A Review of the 2019 Diavik Diamond Mine Wildlife Monitoring Report

Prepared for

Environmental Monitoring Advisory Board

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Prepared by

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Executive Summary

In this review on behalf of the Environmental Monitoring Advisory Board (EMAB or the Board), Management and Solutions in Environmental Science (MSES) assesses the procedures and results of the 2019 Wildlife Monitoring Report (WMR; Golder 2020). The annual data collection is mandated to follow a Wildlife Monitoring Program (WMP), developed in 2002, which determined the testable questions and the objectives that need to be addressed through the life of the project. The WMP is a requirement of the Diavik Environmental Agreement (2000) which is an agreement between Diavik Diamond Mine Inc. (DDMI), local Indigenous groups and the federal and territorial governments that formalizes Diavik's environmental protection commitments. Review of the WMRs assists the Board in partially fulfilling its mandate as outlined in the Diavik Environmental Agreement. Since 2004, MSES reviewed the WMRs to evaluate how the WMP was and is adhered to. In the course of 2010, MSES participated in several communications with DDMI and other parties where a number of recommendations were discussed in workshops and other venues to adapt the data collection in light of the information available at the time (Handley 2010). These recommendations, in part, altered the objectives of the 2002 WMP which are now reflected in the WMRs since 2011. Specific to grizzly bear, the monitoring objective was revised once again at a March 2013 Wildlife Monitoring Workshop hosted by the GNWT (GNWT 2013). Below we have summarized our key review findings for the 2019 WMR.

The overall area of disturbance (km^2) declined in 2019 and remains below predicted levels. Patches of undisturbed terrestrial vegetation within the Mine footprint were removed from the disturbance calculation in 2019 because they will remain intact throughout the life of the project. Only three Ecological Land Classification (ELC) or vegetation types (down from six last year) out of 12 were disturbed in 2019 including heath tundra (0.06 km^2), heath boulder (0.02 km^2), and tussock/hummock (0.01 km^2). In 2019, the overall disturbance of vegetation types was at or slightly exceeded predicted levels for heath tundra, riparian shrub, birch seep and shrub, boulder complex, bedrock complex, and esker (disturbed ELC Type excluded from count).

The 2019 WMR indicates that direct summer caribou habitat loss is ~2.754 habitat units (HU), which is below the 2018 level of 2.90 HU. An explicit reason for the decline in HU disturbed by mining operations from 2018 was not provided, although we assume it is related to the removal of undisturbed terrestrial habitats from Mine footprint calculations described in Section 3.1 of the WMR (pg. 8). Direct summer caribou habitat loss remains below predicted levels of 2.965 HUs.

The mean population size of the Bathurst caribou herd has decreased between 1996 (349,000) and 2018 (8,200) resulting in fewer caribou monitoring opportunities over time relative to the Diavik mine site. The population decrease also corresponds with changes in Bathurst caribou seasonal range patterns including an overall contraction of their range and a delay in their southern (fall) migration to below treeline. Caribou from the Beverly/Ahiak herd are also reported in the Diavik study area in more recent years. Aerial surveys for caribou have not been completed since 2012.

In 2019, DDMI completed a reanalysis of the aerial survey data and concluded there is no ZOI around the Mines for caribou. The new analysis takes into consideration the relationship between caribou density, the amount of preferred habitat, and insect harassment to satisfy previous requests from EMAB. It uses the statistical interaction between distance and the amount of preferred habitat to identify the presence or absence of a ZOI effect on caribou density. We have a number of questions about the approach to,

and interpretation of, the analysis. At this time, we do not concur with DDMI that the analysis as presented clearly demonstrates the absence of a ZOI.

Caribou behaviour data were collected and summarized in the 2019 WMR. Statistical analysis of the data cannot be completed because sample sizes have been, and remain, insufficient. EMAB previously requested behavioural data summaries by mine operator, type of scan, season, distance from mine, and year, DDMI presented those in the 2019 WMR. While DDMI assures that running or trotting is done for very short periods of time. A demonstrated lack of statistical difference would provide more relevant information. We recommend that DDMI continue their efforts to collect caribou behaviour data annually.

No new caribou collar data was presented to inform the questions with respect to seasonal movement in the 2019 WMR. Over the long-term, caribou are following the predicted pattern for the northern migration; however, not for the southern migration. DDMI has concluded that the prediction in the Environmental Effects Report (EER) was inaccurate but conservative and that there is no evidence of an ecological effect of population fragmentation due to changes in the southern migration. As a result, they suggest that deflection monitoring is no longer necessary. There remains uncertainty regarding the primary driver of the observed change in caribou migration: is it a project effect, cumulative effect, or natural phenomenon linked with the population decline? We continue to recommend that the question of the influence of mining on caribou distribution remains "on the table" through the annual collection and evaluation of GPS-collar data, with the possibility of linking caribou energetics to the issue.

For grizzly bears, both mortality and habitat loss remain at or below the levels predicted. The number of days with deterrent actions increased from 2018 to 2019. Hair snagging did not take place in 2019, but previous results suggest a stable or increasing population, and project-specific impacts of the mine on grizzly bears are likely minimal.

For wolverine, mortality due to the Mine remains low. DDMI updated their analysis of snow track survey data in 2019. The Multi-Season Occupancy Model analysis still lacked enough data to isolate the effects of distance to the mine from habitat quality on occupancy. Using two alternative analyses, DDMI demonstrated there is a positive effect of habitat on occupancy, and that distance has a positive effect on wolverine occupancy as well. Given the potentially negative impacts of the Mines on wolverine occupancy, periodic wolverine hair snag sampling would be useful for ensuring regional populations remain stable over time.

There do not appear to be any new findings or changes of note regarding the presence and productivity of falcons. Two active peregrine nests were observed in 2019. Project-specific effects on peregrine falcons are likely minimal.

In 2019, observations of wildlife, primarily red foxes, were highest for the Waste Transfer Area (WTA) and the number of misdirected food and food packaging items was highest for the WTA. In general, the number of wildlife observations in the WTA and the Landfill were lower in 2019 than in 2018, and roughly the same in the A21 Area and the Underground.

In the past, the measurements have adequately addressed the predictions at hand and the analysis of the data yielded a great deal of credible information about the effectiveness of mitigation measures. However, there are some widening gaps in data collection, analysis, and reporting, particularly relating to caribou. Below, we present some highlights for the Boards' consideration. We recommend that the following issues be addressed:

1. DDMI has committed to determine and discuss appropriate ZOI monitoring with EMAB, when required. However, given the lack of anticipated guidance from ENR, it is unclear when this discussion and decision might occur. DDMI should complete an analysis of existing satellite collar data to inform the ZOI question.
2. There is now a seven-year gap in caribou behavioural data analysis (2012-2019) due to insufficient data. Ekati and DDMI are cooperating on data collection. We emphasize the importance of these data in understanding the influence of the Mine on caribou and the mechanism that lead to the avoidance of the Mine vicinity. DDMI provided a summary of caribou behaviour data as requested. Based on that information, we recommend DDMI compare caribou running bouts as a function of distance. Please also consider grouping or separating running and trotting activities for the analysis.
3. No additional data was collected in 2019 to analyse caribou deflection east or west of Lac de Gras. Existing data shows a more consistent departure from predictions for the southern migration in more recent years. Further data collection and analysis is required to understand the reason for the change in migration pattern and the consequences for caribou.
4. Please respond to all recommendations contained in the excel spreadsheet provided by EMAB.
5. Except for our recommendations listed above, we are in agreement with the recommendations listed in the 2019 WMR and do not recommend any actions additional to providing the information requested above.
6. We recommend that the Board accept the 2019 WMR with the understanding that the above listed questions and recommendations will be addressed in a timely fashion via communications and workshops by DDMI in the coming year. The responses to our questions and recommendations are necessary to maintain and improve the understanding of the effects of the Mine on wildlife. Furthermore, we understand that detailed data analyses are required, as identified in our review, and that these analyses will be conducted in the near future.

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1.0 Introduction

The Environmental Monitoring Advisory Board (EMAB or the Board) for the Diavik Diamond Mine Inc. (DDMI) Project requested that Management and Solutions in Environmental Science Inc. (MSES) review and assess the procedures and results of the 2019 Wildlife Monitoring Report (WMR; Golder 2020). A WMR is completed annually while, in the past, a Wildlife Comprehensive Analysis Report (WCAR) has been completed every three years and submitted as a separate report. Currently, comprehensive analyses will be completed every three years but included within the annual WMR rather than as a stand-alone document. The 2019 WMR includes comprehensive analyses. The WMR communicates the findings of surveys conducted during 2018 as well as DDMI's recommendations for future activities.

The annual data collection is mandated to follow a Wildlife Monitoring Program (WMP), developed in 2002, which determined the testable questions and the objectives that need to be addressed through the life of the project. The WMP is a requirement of the Diavik Environmental Agreement, which is an agreement between DDMI, local Indigenous groups and the federal and territorial governments that formalizes Diavik's environmental protection commitments. Review of the WMRs assists the Board in partially fulfilling its mandate as outlined in the Diavik Environmental Agreement. Since 2004, MSES reviewed the WMRs and WCARs to evaluate how the WMP was and is adhered to. In the course of 2010, MSES participated in several communications with DDMI and other parties where a number of recommendations were discussed in workshops and other venues to adapt the data collection in light of the information available at the time (Handley 2010). These recommendations, in part, altered the objectives of the 2002 WMP which are now reflected in the WMRs since 2011.

Based on its annual reviews of past WMRs and detailed data analyses (WCARs), MSES submitted numerous recommendations for EMAB and DDMI to consider. The present report takes past recommendations and discussions, as well as the altered WMP objectives, into account.

In our review below, for the ease of identifying our recommendations and requests, we highlight the **text in bold** where we specifically request actions from DDMI or where a commitment has been made by DDMI.

2.0 General Observations

2.1 Objectives of the Wildlife Monitoring Program

The objectives of the WMP v.2 were developed in 2002 and DDMI has anchored its monitoring reports on these objectives. For more clarity, below we re-state the objectives set forth in the WMP v. 2 of 2002 to emphasize that these objectives are the foundation and focus of our review, and that the methods and results in the 2019 WMR, are reviewed in light of these objectives, as amended in 2010.

"The objectives of the wildlife monitoring program are to:

a. Verify the accuracy of the predicted effects determined in the Environmental Effects Report (Wildlife 1998) and the Comprehensive Study Report (June 1999); and

b. Ensure that management and mitigation measures for wildlife and wildlife habitat are effective in preventing significant adverse impacts to wildlife."

A number of specific questions that have been tested in the course of the years of monitoring have been found to be either largely answered or ineffective for the testing of mitigation effectiveness, prompting discussions about adapting the objectives of data collection in light of current information (Handley 2010). Specific to grizzly bear, the monitoring objective was revised once again at a March 2013 Wildlife Monitoring Workshop hosted by the GNWT (GNWT 2013). The new grizzly bear and wolverine objectives are to provide estimates of grizzly bear and wolverine abundance and distribution in the Diavik Wildlife Study Area over time. The new barren ground caribou monitoring program objectives are to determine whether the zone of influence changes in relation to changes in Mine activity and whether caribou behaviour changes with distance from the mines. The new objectives of the falcon monitoring program are to contribute data to the Canadian Peregrine Falcon Survey (CPFS), identify any pit wall or infrastructure nesting sites, determine nest success and deterrent effectiveness, and determine cause of any Mine-related raptor mortalities.

2.2 The State of Current Information

The 2019 WMR includes a discussion of effects on wildlife from the previous year. Detailed analyses for barren-ground caribou and wolverine were last completed in 2017 (WCAR; Golder 2017a); this year, DDMI completed new analyses for both caribou (e.g., Changes to Movement or ZOI) and wolverine (e.g., updating the Multi-Season Occupancy Model (MSOM)), while other analysis still require more data (e.g. caribou behaviour). Other programs continue to have data collection suspended (e.g., caribou aerial surveys or grizzly bear/wolverine hair snagging for evaluating abundance and distribution). Caribou distribution was not reported on for the first time in 2019.

For the reader of this review, however, we re-state some of the highlights in the previous years' reviews, in addition to results from the current review, as this is the currently best available information on trends and data quality:

- The detailed analyses conducted in past years were generally well presented and informative. We would like to note that some of the recommendations made in previous years have been incorporated into subsequent analyses. We would like to commend the authors for including more detail in the analytical results when sufficient data were available.
- Caribou habitat loss remains at or below the levels predicted. With respect to caribou movement, DDMI conducted a new analysis that attempts to account for habitat and insect harassment. Based on the new analysis, DDMI concludes there is no ZOI around the Mines. We raised several questions about the analysis and do not agree that it conclusively demonstrates the lack of a ZOI. As far as caribou behaviour is concerned, DDMI did not identify any significant trends in the behaviour data. They directly addressed some of the previous requests we made regarding the presentation of the data. DDMI indicates that there continues to be a lack of data that would allow for the statistical analysis of behavior at different distances to the Mines. Finally, regarding caribou distribution, caribou migration patterns are continuing as predicted for the northern migration; however, over the long-term, the southern migration appears to have occurred further

west and more recently has remained further north than anticipated. DDMI has suggested that deflection monitoring is not necessary because an adverse ecological effect is not evident. Predictions relating to caribou movement, behaviour, and distribution are not being verified regularly, which means that mitigation is not being verified and management actions cannot be updated.

- For grizzly bears, both mortality and habitat loss remain at or below the levels predicted. Incidental observations suggest there may be an increasing number of grizzly bear occurrences, number of days with bear visitations, and number of days with deterrent actions over time. Hair snagging did not take place in 2019.
- For wolverine, mortality due to the Mine remains low. DDMI updated their analysis of snow track survey data in 2019. The MSOM analysis still lacked enough data to isolate the effects of distance to the mine from habitat quality on occupancy. Using two alternative analyses, DDMI demonstrated there is a positive effect of habitat on occupancy, and that distance has a positive effect on wolverine occupancy as well. Given the potentially negative impacts of the Mines on wolverine occupancy, periodic wolverine hair snag sampling would be useful for ensuring regional populations remain stable over time.
- In 2019, observations of wildlife, primarily red foxes, were highest for the Waste Transfer Area (WTA) and the number of misdirected food and food packaging items was highest for the WTA. In general, the number of wildlife observations in the WTA and the Landfill were lower in 2019 than in 2018, and roughly the same in the A21 Area and the Underground.
- The Canadian Peregrine Falcon Survey (CPFS) was discontinued in the NWT in 2015; therefore, DDMI is no longer providing nest site occupancy and productivity data to the Canadian Wildlife Service (CWS). Pit walls and other infrastructure are still monitored for nesting raptors and nest monitoring data are still contributed to ENR every 5 years. In 2019 45 pit wall/infrastructure inspections were completed, two active peregrine falcon nests were observed, but no observations of fledglings were recorded.

DDMI provided responses to our recommendations and questions from 2019 (Appendix A, 2019 WMR). Table 1 summarizes the current status of our 2019 recommendations. See Appendix A for a record of requests that have been addressed in previous years.

Table 1: Actions by DDMI in Response to Recommendations that were developed in 2019 or carried over from previous years.

Recommendations/Questions in 2019[1]	Action by DDMI
Vegetation and Wildlife Habitat	
DDMI Reference #: WMP-2019-09	DDMI confirmed that reclamation activities will be applied to areas directly disturbed by Mine

[1] For historical information / additional context for 'Recommendations/Questions in 2019', please refer to Appendix A of the Golder (2020).

DDMI responded that the ecological relevance of the results is uncertain [Vascular plant species richness was actually 54% higher on heath tundra plots and 9% higher on shrub Mine plots], and that current mitigation appears to be effective at minimizing adverse effects to vegetation (Golder 2017b). Changes in vegetation structure may be a contributing factor to the observed caribou ZOI (14km) and there may be cumulative changes over time to vegetation structure. In lieu of additional mitigation measures during operations, the topic should be addressed in the Mine closure plan and proposed reclamation activities with particular attention focused on ensuring that forage species palatable to caribou be part of the mix of species (at a natural ratio) in the reclaimed landscape. DDMI has indicated that vegetation monitoring post-closure will include reference sites to determine whether reclaimed areas provide similar ecological function to that of similar, undisturbed areas. However, we understand that reclamation will be applied to areas within the direct disturbance footprint, rather than areas indirectly affected by mine operations. It would be interesting to see how indirectly affected caribou habitat recovers post-closure. **Please clarify if reclamation activities will be restricted to the project footprint.**	infrastructure. Many indirect effects (e.g. sensory disturbances) will be functionally reclaimed once operations stop. **This request is satisfied**. This simply means that indirect effects to vegetation will not be further mitigated, nor reclaimed, and we just hope that vegetation recovers (species richness returned to baseline levels and dust is no longer a concern) and is not a major mechanism for caribou avoidance. **In order to alleviate any remaining concerns about dust impacts, we recommend that DDMI continue to monitor indirectly impacted vegetation plots outside of reclaimed areas to evaluate how quickly the residual effects of dust are resolved after reclamation activities/post-operations.**
Barren-Ground Caribou	
Caribou Habitat Loss	
DDMI Reference #: WMP-2019-10 DDMI indicated that the ZOI analysis for caribou captures the effect of indirect habitat loss (22 February 2018 conference call). In the 2018 WMR (Appendix A, Table 4), DDMI provided additional information on changes in the area of high, moderate, low, and nil suitability caribou habitat assuming that sensory disturbance reduced habitat suitability by one level. DDMI stated that the area is of marginal quality in the absence of indirect changes and that ecological impacts are likely to be limited considering the limited amount of time caribou are present in the area. **Opportunities for improvement of existing mitigation measures that alleviate noise, dust, light, sounds, smell, and human presence may arise with technological advances and should be implemented to help minimize indirect impacts on caribou habitat.**	DDMI has responded that they already use accepted best practices as part of mitigation designs and to meet regulatory guidelines. It is assumed this practice will continue as technology advances. **This request is satisfied.** DDMI confirmed that reclamation activities will be applied to areas directly disturbed by Mine infrastructure. Many indirect effects (e.g. sensory disturbances) will be functionally reclaimed once operations stop. **This request is satisfied**. **Also see DDMI Reference # WMP-2019-9 response**.

DDMI also stated that vegetation monitoring post-closure will include reference sites to determine whether reclaimed areas provide similar function to similar, undisturbed areas. However, we understand that reclamation will be applied to areas within the direct disturbance footprint, rather than areas indirectly affected by mine operations. It would be interesting to see how indirectly affected caribou habitat recovers post-closure and this information may be useful for other mining operations. **Please clarify if reclamation activities will be restricted to the project footprint.**	
Caribou Movement	
DDMI Reference #: WMP-2019-11 DDMI responded that there was uncertainty regarding the original prediction based on the level of knowledge available at the time (1998) [ZOI: predicted 3-7 km; observed 14 km]. DDMI indicated that the mechanism that causes the pattern is unclear because all sources of sensory disturbance operate simultaneously (noise, dust, light, sounds, etc). DDMI indicated that "A larger observed effect than predicted does not necessarily mean that mitigation for sources of sensory disturbance are not effective because there was uncertainty with the prediction." **Opportunities for improvement of existing mitigation measures that alleviate noise, dust, light, sounds, smell, and human presence may arise with technological advances and should be implemented to help minimize indirect impacts on caribou habitat.** In March 2019, EMAB made the recommendation that "Diavik should include a description of its adaptive management activities and an evaluation of how well they are working as a sub-section for each program component in the 2018 WMP Report and have this as a regular section in future annual WMP Reports" (EMAB 2019a). DDMI has included an "*Adaptive Management and Recommendations*" section for each species. When more information on potential mechanisms for the 14 km ZOI becomes available, we anticipate discussions regarding the implementation of new mitigation measures to manage any project-related effects and that this information appear in these report sections in the future.	DDMI has responded that they already use accepted best practices as part of mitigation designs and to meet regulatory guidelines. It is assumed this practice will continue as technology advances. **This request is satisfied.** DDMI reports on adaptive management activities annually for the WMP. When more information on potential mechanisms for the ZOI becomes available, we anticipate discussions regarding the implementation of new mitigation measures to manage any project-related effects and that this information appear in these report sections in the future. **See DDMI Reference # WMP-2019-15 and WMP-2019-12 responses.**

DDMI Reference #: WMP-2019-12 Boulanger et al. (2012) conclude a zone of influence of 14 km. In the 2018 SGP Wildlife Monitoring Workshop, an approach to ZOI analysis was presented which evaluates ZOI on an annual basis using GPS collar data. This approach could be used to analyze ZOI for the 2018 season for the Diavik mine. DDMI indicated that the amount of variation in the results of this approach suggests that there is a high degree of uncertainty in whether a ZOI exists, that the duration of an effect is periodic, or that caribou may become habituated to mine activity. DDMI concludes that the year-to-year variation indicates there is little value in ZOI monitoring for mitigation effectiveness. **We recommend that EMAB review Boulanger's new approach once more information is available.** Boulanger's approach may offer new insight or opportunity into uncovering a mechanism for the ZOI, which could lead to improvement of effect mitigation.	DDMI's position is that the precision of annual ZOI estimates shown at the workshop by Boulanger indicate it will not be a robust approach for assessing mitigation effectiveness, which was also pointed out by ENR. **See DDMI Reference #: WMP-2019-15 (below) regarding plans for future ZOI monitoring.** In the 2019 WMP, DDMI submitted a new analysis of caribou aerial data (1999 – 2012) to re-evaluate the concept of a ZOI. DDMI concluded that a measurable ZOI was not detected or supported by the data. **Please refer to Section 3.2.2 of this report for comments on this analysis and a suggestion for an alternate analysis that may also allow for the size of the ZOI to be monitored over time.**
DDMI Reference #: WMP-2019-13 DDMI responded that temporal mine activity indices were included as covariates in 2011, 2014, and 2017 analyses with no significant relationships between mine activity and indirect effects being detected (2018 WMR, Appendix A). **We recommend that EMAB review Boulanger's new approach once more information is available.**	**See DDMI Reference # WMP-2019-12 response.**
DDMI Reference #: WMP-2019-14 DDMI stated that the mechanism of caribou ZOIs is unknown at this time and therefore cannot be adaptively managed. DDMI indicated that it incorporates TK into the identification of effects, monitoring, and mitigation design. A TK study noted that caribou will avoid using areas close to the mine during migration because dust on forage will alter its taste or smell (Section 2.0, 2018 WMR). This suggests that a mechanism for the caribou ZOI is dust. **Are there opportunities for improvement of existing mitigation measures that alleviate dust to help minimize indirect impacts on caribou?** **DDMI did not comment on the potential for coordination of mitigation measures between mines to improve current effect mitigation.**	DDMI has responded that they already use accepted best practices as part of mitigation designs and to meet regulatory guidelines. It is assumed this practice will continue as technology advances. **This request is satisfied.** DDMI responded that they do not engage with other mines, including discussions of mitigation, but that to their knowledge, mines all use similar mitigation. **This request is satisfied**. DDMI continues to monitor vegetation and lichen for dust deposition and metal concentrations (see Appendix A of this report for past discussion of the issue).
DDMI Reference #: WMP-2019-15	In 2019, EMAB recommended that "GNWT-ENR should also follow through on its commitment to

We expect that ENR will recommend that in 2019, formal ZOI monitoring will resume given that Diavik was planning for aboveground mining in the A21 pit in 2018 (GNWT 2017). Based on the 22 February 2018 conference call, we expect that monitoring will occur using geo-fence collar data and not aerial surveys given the small number of caribou that occur within the study area in recent years and the increasing sample size from GPS collars over time (currently 50 collars – 40 female, 10 male). **DDMI committed to determine and discuss the appropriate method of ZOI monitoring when required.**	recommend that Diavik resume ZOI monitoring, in accordance with the ZOI Guidance Document, in 2019" (EMAB 2019b). A letter from GNWT-ENR states that "*GNWT-ENR recommends that draft guidance document be used by mine operators to guide their decisions related to meeting the intent of their WEMP and reinstating ZOI monitoring.*" (GNWT, March 9th, 2020). This statement appears to place the decision to re-commence formal ZOI monitoring with mine operators. DDMI has committed to determine and discuss appropriate ZOI monitoring with EMAB, when required. However, given the lack of anticipated guidance from ENR, it is unclear when this discussion and decision might occur. **We recommend DDMI provide additional information on their intentions for reinstating ZOI monitoring and potential methods.** **Also see DDMI Reference # WMP-2019-12 response.**
DDMI Reference #: WMP-2019-16 During the 2018 SGP Wildlife Monitoring Workshop, an approach to ZOI analysis that evaluates ZOI on an annual basis using GPS collar data was presented. Given that aboveground mining in the A21 pit was planned to begin in 2018, we anticipate that Diavik will resume ZOI monitoring in 2019. DDMI responded that they will determine whether collar, aerial survey data or an alternative method will be used for ZOI monitoring when required. **DDMI committed to discuss this with EMAB at that time**.	**See DDMI Reference #: WMP-2019-15 and WMP-2019-12 responses.**
DDMI Reference #: WMP-2019-17 [Regarding caribou density analysis (Golder 2017a):] DDMI indicated that a new analysis that considers habitat and population size, among other factors, is underway and will be reported when complete (Golder 2017b). DDMI responded that linear regression is robust against the violation of the normality assumption, particularly when sample sizes are large, such as in this case (n>142,000). **DDMI indicated that the new analysis that is underway assumes a negative binomial distribution and DDMI agreed and intends to include additional factors such as habitat and population size in the new analysis.** We look forward to seeing the new analysis.	DDMI indicated that the results of this analysis will be included in the 2019 WMP report. **See DDMI Reference # WMP-2019-12 response.**

Caribou Behaviour	
DDMI Reference #: WMP-2019-18 DDMI provided a summary of behaviour data collected in the regional study area, within and beyond 15 km and relative to Bathurst caribou data collected by other researchers (Appendix D, 2018 WMR). The data included information on feeding behaviour only. The dataset provided was a summary and we cannot know the sample size for some of the categories, such as season or by year. DDMI responded that behaviours observed other than feeding time include time spent bedded, trotting, running, walking and alert and that a summary of these behavioural types is provided in annual WMP reports and in Golder (2011). **Please provide a summary of rates of each caribou behavioural activity, particularly those activities with high energetic costs, also categorizing information by year and season (similar format to the information provided in Appendix D).** In the 2018 WMR (Appendix A), DDMI provided references to 4 separate locations where behavioural sample sizes are provided: Golder (2018), Table 2.6-1 (Golder 2011), Figure 2 (Golder 2019), and Figure 3 (Golder 2019). Based on the multiple sources and formats of the information, it is challenging to understand exactly what the sample sizes are for the different caribou activities, seasons, years, near and far from the mine. It would be helpful to have information on samples by season, year, and distance to evaluate this claim. An annual update to such information would provide transparency and clarity on the status of behavioural data. **These information sources should be reconciled into a single file that can be updated annually and easily referenced for future discussions.**	DDMI provided a summary of caribou behaviour data in Appendix B that meets this request. **This request is satisfied**. DDMI provided a summary of the data for different caribou behavior activities in Appendix D. **This request is satisfied.** The purpose of the request was to understand behavioural data availability and whether there are enough data to conduct analyses by specific categories or by pooling data from different categories (e.g., season, time period, etc.). Previously, DDMI has stated: "*Based on these conditions, feeding activity of 55 different caribou groups are required for each of the two distance strata to statistically detect a change in feeding activity of at least 15%.*" (Golder 2017)". **If possible, please clarify why there is not behaviour data from the Ekati mine for the years 2017 –2019 (e.g. are they not collecting data during the winter season or are they not seeing caribou?).** Regarding other caribou activities, while DDMI assures that running or trotting is done for very short periods of time. A demonstrated lack of statistical difference would provide more relevant information. **We recommend DDMI evaluate whether the data can be pooled and analyzed while considering covariates such as year, gender, and distance to the Mine.** The combination of walking with running and trotting in the 2011 behavioural analysis may be diluting the effect of trotting and running (higher energy activities). **We recommend DDMI compare caribou running bouts as a function of distance. Please also consider grouping or separating running and trotting activities for the analysis.** Komers et al. (1999) found that although running made up a very small percentage of the total activity, a small increase in the behaviour resulted in measurable weight lost (i.e., higher energy expenditure). Diavik has indicated that caribou are now most common in the study area during winter when the ability to implement far field data collection is

	constrained by extreme environmental conditions. A letter communication from DDMI explains the challenges of collecting these data (DDMI January 2020). We acknowledge these challenges and encourage DDMI to continue their efforts to collect caribou behaviour data in a way that attempts to balance near-mine and far-field samples.
DDMI Reference #: WMP-2019-19 DDMI has committed to provide the requested summary table [of existing behaviour data] in the next WMR report. **We await the table.**	DDMI provided a summary of caribou behaviour data in Appendix B that meets this request. DDMI provided a summary of the data for different caribou behavior activities in Appendix D. **This request is satisfied.** **See DDMI Reference # WMP-2019-18 response.**
Caribou Distribution	
DDMI Reference #: WMP-2019-20 DDMI responded that Section 1.0 of the 2017 WMP report included a discussion of the adaptive management process, including examples. DDMI reported on monitoring components that have been suspended or removed through adaptive management and the evolution of the WMP in response to changes to objectives, study designs, and methods. DDMI indicates that EMAB (MSES) committed to recommending adaptive management strategies to mitigate caribou deflections around Lac De Gras (June 2018 meeting). Given our restricted level of involvement in the mining operation itself, we can only make general recommendations that we suggest DDMI discuss with their project engineers. **We recommend that DDMI explore opportunities and options to mitigate dust deposition, which may be influencing caribou migration patterns according to TK. This could include a coordination of best management practices for all mining operations in the vicinity. We have suggested some mitigation in the past as well, such as scheduling of air traffic mitigation and blasting around periods of caribou migration.** In addition, the predicted maximum dust deposition rate (125 mg/dm2/y) has been exceeded (DDMI 2018). The average deposition that occurred between 2000-2016 on near-mine sites is 470 mg/dm2/y (measured > predicted). **We recommend DDMI provide a list of adaptive**	Regarding fugitive dust, DDMI has responded that they already use accepted best practices as part of mitigation designs and to meet regulatory guidelines. It is assumed this practice will continue as technology advances. **This request is satisfied.**

management measures that they have put in place to mitigate the higher than anticipated dust deposition associated the mine.	
DDMI Reference #: WMP-2019-21 DDMI responded that there is no evidence of an ecological effect of population fragmentation due to changes in the southern migration. DDMI concludes that the prediction in the ERR was inaccurate but conservative. DDMI also suggests that "*caribou may be more resilient to migration movements around Lac de Gras than previously assumed. Based on the principal of adaptive management, deflection monitoring is not necessary because an adverse ecological effect is not evident*" (Appendix A, 2018 WMR). Considering this information, the population may remain connected, but then does this mean that the prediction and test in the WMR that is intended to evaluate the change in caribou distribution is not appropriate? If the monitoring results do not follow the prediction but one can still conclude the population is connected, then it seems that an incorrect test is being applied in the WMRs. In essence, the monitoring has confirmed that there has been a shift in the southern migration, but this shift is not necessarily linked with the Mine**. There is uncertainty regarding the primary driver of the observed change in caribou migration: Is it a project effect, cumulative effect, or natural phenomenon linked with the population decline (though DDMI largely attributes it to natural range contraction (Table 3, DDMI 2018))? We recommend that the question of the influence of mining on caribou distribution remains "on the table" through the annual collection and evaluation of GPS-collar data. Please provide ideas on how DDMI can continue to monitor changes in herd distribution specifically in relation to the Diavik mine using collar data, if DDMI is proposing to remove the deflection test.** **Please provide a discussion regarding the original intent behind the predictions regarding the northern and southern migrations (i.e. please clarify if the original prediction related to the connectedness of the herd, change in the movement (and thus**	DDMI's adaptive management regarding changes in the southern migration is to remove deflection monitoring from the wildlife program because there is little value to continue evaluating this prediction when the measured change does not correspond to a measurable ecological effect (cows still reach seasonal ranges from year to year). DDMI explained elsewhere that migration predictions were based on a least-cost path (friction) analysis. Movement (energetic) cost was calculated for 10 simulated paths for baseline for fall migration (5 paths moved east, 5 paths moved west, and 1 path traversed Lac de gras via East Island). Thus, more paths were expected east of Lac de Gras than west during fall migration. **We recommend Diavik answer the following questions:** • **If predictions calculated paths of least resistance in terms of energetics, why doesn't the monitoring program evaluate the energetic cost of migration?** This would be more informative than counting East/West deflections. • **Do changes in migration have a consequence for caribou energetics: Can we compare the predicted development scenario ("cost-of-movement index") with what is there now? Is the cost of movement as predicted? Do current pathways used by caribou have higher, same, or lower energetic cost ("cost of movement index") than baseline and predicted scenarios?** Overall, the departure from predictions for the southern migration is small; however, data from more recent years show a trend toward a more consistent departure from predictions. It may be too early to conclude no effect of the mine and

energetics) of the herd, or any other concepts). Please explain why a deflection test was selected to test predictions regarding caribou distribution since predictions were not followed but DDMI can still conclude no effect of the Mine.	remove monitoring. Regarding the potential influence of the mine specifically (i.e., mechanisms): • **Did the southern migration change at a time of new infrastructure (e.g. new pit)?** • **Did important corridors become dysfunctional?** • **Does dust deposition increase energetic costs of migration? (Is dust higher on one side of the mine? What is the prevalent wind direction? Is foraging better going west for fall migration?)**
DDMI Reference #: WMP-2019-22 DDMI responded that TK has identified the importance of Lac De Gras narrows to caribou movements. In Section 2.0 of the 2018 WMR, DDMI reported information from a 2013 TK study in which elders noted that caribou will avoid using areas close to the mine during migration because dust on forage will alter its taste or smell. Based on the principles of adaptive management, DDMI should explore any new opportunities and options to mitigate dust deposition, which in turn may be influencing caribou migration patterns. **Are there any technological advancements for dust suppression or techniques being used by other mine operations in the NWT that could be implemented at the Mine site?**	Regarding fugitive dust, DDMI has responded that they already use accepted best practices as part of mitigation designs and to meet regulatory guidelines. It is assumed this practice will continue as technology advances. **This request is satisfied.** **See DDMI Reference # WMP-2019-21 response.**
Grizzly Bear	
DDMI Reference #: WMP-2019-23 DDMI highlighted that the objective of the grizzly bear hair snagging program is to evaluate cumulative effects of development on grizzly bear populations, rather than a mine-specific effect. Results of the 2012, 2013, and 2017 data collection were provided in Appendix J of the 2018 WMR and the population is stable or increasing. The long-term monitoring frequency will be discussed at the next wildlife monitoring workshop. **We await the outcome of this future discussion.** In March 2019, EMAB made the recommendation that "GNWT-ENR should continue to provide direction on the grizzly bear and wolverine hair snagging surveys to ensure regional objectives and predictions are being tested. GNWT-ENR should confirm the schedule for future hair	DDMI indicated that neither the grizzly bear nor wolverine hair snagging monitoring indicates adverse cumulative effects to regional populations. The monitoring met its objective – provided estimates of grizzly bear and wolverine abundance and distribution over time. The continuation of the studies is a joint decision by program partners. A letter from GNWT-ENR indicates that they intend to organize a meeting to bring parties together to discuss the hair snagging surveys, but no anticipated timing for this meeting was provided other than that it will not be before the fall (GNWT, March 9th, 2020). **We await the outcome of this future discussion.**

snagging surveys for both grizzly bear and wolverine" (EMAB 2019b).	**We continue to support DDMI's involvement in the GNWT hair snagging program but recognize that annual surveys may not be necessary given the stable regional grizzly bear populations and no apparent negative demographic effects associated with the presence of the Mines.**

3.0 Specific Observations

3.1 Vegetation and Wildlife Habitat

There was an increase in the Project footprint in 2019 of 0.09 square kilometres (km^2), with a total reported loss of terrestrial and aquatic habitats to date from mining activities since 2000 of 11.19 km^2. However, the total footprint reported last year was 11.62 km^2. The decrease in total disturbed area is the result of terrestrial habitats within the Mine footprint having remained undisturbed since construction and now being removed from the total Mine footprint calculations. The total vegetation loss due to the mine footprint to date remains under the original prediction of 12.67 km^2. The current footprint is now expected to be the maximum for operations except for the South Country Rock Pile, which is anticipated to expand during the remainder of operations. Although there may be some slight expansion of footprint area during reclamation activities on the North Country Rock Pile.

In 2019, the overall disturbance of vegetation types was at or slightly exceeded predicted levels for heath tundra, riparian shrub, birch seep and shrub, boulder complex, bedrock complex, and esker (disturbed ELC Type excluded from count). Only three ELC types (down from six last year) out of 12 were disturbed, heath tundra (0.06 km^2), heath boulder (0.02 km^2), and tussock/hummock (0.01 km^2). **The methods applied for this part of monitoring are adequate.**

3.2 Barren-Ground Caribou

3.2.1 Habitat Loss

The 2019 WMR indicates that direct summer caribou habitat loss is ~2.754 habitat units (HU), which is below the 2018 level of 2.90 HU. An explicit reason for the decline in HU disturbed by mining operations from 2018 was not provided, although we assume it is related to the removal of undisturbed terrestrial habitats from Mine footprint calculations described in Section 3.1 of the WMR (pg. 8). Direct summer caribou habitat loss remains below predicted levels of 2.965 HUs. **The methods applied for this part of monitoring are adequate.**

3.2.2 Movement

As part of their monitoring requirements, DDMI was to determine whether the zone of influence (ZOI) changes in relation to Mine activity (Handley, 2010). Caribou aerial surveys were used to gather data to evaluate a zone of influence but have not been completed since 2012 because Ekati and Diavik mines requested to omit the ZOI requirement for caribou monitoring in 2013. The request was approved by ENR and so the last aerial surveys were conducted in 2012.

Using a combination of the aerial survey data and satellite collar data Boulanger et al. (2012) concluded that there was a zone of influence of 14 km for caribou around the Mines. The Boulanger et al. analysis was based on the presence or absence of caribou at different distances from the mine. In 2017, DDMI presented a reanalysis of the aerial survey data, gathered from 2002 to 2012, showing there was no correlation between caribou density and distance from mines. As a result of these contrasting findings, EMAB and ENR requested further analysis of the relationship between caribou density and distance while accounting for habitat and insect harassment. This follow-up analysis was completed by DDMI and presented in the 2019 WMR.

In the new analysis DDMI argues that the interaction of distance and amount of preferred habitat, and their combined effect on caribou density is an important indicator of the presence of a ZOI. An interaction in statistics occurs when one independent variable (e.g. amount of preferred habitat) has a different effect on the outcome (i.e., density of caribou) depending on the values of another variable (e.g., distance). In the new analysis DDMI shows that the amount of preferred habitat increases with distance from the Mines (WMR, Figure 13, pg. 26). Their hypothesis is that animals will distribute themselves in accordance with resource availability (WMR, pg. 13), and since the amount of preferred habitat increases with distance from the Mines, then it is expected that there will be lower densities of caribou near the Mines and higher densities further away (WMR, Figure 6, pg. 19). This pattern of caribou density increasing with distance from the mine is confounded by the sampling design used by DDMI, where the amount of area also increases with distance from the mine and as a result caribou density should be positively correlated with distance from the mine simply because the area available for use increases, independent of sensory disturbance from the Mines. In the 2019 WMR, DDMI presents an analysis of random points distributed throughout the study area to demonstrate abundance increases with distance simply because there is additional area available further from the mine. We agree with DDMI that standardizing variables used in the analysis per unit area is an approach to addressing this problem with the sampling design.

DDMI used a mixed-model negative binomial regression approach to examine the relationship between the number of caribou and the explanatory variables: distance to mines (or distance), annual insect harassment, autumn range centroid distance from the Ekati mine (i.e., Paul Lake Bridge), and study area size. They also used amount of preferred habitat (preferred habitat) in their models but this was missing from the description of *Model Structure and Assumptions.* The other variables were meant to control for temporal and spatial variation. DDMI used an information-theoretic model selection approach to assess a set of 4 different models to identify the model that best describes the data (See Table 6 from the 2019 WMR, pg. 23, reprinted below).

Table 6: Candidate Mixed-Models Evaluating Aerial Survey Counts of Caribou and Assumptions of Distance-Habitat Relationship

Model	Covariables	Assumptions of Distance-habitat Relationship	Predicted Pattern Tested
M1	design survey area + distance + preferred habitat + distance*habitat + insect harassment + autumn range distance to Ekati	Caribou abundance-preferred habitat relationship depends on the proximity to mines (i.e., ZOI is present), after accounting for other factors	Figure 6C
M2	design survey area + distance + preferred habitat + insect harassment + autumn range distance to Ekati	Caribou abundance-preferred habitat relationship does not depend on proximity to mines (i.e., no ZOI), after accounting for other factors	Figure 6B
M3	design survey area + preferred habitat + insect harassment + autumn range distance to Ekati	Caribou abundance is correlated with the amount preferred habitat (i.e., no ZOI).	Figure 6B
Null	no covariables included, only a y-intercept is estimated	Caribou distribution is constant across space and time	

All models included year as a random effect.

Autumn range centroid distance was measured to Ekati mine's Paul Lake bridge.

The top two models in DDMI's analysis were the full model (i.e., the one with all the explanatory variables, called M2) and the full model plus the distance*preferred habitat interaction (called M1). Model selection results are in Table 7 from the WMR, pg. 29 reprinted below. Model selection results showed that the two top models were within <2 AIC units. DDMI points out that models less <2 AIC units apart indicates the presence of a non-informative parameter, in this case the interaction term, which they interpret as "*a measurable ZOI was not detected or supported by the aerial survey data*" (WMR, pg. 29) because the 95% confidence interval for the interaction term includes zero (DDMI, 2019, pg. 30). **We recommend examining coefficients with 85% confidence intervals as well, which will allow for interpretation of potentially informative variables that may be discarded with 95% confidence intervals (Arnold, 2010; Conkling et al. 2015).**

Table 7: Negative Binomial Mixed-Model Selection Results of Aerial Survey of Caribou

Model	K	AIC	ΔAIC	Model Likelihood	AICc Weight	-log-likelihood
M2	8	54898.60	0.00	1.00	0.64	-27441.30
M1	9	54899.72	1.12	0.57	0.36	-27440.86
M3	7	54948.03	49.43	0.00	0.00	-27467.02
Null	3	55264.71	366.11	0.00	0.00	-27629.35

K = number of model parameters

AIC = Akaike's Information Criteria score.

ΔAICc = Difference in AIC score relative to the top model.

Below we identify a number of points that DDMI could address to improve the clarity of the analysis and ZOI discussion:

Although caribou density increasing with distance from the Mines is an underlying assumption of the analysis provided by DDMI, they do not present any evidence in the 2019 WMR showing that caribou density does indeed increase with distance. Summary graphs are provided showing the mean number of caribou observed across years and months, but not by distance from the mine data. DDMI developed such

a graph, and associated statistical analysis, for their presentation to EMAB on May 19, 2020, but this graph was not included in the 2019 WMR. **We recommend DDMI include a graph of caribou density by distance, and a statistical analysis of the relationship, in an addendum to the WMR to support their assertion that caribou density increases with distance from the mine**. **We also recommend DDMI include a discussion of the ecological significance of the findings and not just the statistical significance of the caribou by distance relationship (Steel et al. 2013)**. **We recommend discussing effect sizes and the ecological significance of all modelling results presented in this section.**

DDMI's preliminary analysis showed no relationship between caribou abundance and insect severity and so they replaced it with month as a number in their candidate models. Since there was no relationship between insect severity and caribou abundance, and no discussion of how the pattern of caribou abundance was expected to vary by month we are confused as to why this variable was included in the candidate models. Is there variation in the pattern of caribou abundance with distance to the mine by month? **We recommend DDMI provide additional discussion of the ecological reasoning for including month as a covariate in the models, because although the total abundance of caribou in the study area varies by month, it is unclear how that relates to the pattern caribou abundance with distance to the mine, which is the focus of this analysis.**

Reviewing the results of the model selection analysis raised questions about the relative importance of preferred habitat as a predictor of caribou density/abundance. Based on the model selection results, we questioned the strength of the relationship between caribou abundance and preferred habitat. The table below (WMR, Table 7, pg. 29) shows the results of the model selection analysis. The model(s) with the lowest ΔAIC score(s) are considered to do the best job explaining caribou abundance. We discussed the performance of model M1 (i.e., the model with the interaction) above. The top-ranked model was M2, this was the model with both distance and preferred habitat. The results demonstrate that model M3, with a ΔAIC score > 48 units higher than the top-ranked model (i.e., M2) does a poor job explaining the data on caribou density. Model M3 includes preferred habitat, but not distance. Model M3 indicates that preferred habitat is a poor predictor of caribou density. Given that model M2 was top-ranked and included distance, this suggests that distance may be more important in predicting the density of caribou than preferred habitat. We did note that a model with distance and excluding preferred habitat only was not among the set of candidate models used in the model selection analysis, meaning there is no way to see how distance, in the absence of preferred habitat, predicted the density of caribou. **We recommend DDMI include another candidate model with all covariables except preferred habitat and the interaction of distance*habitat in order to see how distance performs in predicting caribou abundance.**

We are confused about the interpretation of the distance variable in DDMIs top model. The top-ranked model in this analysis included both distance and amount of preferred habitat, making it difficult to isolate the effects of distance or preferred habitat. In fact, the top-ranked model (see below; WMR, Table 8, pg. 30) showed that both variables had a significant positive effect on caribou abundance. Based on these results, for each 1 km increase in distance, the density of caribou increases by 0.34 if the other variables remain constant, and for each 1 ha increase in the amount of preferred habitat there is an increase of 0.86 in caribou density if other variables remain constant. In short, according to the DDMI top-ranked model, caribou density increases with both distance and the amount of preferred habitat. This demonstrates that both distance and the amount of preferred habitat appear to have a role in determining caribou density

even after removing the interaction. DDMI did a separate analysis that distributed random points throughout the study area to show that the positive correlation of abundance and distance from the mine could be explained by the increase in area with increasing distance from the mine. DDMI concluded that without standardizing per unit area, and in the absence of sensory disturbances from the Mines, that caribou distribution should be positively correlated with distance from the Mines, which is what the top-ranked model showed. It is unclear if DDMI standardized the model variables to account for the geometric phenomena their random points analysis identified.

Table 8: Regression Coefficients (95% Confidence Intervals) of the Top-ranked M2 Model

Design Survey Area (km^2)	Distance (km)	Preferred Habitat (ha)	Month[a]	Distance of Autumn Range Centroid to Paul Lake Bridge
-0.49 (-0.86 to -0.12)	0.34 (0.24 to 0.43)	0.86 (0.76 to 0.95)	0.16 (0.09 to 0.24)	0.28 (-0.05 to 0.60)

Note: 95% confidence intervals that overlap zero are not considered statistically different from zero. All predictor variables were centre-scaled prior to analysis.

(a) Month number replaced insect severity as a covariable in all models except for the null model.

We interpreted DDMIs use of transect segments 1 km in length x 1.2 km wide as an attempt to standardize per unit area to address the geometric issues in the original sampling design. But then in the discussion of this analysis DDMI states that "[t]*he application and pattern of random points demonstrated that a positive correlation with distance can be explained by increasing sampled area from the mines. Standardizing variables to be in per unit area is a way to adjust for such geometric phenomena*" (DDMI, 2019, pg.33). This statement suggests the sampling units were not in fact standardized per unit area even though this was repeatedly cited as an issue in the interpretation of the distance variable. **We recommend DDMI provide additional discussion to clarify whether or not the variables included in the candidate models were standardized per unit area. If not, can DDMI explain why they did not standardize variables per unit area. And if they did, can they please provide further discussion about what distance means in the context of their mixed-model analysis since they controlled for the increasing amount of sampling area with distance from the mine.**

Finally, we agree it is crucial to isolate the effects of preferred habitat and distance to understand the ZOI effect. We agree that analyzing an interaction term may be informative in this regard. For example, Boulanger et al. (2004) mentioned that a distance*time interaction was potentially indicative of a ZOI as part of a habitat selection analysis for Bathurst caribou in relation to the Mines. While DDMI highlights their use of a "*habitat selection framework*" (WMR, pg. 33) in this analysis to detect a ZOI, the relationship between caribou and preferred habitat was inferred at a broad scale only (i.e., hectares of preferred habitat per transect segment). The aerial survey data does not allow for an analysis of caribou use and avoidance of habitats at different distances from the Mines. No information was provided that sheds light on how caribou selected habitats of different qualities within each transect segment. A more detailed description of the use and avoidance of preferred habitat, which would require a more detailed understanding of how caribou use habitats of differing qualities within each transect segment, would allow us to separate the effects of distance and amount of preferred habitat as part of a ZOI analysis.

We suggest exploring the utility of calculating distance-specific selection ratios (i.e., observed/expected) to test how caribou select predicted habitat at different distances from the mine (White and Gregovich, 2017). By considering caribou use of different habitat types (preferred or avoided) at different distances (e.g., 0-5 km, 5-10 km, 10 – 15 km …), the analysis could isolate the confounding impacts of distance and the amount of preferred habitat increasing as one moves away from the mine. Independent of the total

amount of preferred habitat in a transect segment at a given distance from the mine, looking at the change in selection ratios with distance directly addresses the hypothesis set out by DDMI in Figure 6 (WMR, pg. 19) and isolates the seemingly correlated effects of distance and amount of preferred habitat. With this analysis, the null hypothesis is that with no ZOI, caribou should select preferred habitat in proportion to its availability. This is in line with DDMIs hypothesis that underlies this year's ZOI analysis, that animals should select preferred habitat in proportion to its availability. Basically, as the amount of preferred habitat increases with distance from the mine, so should the density of caribou.

We think analyzing selection ratios of satellite collared caribou within different distance zones may be a viable method to address the ZOI predictions. If caribou select preferred habitat less than it is available on the landscape, this would be a signal of avoidance. It is also unclear how the size (i.e., distance on the ground (km)) of any potential ZOI could be estimated using the interaction term alone, while the use of selection ratios based on satellite collar data may allow for the size of the ZOI to be monitored over time. DDMI has indicated a willingness to explore such an analysis for the 2022 WMR (next comprehensive analysis report). However, it is our understanding there is existing satellite collar data that can be analyzed, and because there has been no aerial survey data collected since 2012, **we recommend utilizing the existing satellite collar data for a ZOI analysis based on spatial variation of selection ratios for inclusion in the 2020 monitoring report (or an addendum to the report).** The information from such an analysis could be used to guide decision making regarding the need for additional aerial surveys.

3.2.3 Behaviour

The ground-based behavior survey was designed to test changes in caribou behaviour as a function of distance from the Mine. In accordance with recommendations from a workshop in 2009 with ENR and other mines and monitoring boards (Handley 2010), DDMI adapted its monitoring program for caribou in 2010 by coordinating with BHP-Billiton's Ekati mine and implementing ground observations of caribou behaviour for 2010. In 2019, between January 11 and April 18, observations were collected on 33 caribou groups from 0 to 15 km from the Mine and observations were collected from 3 caribou group > 15 km from the Mine. Overall, fewer caribou groups were observed in 2019 compared to 2018. DDMI indicated that there remains insufficient data (# caribou groups) to detect a 15% change in behaviour (55 unique groups of caribou in two distance groups are required). Based on a qualitative comparison of activity data it appears as though caribou behaviour varies across years and by distance category. Changes in feeding time varies annually, but not in a systematic way with distance from the mine. **We continue to emphasize the importance of these data in understanding the influence of the Mine on caribou and recommend that DDMI continue their efforts to collect caribou behaviour data annually (also see Table 1, DDMI Reference #: WMP-2019-18).**

3.2.4 Distribution

No additional data was collected in 2019 to analyse caribou deflection east or west of Lac de Gras. DDMI provides additional graphs and correlation analysis in the 2019 WMR (Figure 20 and 21, pg. 38) meant to show that the movement rate of collared caribou west of Lac de Gras is not related to the centroid of

the autumn range. They go on to suggest that herd size may be a factor, as visual inspection of the graph reveals that data from more recent years has a more western autumn range. However, no quantitative analysis of this pattern is provided. This finding confirms the western deflection of collared caribou, but only generates potential hypotheses to explain the pattern.

Figure 21 shows the proportion of east deflections in relation to Full-Time-Equivalents (FTEs), a proxy measure for mine activity. DDMI states there is no correlation between east movement and mean annual FTEs during the fall migration. There does not appear to be a clear pattern between the proportion of east deflections and FTEs, although it does appear that in recent years (2011, 2012, 2013, 2014, 2015, 2018), as herd size is declining, only a small proportion of caribou are moving east of Lac de Gras during the fall migration. Is this a reflection of chronic effect of the mine? **Further data collection and analysis is required to understand clearly why the impact prediction in the EER was incorrect regarding the southern (fall) migration (See Table 1, DDMI Reference #: WMP-2019-21).**

3.2.5 Incidents and Mortality

As far as caribou mortality is concerned, the effect remains at or below predicted levels, which is that Mine-related caribou mortality is expected to be low. No Mine-related mortalities were reported in 2019, and one Natural Mortality was reported on East Island. **The methods applied for this part of monitoring are adequate.** Overall, the mean population size of the Bathurst caribou herd has decreased between 1996 (349,000) and 2018 (8,0). To support recovery of all barren-ground caribou herds, the 2011 to 2015 NWT Barren-ground Caribou Management Strategy was developed. A new management strategy for 2018 to 2022 is under development. In addition, ENR has developed a draft Bathurst Caribou Range Plan (GNWT 2018) to address issues related to cumulative land disturbance.

3.2.6 Advisory

Incidental observation of caribou ranged from 2 to 2000 individuals on the East Island in 2019, caribou were thought to be from the Beverly/Ahiak and Bathurst herds. As the caribou remained away from haul roads, no deterrent actions or elevation from "No Advisory" was required in 2019. There were no reported incidents involving caribou in 2019 and there was no need for herding of caribou away from hazardous areas. Caribou were observed by the airport twice, but no deterrent actions were required.

3.3 Grizzly Bears

The 2019 WMR indicates that total direct terrestrial grizzly bear habitat loss was 8.02 km^2 which remains below the predicted level of 8.67 km^2. Grizzly bear mortalities associated with mining activities also remain below the predicted range of 0.12 to 0.24 bears per year. There were zero bear mortalities in 2019, but there were 45 days that deterrent actions were used, which is an increase from 36 in 2018. **The methods applied for this part of monitoring are adequate**.

Hair snagging has been used since 2012 to assess grizzly bear abundance and distribution over time as per the revised monitoring objective (GNWT, 2013). No hair snagging was completed in 2018 or 2019. Analysis of data from 2012 to 2017 suggest a stable or increasing number of grizzly bears and that there have been no negative demographic effects on the regional population of grizzly bears due to the mines. DDMI states that the long-term monitoring frequency will be discussed and determined with partners. **We continue to support DDMI's involvement in the GNWT hair snagging program but recognize that annual surveys may not be necessary given the stable regional grizzly bear populations and no apparent negative demographic effects associated with the presence of the Mines.**

3.4 Wolverine

The most recent objective of the WMP related to wolverine is:

> *To provide estimates of wolverine abundance and distribution in the study area over time* (Handley 2010).

Wolverine presence around the Mine is monitored using snow track surveys, hair-snagging, and incidental observations.

Snow track surveys for wolverine were completed in 2019. Since 2015, each winter track transect is surveyed twice instead of only once, as was done in previous years. During the first survey wolverine tracks were identified at 7 of 40 transects, and 15 of 40 transects during the second survey. This translated into 14 and 32 tracks observed per survey respectively, which is higher than in 2018.

The 2019 WMR includes the analysis of a Multi-season Occupancy Model (MSOM) which uses detection history at a site to estimate changes in occupancy over time. Model selection was used to test hypotheses about the factors that influence wolverine detectability, occupancy, colonization and extinction over time. The covariates DDMI analyzed in the models include: the minimum number of days since last snowfall or high wind events; the number of days since last snowfall; the number of days since the last windy day; years since first survey; habitat; distance to nearest Mine infrastructure; distance from centroid of Bathurst caribou winter range; full-time equivalents, a proxy measure of mine activity.

Wind had the biggest effect on wolverine snow track detectability. There was insufficient data to simultaneously test the effects of distance to the Mine, habitat and their interaction on the initial probability of occupancy. Small sample sizes from 2008 meant the habitat and interaction models could not be interpreted. As a result, DDMI modelled the effect of habitat availability on occupancy in a separate analysis (i.e. separate from the MSOM). This analysis showed there is a weak positive effect of habitat on wolverine track occurrence. Because imperfect detectability was not accounted for in this model, as it is in the MSOM, wolverine occupancy could not be estimated, only the probability of occurrence. DDMI was able to analyze distance effects on occupancy with the MSOM. This analysis demonstrated that distance has a weak positive effect on the probability of wolverine occupancy, which suggests that transects closer to the Mines were less likely to be occupied. Larger sample sizes are required to allow for the simultaneous analysis of distance and habitat effects on wolverine occupancy. Although data on the initial occupancy

estimation in 2008 was limited we are comfortable with the approach DDMI took to addressing this issue in the 2019 WMR.

In their analysis of transect colonization, three models had equal support for the effect on colonization probability: the null model with the null process for occupancy (i.e., no covariate effects), habitat as a covariate only, and a model with habitat as a predictor of colonization with distance as a predictor for occupancy. This final model showed that habitat actually had a negative effect on colonization, meaning that colonization events were more likely in poorer quality habitat. DDMI suggests that wolverines may be changing their habitat selection over time in response to varying environmental pressures (e.g., food availability, competition) and so what constitutes high quality habitat changes over time. We agree with this assessment and note that distance to the Mine is also another factor that appears to influence wolverine habitat use over time.

DDMI also tested the effects of caribou, year and FTE on the probability that an occupied transect becomes unoccupied (i.e., extinction). This analysis showed that FTE had a positive effect on the probability of extinction, or that an occupied transect is unoccupied the following year. Wolverines appear to lower their use of the study area as Mine activity increases. DDMI will continue their monitoring efforts. We commend DDMI for their continued efforts to monitor wolverines and understand the impacts of the Mines on wolverine use of the study area. **We recommend the continuation of the snow tracking program to monitor impacts of the mine on wolverine detectability, occupancy, colonization and extinction.**

No wolverine hair snagging was undertaken in 2019. This program was last completed in 2014. DDMI is awaiting the completion of a data summary analysis report from ENR before engaging in discussions to determine the schedule for future monitoring programs. **We recommend that a schedule for future hair snagging be determined in collaboration with GNWT-ENR. Given the findings of the MSOM which shows distance to the Mines effects wolverine occupancy, ongoing monitoring of population size and stability would be prudent to ensure negative impacts of the Mines on wolverines does not lead to population extinction.**

The 2019 WMR reported zero mortalities, two relocations, and seven deterrent actions for wolverine on-site (Table 24, pg. 67). There were 19 days with wolverine visitations on East Island; this measure has been decreasing since 2015. We commend Diavik for their ongoing efforts to mitigate impacts on wolverine.

3.5 Falcons

Monitoring of raptor nest occupancy and success in the study area were removed from the WMP in 2010. However, DDMI contributes nest monitoring data to ENR every five years and last collected these data in 2015; the next survey is scheduled for 2020. DDMI also remains focused on data collection and mitigating effects to raptors nesting in open pits and on Mine infrastructure. 45 pit wall/infrastructure inspections were completed during the nesting season in 2019. Two active peregrine falcon nests were

observed, one was located at the Site Services Building and one at the Process Plant. No observations of fledglings were recorded.

We support DDMI's continued Pit Wall/Mine Infrastructure monitoring for nesting raptors. DDMI will discuss options with ENR for future monitoring. The Canadian Peregrine Falcon Survey (CPFS) was discontinued in the NWT in 2015; therefore, DDMI no longer provides nest site occupancy and productivity data to the Canadian Wildlife Service (CWS). Regional nest monitoring is scheduled to occur in 2020 and will be conducted by ENR.

3.6 Waste Management

In 2019, the total number of misdirected attractants (food and food packaging) are lower than 2018 levels in the Waste Transfer Area (WTA), but not the Landfill area, the A21 Area, and Underground. In 2019, there appeared to be a higher number of misdirected food items in the WTA and Landfill (relative to the other inspected areas), similar to the pattern in 2018. Wildlife were only observed in the WTA and the Underground in 2019, no wildlife was observed in the Landfill or A21 Area. Red fox were the most commonly observed species (2019 WMR, Table 27). In general, the number of wildlife observations in the WTA and the Landfill were lower in 2019 than in 2018, and roughly the same in the A21 Area and the Underground. The overall outcome of waste management appears to be positive. **We commend DDMI for its efforts which probably led to the low attraction effect on wildlife and we concur with their commitment to continue to carry out employee education programs related to waste handling to decrease misdirected waste.**

4.0 Closure

The review of the 2019 WMR reported herein presents the conclusions arrived at by MSES. DDMI included responses to all previous recommendations and requests (Appendix A, 2019 WMR). We appreciate the time and effort spent providing the responses to our questions and recommendations, as the information is necessary to maintain and improve the understanding of the effects of the Mine on wildlife (see Appendix A for a record of requests that have been addressed in previous years). We hope that future communications will lead to further clarification on several details of the 2019 WMR. Our views are submitted to EMAB for its consideration of potential recommendations and actions.

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Appendix A

Table 1: Actions by DDMI in response to recommendations that were developed in previous years.

Recommendations/Questions	Action by DDMI
Vegetation and Wildlife Habitat	
The 2013 Comprehensive Vegetation and Lichen Monitoring Program report concludes that "*the Mine may be having local-scale effects on plant species composition*". The report does not suggest any strategies that could mitigate these effects. Please consider if and how these potential project effects could be mitigated.	A comprehensive analysis of vegetation and lichen data was last completed as an Appendix of the 2016 WMR. The same conclusion was reported. DDMI responded that impacts are within the range predicted because of mitigation they've already implemented – i.e. mitigation is successful (Golder 2017a). If the initial prediction is accurate, then additional mitigation is not required. **This request is satisfied.**
DDMI concluded that "*given that the majority of metals concentrations have decreased below concentrations reported in the 2010 risk assessment, a follow up risk assessment based on 2016 data is not required*". The risk assessment did not include information on any changes in the concentrations of metals present in caribou and humans pre- and post-exposure or how these levels of metals relate to the health of either caribou or humans. We recommend DDMI provide additional information that would support their conclusion that concentrations of metals in lichen are safe for caribou.	It was agreed between EMAB and MSES that it does appear that health risks to caribou are low, particularly given that the 2016 concentrations are said to be lower than previously measured and given that the caribou do not stay long in the near-field where metal concentrations are higher. Our past comments questioned some of the methods, but in the big picture, even with a potential for measurement error, the exposure risk may well be low. **This request is satisfied.**
DDMI has recommended that vegetation and lichen monitoring frequency should be reduced from once every three years to once every five years, with the exception that if dust deposition values exceed 400 mg/dm^2/y, then sampling frequency may resume on a 3-year cycle. Given that above-ground mining is anticipated at the A21 Area in 2018, dust deposition and metal concentrations in lichen are likely to increase again. We recommend that the established three-year timeframe be continued in order to capture changes in vegetation and lichen parameters. In addition, we recommend DDMI provide further justification for setting 400 mg/dm^2/y as a trigger for changing monitoring frequency as compared to using a trigger associated with dust deposition rates for reference stations.	During a conference call (22 February 2018), DDMI explained that the trigger is based on average deposition that occurred between 2000-2016 on near-mine sites, which is 470 mg/dm2/y. They use a conservative 400 mg/dm2/y trigger based on this information. However, they are saying there are "no impacts" at 400 mg/dm2/y and that there is not much deviation between mine and reference sites. They noted that they do see small changes <400 but that doesn't mean there is an ecological impact on caribou. We do not agree that there are "no impacts" with a metal deposition of 400 mg/dm2/y. As long as values near the mine are above the range of "baseline" (reference station) values, there is potential for associated impacts. They are either not ecologically measurable or they are not being measured (incorrect response variables are being measured). A trigger associated with original predictions or literature regarding impacts to vegetation and lichen would be more appropriate. Golder agreed to look into the original prediction and include the information in the next WMR, including any literature that may be relevant. Confirmation of this action was also requested by EMAB (EMAB 2018).

	During a 6 June 2018 teleconference, DDMI indicated that the trigger for changing vegetation and lichen monitoring frequency has been changed to reference station values for dust deposition. **This request is satisfied.**
	DDMI indicated that the results have not changed over time. Looking back at the 2013 Comprehensive Vegetation and Lichen Monitoring Program report, the statement in the report (Section 3.3.2.2) does not appear to match the data presented in Figure 3.3-3. Mercury looks to be statistically similar between near and far field in both 2010 and 2013. **This issue is satisfied**. The 2013 Comprehensive Vegetation and Lichen Monitoring Program report stated that mercury concentrations were statistically lower near the Mine than farther away in both 2010 and 2014 [typo: should read 2013]. No discussion on this finding was presented. Please discuss possible causes of this pattern in mercury concentrations and what effects this may have on caribou ingesting lichen far from the Mine.
Barren-Ground Caribou	
DDMI recommended a reduced survey frequency for the assessment of caribou occurrence relative to the Mine site, roads, rock piles, and Processed Kimberlite Containment (PKC). We suggest that these surveys continue at least bi-weekly to ensure no caribou are present in areas that are visually obstructed to on-site staff.	DDMI recommended reducing survey frequency because of the ineffectiveness of the surveys at detecting caribou at the Mine that were not already detected by other employees and pilots. In 2017, incidental observations of caribou ranged from 1 to ~2,150 individuals on East Island. There were no reported incidents. It appears that caribou presence near the Mine is being adequately captured. **This issue is satisfied.**
Has the ZOI guidance document been finalized? If so, please provide the document to EMAB for their review. If not, please have ENR explain why not and when it is expected.	ENR is treating the March 2015 guidance document as a "living" document that represents the best current advice of the ZOI TTG (GNWT 2017). **This request is satisfied.**
A regression analysis evaluated the relationship between caribou density and nearest distance to the Ekati or Diavik Mine footprint. The results showed that distance to a mine footprint explained very little of the variation in caribou density. To confirm this result, we recommend that DDMI present information on the power of the data to detect an effect.	DDMI provided a power analysis and concluded there is sufficient power and sample size to detect an effect (Golder 2017a). **This request is satisfied.**
If Ekati has sufficient data near-mine, please analyze a DDMI-Ekati combined dataset to test how caribou behaviour changes as a function of distance from the Mine. If data are still deemed to be insufficient, please present a power analysis indicating the target sample size for near-mine observations.	A power analysis in the 2017 WMR concluded that 55 different caribou groups are required for both near and far from mine categories in order to statistically detect a change in feeding activity. **This request is satisfied.**

Given the insufficient Diavik-data near-Mine, will DDMI collect data outside of autumn and use GPS collar information to collect data opportunistically? If this is already being done, please provide a summary of how much additional data have been collected using this protocol both near and far from the Mine.	DDMI has been collecting caribou behaviour monitoring data when caribou are present in the study area, including outside of autumn. Observations on 32 groups were collected in 2017 in the winter season within 0 to 2.7km of the Mine. **This request is satisfied.**
Please explain what triggers/criteria are used to initiate the collection of far from mine caribou behavioural observations.	During the 22 February 2018 conference call, DDMI indicated that collar locations and incidental observations of caribou can trigger the collection of far from mine caribou behavioural observations. **This request is satisfied.**
There was some discussion in the past about the Cumulative Impacts Monitoring Program (CIMP) leading a behaviour monitoring task group but given the lack of information on the status of this group, we recommend DDMI continue with its own monitoring, coordination with Ekati, and data analysis until such a working group is established and operational.	ENR will not be setting up a dedicated behaviour monitoring group (GNWT 2017). However, during the 2018 SGP Wildlife Monitoring Workshop, ENR presented information on their caribou behaviour pilot project. The intention was for the government to standardize protocols, share/pool datasets on behaviour, and coordinate field efforts; however, no timelines were provided for the development of guidelines / protocols. In the absence of standardized protocols, we recommend Ekati and Diavik independently move forward on collaboration and coordination of efforts, including both data collection and analysis, on the caribou behaviour monitoring program. In general, it appears there will more consistency between data collected by Ekati and Diavik in the future (14 June 2018 conference call). **This request is satisfied.**
Given the delayed southern migration in recent years, please redo the statistical analysis including data up to the end of November or later, if warranted.	DDMI provided an analysis of caribou distribution including data up the end of November in the 2017 WMR. Over the long-term, caribou are following the predicted pattern for the northern migration, but not for the southern migration. **This request is satisfied.**
The 2016 WMR mentions that caribou that are most likely from the Beverly/Ahiak herd were present in the study area. Please explain how the presence of caribou from the Beverly/Ahiak herd is managed during the collection and analysis of all caribou data.	DDMI indicated that caribou will be monitored if they fall within the Diavik mine study area regardless of which herd they belong to (Golder 2017a). This includes caribou movement and behaviour monitoring programs. Golder mentioned the presence of caribou from the different herds in the study area in the data collection for the 2017 WMR. It appears as though only Bathurst caribou are analyzed when testing the caribou distribution predictions. **This request is satisfied.**
What is the effect of Mine closure on caribou range re-establishment? Are data collected to date sufficient to show a change of caribou distribution in light of the uncertainty of the size of the large ZOI? Also, current baseline (pre-disturbance) information is poor, rendering conclusions on changes from pre- to post-disturbance inconclusive.	The issue was discussed verbally in 2013 and DDMI admitted that it is possible that the currently observed ZOIs (14 km; Boulanger et al. 2012) may have always existed. DDMI confirmed that true baselines do not exist. Using TK instead was suggested for discussion.

Does DDMI believe that the current data quality is sufficient to show a potential reversal of the effects after closure?	DDMI responded that vegetation monitoring during post-closure, that includes reference sites, will determine whether reclaimed areas provide similar ecological function of vegetation communities for caribou and other wildlife. Some features of Diavik such as waste rock storage areas will not be reclaimed so complete reversal of effects is unlikely. Given that pre-disturbance data cannot be improved, the commitment by DDMI to use reference sites in post-closure monitoring is sufficient. **This issue is satisfied**.
We recommend that the ideas to evaluate caribou health and to ask traditional knowledge holders about the behaviours that should be included in the observation protocol should be carefully considered, particularly from the point of view that the health of wide ranging animals are a result of many factors that occur in the region through which they range. Future discussions about these ideas could be fruitful.	DDMI responded that they regularly engage communities about the WMP. Diavik highlighted a few instances of community involvement in caribou monitoring. DDMI has also included a section in the 2018 WMR that discusses community engagement and traditional knowledge as it relates to Diavik's WMP. **This issue is satisfied**.
Regarding the 2014 WCAR (Golder 2014): A common concern with GPS collar data is that multiple samples from the same individual may not be statistically independent of each other. That is, one response from an individual affects the probability of another response from that same individual. Clarification is needed on how caribou GPS data independence was achieved.	DDMI indicated that they did not make any assumptions about or evaluate whether caribou observations from the same individual were independent. The mixed model analysis they discuss and propose to do moving forward is a reasonable approach to addressing the non-independence of the data. **This issue is satisfied.**
We recommend DDMI provide a more detailed explanation and justification as to why they propose postponement of aerial surveys "in favour of other studies". DDMI should also indicate what "other studies" would examine regarding mechanisms that may cause caribou to avoid the mine.	DDMI previously listed (Golder 2016) other studies that would contribute to our understanding of a mechanism that may cause caribou to avoid the mine, including behavioural scanning observations, increasing the number of caribou with collars, research on winter range resource selection, the NWT wolf project, and support for the deployment of geo-fenced collars on Bathurst caribou. **This issue is satisfied.**
Please clarify whether or not Ekati and Diavik are using the same behavioural data collection methods and, if so, indicate when the mines began coordinating their methods.	Diavik and Ekati use the same methods for collecting group-level behaviour data, which was verified in the June 2018 (14 June 2018 conference call[2]) meeting with EMAB and ENR. **This issue is satisfied.**
Given that the feeding data presented by DDMI (DDMI's Response on 14 June 2018) do not appear to show the same pattern, we recommend DDMI comment on why there might be a difference in the pattern between 2011 and 2018 and discuss whether they implemented a change to mine	DDMI explained that the data were not evaluated in the same way in 2011 and 2018. The 2011 analysis considered behaviour by nursery and non-nursery group status, while the 2018 analysis did not. The 2011 analysis used 10 distance categories while the 2018 analysis used 2. This could account for the differing results. **This issue is satisfied.** We look

[2] Participants included representatives from Diavik mine, EMAB, MSES, Ekati mine, IEMA, Golder, and ENR.

protocol that may have minimized the impacts on caribou behaviour. [For reference: In 2011, DDMI found that for caribou groups with calves: "Time spent feeding and feeding/resting increased among groups that were further from the mines". In this case, behavioural responses appeared to be influenced within approximately 5 km from the mines. This suggests that caribou behaviour and potentially the energy balance of young caribou is affected within that distance. In 2018, DDMI concluded that feeding behaviour is generally consistent across spatial and temporal strata (Percent Time Feeding ranged between 40.2-46.6), but no statistical analysis was completed.]	forward to seeing behavioural data analyses once sufficient data are available.
Please describe if and how non-parametric statistics have or could be used in the analysis of the behavioural data.	DDMI responded that "*A number of different analyses could be used including non-parametric statistics; however, the approach used is consistent with methods used in the scientific literature (e.g., Duquette and Klein 1987). Golder (2018) also summarized behaviour data among different distance strata as requested by EMAB in February, 2018. Non-parametric statistics were not used in this analysis*." (Appendix A, Table 1, 2018 WMR). We are trying to determine whether there are other angles from which the data can be analyzed that might be useful. DDMI is intent on using a parametric approach. **This issue is satisfied with the suggestion that non-parametric approaches may be an alternative option for consideration in future analyses.**
During the 2018 SGP Wildlife Monitoring Workshop, ENR presented information on their caribou behaviour pilot project. The intention was for the government to standardize protocols, share/pool datasets on behaviour, and coordinate field efforts; however, no timelines were provided for the development of guidelines / protocols. In the absence of standardized protocols, we recommend Ekati and Diavik independently move forward on collaboration and coordination of efforts, including both data collection and analysis, on the caribou behaviour monitoring program. In particular, to avoid bias in behavioural data, please ensure that Ekati and Diavik are coordinating their methods for duration of group scans such that they cover the average caribou activity cycle. In general, it appears there will be more consistency between data collected by Ekati and Diavik in the future.	Diavik and Ekati use the same methods for collecting group-level behaviour data, which was verified in the June 2018 (14 June 2018 conference call) meeting with EMAB and ENR. **This issue is satisfied.**

Please consider the use of TK to help uncover causes for unanticipated impacts on caribou behaviour and to develop adaptive mitigation measures	DDMI responded that they regularly engage communities about the WMP. Diavik highlighted a few instances of community involvement in caribou monitoring. DDMI has also included a section in the 2018 WMR that discusses community engagement and traditional knowledge as it relates to Diavik's WMP. We anticipate this participation will continue once new analyses on caribou behaviour are available. **This issue is satisfied**.
The analysis used by DDMI to test the hypotheses about caribou movement during the northern and southern migrations is potentially flawed. We recommend that DDMI provide more information on the pool of collared caribou used over the course of this study. How many separate caribou were collared? How many times did collaring occur? How many times do the same animals appear in annual counts? We recommend that DDMI utilize statistical techniques that account for the independence (or lack of independence) of samples and interannual variation in migration movements.	DDMI provided information on the collared caribou used in the study and details regarding their mixed model logistic regression. The mixed model analysis they discuss is a reasonable approach to addressing the non-independence of the data. **This issue is satisfied.**
Given that analyses of change in behaviour with distance are still planned for the future, we re-state, for the record, that analyses of data should address the following: • Clearly state the assumption of no yearly variation in caribou behaviour if the data are insufficient to detect annual variation. • In the event that collaboration on/sharing of behaviour data between operators occurs, please be explicit about all assumptions made in future analyses. • Reconcile behavioural observations with the occurrence of caribou: does behaviour change with distance as occurrence does, i.e. is behaviour "normalized" past the zone of influence of 14 km? • How can the information gained from the various caribou analyses be used to adjust or develop mitigation measures if there is a larger than predicted effect of the Mine on caribou?	• DDMI responded that the EER assumed that adverse effects would be continuous. Analyses from 2011 detected intermittent annual effects, implying that duration of effects is periodic and less than assumed in the EER. Data used in the 2011 analyses appear to be sufficient to detect annual variation. **This issue is satisfied, and we expect DDMI to report information on annual variation in future analyses**. • **DDMI committed to include assumptions related to future analyses**. • DDMI responded that patterns in behaviour cannot be reconciled with patterns in occurrence at different distance categories due to differences in the scale of the studies. **We look forward to seeing the future behavioural analyses and will revisit this topic at that point in time, as necessary**. Interpretation of the results may be challenging given that no pre-development data (baseline) on caribou behaviour are available to compare against. An effect could have existed prior to the Mine. Alternatively, the mine may influence caribou behaviour. • DDMI responded that mitigation would have to measurably reduce the effect of the Mine on caribou and that a strong link between an activity and the change in caribou behaviour is needed. **We await results of future analyses to evaluate this link.**

Grizzly Bear	
Please give careful consideration to the possibility that bears may be becoming habituated and their presence on the site may be on the rise. Given the increase in grizzly bear observations near the Mine, DDMI should increase vigilance and future years of data collection should be used to evaluate whether the re-instated deterrent system is effective at reducing grizzly bear presence near the Mine. In terms of grizzly bear management, we recommend DDMI investigate if there is something in particular that is attracting grizzly bears to the site that could be determined by evaluating the location and timing of the incidental observations and, in turn, whether some mitigation could be applied to remove any attractants	Although there appears to be an increasing trend in the number of incidental grizzly bear observations and a corresponding increase in deterrent actions, grizzly bear mortality predictions have not been exceeded and there does not appear to be any population-level effect. We recommend DDMI investigate if there is something in particular that is attracting grizzly bears to the site that could be determined by evaluating the location and timing of the incidental observations and, in turn, whether some mitigation could be applied to remove any attractants. DDMI responded that all incidents are reported and investigation by the Environment Department. A single bear appears to be responsible for the majority of the incidental observations and has been interacting with the site since it was a cub. Despite relocation, it returned to the site. Grizzly bear mortality predictions have not been exceeded, DNA results suggest a stable or increasing population, mitigation measures and deterrent actions have been implemented. Grizzly bears appear to be well-managed. **This issue is satisfied.**
Wolverine	
Please give careful consideration to the possibility that wolverine may be becoming habituated and their presence on the site may be on the rise.	The 2017 WCAR (Golder 2017b) presented detailed analyses that found that wolverine occurrence has increased over time. An analysis of data from 2004 – 2015 from the wolverine hair snagging program was completed in 2018 and found a weak decline in average wolverine density at the Diavik Mine over time. A possible explanation is that that wolverines are attracted to the mine area because of the new more northerly distribution of caribou due to their recent range contraction, or alternatively, the mine may be attracting wolverines. DDMI's ongoing monitoring of wolverine track density and mortality, along with the regional research on the wolverine population, will inform DDMI of whether adaptive management is required to minimize impacts on wolverine. **This request is satisfied.**
The wolverine hair snagging program was not completed in 2015 or 2016. It was last completed in 2014. Last year DDMI anticipated that the next wolverine hair snagging survey would occur in 2017, though the long-term frequency of this program has not been determined. ENR should indicate when they expect to complete the 2014 wolverine hair snagging data analysis. If more data collection and analysis is not	An analysis of data from 2004 – 2015 from the wolverine hair snagging program was completed in 2018 (Efford and Boulanger 2018). Decisions regarding program frequency are anticipated to be determined collaboratively once the 2018 report has been reviewed. We support DDMI's continued involvement in this program. **This request is satisfied.**

anticipated for 2017, DDMI should describe alternative plans for evaluating wolverine abundance in the study area.	
There may be opportunities for more systematic site surveys/checks for wolverines and waste management to mitigate instances of wolverines in waste bins. For instance, could waste collection bin checks be included in already scheduled waste inspections at the Waste Transfer Area (WTA) and Landfill?	DDMI responded that they currently include waste bin checks as part of waste bin inspections of the WTA and landfill (Golder 2017a). We have no further mitigation recommendations for wolverine at this time. **This request is satisfied**.
Regarding the 2014 WCAR (Golder 2014), it was not clear why caribou herd size was related to wolverine occurrence and how this specifically relates to objective of the WCAR "to examine indirect Mine-related effects". We recommend a brief explanation be provided.	DDMI responded that the analysis was designed to test effects predictions and to place mine-related effects into context of natural factors. Caribou could influence the regional abundance and distribution of wolverine. **This issue is satisfied.**
The WMP evaluates the prediction that Mine-related mortalities, if they occur, are not expected to alter wolverine population parameters in the Lac de Gras area. We recommend DDMI elaborate on how they are testing this particular prediction given the absence of data on population size.	DDMI responded that results from Efford and Boulanger (2018) indicated a stable wolverine population growth rate through time across study areas, except for Daring Lake, which showed a slight decline. Apparent survival was similar across study areas. DDMI concluded that this information supports the prediction that mine-related wolverine mortalities are unlikely to be influencing population parameters. **This issue is satisfied**.
Waste Monitoring	
While fox observations looked to be steadily increasing in the WTA since 2009, they appear to have levelled off in 2013 (the tabular presentation of data in the 2013 WMR makes it difficult to confirm). We recommend DDMI evaluate whether this levelling-off of fox observations in the WTA persists in future years.	In 2017, there appeared to be a high number of misdirected food items for the WTA and Landfill Areas relative to the other inspected areas and observations of fox and wolverine were highest for the WTA. DDMI should explore reasons for the higher levels of misdirected food waste in the WTA in 2017 as this may be contributing to wildlife presence and possible habituation near the Mine site. DDMI responded that the results are reviewed as part of an adaptive management process and that they will continue employee education programs. This appears to have been effective because fox and wolverine numbers are lower in 2017 compared to 2016 at the A21 Area. **This request is satisfied**.
DDMI should explore the reasons for the higher levels of misdirected food waste in the A21 Area as this may be contributing to wildlife (particularly wolverine) presence and possible habituation near the Mine site.	