1st Year)	South Camp	Bear Alert/Bear Advisory	South Camp Kitchen - Odor	None Taken	No Deterrent Action	Unable to locate bears
19-Aug-06	2	Sow & Cub (1st Year)	South Camp	Bear Alert/Bear Advisory	South Camp Kitchen - Odor	None Taken	Deterrent Action - 5 12ga Cracker Shells/1 Rubber Bullet	Bears very persistant, last seen over hiull between Water Intake and Env. Boat Dock.
20-Aug-06	2	Sow & Cub (1st Year)	South Camp	Bear Alert/Bear Advisory	None	Main Accomodations - C Dorm	No Deterrent Action	Unable to locate bears
1-Sep-06	1	Unknown	Airport	Bear Alert	None	N/A	Deterrent Action - Helicopter	Bear moved off to West Island

12-Sep-06	1	Sex Unknown (2-3 yrs old), Dark Color	Shallow Bays	Bear Alert/Bear Advisory	None	N/A	No Deterrent Action	Bear moved around south shore of East Island, last seen behind A21 area
1-Oct-06	1	Male (2-3 yrs old), Dark Color	North of Runway	Bear Alert	None	N/A	Deterrent Action - 7 bear bangers, 3 12ga Crackers Shells	Bear moved west towards West Island
6-Oct-06	1	Unknown	Pond 2	Bear Alert	None	N/A	No Deterrent Action	6

APPENDIX V

INCIDENTAL OBSERVATIONS OF WOLVERINE ON EAST ISLAND

Date	Number Of Animals	Location	Attractant Present	Deterrent Action Taken	Corrective Measures Taken	Comments	Colour, Size, Markings Of Animal	Advisory Issued
8-Jan-06	1	Near Comm. Shack	No	None	None	Travelled on ice around A154 Dike	Very Dark	N
22-Jan-06	1	Waste Transfer Area (WTA)	No	Bear Bangers and Pick-up Used	Animal Deterred, Area Inspected	Deterred NW to West Island	None Available (N/A)	Y
23-Jan-06	1	A154 Portal Area	No	None	None	None	N/A	N
23-Jan-06	1	A154 Dike	No	None	None	None	N/A	N
25-Jan-06	1	WTA	Unknown	None	None	Ran under fence – East corner	N/A	N
29-Jan-06	1	Cold Storage Sprung	No	None	None	Tracks Present	N/A	N
30-Jan-06	1	WTA	Unknown	None	None	Ran out front gate	N/A	N
1-Feb-06	1	DI Laydown	Unknown	None	None	None	N/A	N
4-Feb-06	1	South Camp	Unknown	None	None	Late at night	N/A	N
5-Feb-06	1	South Camp/WTA	No	Pick-up	None	Detered west behind AN storage	N/A	N

9-Feb-06	1	WTA	No	None	None	Climbed WTA fence and headed west	N/A	Y
9-Feb-06	1	Truckshop	No	None	None	None	N/A	N
18-Feb-06	1	WTA - Outside of fence	No	None	None	Moved of to the west	N/A	Y
18-Feb-06	1	WTA	No	None	None	None	N/A	N
19-Feb-06	1	WTA	No	None	None	Climbed over fence	N/A	Y
20-Feb-06	1	Main Accommodations Parking Lot	No	None	None	Passing through	N/A	N
23-Feb-06	1	South Tank Farm	No	None	None	Passing through	N/A	N
25-Feb-06	1	A21 Portal	No	None	None	Passing by	N/A	N
27-Feb-06	1	South Camp	No	None	None	Went under south camp	N/A	N
1-Mar-06	1	South Camp	No	None	None	On roof of X-dorm	N/A	Y
3-Mar-06	1	South Camp	No	None	None	Near Kitchen	N/A	Y
6-Apr-06	1	East Dam/Sample Plant	No	None	None	Passing through	N/A	N
8-Apr-06	1	A154 Dike, Lac de Gras	No	None	None	Passing by	N/A	N
14-Apr-06	1	Lac de Gras, on ice south of camp	No	None	None	Running on lake ice, South	N/A	N

14-Apr-06	1	South Camp, Parking Lot	No	None	None	Near W wing	N/A	N
26-Jun-06	1	Emulsion Plant	No	None	None	Heading South	N/A	N
11-Nov-06	1	A418 Toe Berm	No	None	None	N/A	N/A	N
28-Nov-06	1	Airport	No	None	None	Runway	N/A	N
1-Dec-06	1	Explosive Magazine Storage	No	None	None	Moved west behind AN storage	N/A	N
6-Dec-06	1	FRPD Pad LDG	No	None	None	N/A	N/A	N
10-Dec-06	1	South Tank Farm	No	None	None	Heading towards A21 Area	N/A	N

APPENDIX VI

WOLVERINE INCIDENT REPORT 03 MARCH 2006

DIAMOND MINES INC.

Environmental Incident Investigation Report

Spills / Water / Wildlife

Tracking No.:

PART A	**GENERAL INFORMATION**
Department Or Contractor: Environment	**Contact Name: Karl Cox**
Specific Location Of Incident (use detail): DDMI Waste Transfer Area	**Contact Information:** **Alternate Contact Name:**
Date of Incident: 03 MArch 2006	**Date Submitted to Environment Dept:** **03 March 2006**
Time (24 Hours): 02h45	**# of Days on Rotation: N/A**
Equipment or Materials Involved: **Plastic 1000 L Oil Tote - Empty**	
Employee(s) Involved: N/A	**Witnesses:** WTA Attendants - Site Services

PART B	**SPILLS**	**ALL SPILLS MUST BE REPORTED**
Specific Equipment Type:		**Note: If spill is greater than 100L, you must complete an RCA (Part E)**
Vehicle ID:		**Amount/Volume Spilled:**
Spilled Material:		**Approx. Area Affected (i.e. m^2):**
Cause of Spill (i.e. mechanical failure, etc) **Explain:**		**Clean-up Procedure:**
Disposal Procedure:		**Comments:**

PART C	WATER	Note: For <u>all</u> water incidents you must complete an RCA (Part E)
Specific Incident (describe in detail):		**Result (pH, turbidity, ammonia, etc):**
Material(s) Involved:		**How was Incident Discovered:**
Actions Taken:		**Comments:**

PART D	WILDLIFE	Note: For <u>all</u> wildlife incidents you must complete an RCA (Part E)
Specific Incident (describe in detail): Site Services WTA attendant contacted security to report a wolverine trapped inside an empty oil tote in the WTA compound. Environment personnel were contacted immidiately by security. Environment Coordinator Karl Cox responded and confirmed that a wolverine had climbed inside the empty tote and was unable to escape.		**Species:** Wolverine
Weather Conditions: N/A		**Behavior of Animal <u>before</u> the incident:** Unknown **Behavior of Animal <u>after</u> the incident:** **Animal appeared fatigued, but otherwise uninjured.**
Animal State (choose one): ☐ **Aggressive (describe actions:)** ☒ **Stressed** ☐ **Injured (body part injured:)** ☐ **Non-responsive** ☐ **Fatality**		**Actions Taken:** A rope was fastened to the tote which was then pulled slowly with a pick-up truck until it tipped onto its side. Approximately 1 minute later, the wolverine climbed out of the tote. The animal attempted to climb over the WTA fence but was unable to. The WTA gate was left open the remainder of the night to allow the animal to escape. WTA personnel were instructed to ensure all totes were properly capped in the future to ensure future occurrence do not occur.

Photos Taken (choose one): ☒**Yes** ☐**No** **Where are the photos? (emailed, attached, etc)** Attached	**Comments:** Hole in top of tote is 6" in diameter. Tote was checked the next morning - Small volume of bearing lubricant inside, frozen (no trace fumes or odors)

PART E	**ROOT CAUSE ANALYSIS (RCA)**	**Must be filled out for all spills greater than 100L, all water incidents and all wildlife incidents.**

Describe the Direct Causes (Specific Actions or Inactions, or Workplace Conditions) of the Incident:
Improper storage of oil tote. Tote was left open, no cap in place permitted wildlife access.

Describe the Contributing Factors Surrounding the Incident:
Bearing lubricant residue likley attrackted animal, may have just been seaking shelter.
WTA fencing does not restrict wildlife access - Wolveriens regulary climb over the fencing.

Describe the Root Causes of the Incident, using the "5 W" system:

PART F	**CORRECTIVE ACTIONS / PREVENTIVE MEASURES**

Describe:
Site services WTA attendants required to cap all totes ensure access is denied.

Signatures:

_____ _____
Person Reporting Spill or Incident Date

_____ _____
Reviewed by: (Supervisor) Date

_____ _____
Accepted by: (Environment Department) Date

APPENDIX VII

WOLVERINE DNA ANALYSIS REPORT

A COMPARISON OF METHODS FOR MONITORING ABUNDANCE AND DISTRIBUTION OF WOLVERINE AT THE DIAVIK DIAMOND MINE

Prepared for:

Diavik Diamond Mines Inc.
Yellowknife, Northwest Territories

Attention: Mr. Scott Wytrychowski

Prepared by:

Golder Associates Ltd., Saskatoon, Saskatchewan

Executive Summary

From 2003 through 2006, Diavik Diamond Mines Inc. has conducted a wolverine monitoring program designed to measure the temporal and spatial effects from mine development on the relative activity (or occurrence) of animals using the study area (1,270 km^2). The study design and data collection used the experience of "Inuit Qaujimajatuqangit" to record wolverine snow tracks among 23 transects of variable length and distance from the mine. As part of a government initiative to explore an alternative approach to monitoring wolverine populations, Diavik Diamond Mines Inc. participated in a DNA-based mark-recapture study during 2005 and 2006.

The primary goal of this study was to compare the efficiency of measurements between DNA-based mark-recapture and snow track methods for detecting mine-related temporal and spatial changes in wolverine use of the study area. Statistical power of the monitoring methods was assessed, and defined as the probability of detecting a 10% decline in sample counts when the trend is real, despite natural variation. Logistic multiple regression models were used to determine the effect of environmental (including the mine site) and study design variables on the probability of wolverine track and hair occurrence. The spatial relationship between data collected from bait posts and wolverine snow tracks was quantified to demonstrate possible overlap in measurements between the two monitoring methods. Finally, an evaluation of the effectiveness of each method for providing appropriate feedback for adaptive management and mitigation is provided.

DNA-based mark-recapture methods provided precise estimates of the number of wolverines using the study area. Fewer wolverine were estimated in 2006 (23 animals) than in 2005 (26 animals), although the difference was likely not statistically significant. High capture probabilities (>0.65) predicted good statistical power (0.92) to detect a 10% decline in current wolverine numbers within the study area, by sampling every third year over a 12-year period. The high degree of precision obtained from the mark-recapture study provided a reliable basis for comparing the relative change in the magnitude and direction of non-enumeration measurements from snow track data. However, to provide a more effective monitoring program for determining the causes of annual changes in wolverine abundance, hair samples should be collected from individuals removed from mine site areas (due to relocation or mortality) and from local outfitting camps to help identify the fate of marked individuals.

This study also assessed the occurrence of wolverine hair samples on bait posts as a measurement for monitoring mine-related effects to wolverine activity levels and distribution. Analysis indicated that the probability of capturing wolverine hair on a bait post was dependent on several factors related to environmental conditions and study design. Similar to the likelihood of detecting wolverine tracks, the probability of capturing wolverine hair was moderately correlated with wind speed. Factors that explained a large amount of the variation in occurrence of hair samples included habitat, year, sampling period, and number of days between deploying bait posts and sample collection.

The observed increase in occurrence of hair samples with sampling period and year may be the result of a 'trap happy' response by resident wolverines, which likely produced an underestimate of population size. Thus, statistical performance (*e.g.*, bias, precision) of measurements from hair sampling methods can be influenced by factors associated with environmental conditions and study protocols.

Relative to mark-recapture values, estimates of wolverine density and track density indices from snow track surveys were associated with large error variances, which resulted in low statistical power (<0.15) to detect a temporal decline in current values. In addition, the direction of the change in these estimates between 2005 and 2006 was opposite to the trend observed using mark-recapture techniques. Under the current study design, these indices do not provide efficient statistical measurements for monitoring annual changes in the relative abundance or activity of wolverines in the area.

The probability of detecting a wolverine track was independent of season, the number of days since the most recent snowfall, and habitat, but strongly dependent on transect length and less influenced by the number of days since threshold wind speed. Similar to the mark-recapture method, there was a non-significant decreasing trend in the probability of detecting tracks between 2005 and 2006. A significant temporal change also was detected in the probability of track occurrence between 2004 and 2006. Power analysis indicated that this measurement had moderate power (0.75) to detect a decline in current estimates, however, power is anticipated to increase following the adoption of a study design that uses transects of equal length, and increases the number of transects surveyed. The significant spatial correlation between the density of hair samples collected on a bait post and wolverine track observations provides strong support for using the probability of track occurrence as an efficient measurement for monitoring changes in the temporal and spatial use of the study area by wolverines.

Analysis also indicated that the probability of track occurrences was statistically and negatively dependent on distance from the mine. The power to detect an attraction of wolverines to the mine site represents a key objective of the monitoring program, and provides effective feedback into adaptive management and mitigation plans. Diavik Diamond Mines Inc. must continue to remain diligent with respect to mitigation measures (*e.g.*, food waste management practices) that limit on-site negative interactions with wolverines and can lead to the removal of individuals from the population. If direct-mine related mortality occurs, then estimates of abundance from mark-recapture techniques would provide the best information for predicting the effect to the population. Thus, a combination of measurements from mark-recapture and snow track surveys likely provides the best approach for determining the effects of human development and natural factors on wolverine populations.

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1 INTRODUCTION

Wolverines are annual residents of the Lac de Gras region, and the western Canada population, including Nunavut, is listed as a species of special concern (COSEWIC 2007). Their status in the Northwest Territories (NWT) is considered sensitive (ENR 2007). Satellite collar studies on the central Canadian Arctic barrens estimated that adult female wolverines had a home range of 126 km^2, while the home range of adult males was 404 km^2 (Mulders 2000). With these large home ranges, populations generally exhibit low densities. Although little scientific information is available on wolverine habitat use and demography, the animals are an important cultural and economic resource for people of the NWT and Nunavut.

In their Environmental Effects Report, Diavik Diamond Mines Inc. (DDMI), predicted that activities during construction and operation of the mine would have little to no measurable direct and indirect effects on wolverine populations in the area (DDMI 1998). More specifically, the Wildlife Monitoring Program for DDMI (Diavik mine) predicts that the project should not alter wolverine population parameters or cause a measurable shift in the presence of wolverines in the Lac de Gras area (DDMI 2004). In late winter 2003, DDMI implemented a wolverine effects monitoring program designed to measure the temporal and spatial changes in the relative activity (or occurrence) of animals using the study area. The study design and data collection uses the experience of “Inuit Qaujimajatuqangit” (IQ) to record wolverine snow tracks among 23 transects of variable length and distance from the mine within a 1,270 km^2 area. The study design was never intended to measure the abundance or density of individuals using the area.

Due to concerns regarding the potential cumulative direct and indirect effects on wolverine populations from human development and hunting/trapping pressures, the Department of Environment and Natural Resources, Government of NWT (ENR, GNWT) initiated a pilot project on the use of DNA-based mark-recapture methods for monitoring wolverines (Mulders *et al.* 2006). DDMI implemented a similar wolverine hair sampling program in late winter 2005, and continued the program in late winter 2006. Hair samples collected during these periods have been used to identify individual wolverines using DNA finger printing techniques. The objective of the program was to estimate the population size of wolverine within the wildlife monitoring study area, and then use this information to determine mine-related temporal effects on the population. The assumption is that non-lethal effects (*i.e.*, changes in movement and behaviour) from the Diavik mine are large enough to cause a decline in the number of individuals using the study area.

The primary goal of this study was to compare the efficiency of measurements between DNA-based mark-recapture and snow track methods for detecting mine-related temporal and spatial changes in wolverine use of the study area. Statistical power of the monitoring methods was assessed, and defined as the probability of detecting a 10% decline in sample counts when the trend is real, despite natural variation. Logistic multiple regression models were used to determine the effect of environmental (including the mine site) and study design variables on the probability of wolverine track and hair occurrence.

The spatial relationship between data collected from bait posts and wolverine snow tracks was quantified to demonstrate possible overlap in measurements between the two monitoring methods. Finally, an evaluation of the effectiveness of each method for providing appropriate feedback for adaptive management and mitigation is provided.

2 METHODS

2.1 Study Area

The Diavik mine is located approximately 300 km northeast of Yellowknife, NWT on an island within Lac de Gras. The study area for the wildlife monitoring program encompasses approximately 1,270 km^2, and was determined during the development of the wildlife monitoring program (DDMI 2002). Lac de Gras, Lac du Sauvage, and numerous small lakes comprise about 38% the landscape (Figure 2-1). The majority of terrestrial habitat within the study area includes heath tundra (39%), heath tundra with boulders (8%), and tussock/hummock (8%). Sedge wetland, riparian shrub and birch seep, heath tundra with bedrock, boulder, bedrock, and eskers comprise the remaining habitats in the study area (Figure 2-1). Currently, the Diavik mine has directly disturbed about 882 ha (less than 1%) of the study area. Although most of the physical disturbance from the mine has occurred within the predicted boundary of the project footprint, the geographic extent of the footprint did increase during the ice-free period of 2004.

Other human developments within the study area include DDMI's exploration camp that is located on the north eastern shore of Lac du Sauvage, and a hunting/outfitting camp that is located on the south eastern shore of Lac de Gras (Figure 2-1). Nuna Logistics also operates a camp during the period when the Tibbitt to Contwoyto winter ice road is in operation (typically from mid-January to mid-March). The Misery Camp, which is owned and operated by BHP Billiton, is located near the north eastern shore of Lac de Gras, approximately 8 km from the Diavik mine (Figure 2-1).

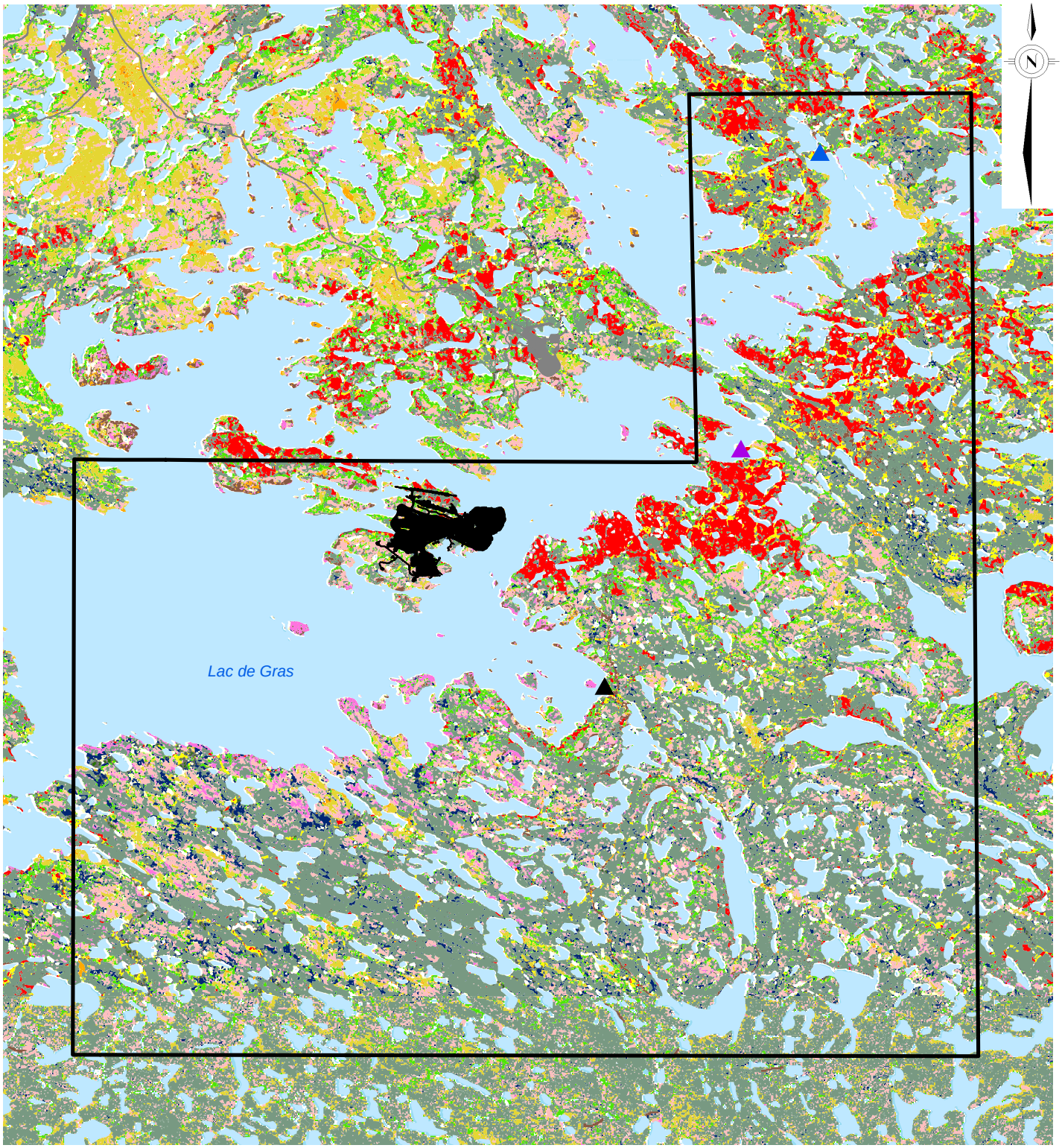
2.2 HAIR SAMPLING

Wolverine hair samples were collected within the study area during the late winter of 2005 and 2006 using field techniques developed by Mulders *et al.* (2006). Briefly, the study area was partitioned into a sampling grid of 3 km x 3 km cells (N = 141 cells; Figure 2-2). At the center of each cell, a 1.5 m spruce post was installed and fitted with double stranded barb wire. Each post was baited with caribou meat, and commercially prepared lures. Two sampling periods were completed for each year (Table 2-1).

Table 2-1 Sampling Periods for Wolverine Hair Collection, 2005 – 2006

Year	Period 1		Period 2	
	Date	Capture Interval [1]	Date	Capture Interval
2005	April 6 – April 24	9 - 17	April 21 – May 1	6 - 10
2006	April 1 – April 17	8 - 14	April 12 – April 30	10 - 18

[1] Number of days between deployment of bait posts and sample collection.



Legend

- Diavik Exploration Camp
- Lac de Gras Road Camp
- Outfitting Camp
- Diavik Mine
- Ekati Mine
- Study Area
- Tussock\Hummock
- Esker Complex
- Sedge Wetland
- Lichen Veneer
- Heath Tundra
- Spruce Forest
- Birch Seep and Riparian Shoreline Shrub
- Riparian Tall Shrub
- Bedrock Complex
- Heath Tundra Boulder
- Heath Tundra Bedrock
- Boulder Complex

5 0 5

SCALE 1:250,000 KILOMETRES

PROJECT

DIAVIK DIAMOND MINES INC.

TITLE

WILDLIFE STUDY AREA

Golder Associates
Saskatoon, Saskatchewan

PROJECT	06-1328-001		FILE No.	
DESIGN			SCALE AS SHOWN	REV. 0
GIS	JSB	29/03/07	FIGURE: 2-1	
CHECK				
REVIEW	JV	29/03/07		

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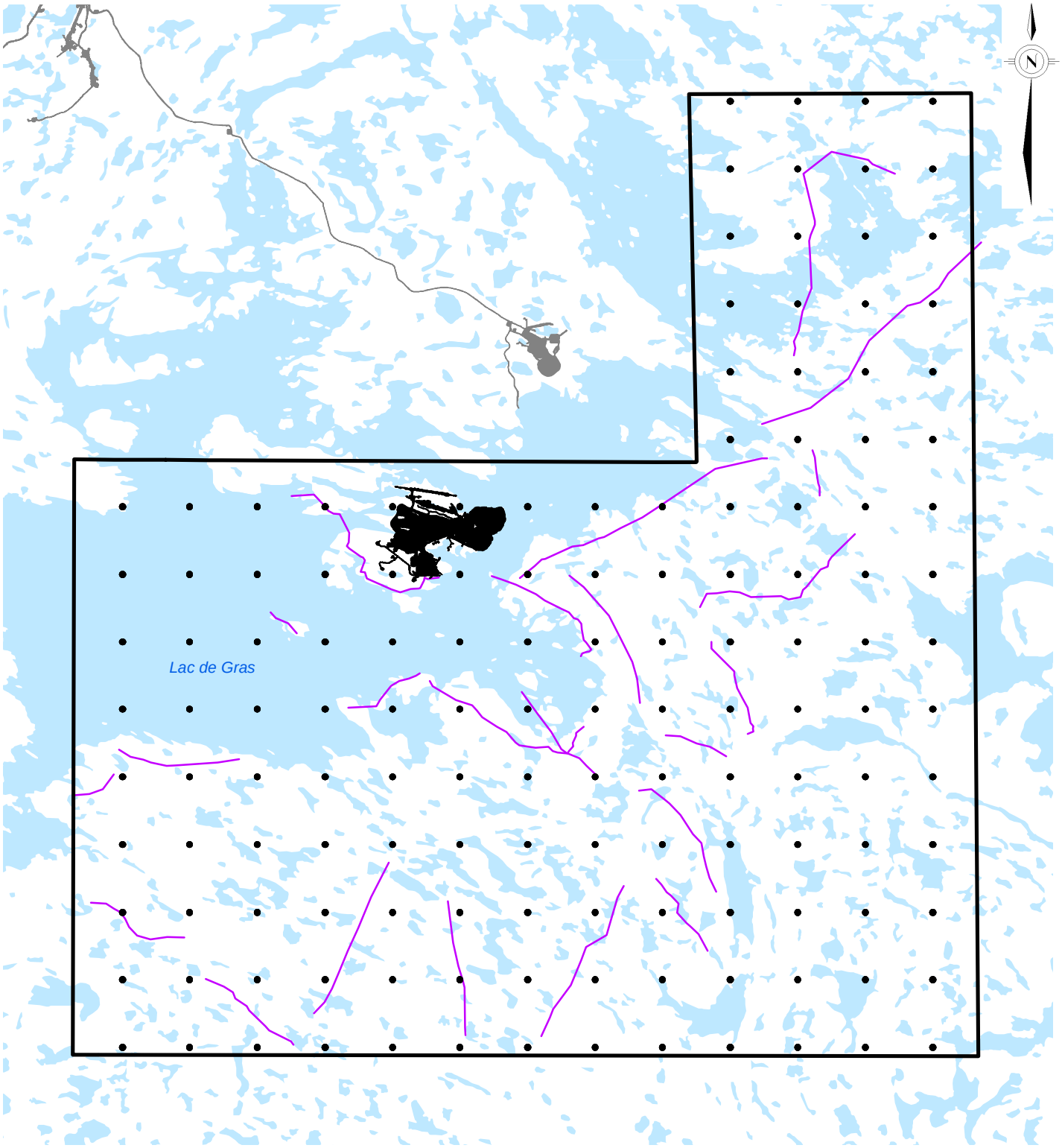


5 0 5

SCALE 1:250,000 KILOMETRES

Legend

- Post Location
- Wolverine Transects
- Diavik Mine
- Ekati Mine
- Study Area

PROJECT

DIAVIK DIAMOND MINES INC.

TITLE

TRANSECTS AND BAIT POST LOCATIONS IN THE WILDLIFE STUDY AREA

Golder Associates
Saskatoon, Saskatchewan

PROJECT	06-1328-001		FILE No.	
DESIGN			SCALE AS SHOWN	REV. 0
GIS	JSB	29/03/07		
CHECK				
REVIEW	JV	29/03/07		

FIGURE: 2-2

G:\2006\1328\06-1328-001\GIS\Phase 2300\06-1328-001 Terr-Transects and Bait Post Locations in the Wildlife Study Area.mxd - 3/29/2007 @ 10:31:05 AM

The distance from each bait post to the nearest edge of Diavik mine footprint was calculated using a Geographical Information System (GIS) platform, and ranged from 0.2 km to 29.7 km (mean = 14.9 km). Using the GIS platform and vegetation classification, the area of each habitat type was determined within each 3 km x 3 km cell. The dominant habitat was then assigned to each cell.

For each bait post and sampling period, hair collected from a single barb was placed in a paper envelope bag and marked with a unique number combination identifying the sample period, post, and sample number. During the four sampling periods, the number of hair samples per bait post ranged from 0 to 12, and the median frequency of hair samples per post was 2 (total number of hair samples = 1,247). Some samples (4.4%) contained insufficient material to be identified as wolverine. One sample from each post was selected for complete genetic analysis, and samples were biased towards high quality hairs (*i.e.*, visible root bulbs). Seven microsatellite markers were chosen to identify individuals (see Kyle and Strobeck 2002), and further details on DNA finger printing methods are provided in Paetkau (2003).

2.3 SNOW TRACK SURVEYS

Surveys for wolverine tracks were conducted along 23 transects distributed among key habitats and landscape features throughout the study area, and at varying distances from the mine (Figure 2-2). The location of transects was based on traditional knowledge of wolverine life history and behaviour. Transects were established within habitats that contained boulders and valleys, and intersected lakes and drainages. A number of GPS recordings were acquired to permanently identify the location of each transect. The total length of transects was 148 km, while the length of individual transects ranged from 1.5 km to 13 km (mean = 6.4 km).

Surveys were completed by snowmobile during six periods over four years (Table 2-2). The distance from the center of each transect to the nearest edge of the mine footprint was calculated within a GIS platform to account for the increase in the spatial extent of the mine footprint during 2004. Distance between the mine and the center of transects ranged from 0.7 km to 20 km (mean = 12.5 km). Using the GIS platform and vegetation classification, the area of each habitat type was determined within a 1 km buffer around each transect. The dominant habitat was then assigned to each transect.

Table 2-2 Survey Periods for Wolverine Snow Tracks, 2003 – 2006

Year	Survey Period
2003	April 10 – April 12
2004	April 16 – April 24
2004	December 2 - December 8
2005	March 30 – March 31
2005	December 7 – December 12
2006	March 30 – April 1

Transects were driven slowly to limit the number of missed tracks. A community assistant (from Kugluktuk) and an environmental technician drove parallel to each other, separated by a distance of approximately 25 m, to further reduce the chance of missing tracks. If weather conditions were deemed unsuitable for tracking due to high winds or heavy snow fall, then the survey was postponed. During the survey, observations were collected on the number of wolverine tracks encountered, the estimated age of the track, and the location (recorded with a GPS unit). Through the expertise of the community assistant, the sex of the wolverine was also recorded, where possible.

The detection of snow tracks can be influenced by wind or snowfall. The effect of snowfall was estimated by determining the number of days from the survey date since the most recent snowfall. A wind threshold index was estimated by determining the number of days from the survey date since the mean hourly wind speed had reached 7.7 m/s. The threshold wind speed of 7.7 m/s is sufficient to move dry snow along the ground (Li and Pomeroy 1997).

Track counts were adjusted for weather by using the minimum number of days prior to reaching the most recent snowfall or threshold wind speed. For each transect, a track density index (TDI) was calculated as the number of wolverine tracks per transect length per number of days since recent snowfall or threshold wind speed. Assuming that the surveys would capture the relative activity and distribution of resident individuals within and adjacent to the study area, data for mid-winter (December) and late winter (March/April) were pooled for 2004/2005 and 2005/2006. The assumption is reasonable considering the time of parturition, lactation, and dispersal in wolverine. For example, young are born from January through April with most females giving birth before March (Pasitschniak-Arts and Larivière 1995). Females remain close to the natal den during the seven to eight week lactation period, and the young begin to accompany mothers on daily foraging trips in April or May (Pasitschniak-Arts and Larivière 1995). Although Vangen *et al.* (2001) found that the average age of dispersal in females and males was 13 months; the range in age at dispersal was 7 to 26 months. Therefore, annual changes in the activity and distribution of wolverine in the study area were examined over four survey periods (years): late winter 2003; late winter 2004; winter 2004/2005; and winter 2005/2006.

2.4 STATISTICAL ANALYSES

2.4.1 Estimating Abundance and Indices of Abundance

Wolverine abundance within the study area was estimated for 2005 and 2006 using individuals identified from hair sampling and DNA techniques, and based on closed population capture-recapture models in program MARK (Cooch and White 2006). Analyses were conducted for each year and it was assumed that the individuals of interest were closed geographically between sampling periods: no movement on or off the study area, and no births or deaths (*e.g.*, Boulanger *et al.* 2002). Further, model types include those described in Otis *et al.* (1978), and were based on full likelihood parameterization; p_i is the probability of first capture, c_i is the probability of recapture, and $\hat{N}$ is estimated abundance. The coefficient of variation (CV) of the estimate of $\hat{N}$ (which is a relative measure of precision) was calculated according to Mahoney *et al.* (1998):

$$CV = 1.96 \times \frac{SE}{\hat{N}}$$

Where SE is the standard error of $\hat{N}$.

Models also incorporated individual heterogeneity in capture probability but assumed that $p_i = c_i$ was constant to simplify models. Other model types were explored including $p_i \neq c_i$, sex-specific capture rates, and closed capture models without heterogeneity and robust designs for estimations based on animals pooled from both years (Cooch and White 2006). However, these models typically failed to meet convergence criteria, and did not provide robust or precise estimates, which was likely associated with the low number of individuals in the sampled population.

Hair samples collected from bait posts were also used to provide an index of relative abundance (or activity) of wolverines for each year. Data from the two sampling periods within each year were combined to calculate the proportion of posts with at least one hair collected (*i.e.*, $\hat{p}$). The variance of $\hat{p}$ (*i.e.*, standard deviation) was calculated using a robust cluster to account for intraclass correlation for hits between sampling periods in program STATA (Hosmer and Lemeshow 2000).

Wolverine snow track data were also used to provide an annual and seasonal index of abundance within the study area from 2003 through 2006. Using track observations (x) and the Formorov-Malyshev-Pereleshin (FMP) formula (Stephens *et al.* 2007), the density of wolverines (D) was estimated as:

$$D = \frac{\pi}{2} \times \frac{x}{S\hat{M}}$$

This formula requires counts of tracks of known age (x), estimates of animal daily travel distances ($\hat{M}$), and the sum of the total length of all study transects (S). The estimate for daily travel distance was based on a four-year study of wolverines in Montana where the average daily movement rate was 1.65 km/day for female and male individuals during winter (Hornocker and Hash 1981). To estimate 95% confidence intervals (CI), a nonparametric bootstrapping method (using 5,000 bootstraps) was performed (Stephens *et al.* 2006). Specifically, bias corrected and accelerated bootstrapping was used to account for both discrepancy between the proportion of bootstrap samples that lie below the mean and the proportion that lie above the mean, and heteroscedascity in the data (Stephens *et al.* 2006).

Similar to the bait post hair sample data, the proportion of transects with tracks (*i.e.*, $\hat{p}$) was used to provide an index of relative activity of wolverines for each year. The variance of $\hat{p}$ (*i.e.*, standard deviation) was calculated using a robust cluster to account for intraclass correlation for tracks between survey periods in program STATA.

Program MONITOR[1] was used to estimate power and determine how effective each monitoring program was at detecting long-term trends in abundance. For all power analyses, it was assumed that current study design for hair sampling and snow tracking (*i.e.*, two sampling periods per year [= one annual survey], number of bait posts, and number and length of transects) would not change. However, for the DNA-based mark-recapture program, the number of survey periods and program duration were varied to determine the most cost-effective approach. The starting point for these analyses was 10 annual surveys over 10 years (*i.e.*, one survey per year for 10 years). However, the goal was to enable DDMI to detect a 10% decline in wolverine abundance over a 15-year period (*i.e.*, approximately three generations of wolverine; Hash 1987). This criteria is based on COSEWIC (2007) and IUCN Red List categories for populations with a small number of mature individuals (*i.e.*, <10,000). Thus, given that MONITOR produces outputs showing power to detect changes over only 10 years, the power estimate at year seven in the output was used to evaluate the ability of a 10-year program to detect a rate of change comparable to a 10% change over 15 years (*i.e.*, 0.67% per year). Similarly, year six in the output was used for a 9-year program, year eight for a 12-year program and year 15 for a 15-year program. Power that exceeded 0.80 was determined to be sufficient for detecting trends (Gibbs *et al.* 1998). The significance level was set at alpha = 0.10 for all power analyses (Gibbs *et al.* 1988). Measures of central tendency and dispersion (*i.e.*, variance) were based on current estimates pooled across years. Uncertainty associated with environmental stochasticity in trends were incorporated using CV = 0.40.

[1] (http://www.mbr-pwrc.usgs.gov/software/monitor.html)

2.4.2 Habitat Modeling

To examine the effect of mine operations on the relative activity and distribution of wolverines, logistic regression analyses were used to predict the probability of occurrences within the study area. Two datasets were explored: wolverine hair samples collected from bait posts (post hits) and snow track observations from surveyed transects. Logistic models were chosen because they explained almost twice the variation in habitat-use patterns than negative-binomial models, which predicted counts (*i.e.*, number of hits per post or tracks per transect). Thus, for both types of data, the response variable was based on detecting at least one wolverine hair on a bait post or observing at least one wolverine track on a transect.

The primary environmental parameter (independent variable) of interest was distance from the Diavik mine footprint, and was included in the analysis of the probability of occurrence of a hair sample on a bait post and observing a snow track on a transect. Other environmental covariates known to influence animal behaviour and distribution were included in the models to statistically control for the effects of several independent variables while determining which covariates explained the most variation in the response variable (Greenland *et al.* 1999). For the post hit data, other environmental covariates included year, capture interval, habitat (heath tundra, wetland, frozen lake), sampling period, mean maximum daily wind speed during each capture interval, and mean average daily wind speed during each capture interval. For the snow track data, other explanatory variables included year, survey period (mid-winter, late winter), habitat (heath tundra, wetland, frozen lake), transect length, number of days since recent snowfall, and number of days since threshold wind speed (7.7 m/s).

For the analysis of post hits and snow track observations, the interaction between year and distance from the mine was also included in the models if the associated coefficient was significant at alpha = 0.10. Clustering was added to models to improve model fit and to adjust standard errors for autocorrelation between sampling periods for post hits, or between survey periods for snow track occurrences (Hosmer and Lemeshow 2000). Pearson Chi-squared goodness-of-fit tests were conducted for all models.

2.4.3 Comparison of Post Hits with Track Counts

The spatial relationship between post hits and snow tracks on nearby transects also was examined. First, using editing tools in GIS, points were randomly added every 3 km to transects. Next, random points in close proximity to a track observation were removed such that all non-track and track points were approximately 3 km from one another. The procedure generated 78 non-track and 38 track points on transects (116 total) for the analyses. The response variable was the mean number of hits per post per sampling period per year, and the response values were assigned to each track and non-track point using information from the nearest post. This response was chosen because preliminary analyses indicated that more than 80% of posts had >1 hit by wolverine.

Cook-Weisberg tests were also conducted. If the test showed heteroscedasticity, then the mean number of hits was square-root transformed prior to conducting statistical analysis. A one-way analysis of variance (ANOVA) was performed to determine the spatial correlation between the mean number of hits on a post and the location of non-track and track observations.

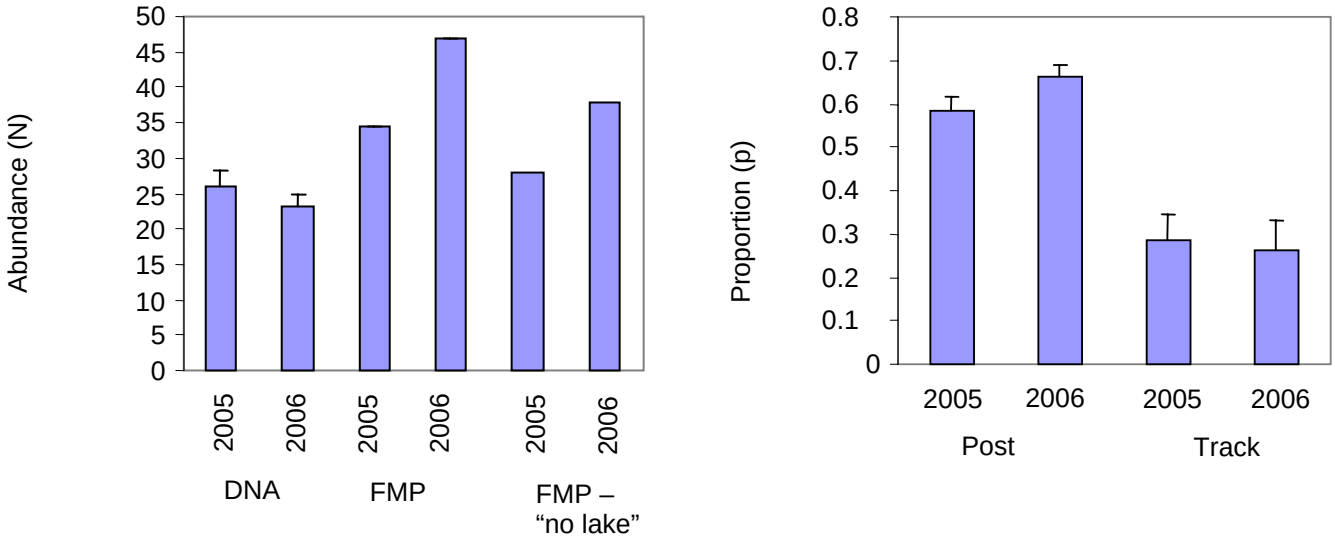
3 RESULTS

3.1 ABUNDANCE ESTIMATES FROM BAIT POST DATA

The DNA-based mark-recapture method identified 24 wolverines using the study area in 2005, and 22 wolverines in 2006. The ratio of females to males was lower during 2005 (13F:11M) than in 2006 (14F:8M). Closed population models estimated a high probability of capture during 2005 (0.69, 0.50 - 0.84 [95% CI]) and 2006 (0.73, 0.54 - 0.87). Models estimated 26.0 wolverines (24.3 - 36.2 [95% CI]) in 2005 and 23.1 wolverines (22.2 - 32.2) in 2006 (Figure 3-1). The overlap in CI and point estimates (*i.e.*, $\hat{N}$) suggests that the number of wolverines using the study area did not differ statistically between years. The CV of $\hat{N}$ was similar between years and ranged from 0.17 in 2005 to 0.15 in 2006. Based on abundance estimates and size of the study area (1,267 km^2), densities were 2.05 and 1.82 wolverines per 100 km^2 in 2005 and 2006, respectively. Excluding Lac de Gras, densities for the terrestrial portion of study area (1,023 km^2) were 2.54 and 2.26 wolverines per 100 km^2 in 2005 and 2006, respectively.

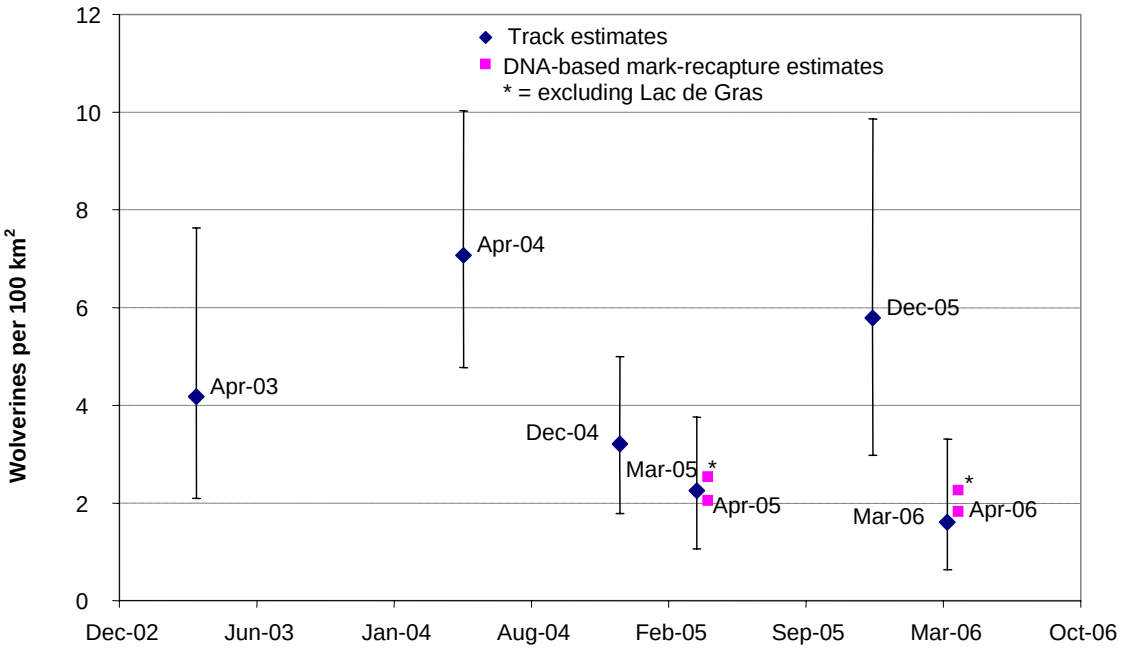
In contrast to DNA-based mark-recapture abundance estimates, the proportion of posts with at least one wolverine hair sample was higher in 2006 than in 2005 (Figure 3-1). The proportion of posts with hits in 2005 was 0.585 (0.531 - 0.639 [90% CI]) and in 2006 was 0.663 (0.617 - 0.709). Logistic regression analysis indicated that the difference between years was significant ($P < 0.01$; Section 3.3).

Figure 3-1 Estimates of Abundance (+ 1SE) from DNA-Based Mark-Recapture Models, the Formorov-Malyshev-Pereleshin (FMP) Track Data Formula, and Indices of Abundance Measured as the Proportion of Bait Posts with Hair Samples and Transects with Tracks during 2005 and 2006. FMP Abundances for the Area Excluding Lac de Gras are also Shown. SE was not Available for FMP Estimates.



When using snow track observations from late winter (March) survey periods only, FMP density estimates were similar to values from the DNA-based mark-recapture approach for 2005 and 2006 (Figure 3-2). FMP estimated 28.5 wolverines (13.5 - 47.7 [90% CI]) in late winter 2005 (2.2 per 100 km^2) and 20.4 wolverines (8.1 - 41.5) in late winter 2006 (1.6 per 100 km^2). However, the estimated CV (1.8) for these survey periods was twelve times the estimated CV of abundances calculated from mark-recapture methods, which indicates greater precision was obtained using mark-recapture. The size of CI for FMP estimates for 2003 through 2006 also indicates that this measurement would likely not be effective for effects monitoring using the current study design (*i.e.*, distribution of transect lengths and locations).

Figure 3-2 Density Estimates (and 90% CIs) of Wolverine from the Formorov-Malyshev-Pereleshin Formula Relative to Estimates from the DNA-Based Mark-Recapture Approach.



Estimates generated from the wolverine track density index (TDI) varied from 0.037 in winter 2004/05 to 0.067 in winter 2005/06 (Table 3-1). However, the overlap in CI (based on 2SE) with mean values indicated that the difference among years was not statistically significant. The CV for TDI (2.0) was twelve times greater than the estimates for abundance from mark-recapture methods. Similar to the FMP estimates (Figure 3-1), the TDI suggested that the relative activity of wolverines in the study area increased from 2005 to 2006 (Table 3-1). In contrast, the trend in mark-recapture estimates indicated that there were fewer wolverine using the study area in 2006 relative to 2005. Annual changes in the proportion of transects with tracks also suggested that the relative activity of wolverine was lower in 2006 than in 2005 (Figure 3-1; Table 3-2). In general, there was a negligible correlation between annual estimates for the probability of occurrence of tracks on transects and TDI values. For example, the lowest values for the proportion of transects with tracks (2003 and 2006) corresponded to moderate and high TDI estimates (Table 3-1; Table 3-2).

The probability of detecting a track on a transect ranged from 0.26 in 2003 and 2006 to 0.52 in 2004 (Table 3-2), and the CV was 0.25. To determine the ability of this method to detect a temporal change in relative activity of wolverines, the Z-test for two independent proportions was used to analyze the difference between estimates obtained for 2004 and 2006 (Zar 1984). These estimates represent the largest effect size, and consequently maximize statistical power (Toft and Shea 1983). The analysis indicated that the probability of occurrence of wolverine tracks in the study area in 2004 was significantly greater than in 2006 ($Z = 2.14$, $P = 0.03$).

Table 3-1 Summary of Wolverine Track Density Index, 2003 – 2006

Survey Period	Total Number of Tracks	Total Distance Surveyed (km)	Mean Days Since Snowfall[1]	Mean Days Since Threshold Wind Speed[1]	Mean Track Density[2] (± 2SE)
Late winter 2003	13	148	2.2	2.1	0.046 ± 0.044
Late winter 2004	22	148	4.0	4.6	0.061 ± 0.040
Winter 2004/05[3]	17	296	5.7	3.2	0.037 ± 0.028
Winter 2005/06[3]	23	296	1.7	3.0	0.067 ± 0.038

[1] Presented only as a summary of the data used to calculate track densities.

[2] Mean number of tracks per km surveyed per days since last weather threshold.

[3] Based on pooled survey periods (*e.g.*, mid-winter 2004 and late winter 2005 = 2005 [see Methods]).

Table 3-2 Proportion of Transects with Wolverine Track Occurrences, 2003 – 2006

Survey Period	Number Transects Surveyed	Proportion of Transects with Tracks	95% CI[1]
Late winter 2003	23	0.26	0.10 – 0.48
Late winter 2004	23	0.52	0.31 – 0.73
Winter 2004/05[2]	46	0.28	0.16 – 0.43
Winter 2005/06[2]	46	0.26	0.14 – 0.41

[1] Based on binomial distribution.

[2] Based on pooled survey periods (*e.g.*, mid-winter 2004 and late winter 2005 = 2005 [see Methods]).

3.2 POWER ANALYSES

The monitoring method with the most power for detecting a 10% decline in current estimates over 10 survey periods and years was the proportion of posts with hits (0.99), followed by DNA-based mark-recapture estimates (0.92), proportion of transects with tracks (0.75), and the FMP and TDI estimates (0.14).

For the DNA-based mark-recapture program, three alternate scenarios were evaluated in addition to the 10 survey periods over 10 years. A power analysis conducted for nine survey periods over nine years had adequate statistical power (0.86). Similarly, a program of surveys conducted at year 0 and then every second year for 11 years (six survey periods in total) had adequate statistical power for detecting trends (0.88). A survey schedule based on surveys conducted at year 0 and then every third year for 12 years (five survey periods) also had adequate statistical power for detecting trends (0.92).

3.3 HABITAT-USE PATTERNS

Over a two year period, there were 352 posts with wolverine hits compared to 212 posts showing no signs of wolverine. Based on pooled data from 2005 and 2006, the mean (± 1SE) distance to mine was 14.7 ± 0.7 km for posts with no hits and 15.0 ± 0.6 km for posts with hits. Posts with hits were approximately 2% further from the mine than posts without hits. However, trends varied between years. In 2005, posts with hits were 12% further from the mine footprint than posts without hits; whereas in 2006, posts with hits were 8% closer to the mine site (Table 3-3).

Table 3-3 Mean (± 1SE) Distance from Mine Footprint for Posts without Hits and Posts with Hits in 2005 and 2006. Analyses were Based on 564 Observations and 141 Clusters (*i.e.*, Individual Posts).

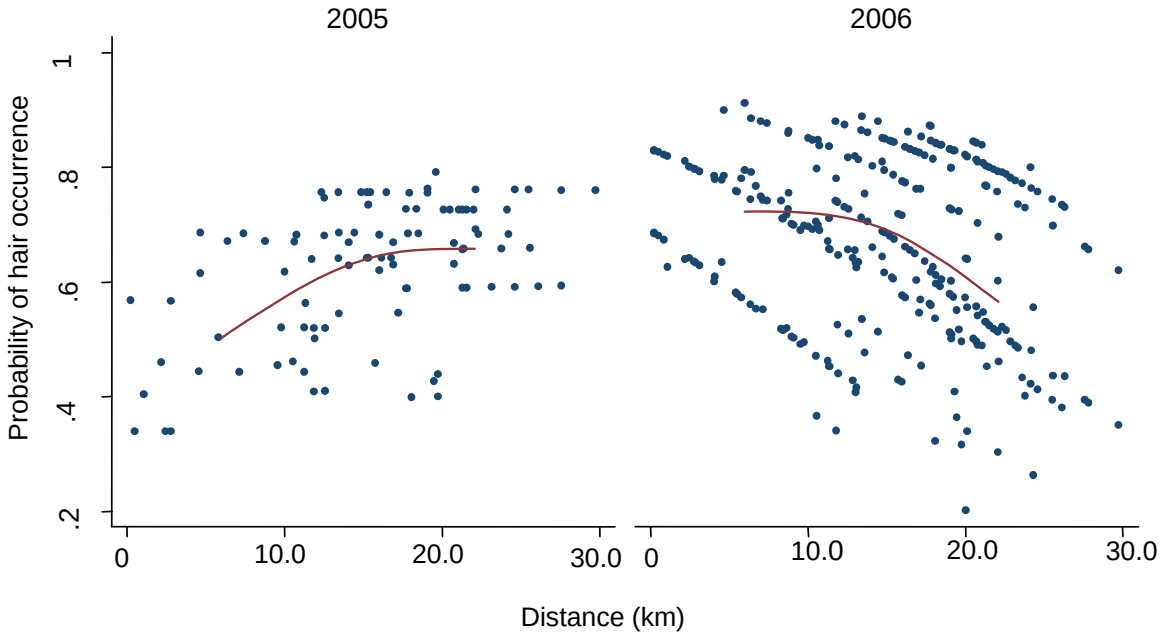
		Mean Distance (km)	90% CI (km)
Pooled	No-hit posts	14.7 ± 0.7	13.5 - 16.0
	Hit posts	15.0 ± 0.6	14.0 - 16.0
2005	No-hit posts	13.9 ± 0.8	12.6 – 15.2
	Hit posts	15.6 ± 0.7	14.5 – 16.7
2006	No-hit posts	15.7 ± 0.8	14.4 – 17.1
	Hit posts	14.5 ± 0.6	13.4 - 15.5

Logistic multiple regression showed that although distance to mine was unrelated to the probability of post hit occurrence (P = 0.99), the interaction between distance to mine and year was significant (P = 0.001; Table 3-4; Figure 3-3). The reason for this interaction is not known, however, it may simply be a random effect from the annual variation in amount of attractants / lure applied to posts, and the techniques used to bait posts. Covariates such as the length of capture interval, heath tundra, wetland habitat, year and sampling period were positively associated with wolverine hit occurrence (P < 0.01; Table 3-4). Results suggest that posts on frozen lakes received less hits relative to heath tundra and wetland habitats. Mean maximum daily wind speed showed a negative and moderately significant relationship with the probability of wolverine post hit occurrence (P = 0.06). The model explained only 7.2% of the variation in post hit occurrences, but passed the Pearson Chi-squared goodness of fit test (P = 0.36).

Table 3-4 Results from Logistic Model Predicting Probability of Occurrence of Wolverine Hair Samples on 141 Bait Posts, 2005 - 2006.

	Coefficient	Robust SE	Z-value	P-value
Capture interval	0.17	0.03	4.82	<0.001
Tundra (vs. non-tundra) habitat	0.94	0.30	3.10	0.002
Wetland (vs. non-wetland) habitat	1.08	0.21	5.21	<0.001
Year	1.33	0.42	3.20	0.001
Sampling period	0.72	0.21	3.41	0.001
Mean maximum daily wind speed	-0.40	0.21	-1.91	0.056
Distance to mine (m)	0.0004	0.023	0.02	0.986
Distance to mine x year	0.086	0.025	-3.47	0.001

Figure 3-3 Scatterplots and Spline Curves Showing the Interaction Between Distance to Mine and Year Effects on Probability of Detecting Wolverine Hair on Bait Posts.



Pooling snow track observations for 2005 and 2006 resulted in 31% of transects recording a wolverine track. Tracks occurred more frequently on transects that were closer to the mine. The mean (± 1SE) distance to mine from a transect without tracks was 13.1 ± 1.1, and with tracks was 11.2 ± 1.9. In contrast to wolverine hit occurrence on bait posts, track trends were consistent across years. There was a noticeable affinity for areas closer to the mine during spring 2003 and winter 2006 (Table 3-5). Distance to mine was not different between transect with and without tracks for most survey periods with the exception of mid-winter 2006 (based on non-overlapping 90% CI). In mid-winter 2006, transects with tracks were 45% closer to the mine footprint than transects without tracks.

Table 3-5 Mean (± 1SE) Distance from Mine Footprint for Transects without Wolverine Tracks and Transects with Tracks during Late Winter and Mid-Winter Surveys from 2003 Through 2006. Estimates were Based on 138 Observations and 23 Clusters (*i.e.*, Transects).

			Mean distance (km)	90% CI (km)	% Change
2003	Late winter	Absent	13.4 ± 1.2	11.3 – 15.5	
		Present	10.2 ± 2.9	5.2 – 15.1	-24.3*
2004	Late winter	Absent	12.3 ± 1.7	9.4 – 15.2	
		Present	12.8 ± 1.7	9.8 – 15.7	4.0
2005	Late winter	Absent	12.6 ± 1.3	10.4 – 14.7	
		Present	12.2 ± 3.2	6.7 – 17.6	-3.1
2005	Mid-winter	Absent	12.7 ± 1.5	10.2 – 15.3	
		Present	12.2 ± 2.0	8.7 – 15.8	-3.7
2006	Late winter	Absent	12.8 ± 1.2	10.7 – 14.9	
		Present	11.0 ± 3.8	4.4 – 17.6	-13.8
2006	Mid-winter	Absent	14.8 ± 1.1	12.8 – 16.8	
		Present	8.2 ± 1.9	4.9 – 11.5	-44.9*[a]

* Large effect sizes.

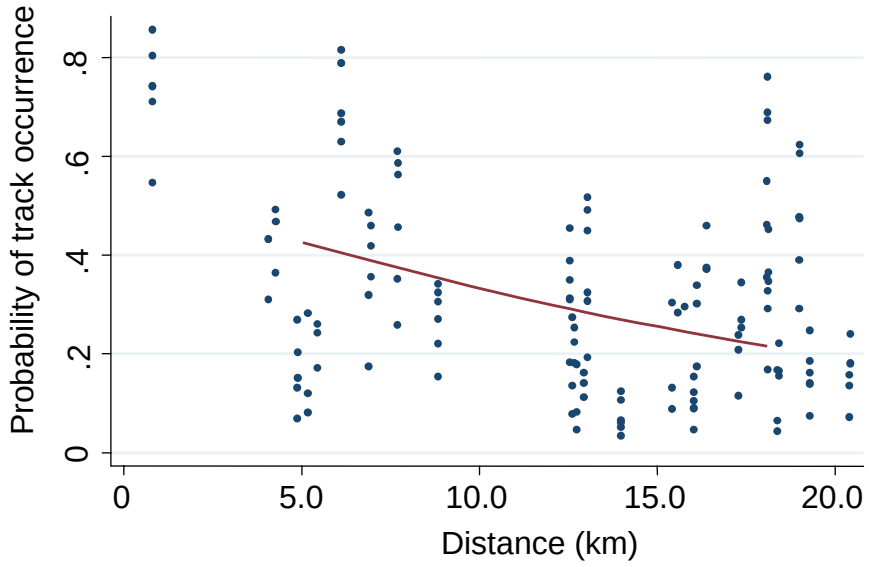
[a] Non-overlapping confidence intervals.

The logistic regression model indicated that the probability of track occurrence was negatively related to distance from the mine (P = 0.02; Table 3-6; Figure 3-4). Transect length and days since threshold wind were positively correlated with track occurrence (P < 0.05). Annual changes in track occurrence were marginally non-significant (P = 0.10) at alpha = 0.05. Results indicated that the likelihood of detecting a wolverine track did not vary with habitat type (P > 0.25; Table 3-6). The model explained 15.4% of the variation in track occurrences and passed the Pearson Chi-squared goodness-of-fit test (P = 0.19).

Table 3-6 Results from Logistic Model Predicting Probability of Occurrence of Wolverine Tracks on 23 Transects during 2003 Through 2006.

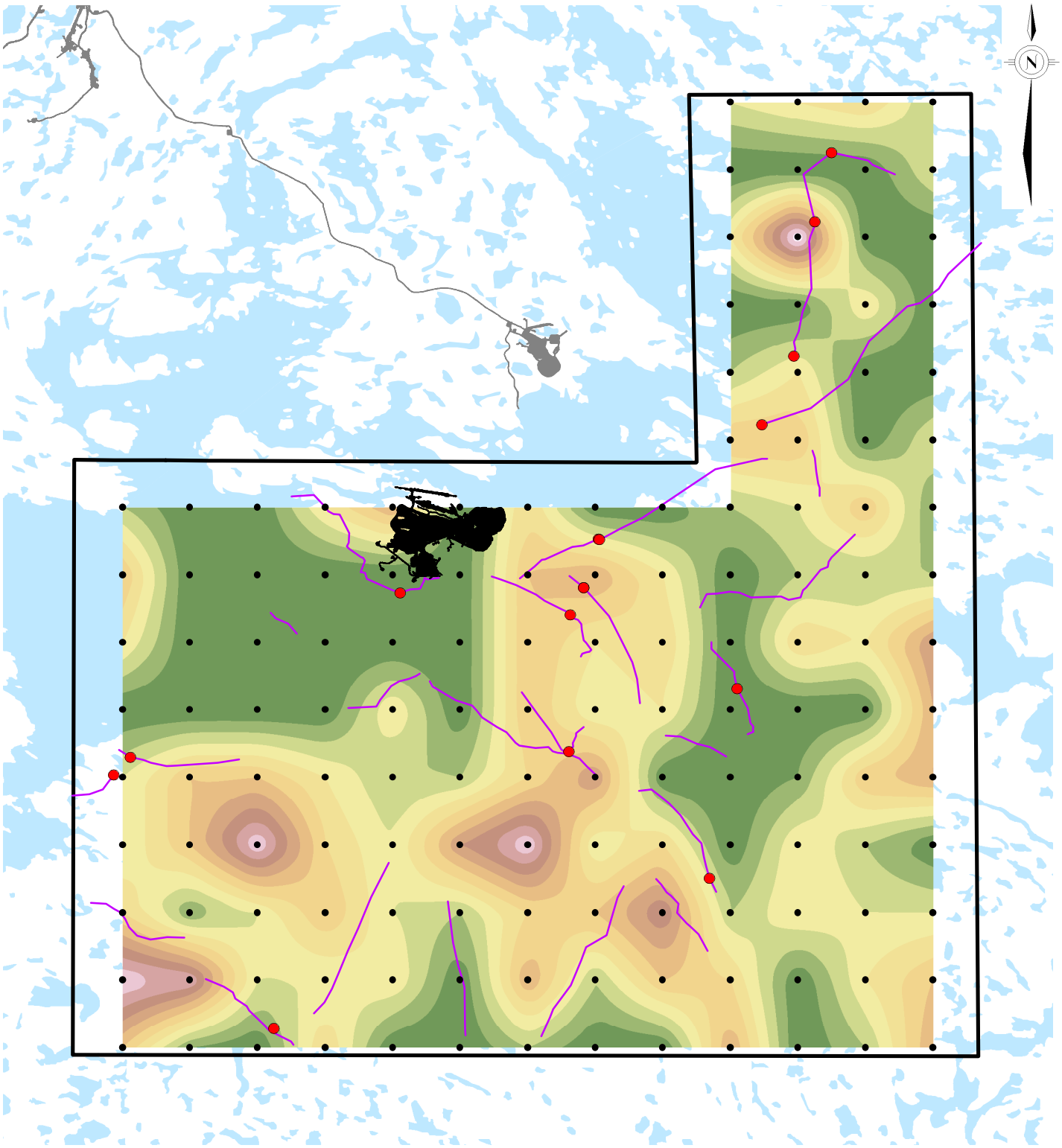
	Coefficient	Robust SE	Z-value	P-value
Year	-0.35	0.21	-1.64	0.100
Survey period	0.70	0.60	1.18	0.239
Distance to mine (m)	-0.072	0.030	-2.40	0.016
Days since recent snowfall	-0.087	0.094	-0.93	0.353
Days since threshold wind speed	0.18	0.09	1.96	0.050
Transect length (km)	0.28	0.053	5.29	<0.001
Tundra (vs. non-tundra) habitat	0.20	0.55	0.36	0.720
Wetland (vs. non-wetland) habitat	0.55	0.50	1.10	0.271

Figure 3-4 Scatterplot with Spline Curve for Probability of Occurrence of Wolverine Tracks Related to Distance from Mine.



3.4 RELATIONSHIP BETWEEN TRACKS AND POST HITS

Results indicated that the mean (± 1SE) number of wolverine hits on posts in close proximity to track locations was 4.62 ± 0.62 hits per post, and 3.35 ± 0.37 hits per post for bait posts adjacent to points on transects with no wolverine tracks. ANOVA indicated that the number of hits per post was statistically higher on posts adjacent to track observations than non-track locations ($F_{1,115}$ = 4.24, P = 0.04). Thus, there was a statistical spatial correlation between snow track observations and the density of wolverine hair samples collected from bait posts (or core areas of use; see Figures 3-5 and 3-6). Furthermore, the independence of these two data sets strengthens the result. For example, in late winter 2005 and 2006, wolverine snow track surveys were completed prior to the DNA-based mark-recapture studies (Table 2-1; Table 2-2). Consequently, attractants at bait posts had no influence on wolverine distribution during the snow track surveys.



PROJECT

DIAVIK DIAMOND MINES INC.

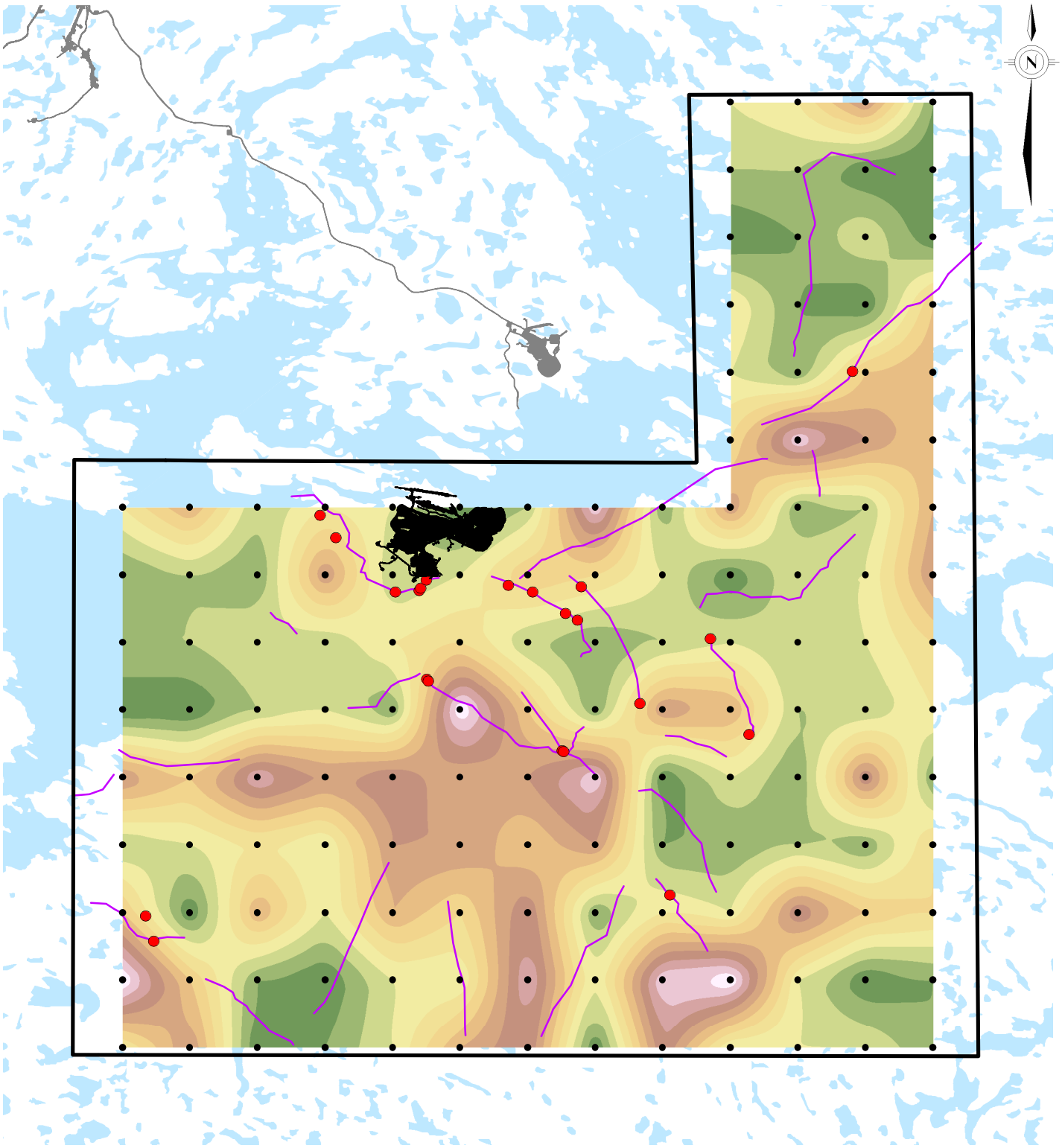
TITLE

DISTRIBUTION OF WOLVERINE SNOW TRACKS AND FREQUENCY OF WOLVERINE HAIR SAMPLES (HITS), 2005

Golder Associates
Saskatoon, Saskatchewan

PROJECT	06-1328-001		FILE No.	
DESIGN			SCALE AS SHOWN	REV. 0
GIS	JSB	29/03/07	FIGURE: 3-5	
CHECK				
REVIEW	JV	29/03/07		

G:\2006\1328\06-1328-001\GIS\Phase 2300\06-1328-001 Terr-Distribution of Wolverine Snow Tracks 2005.mxd - 3/29/2007 @ 10:35:15 AM



PROJECT

DIAVIK
DIAMOND MINES INC.

TITLE

DISTRIBUTION OF WOLVERINE SNOW TRACKS AND FREQUENCY OF WOLVERINE HAIR SAMPLES (HITS), 2006

Golder Associates
Saskatoon, Saskatchewan

PROJECT	06-1328-001		FILE No.	
DESIGN			SCALE AS SHOWN	REV. 0
GIS	JSB	29/03/07	FIGURE: 3-6	
CHECK				
REVIEW	JV	29/03/07		

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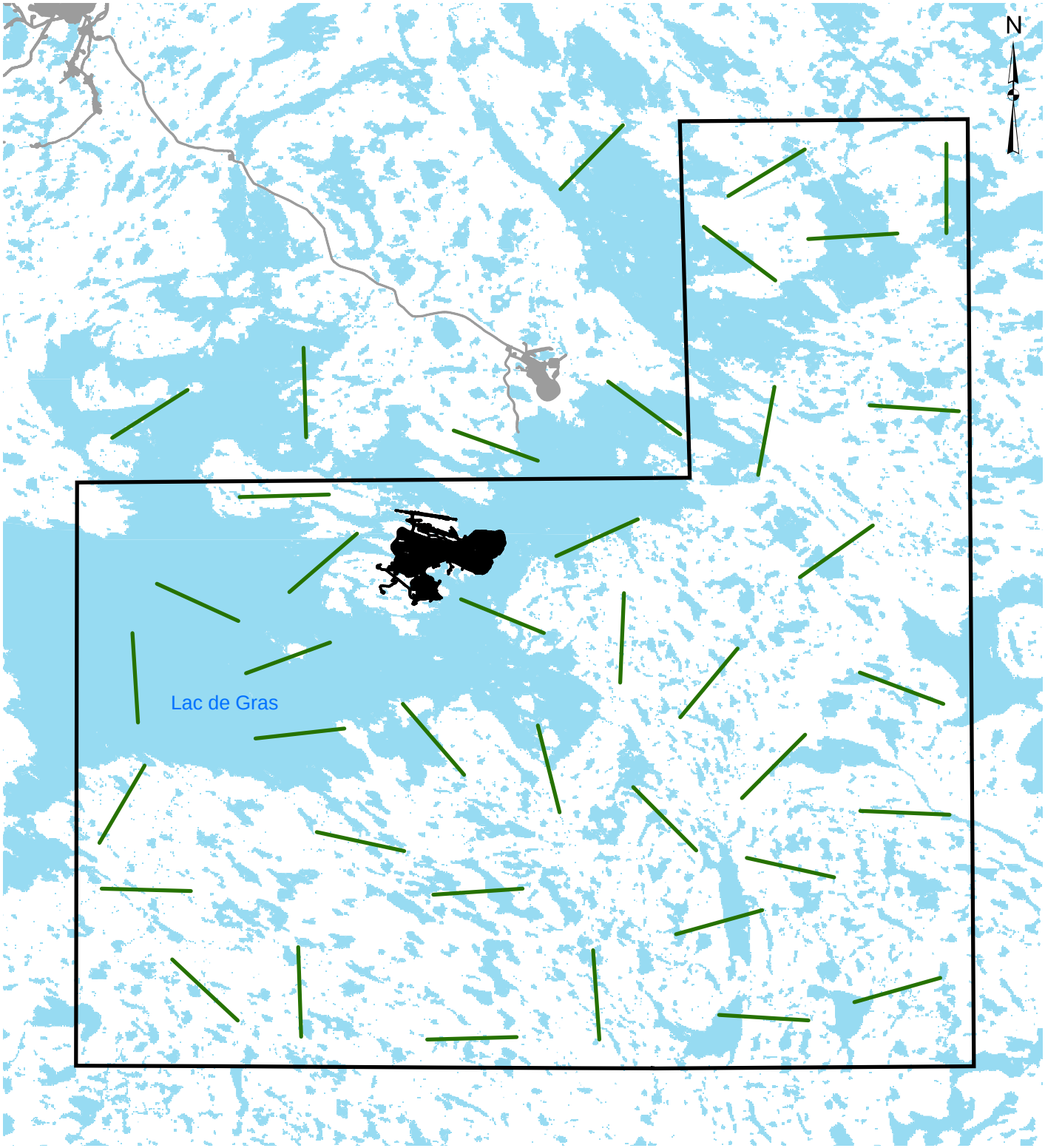
4 DISCUSSION

Results indicated that DNA-based mark-recapture methods can provide precise estimates of the number of wolverines using the study area (CV = 0.16). In a similar study at Daring Lake, NWT, Mulders *et al.* (2006) also demonstrated that the combination of bait posts and DNA finger printing of hair samples provides robust measurements of wolverine density and abundance. High capture probabilities (>0.65) predicted good statistical power (0.92) to detect a 10% decline in current wolverine numbers within the study area, by sampling every third year over a 12-year period. Estimates generated from the mark-recapture method suggested that fewer wolverine were using the study area in 2006 than in 2005, although overlap between 95% CI indicates that the difference was likely not statistically significant. The high degree of precision obtained from the mark-recapture study provided a reliable basis for comparing the relative change in the magnitude and direction of non-enumeration measurements from snow track data.

Count-based indices, such as those generated by snow track data, have been criticized as an effective monitoring technique due to variation in snow conditions, wind, season, and survey methods (Mulders *et al.* 2006). Logistic regression analysis indicated that the probability of detecting a wolverine track was independent of season (*i.e.*, mid-winter and late winter survey periods), the number of days since the most recent snowfall, and habitat. The lack of a habitat effect was likely due to the assignment of transects in preferred wolverine habitat during the initial study design, which was based on Inuit Qaujimajatuqangit (IQ). For example, dominant habitats within a 1 km buffer around snow track transects included heath tundra (with boulder patches) and wetlands associated with the shoreline of water bodies. A recent study by Johnson *et al.* (2005) supports the experience of traditional hunters and trappers as wolverines were found to prefer habitats dominated by rocks and sedge wetlands. Analysis also showed that the probability of track occurrences was strongly dependent on transect length ($P < 0.001$) and less influenced by the number of days since threshold wind speed ($P = 0.05$). DDMI is currently evaluating a change in the snow track study design that uses transects of equal length, and increases the number of transects surveyed in the study area (35 – 40 transects), which is expected to decrease error variances associated with the probability estimates (Figure 4-1). Similar to the previous study design, the location of new transects was based on IQ of wolverine habitat preferences during winter.

This study also assessed the occurrence of wolverine hair samples on bait posts (a surrogate measure of capture probability) as a measurement for monitoring mine-related effects to wolverine activity levels and distribution. A logistic model indicated that the probability of capturing wolverine hair on a bait post was dependent on several factors related to environmental conditions and study design. Habitat explained a significant amount of the variation in capture probability, and suggested that wolverines avoided bait posts on frozen lakes relative to areas dominated by heath tundra (with patches of boulders) and sedge wetlands.



5 0 5
SCALE 1:250,000 KILOMETRES

Legend

- Wolverine Transects
- Ekati Footprint
- Diavik Study Area
- Diavik Mine

REFERENCE

Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 12

PROJECT

DIAVIK DIAMOND MINES INC.

TITLE

PROPOSED STUDY DESIGN FOR WOLVERINE SNOW TRACK SURVEYS

Golder Associates
Yellowknife, Northwest Territories

PROJECT		06-1328-001	SCALE AS SHOWN	REV. 0
DESIGN	DP	Mar. 2006		
GIS	KB	Mar. 2006		
CHECK	DP	Mar. 2006		
REVIEW	JV	Mar. 2006		

FIGURE: 4-1

Project: N:\ACTIVE\GIS\DIAVIK\2006\FIGURE 5-1

Similar to the likelihood of detecting wolverine tracks, the probability of capturing wolverine hair was moderately correlated with wind speed (P = 0.06). On the arctic tundra, mark-recapture methods and snow track surveys can not control for wind, but statistical models of estimators can help reduce the error rates associated with natural environmental factors.

Other factors such as year, sampling period, and capture interval (*i.e.*, days between deployment and sample collection) were positively related to capture probability. The increase in probability of occurrence of hair samples with sampling period may be the result of a 'trap happy' response by resident individuals. Mulders *et al.* (2006) also detected an increase in recapture probabilities between sampling periods for female and male wolverines. More striking was the significant increase in capture probability from 2005 to 2006. In wolverines, the strong behavioural attraction to bait posts may continue for as long as the individual's home range includes the study area. For example, the recapture rate for the sampled population from 2005 to 2006 was 0.519 (14 recaptures/27 initial captures [includes three individuals initially captured in a different study area in 2005]). Thus, capture probabilities in this study were likely positively biased, which typically generates an underestimate of population size (Otis *et al.* 1978).

Relative to mark-recapture values, FMP and TDI estimates were associated with large error variances (*i.e.*, CVs = 1.8 – 2.0), which resulted in low statistical power (<0.15) to detect a temporal 10% decline in current values during the next 15 years. In addition, the direction of the change in FMP and TDI estimates between 2005 and 2006 was opposite to the trend observed using mark-recapture techniques. Under the current study design, FMP and TDI estimates do not provide efficient statistical measurements for monitoring annual changes in the relative abundance or activity of wolverines in the area.

In contrast, estimates of the probability of track occurrences in the study area were associated with much higher precision (CV = 0.25) relative to FMP and TDI measurements. Similar to the enumeration method, there was a non-significant decreasing trend in the probability of detecting tracks between 2005 and 2006. After statistically controlling for several environmental and study design variables, analysis indicated that the probability of track occurrences was statistically and negatively dependent on distance from the mine. Consequently, this measure had enough statistical power to detect an effect from the mine on the distribution of wolverine activity within the study area. A significant temporal change also was detected in the probability of track occurrence (relative activity) between 2004 and 2006, and the logistic model showed a moderate correlation between track occurrence and year (P = 0.10). Power analysis indicated that this measurement has moderate power (0.75) to detect a 10% decline in current estimates, however, power is anticipated to increase following the adoption of a study design that uses transects of equal length, and increases the number of transects surveyed (Figure 4-1). The significant spatial correlation between the density of hair samples collected on a bait post and wolverine track observations provides strong support for using the probability of track occurrence as an efficient measurement for monitoring changes in the temporal and spatial use of the study area by wolverines.

From the onset of this study, it was recognized that there is a fundamental difference between the measurements generated from mark-recapture and snow track survey methods. Enumeration methods provide estimates of animal abundance, while count-based data generate indices of the probability of occurrence or relative activity of individuals within a study area. DNA-based mark-recapture studies at Daring Lake, and the Ekati and Diavik mines have provided much needed information on wolverine abundance and density in the Lac de Gras region. Estimates of survival rates, sex ratio, and movement of individuals between sampled areas (*i.e.*, sub-populations) also can be used by government to make more informed decisions on harvest quotas for non-traditional hunters and trappers. However, to provide a more effective monitoring program for determining the causes of annual changes in wolverine abundance, hair samples should be collected from individuals removed from mine site areas (due to relocation or mortality) and from local outfitting camps. The collection and finger printing of hair samples from wolverine removed from a development or harvested near the study area is necessary to help understand the fate of marked individuals, and the factors related to annual changes in the local population. For example, information from the Lac de Gras outfitting camp indicated that the annual number of wolverine harvested from the area ranged from two to five individuals between 2003 and 2006 (Audrey Busetto, pers. comm. [JB's Taxidermy]). If DNA-based mark-recapture techniques are to be used to monitor mine-related influences on wolverines, then knowledge of mortality agents is required to provide effective feedback for appropriate adaptive environmental management and mitigation measures.

Generating effective feedback for the management and mitigation of mining operations on wolverines was the principal objective of the snow track surveys. DDMI used the benefit of IQ to implement a study design and record snow tracks to determine temporal and spatial mine-related influences on the occurrence and distribution of animals using the study area. As predicted in the environmental assessment, results suggest that the annual change in the occurrence of wolverines in the study area has been negligible (DDMI 1998), but individuals appear to be attracted to the mine. Consequently, DDMI must continue to remain diligent with respect to mitigation measures (*e.g.*, food waste management practices) that limit on-site negative interactions with wolverines and can lead to the removal of individuals from the population. If direct mine-related mortality occurs, then estimates of abundance from mark-recapture techniques would provide the best information for predicting the effect to the population. Thus, a combination of measurements from mark-recapture and snow track surveys likely provides the best approach for determining the effects of human development and natural factors on wolverine populations.

5 ACKNOWLEDGEMENTS

DDMI would like to thank their staff Seth Bohnet, Karl Cox, Colleen English, Ray Eskelson, Justin Grandjambe, Scott Morrison, and George Taptuna for support during the collection of field data for hair sampling and snow track surveys. DDMI greatly appreciates the experience of Bobby Algona and Peter Katiak (Hunters/Trappers from Kuglugtuk) for their assistance in the design of wolverine snow track surveys and data collection. Dean Cluff (ENR, GNWT) provided training and assistance on the methods and protocols for DNA-based mark-recapture of wolverines. Special thanks to Scott Bailey, Kelly Bourassa, and Damian Panayi for GIS modeling and mapping.

6 CLOSURE

We trust the above meets your present requirements. If you have any questions or require additional details, please contact the undersigned.

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A PEER REVIEW OF:

A Comparison of Effects Monitoring Methods For Wolverine at the Diavik Diamond Mine

by

Philip D. McLoughlin, Ph.D.[1]

27 March 2007

[1] Department of Biology, University of Saskatchewan, 112 Science Place, Saskatoon, SK S7N 5E2

PREAMBLE

This paper presents a peer review of the Draft Document entitled: "*A Comparison of Effects Monitoring Methods For Wolverine at the Diavik Diamond Mine*", prepared for Diavik Diamond Mines Inc. (Yellowknife) by Golder Associates Ltd. (Saskatoon). This review focuses on the quality of data inputs, project design and methodology, data analysis, and validity of the conclusions. This evaluation is based on my professional experience with experimental design, mark-and-recapture models including Program Mark, logistic regression and other statistics used by the authors, and my assessment of the methods, results, and conclusions as presented in the document. I made no attempt to re-evaluate models based on data for the species of interest. I wrote this review without solicitation of comments from Diavik Diamond Mines Inc. or Golder Associates Ltd.; this report rests on my own judgment. The conclusions contained in this report reflect my professional opinion without any form of editing or censuring by the concerned parties.

P.D.M.

March 27, 2007

PHILIP D. McLOUGHLIN (BIOGRAPHY)

Philip D. McLoughlin, B.Sc. Hons. (Alberta), Ph.D. (University of Saskatchewan) is presently a Research Associate in the Department of Biology, University of Saskatchewan. He has more than 10 years of post-graduate experience in the areas of biostatistics, analysis of mark-recapture models, population ecology, and conservation of vertebrate species. Philip has developed mathematical and simulation models for populations of red deer in Scotland, roe deer in France, woodland caribou in Alberta, polar bears in Nunavut, grizzly bears in the NWT and British Columbia, and Swainson's and ferruginous hawks in Alberta and Saskatchewan. He teaches graduate and undergraduate courses in population ecology and applied statistics for ecologists. Philip is an associate editor of the peer-reviewed journal *Ursus*, and is author to numerous peer-reviewed journal articles in animal ecology.

Overview

The reviewed report presents an analysis of the relative efficiency of techniques used for the purpose of detecting mine-related temporal and spatial changes in wolverine use or occupancy of the Diavik Diamond Mine project study area. In the main analysis the authors compared results obtained from hair-snag, DNA-based mark-and-recapture estimates of abundance to concurrent assessments of abundance from snow-tracking. The authors also assessed the simple occurrence of wolverine hair samples on bait posts as a measurement for monitoring mine-related effects to wolverine activity levels and distribution, and present some additional, related analyses. I found no fault with the choice of statistics or analysis. The results (main finding) clearly showed the superiority of mark-recapture analysis using hair snagging relative to track counts to monitor the local wolverine population, and I suspect this result will be of high value for the maintenance of any future monitoring program in the region. The report is generally well-written; however, I found several instances where presentation could be improved (described below).

Title

1) I found the title to be somewhat misleading due to the awkward phrase "effects monitoring methods". An improvement would be to title the document: "A comparison of methods to monitor distribution and abundance of wolverine at the Diavik Diamond Mine", or something to that effect. The word "effects" is vague and as used in the original title it may entail analyses of ecotoxicology to survival and reproduction, which of course the authors did not measure.

Executive Summary

1) Both the Executive Summary and main document refer to: "the experience of Inuit Traditional Knowledge" to record wolverine snow tracks. In my experience Inuit are careful of assigning English phrases like "traditional knowledge" to work involving tracking skills, etc. In such cases, the better phrase might be "Inuit Qaujimajatuqangit" or IQ; however, it may be worth clarifying the most accurate term to be used in this report with your Inuit participants.

2) The first paragraph of the Executive Summary (second sentence) describes methods used in the present tense, which is not consistent with the past tense of all other paragraphs in the Summary.

3) For readers not familiar with the Diavik study area, it may be worth adding a line in the Executvie Summary to clarify where the study area is located (e.g., Central Canadian Arctic and latitude and longitude).

4) The last sentence of the third paragraph in the Executive Summary should clarify why hair samples should be collected (i.e., to identify deaths of previously known marks in the study area). Also see point three for the Discussion, below.

5) The last paragraph of the Summary presents some management recommendations that, although of obvious import to the conservation of wolverine in the region, do not directly follow from the goals of the report which is largely a comparison of methods (i.e., third sentence of last paragraph might be considered for removal).

Table of Contents and Lists of Tables and Figures

1) There is no list or legend presented to describe Figure 3-1 (the legend should appear on page iv with the others).

2) There is inconsistency in the use of capital lettering among Table and Figure legends. Some legends read with only a starting capital letter, and others read as a title with every main word capitalized (compare list of Tables and list of Figures).

Introduction

1) The introduction is succinct and to the point; however, I found the first paragraph to jump somewhat jump around. To improve the flow of the first paragraph I would suggest that the authors keep sentences related to the discussion of home ranges together.

2) If I am not mistaken wolverine is not yet listed on Schedule 1 of SARA, but is still undergoing consultation. It is a species of Special Concern by COSEWIC, which should not be confused with a scheduling by SARA. Also, I believe it is now listed as Sensitive for NWT status rank. See these links:

http://laws.justice.gc.ca/en/showdoc/cs/S-15.3/sc:2//en

http://www.ngps.nt.ca/Upload/Interveners/Government%20of%20the%20Northwest%20Territories/GNWT_SAR_presentation.pdf

3) A missing reference that might be useful in the Introduction (first paragraph) would be Jessica Elliot and Mathieu Dumond (2006) Wolverine (*Gulo gulo*) carcass report West-Kitikmeot Region (Nunavut) 2001-2005. Govt. of Nunavut (file report). I believe this is now available but I could be wrong (contact the Govt. of Nunavut for a copy…start with Mitch Taylor mtaylor2@gov.nu.ca). It provides some indication about the importance of wolverine to the economy of Inuit in the region.

Methods

1) Again, I can find no fault regarding the choice of methods as presented, and so I can offer only minor suggestions to improve this part of the paper.

2) P. 3 (study area)…there is no information on why 1,270 km^2 was chosen as a study area. This might be useful to know (e.g., this study area was decided on previously for the long-term monitoring of biota around the mine [reference]).

3) P. 6…is fingerprinting one word or two? The wording is inconsistent in document.

4) P.10…I believe the logistic regression model was used over the negative binomial for good reason; however, it might be worth presenting at this point why the logistic regression model was preferred other than by referring to amount of variation explained (the skeptic might then question reasons why). I am assuming, however, that there were a large number of zero hits in your data, and so the lack of variation in your samples made the hit-no-hit analysis preferred over the negative binomial analysis. Note: there are available modifications of the negative binomial model to account for many zeros (e.g., the zero-inflated negative binomial or zero-inflated Poisson models), but these are not likely necessary for this analysis.

Results

1) Figure 3-1 might better be presented as Figure 3-1A and 3-1B (for ease in referencing from the text). There needs to be greater separation between the two graphs. The legend jumps around by referring back to what I call Figure 3-1A in the last two sentences of the legend, after describing Figure 3-1B. It is a bit confusing.

2) It may yet be helpful to write out the full name of abbreviations just before first use again in the Results (e.g., TDI).

3) P.16, Table 3-4. If not describing what an odds ratio is to the reader (this may in fact be a good thing to do in anticipation of readers without a statistical background), it might be more useful to present the model coefficients (B). To me, the coefficients are easier to interpret because a negative effect will have a negative sign. I cannot tell if the SE as presented is for B or the odds ratio (e^B) as presented; please clarify if this is the case.

4) P. 16, Table 3-4. The additive effect of Distance to the mine is missing from the table. If presenting an interaction, the additive effect of all interacting parameters should be included in the presentation since predictions will require all additive and interacting parameters to make sense.

5) Often a model-selection routine is used (e.g., AIC) to select a final model. I do not think that this is an issue for Table 3-4 since all parameters are highly significant or near significant (i.e., the full model would most certainly be selected anyway); however, the report writers may be questioned on this point (and Table 3-6 may benefit from some sort of model selection). This would not,

however, change the results or the authors' interpretation of the results, and so the analysis is likely sufficient for the purpose of this report.

6) P. 17 Figure 3-3. I would remove the spline lines from the curves. What you really want to present is a sigmoid (slanted-S) curve, or a background line that starts at 0 and ends at 1 (vice versa for the second figure). However, the trends are evident regardless.

Discussion

1) The discussion appears polished and for the purpose of this document, well done. I can offer only a couple of comments to improve the discussion.

2) Given the objectives of this paper, I thought that it might be worth documenting or at least mentioning the differences in working days and/or costs required to carry out the various analyses. How much more cost-effective was DNA mark-recapture, for example? I believe your results suggest that the mark-recapture method is to be overwhelmingly preferred; however, others may wish to compare the amount of effort and costs needed to carry out this type of analysis compared to snow-track surveys.

3) It might be worth mentioning the limitations imposed on the proposed monitoring program (last two paragraphs of the discussion) if hair returns from killed individuals are restricted to coming only from the Diavik study area. The study area abruptly stops just a few km north of the mine itself. Clearly the neighbouring project to the north should also be monitoring wolverine and returning hair samples of any killed wolverine which are likely to use the Diavik study area. Future monitoring that makes use of wolverine DNA will require this information. I think the authors try to convey this concern in the second last paragraph of the discussion, but it could be more clear by expounding a need for collaboration on a region-wide DNA mark-recapture monitoring program. I am not sure if Daring Lake and Ekati plan to include future DNA work in their long-term wolverine monitoring plans, but I imagine they may wish to do so after reading this report.

Literature Cited

1) Length is sufficient for objectives and nature of this report. I would, however, also add the Elliot and Dumond (2006) report, if available (see comment 3 of the introduction review) I am aware of this report, but it may be best to be sure of its availability to the public.

Overall Value of Report

This report presents a very useful study that will focus methods for monitoring the response of wolverine to the Diavik project. The clarity of the results concerning the main question (DNA mark-recapture versus snow-tracking) is impressive. I anticipate that this report will be sought after by several other agencies if it were to be made public, and, if shortened considerably, will likely not be difficult to publish in a techniques journal such as the *Wildlife Society Bulletin*.

Golder Associates Ltd.

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March 29, 2008 06-1328-001/2300

Mr. Scott Wytrychowski
Environmental Manager
Diavik Diamond Mines Inc.
P.O. Box 2498
Yellowknife, NWT, Canada
X1A 2P8

RE: RESPONSE TO PEER REVIEW BY DR. PHIL MCLOUGHLIN ON COMPARISON OF WOLVERINE MONITORING METHODS

Dear Mr. Wytrychowski:

Golder Associates Ltd. (Golder) received comments from Dr. Phil McLoughlin regarding his review of the report entitled, "A Comparison of Effects Monitoring Methods for Wolverine at the Diavik Diamond Mine". Golder appreciates the constructive comments and suggestions from Dr. McLoughlin, and we provide the following responses.

Title

1) We agree, and have made the suggested change to the title of the report.

Executive Summary

We agree with comments (1), (2), and (4) and have made revisions to the report.

3) For this report, which is an Appendix to the Annual Wildlife Monitoring Report, we do not believe that it is necessary to provide the location of the mine in the Executive Summary. The location is provided in the Methods section.

5) We disagree. Mitigation and adaptive management are essential components of an effects monitoring program. Although the primary goal of this study was to compare methods for monitoring wolverine abundance and distribution, the Introduction clearly states that an additional objective of the study was to evaluate the effectiveness of each method for providing feedback for adaptive management and mitigation.

Table of Contents and List of Tables and Figures

The suggested changes have been incorporated into the report.

Introduction

Regarding comments (1) and (2), the appropriate revisions have been completed. With respect to comment (3), we will endeavour to acquire a copy of the report written by Jessica Elliot and Mathieu Dumond. This will provide much needed information on harvest estimates of wolverine in Nunavut. Similar data would be equally helpful for the Northwest Territories.

Methods

We have made changes to the report, where requested.

Results

1) We have decided to not revise the numbering for Figure 3-1.

2) We agree, and have made the change.

3) Odds ratios have been replaced by regression coefficients in Table 3-4 and Table 3-6.

4) The independent variable 'distance' has been included in Table 3-4.

5) For this study, we decided not to use the information theoretic approach. Our objective was to explore the relationships between several environmental and study design variables, and the probability of occurrence of hair and tracks. We did not have specific hypotheses to test, which is a key objective of the information theoretic approach (*e.g.*, AIC selection methods). However, we do agree that model-selection routines provide a reliable approach for choosing among models that are ecologically relevant and generate statistically robust estimators.

6) We have decided to not revise the choice of presentation of data in Figure 3-3.

Discussion

2) Dr. McLoughlin raises a good point regarding the differences in effort/cost between mark-recapture and track count methods. For future studies or reports, this analysis should be considered.

3) We have added a sentence to clarify the need for collection and fingerprinting of hair samples from wolverines that have been removed from development sites and harvested near the study area.

Once again, we would like to express our appreciation to Dr. McLoughlin for his constructive comments and suggestions, which has increased the quality of the report.

Yours very truly,

GOLDER ASSOCIATES LTD.

John Virgl, Ph.D.
Associate, Senior Environmental Scientist

JV/ldmg

N:\ACTIVE\2006\1328 YELLOWKNIFE\06-1328-001 DDMI\WILDLIFE\WOLVERINE DNA SAMPLING\PROJECT MANAGEMENT\RESPONSE TO PEER REVIEW.DOC

APPENDIX VIII

VEGETATION PVP TABLES

Mean percent cover of species in permanent vegetation plots, Diavik Diamond Mine, 2006

	Mine Sites										Control Sites								
PVP Number	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
Plant Community[1]	**H**	**H**	**WT**	**WT**	**S**	**H**	**WT**	**E**	**S**	**S**	**H**	**WT**	**S**	**H**	**WT**	**S**	**H**	**WT**	**S**
Vegetation Cover																			
Betula glandulosa	2.5	9.5	8.3	2.1	14.0	0.1	2.6	8.8	16.8	25.3	4.0	3.6	12.0	1.8	0.1	13.5	3.3	1.3	33.8
Salix glauca	0.9	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	2.3
Salix planifolia	0.1	1.0	0.0	0.1	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.3	0.0	0.0	4.0	0.8	0.0	0.0	0.3
Salix fruscescens	0.0	0.0	0.0	0.1	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Andromeda polifolia	0.0	0.0	0.0	2.8	0.2	0.0	9.0	0.0	0.1	0.0	0.0	4.5	0.3	0.0	0.6	0.0	0.0	0.3	0.0
Arctostaphylos rubra	4.8	1.3	0.8	0.0	0.0	0.0	0.0	0.0	8.8	6.8	13.0	7.5	0.0	0.0	0.0	4.3	5.3	0.0	15.8
Empetrum nigrum	4.3	6.3	1.0	0.3	0.1	0.0	0.0	34.3	3.3	13.0	0.0	1.8	6.3	7.3	0.8	30.0	11.8	0.6	6.0
Ledum decumbens	3.3	11.5	16.8	1.8	21.8	20.3	0.3	0.0	7.8	9.0	14.5	12.8	29.0	12.5	0.3	17.0	8.5	5.0	1.6
Loiseleuria procumbens	14.5	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.8	0.0	0.8	7.0	0.5	0.0
Oxycoccus microcarpus	0.0	0.0	0.0	0.0	0.0	0.0	1.8	0.0	0.0	0.0	0.0	0.0	0.8	0.0	1.3	0.0	0.0	0.1	0.0
Vaccinium uliginosum	0.4	0.3	0.0	0.4	3.3	1.8	2.6	1.3	4.5	6.3	0.5	8.0	6.5	7.5	4.3	7.3	1.8	0.8	1.3
Vaccinium vitis idaea	3.3	10.0	8.5	4.3	28.5	13.8	0.0	0.6	16.8	4.3	18.5	8.0	20.3	16.5	0.6	21.0	2.5	1.8	12.0
Astragalus agrestis	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Astragalus alpinus	3.3	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Astragalus sp.	0.6	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pedicularis lapponica	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0

Rubus chamaemorus	0.0	0.0	0.0	3.3	3.8	2.5	0.0	0.0	1.1	0.3	0.0	19.8	0.4	0.5	1.3	0.0	0.0	2.3	0.0
Stellaria sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Tofieldia pusilla	0.4	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Agrostis borealis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calamagrostis inexpansa	0.3	0.19	0.3	0.0	0.3	0.1	0.0	0.0	0.2	0.4	0.0	0.0	1.6	0.0	0.0	0.2	0.0	0.0	0.3
Poaceae	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Eriophorum angustifolium	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Eriophorum vaginatum	0.0	0.0	11.0	10.3	0.0	3.3	0.0	0.0	0.1	0.0	0.0	1.4	0.0	0.0	19.0	0.0	0.0	10.0	0.0
Carex aquatilus var. *stans*	0.6	0.4	0.0	0.6	0.6	0.1	18.3	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0
Carex aqualtius var. *aquatilus*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Carex saxatilis	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	1.5	0.0
Carex sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.1	0.0	0.1	0.0
Polytrichum sp.	0.0	0.0	0.0	0.2	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0
Moss	4.5	20.3	42.0	68.5	8.5	2.0	80.3	2.3	12.8	6.0	0.8	29.3	3.1	0.9	47.8	0.5	0.2	51.3	8.3
Fungus	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Non Vegetation Cover																			
Terricolous (soil) lichen	2.0	4.3	0.2	4.0	1.8	12.3	0.8	7.8	0.9	1.75	15.5	6.8	6.8	19.3	0.0	0.8	22.8	15.0	2.5
Saxicolous (rock) lichen	0.2	0.1	0.0	3.8	0.0	0.0	0.0	0.0	0.6	0.0	5.3	0.0	0.0	2.6	0.0	0.0	0.6	0.0	0.0
Litter	0.8	3.8	2.5	0.3	26.0	7.3	0.0	17.0	26.5	44.8	3.3	0.6	3.0	1.5	0.0	40.0	3.3	0.0	32.8
Rock	2.0	0.8	0.0	7.8	0.0	0.0	0.0	0.2	2.8	0.0	10.0	0.0	0.0	6.3	0.0	0.6	2.0	0.0	0.0
Animal pellets	0.4	0.3	0.3	0.1	0.0	0.2	0.1	1.3	0.0	0.1	0.1	0.0	0.0	0.2	0.0	0.0	0.2	0.1	0.1
Bare ground	8.3	3.8	0.0	2.0	0.0	1.1	0.3	8.6	0.3	0.0	1.1	0.0	0.3	3.3	6.8	0.0	2.5	1.0	0.3

[1] ***H = Heath, ST = Wet Tundra, S = Shrub and E = Esker community***

Mean percent cover on mine and reference sites, Diavik Diamond Mine, 2006

	Mine Heath	Reference Heath	Mine Wet Tundra	Reference Wet Tundra	Mine Shrub	Reference Shrub
Vegetation Cover						
Betula glandulosa	4 (3)[1]	3 (1)	4 (2)	2 (1)	19 (3)	20 (7)
Salix glauca	1 (1)	0 (0)	0 (0)	0 (0)	0 (0)	1 (1)
Salix planifolia	0 (0)[2]	0 (0)	0 (0)[2]	1 (1)	0 (0)	0 (0)[2]
Salix fruscescens	0 (0)	0 (0)	0 (0)[2]	0 (0)[2]	0 (0)	0 (0)
Andromeda polifolia	0 (0)	0 (0)	4 (3)	2 (1)	0 (0)[2]	0 (0)[2]
Arctostaphylos rubra	2 (1)	6 (4)	0 (0)[2]	3 (3)	5 (3)	7 (5)
Empetrum nigrum	4 (2)	6 (3)	0 (0)	1 (0)	5 (4)	14 (8)
Ledum decumbens	12 (5)	12 (2)	6 (5)	6 (4)	13 (5)	16 (8)
Loiseleuria procumbens	6 (5)	3 (2)	0 (0)	0 (0)[2]	0 (0)[2]	0 (0)[2]
Oxycoccus microcarpus	0 (0)	0 (0)	1 (1)	1 (0)	0 (0)	0 (0)[2]
Vaccinium uliginosum	1 (1)	3 (2)	1 (1)	4 (2)	5 (1)	5 (2)
Vaccinium vitis idaea	9 (3)	13 (5)	4 (2)	4 (2)	17 (7)	18 (3)
Astragalus agrestis	0 (0)[2]	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)[2]
Astragalus alpinus	1 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Astragalus sp.	0 (0)[2]	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Pedicularis lapponica	0 (0)	0 (0)	0 (0)[2]	0 (0)[2]	0 (0)	0 (0)[2]
Rubus chamaemorus	1 (1)	0 (0)[2]	1 (1)	8 (6)	2 (1)	0 (0)[2]
Stellaria sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)[2]
Tofieldia pusilla	0 (0)[2]	0 (0)	0 (0)[2]	0 (0)	0 (0)	0 (0)
Agrostis borealis	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)[2]	0 (0)
Calamagrostis inexpansa	0 (0)[2]	0 (0)	0 (0)[2]	0 (0)	0 (0)[2]	1 (0)
Poaceae	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Eriophorum angustifolium	0 (0)	0 (0)	0 (0)[2]	0 (0)	0 (0)	0 (0)
Eriophorum vaginatum	1 (1)	0 (0)	7 (4)	10 (5)	0 (0)[2]	0 (0)
Carex aquatilus var. *stans*	0 (0)[2]	0 (0)[2]	6 (6)	0 (0)[2]	0 (0)[2]	0 (0)
Carex aquatilus var. *aquatilus*	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)[2]	0 (0)
Carex saxatilus	0 (0)	0 (0)	0 (0)[2]	1 (1)	0 (0)	0 (0)
Carex sp.	0 (0)	0 (0)	0 (0)[2]	0 (0)[2]	0 (0)	0 (0)[2]
Polytrichum sp.	0 (0)	0 (0)	0 (0)[2]	0 (0)[2]	0 (0)	0 (0)
Moss	9 (6)	1 (0)	64 (11)	43 (7)	9 (2)	4 (2)
Fungus	0 (0)[2]	0 (0)	0 (0)	0 (0)	0 (0)[2]	0 (0)
Non Vegetation Cover						
Terricolous (soil) lichen	**6 (3)**	**19 (2)**	2 (1)	7 (4)	2 (0)	3 (2)
Saxicolous (rock) lichen	0 (0)[2]	3 (1)	1 (1)	0 (0)	0 (0)[2]	0 (0)

Litter	4 (2)	3 (1)	1 (1)	0 (0)	32 (6)	25 (11)
Rock	1 (1)	6 (2)	3 (3)	0 (0)	1 (1)	0 (0)[2]
Animal pellets	0 (0)[2]	0 (0)[2]	0 (0)[2]	0 (0)	0 (0)[2]	0 (0)[2]
Bare ground	4 (2)	2 (1)	1 (1)	3 (2)	0 (0)[2]	0 (0)[2]

SE are in brackets after the means
Significant differences at p = 0.05 are in bold type
[1] Means and SE are rounded to the nearest whole number
[2] Species present but in low abundance

Mean percent cover in mine heath and wet tundra, Diavik Diamond Mine, 2001, 2004, 2006

	Heath 2001	Heath 2004	Heath 2006	Wet Tundra 2001	Wet Tundra 2004	Wet Tundra 2006
Vegetation Cover						
Betula glandulosa	13 (6)	10 (4)	4 (3)[1]	12 (4)	13 (3)	4 (2)
Salix glauca	0 (0)	3 (1)	1 (0)	0 (0)	0 (0)	0 (0)
Salix planifolia	2 (1)	1 (1)	0 (0)[2]	1 (1)	0 (0)	0 (0)[2]
Salix herbecea	0 (0)[2]	0 (0)[2]	0 (0)	0 (0)	0 (0)[2]	0 (0)
Salix fruscescens	0 (0)	0 (0)[2]	0 (0)[2]	0 (0)	4 (4)	0 (0)[2]
Andromeda polifolia	3 (3)	2 (2)	0 (0)	2 (1)	3 (2)	4 (3)
Arctostaphylos rubra	5 (2)	6 (2)	2 (1)	1 (0)	1 (0)	0 (0)[2]
Empetrum nigrum	5 (1)	6 (2)	4 (2)	2 (1)	2 (1)	0 (0)[2]
Kalmia polifolia	0 (0)[2]	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Ledum decumbens	10 (4)	9 (3)	12 (5)	8 (4)	11 (6)	6 (5)
Loiseleuria procumbens	6 (4)	7 (5)	6 (5)	0 (0)	0 (0)	0 (0)
Oxycoccus microcarpus	0 (0)	0 (0)[2]	0 (0)	0 (0)	0 (0)	1 (1)
Vaccinium uliginosum	2 (1)	2 (0)	1 (1)	1 (0)	1 (0)	1 (1)
Vaccinium vitis idaea	13 (3)	10 (3)	9 (3)	9 (3)	8 (3)	4 (2)
Astragalus agrestis	0 (0)	0 (0)	0 (0)[2]	0 (0)	0 (0)	0 (0)
Astragalus alpinus	1 (1)	1 (1)	1 (1)	0 (0)	0 (0)	0 (0)
Astragalus sp.	0 (0)	0 (0)	0 (0)[2]	0 (0)	0 (0)	0 (0)
Pedicularis lapponica	0 (0)	0 (0)[2]	0 (0)	0 (0)[2]	0 (0)[2]	0 (0)[2]
Rubus chamaemorus	0 (0)[2]	0 (0)[2]	1 (1)	4 (2)	2 (2)	1 (1)
Tofieldia pusilla	0 (0)[2]	0 (0)	0 (0)[2]	0 (0)	0 (0)	0 (0)[2]
Agrostis borealis	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)[2]	0 (0)
Calamagrostis inexpansa	0 (0)	0 (0)	0 (0)[2]	0 (0)	0 (0)[2]	0 (0)[2]
Poaceae	0 (0)	0 (0)[2]	0 (0)	0 (0)	0 (0)	0 (0)
Eriophorum angustifolium	0 (0)	0 (0)	0 (0)	0 (0)	2 (2)	0 (0)[2]
Eriophorum vaginatum	0 (0)	0 (0)	1 (1)	17 (14)	8 (5)	7 (4)
Carex aquatilus	3 (2)	3 (2)	0 (0)[2]	2 (2)	7 (6)	6 (6)
Carex rotundata	0 (0)	0 (0)	0 (0)	4 (2)	3 (3)[3]	0 (0)
Carex saxatilis	0 (0)[2]	0 (0)	0 (0)	0 (0)[2]	0 (0)	0 (0)[2]
Carex sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)[2]
Polytrichum sp.	0 (0)	0 (0)	0 (0)	0 (0)[2]	0 (0)[2]	0 (0)[2]

Moss	17 (13)	31 (14)	9 (6)	33 (14)	47 (12)	64 (11)
Fungus	0 (0)[2]	0 (0)	0 (0)[2]	0 (0)	0 (0)	0 (0)
Non Vegetation Cover						
Terricolous (soil) lichen	8 (2)	6 (2)	6 (3)	2 (2)	1 (1)	2 (1)
Saxicolous (rock) lichen	nm[4]	nm	0 (0)[2]	nm	nm	1 (1)
Litter	nm	nm	4 (2)	nm	nm	1 (1)
Rock	2 (1)	1 (0)	1 (1)	0 (0)	0 (0)	3 (3)
Animal pellets	nm	0 (0)[2]	0 (0)[2]	nm	0 (0)[2]	0 (0)[2]
Bare ground	**11 (3)**	**2 (0)**	**4 (2)**	2 (2)	1 (1)	1 (1)

SE are in brackets after the means; Significant differences at p = 0.05 are in bold type
[1] Means and SE are rounded to the nearest whole number
[2] Species present but in low abundance
[3] Listed as Carex #1 in 2004 but included in Carex rotundata for analysis as only Carex in plot and similar abundance.
[4] nm = not measured