A Review of the 2020 Diavik Diamond Mine Wildlife Monitoring Report

Prepared for

Environmental Monitoring Advisory Board

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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 2020 Wildlife Monitoring Report (WMR; Golder 2021). 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. In 2020, EMAB provided recommendations for consideration by Diavik as they developed a draft Wildlife Management and Monitoring Plan (WMMP). We are currently waiting for a final version of the WMMP, which is anticipated to be available in spring of 2021. 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 2020 WMR.

The overall area of disturbance (km^2) increased in 2020 but remains below predicted levels. Seven Ecological Land Classification (ELC) or vegetation types (up from three last year) out of 12 were disturbed in 2020 including heath tundra (0.06 km^2), heath boulder (0.02 km^2), heath bedrock (0.02 km^2), tussock/hummock (0.03 km^2), birch seep and shrub (0.01 km^2), shallow water (0.01 km2), and deep water (0.01 km^2).

The 2020 WMR indicates that cumulative direct summer caribou habitat loss is 2.815 habitat units (HU), which is 0.06 HUs higher than in 2019. 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 2020, no data was reported on caribou movement and no additional analyses for ZOI monitoring were completed. DDMI restated the conclusion from their 2019 analysis of aerial survey data that no ZOI was detected. Both MSES and GNWT disagree with DDMIs conclusion that there is no ZOI. DDMI also affirmed their commitment to use collared caribou data for future ZOI monitoring. We note however that two studies have already identified a ZOI using the caribou collar data (Boulanger et al. 2012 and 2021). DDMI did not acknowledge the findings of these two peer-reviewed publications in the WMR, instead basing their claim of no ZOI around the mine entirely on their 2019 analysis of the aerial survey

data. We recommend DDMI integrate the results of these peer-reviewed studies into their discussion of a ZOI around the mine and stress the need for implementation of a mitigation and monitoring plan to address this effect of the mine on caribou distribution.

Caribou behaviour data were collected and summarized in the 2020 WMR. Statistical analysis of the data cannot be completed because sample sizes have been, and remain, insufficient. There appears to be some discrepancy regarding outcomes of the 2021 Slave Geological Provincial (SGP) Wildlife Workshop regarding the continuation of caribou behaviour monitoring. DDMI suggest that caribou behaviour monitoring was deemed to no longer be necessary; however, this was not our understanding from the workshop discussion. DDMI indicated that the continued collection of caribou behaviour data is included in their WMMP. We recommend that DDMI continue their efforts to collect caribou behaviour data annually and complete statistical analyses when data permits.

No new caribou collar data was presented to inform the questions with respect to seasonal movement. We continue to recommend that the question of the influence of mining on caribou distribution remains "on the table" through the collection and evaluation of GPS-collar data every 3 years, 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 2019 to 2020. Hair snagging did not take place in 2020, but previous results suggest a stable or increasing population, and project-specific impacts of the mine on grizzly bears are likely minimal. A trigger for reinstituting future annual hair snagging should be developed (e.g., based on mine-related mortalities).

For wolverine, mortality due to the Mine remains low. The 2020 WMR reported zero mortalities, one relocation, and 35 deterrent actions for wolverine on-site. DDMI collected snow track survey data in 2020. Wolverine hair snagging did not take place in 2020 (last completed in 2014). A trigger for reinstituting future annual hair snagging should be developed (e.g., based on mine-related mortalities).

There do not appear to be any new findings or changes of note regarding the presence and productivity of raptors. One active rough-legged hawk nest and one active common raven nest were observed in 2020. Project-specific effects on peregrine falcons are likely minimal.

In 2020, wildlife was observed on 2.4% of the WTA inspections and 1.3% of Landfill inspections. Red fox, or their sign, was the most commonly observed wildlife species, this is similar to previous years. In general, the number of wildlife observations in the WTA, Landfill area, A21 area, and Underground were lower in 2020 than in 2019.

Below, we present some highlights for the Boards' consideration. We recommend that the following issues be addressed:

1. DDMI has committed to use collared caribou data for future ZOI monitoring but fails to act upon information from existing peer-reviewed publications that already analyzes collar data to demonstrate a ZOI around the mine. In order to develop meaningful mitigation measures to try to address the ZOI issue, the focus must shift to gathering information on covariates of mine activity (i.e., traffic volumes, noise disturbance) and better methods to monitor caribou abundance and distribution when present around the mine for use in ZOI models to determine whether these are important mechanisms contributing to the ZOI. GNWT and DDMI should develop a

rigorous ZOI mitigation and monitoring plan to be implemented immediately so monitoring methods can be incorporated into the WMMP in order to monitor the ZOI as the mine enters the closure and reclamation phase, a time when it should decline from its current average extent of 7.2 km (Boulanger et al. 2021).

2. During the 2021 SGP Wildlife Workshop, the possibility of holding a forum focussing on caribou mitigation measures was proposed. We support this type of forum and encourage Indigenous community participation in the forum as it could be a successful avenue to adaptively manage mine-related changes in caribou movement. There was also general agreement among program partners to increase the frequency of ZOI technical task group meetings which would discuss the use of covariates in models, the development of a caribou resource selection function (important habitat characteristics), and other issues relating to the ZOI issue. We support this forum and recommend that actionable items from meetings be developed whenever possible to ensure that relevant advancements in managing ZOI issues are implemented in Mine monitoring programs.
3. There is now an eight-year gap in caribou behavioural data analysis (2012-2020) 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 and recommend data collection and analysis be completed when possible. Exploratory results on caribou movements near mine infrastructure using sequential movements gathered from collar data were presented at the 2021 SGP Wildlife Workshop. This type of information could supplement our understanding of caribou behaviour and assist in the development of appropriate mitigation measures. However, this approach may also suffer from the same limitation of current ground-based behavioural surveys in that they both have a limited sample size.
4. No additional data was collected in 2020 to analyse caribou deflection east or west of Lac de Gras. GPS-collar data collection and analysis are recommended for the next comprehensive analysis to verify range fidelity and the correlation between northern migration and the winter range.
5. DDMI indicated that the grizzly bear and wolverine hair snagging programs have been discontinued, as determined by program partners during the February 2021 Slave Geological Province Wildlife Monitoring Workshop. We do not agree that this was the consensus decision of the program partners. While industry representatives expressed no interest in continuing regional research on carnivores, ENR expressed interest in continuing to collect regional datasets and baseline data for use in impact assessment in the future. We are uncertain if program partners decided to stop hair snag monitoring surveys for the foreseeable future, or settled on a longer frequency (e.g., every 5 years) between surveys. We recommend EMAB request meeting summaries from GNWT for the 2021 Monitoring Workshop before determining a preferred frequency for hair snag monitoring. In addition, we recommend DDMI and GNWT develop triggers for reinstituting future annual hair snagging, for example, if the number of mortalities associated with the mine increases substantially, or if mortalities are recorded for 3 years in a row for grizzly bear or wolverine.
6. Please respond to all recommendations contained in the excel spreadsheet provided by EMAB.

7. Except for our recommendations listed above, we are in agreement with the recommendations listed in the 2020 WMR and do not recommend any actions additional to providing the information requested above.
8. The recommendations contained herein must be addressed to the satisfaction of EMAB either before the next WMR is produced or incorporated into the next WMR, as appropriate. With the understanding that recommendations will be meaningfully addressed, we recommend the Board accept the 2020 WMR. The responses to our questions and recommendations are necessary to maintain and improve the understanding of the effects of the Mine on wildlife and must not be delayed. Furthermore, we understand that detailed data analyses are required, as identified in our review, and that these analyses will be conducted at the 3-year interval.

TABLE OF CONTENTS

LIST OF TABLES

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 2020 Wildlife Monitoring Report (WMR; Golder 2021). 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 next comprehensive analyses will be completed in 2023. The WMR communicates the findings of surveys conducted during 2020 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. In 2020, EMAB provided recommendations for consideration by Diavik as they developed a draft Wildlife Management and Monitoring Plan (WMMP). We are currently waiting for a final version of the WMMP, which is anticipated to be available in spring of 2021.

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 2020 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; however, DDMI reported that program partners agreed in February 2021 to discontinue hair snagging programs that would address these objectives (Golder 2020) 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 2020 WMR includes a discussion of effects on wildlife from the previous year. Detailed analyses for barren-ground caribou and wolverine were last completed in 2019 (Golder 2019). This year, DDMI summarized the data collected in 2020 for caribou (habitat, behaviour, incidents, mortality), grizzly bear (habitat, incidents, mortality), wolverine (snow tracks, incidents, mortality), raptors (nests, incidents, mortality), and waste management, but no detailed analyses were completed. Some programs continue to have data collection suspended (e.g., caribou aerial surveys, grizzly bear/wolverine hair snagging for evaluating abundance and distribution, caribou distribution).

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:

- Caribou habitat loss remains below the levels predicted. As of 2020, cumulative HR loss was 2.815 HUs, which is 0.06 HUs below the total predicted habitat loss of 2.965 HUs. No data was reported regarding caribou movement in 2020 and no analyses were completed. DDMI restates their commitment to use collared caribou data for future ZOI monitoring. We note that two peer-reviewed publications are currently available that demonstrate the existence of a ZOI around the mine. As far as caribou behaviour is concerned, DDMI reported that additional caribou observation data was collected; however, there continues to be a lack of data that would allow for the statistical analysis of behavior at different distances to the Mines. No information was presented regarding caribou distribution (northern and southern migration patterns). 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 2020.
- For wolverine, mortality due to the Mine remains low. Wolverine snow track surveys were completed in 2020, although only one round instead of two rounds was completed due to the COVID-19 pandemic. Mean track density was lower in 2020 compared to 2019. Hair snagging did not take place in 2020.
- In 2020, wildlife was observed on 2.4% of the WTA inspections and 1.3% of Landfill inspections. Red fox, or their sign, was the most commonly observed wildlife species, this is similar to previous years. In general, the number of wildlife observations in the WTA, the Landfill area, the A21 area, and Underground were lower in 2020 than in 2019.
- Pit walls and other infrastructure are monitored for nesting raptors and nest monitoring data are contributed to ENR every 5 years. In 2020, 55 pit wall/infrastructure inspections were completed with one active rough-legged hawk nest and one common raven nest observed. Deterrent actions successfully kept a pair of peregrine falcons from nesting in the A21 pit.

DDMI provided responses to our recommendations and questions from 2020 (Appendix A, 2019 WMR). Table 1 summarizes the current status of our 2020 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 2020 for the 2019 WMR or carried over from previous years.

Recommendations/Questions in 2020[1]	Action by DDMI
Vegetation and Wildlife Habitat	
Reference #: DDMI-WMP-14 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 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**	DDMI pointed out that when mining activities cease, sources of indirect effects to vegetation will no longer be present. They acknowledge that vegetation will require an unknown amount of time to progress to a natural state and that the natural state may be different than baseline as the environment generally continues to change through time. They state that vegetation monitoring post-closure will be determined through review and approval of the ICRP. **Please see recommendations by EMAB through the Wek'èezhìi Land and Water Board (WLWB) review process for ICRP 4.1 (SW4 Closure Objective).**

[1] For historical information / additional context for 'Recommendations/Questions in 2020', please refer to Appendix A of the Golder (2021).

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 Movement	
Reference #: DDMI-WMP-5 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).**	DDMI responded that the 85% confidence intervals for the distance-preferred habitat interaction term still overlap zero and suggest that interaction term is a non-informative parameter. **This request is satisfied.**
Reference #: DDMI-WMP-6 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**	DDMI supplied the requested graph and statistical analysis (negative binomial regression; Attachment 1 of 2020 WMP Report). **This request is satisfied.** DDMI referred EMAB back to Section 4.2 of the 2019 WMP report for information on ecological context for the statistical results and effect sizes. **This request is satisfied.**

not just the statistical significance of the caribou by distance relationship. **We recommend discussing effect sizes and the ecological significance of all modelling results presented in this section.**	
Reference #: DDMI-WMP-7 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.**	DDMI provided the explanation that month was used instead of insect harassment because weather conditions influenced the insect harassment index during October and November. Month was used to capture caribou aggregation in July, during the severe insect harassment period. **This request is satisfied.**
Reference #: DDMI-WMP-8 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	DDMI supplied the requested model and statistical analysis (Attachment 1 of 2020 WMP Report). They concluded that the ΔAIC value for the requested model was >2 AIC units larger than both the M2 and M3 models, indicating less support for the distance variable than for the preferred habitat variable. This is a reasonable conclusion for an analysis of this type. **This request is satisfied.**

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.**	
Reference #: DDMI-WMP-9 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.**	DDMI provided further discussion of the sampling unit standardization as requested. **This request is satisfied.**
Reference #: DDMI-WMP-10 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. It is our understanding there is existing satellite collar data that can be analyzed and that there has been no aerial survey data collected since 2012.	DDMI's response contains a discussion of the strengths and weaknesses of different statistical approaches (ANOVA/ANCOVA vs. multiple regression) and does not commit to try an alternative approach to the ZOI analysis. In their response to our recommendation to use a ZOI analysis approach similar to White and Gregovich (2017), DDMI's response stated that those authors used "*a completely different statistical design than the multiple regression approached* (sic) *used in the 2019 WMP report"* (DDMI, 2020, Appendix A, pg. 5). Then in response to comments on the 2019 WMP report from the GNWT DDMI stated "[t]*he statistical approach applied is consistent with White and Gregovich (2017),*

We recommend DDMI utilize 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).	*which also applied a regression interaction between distance and habitat to test for a zone of influence*." (DDMI, 2020, Appendix B, pg. 1). These are confusing responses to similar but different requests from EMAB and GNWT. EMAB was requesting an analysis of collar data using methodologies similar to White and Gregovich (2017), not a reanalysis of the aerial survey data. Whereas, the GNWT recommendation was to reanalyze the aerial survey data using established methods. DDMI then suggested that the approach used by White and Gregovich (2017) is consistent with the approach they used to test for a ZOI. **We recommend DDMI clarify their responses to DDMI-WMP-10 and GNWT-20-WMP-3 to clearly address EMAB's original recommendation and the apparent contradiction as to the applicability of the approach used in White and Gregovich (2017) to estimate a ZOI.** In our opinion the confusion around the analysis of the aerial survey data is rendered moot by the analysis of collared caribou data from 2012 and 2021 that demonstrate the presence of a ZOI around the mine (Boulanger et al., 2012; Boulanger et al., 2021). Focus should already be turned to the development of a mitigation and monitoring plan that attempts to reduce the size of the ZOI around the mine and monitor it over time scales that will allow for the near real time assessment of mitigation measures and caribou response. **See Section 3.2.2 of this report for additional comments and a recommendation to this effect**.
Reference #: DDMI-WMP-15 In 2019, EMAB recommended that "GNWT-ENR should also follow through on its commitment to 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	DDMI referred to their response to DDMI-WMP-10, which states that the analysis of caribou collar data will be completed in 2022, according to Diavik's Wildlife Management and Monitoring Plan (WMMP). **See Section 3.2.2 of this report for recommendation to this effect.**

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.**	
Caribou Behaviour	
Reference #: DDMI-WMP-11 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 recommend that DDMI continue their efforts to collect caribou behaviour data annually (see also DDMI-WMP-16).**	DDMI responded that the continued collection of caribou behaviour data is included in Diavik's WMMP. However, within the 2020 WMP Report, DDMI reported that "*The 2021 Slave Geological Provincial Wildlife Workshop also concluded that caribou behaviour monitoring is no longer necessary*." (Section 4.7). While DDMI commits to continue to monitor caribou behaviour in 2021, they also state that the discontinuation of the program through adaptive management "*precludes the need to complete statistical analyses*" (Section 1.1). We also attended the 2021 workshop and noted no obvious consensus regarding the continuation or discontinuation of caribou behaviour monitoring. **Please provide documentation supporting the decision to discontinue caribou behaviour monitoring.** **We recommend that behaviour surveys continue to be conducted because the information could be useful in understanding the mechanism behind the ZOI and, subsequently, in developing associated mitigation measures. Ground-based behavioural data will also be needed for comparison against behaviour data collected during closure and post-closure phases to test predictions. The data may also assist in understanding the impacts of mine activity on caribou energetics, which can be used to inform future development applications and cumulative effects assessments.** The challenge, as with all approaches presented during the workshop, continues to be sample size and the availability of mine-activity covariates**.**
Reference #: DDMI-WMP-16 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.	DDMI directed EMAB to inquire directly with Ekati mine about their caribou behaviour data from 2017 – 2019. **Can ENR please provide behaviour data from the Ekati mine for the years 2017-2019?**

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 no 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 did not commit to evaluate different types of movement separately (i.e., walking vs. trotting vs running) and expressed concern that pooling data may confound effects because of data gaps. They state that there is no discernable pattern between distance strata with respect to trotting or running. A demonstrated lack of statistical difference would provide more relevant information. **Data permitting, it may be informative to distinguish running from trotting from walking in future behavioural analyses**. **Please also see issue DDMI-WMP-11.**
Caribou Distribution	
Reference #: DDMI-WMP-17	DDMI evaluated the original predictions relating to caribou migration and determined the prediction for

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, 4 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 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)?**

the southern migration was "*not well developed and likely incorrect*". DDMI suggested that the prediction should have focused on the loss of the East Island route and not specified whether an east or west trajectory would dominate future movements. We agree that the sample size of 10 routes and the predicted results only narrowly suggests that caribou should travel East most of the time for the southern migration:

Baseline Routes relative to East Island: 5 East, 1 across, 4 West.

Predicted Routes relative to East Island: 6 East, 0 across, 4 West.

Across all years, DDMI found that more caribou moved west past Lac de Gras during the northern migration (77%; 255 W vs. 76 E) and during the southern migration (57%; 170 W vs. 127 E; Golder 2019). 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. We agree that monitoring west vs. east deflections is not very informative regarding impacts of the Project on caribou migration. This does not tell us why they would migrate in either direction or if the Mine is influencing this decision. **We agree with removing the caribou deflection component of the monitoring program.** DDMI has used GPS collar analyses to support their conclusion that observed changes in caribou migration can be largely attributed to natural range contraction (Virgl et al. 2017 use GPS data from 1996-2013; 2019 WMR (Golder 2020b Appendix C) graphed data from 1996-2018). The data show a contraction in autumn range size over time, high autumn range fidelity over time, and a northern shift in the autumn range location over time. **We recommend that DDMI re-evaluate these relationships through quantitative analysis of GPS collar data at the time of the next comprehensive analysis (2022). The analysis would verify that autumn range fidelity remains high and that the travel routes for the northern migration remain correlated with the location of the winter range (i.e., that the mine is having no measurable effect on the caribou migration).** However, it should be noted that the contraction and the northern shift of the autumn range could reflect chronic effects (avoidance) of the mine and that the influence of herd size on caribou range attributes should be quantitatively

• **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?)**	evaluated. Re-evaluation of these range attributes would also align with DDMI's statement that "*In some cases, even when Mine-related effects are determined to be negligible, monitoring may be continued because it can increase the confidence of impact predictions in future environmental assessments and contributes to the assessment and management of cumulative effects by government*." (p. 21; emphasis added) With respect to caribou energetics, DDMI does not propose to evaluate the energetic consequence of changes in the southern migration. Impacts to the southern migration were predicted by DDMI (loss of East Island route), but the energetic cost was likely overestimated because of the low amount of use of the east island route (baseline case). Caribou are roughly equally likely to use a west or east route in the absence of the east island route. Aside from existing mitigation measures in place relating to noise, dust, and light, impacts on caribou migration are likely only going to be reduced further through mine site reclamation. The value of completing an assessment of change in energetics at this point in time, if possible, would be to inform future project applications. An energetics model has already been completed for the Jay Project application, in which Dominion Diamond Ekati Corporation (Dominion) concluded that the Jay Project would cumulatively decrease caribou fecundity by 0.3% (MVRB 2016). Based on this information, we could assume that impacts from the Diavik Project would not exceed this cost in fecundity. However, **if changes in caribou range attributes are detected in future GPS collar data analysis that incorporates more recent data, this assumption regarding the extent of the energetic cost may need to be reconsidered.**
Wolverine	
Reference #: DDMI-WMP-12 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.	DDMI indicated that wolverine snow tracking is included in Diavik's WMMP. **This issue is satisfied.** After MSES completed our initial review, GNWT provided comment on the WMMP (GNWT-ENR, 2020). Their review questioned DDMI's approach to estimating a ZOI which relied upon the significance of a statistical interaction. In their review of the WMMP, the GNWT identified issues with using a statistical interaction term to examine the occurrence and size of a ZOI. While we think a statistical interaction term may

We recommend the continuation of the snow tracking program to monitor impacts of the mine on wolverine detectability, occupancy, colonization and extinction.	be useful for examining the size of ZOI if the correct data collection approach is used during monitoring, we remain uncertain if DDMIs approach can define a specific ZOI size if it should exist (See Comments in response to DDMI-WMP-10 above). As a result, **we agree with the GNWT and recommend that DDMI revise their approach for future annual reports.**
Reference #: DDMI-WMP-13 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**.	DDMI responded that continuation of the wolverine hair snagging program will be determined with program partners. **See Section 3.4 of this report for recommendation regarding wolverine monitoring.**

3.0 Specific Observations

3.1 Vegetation and Wildlife Habitat

There was an increase in the Project footprint in 2020 of 0.22 square kilometres (km^2), with a total reported loss of terrestrial and aquatic habitats to date from mining activities since 2000 of 11.41 km^2 (compared to 11.19 km^2 in 2019). The total vegetation loss due to the mine footprint to date remains under the original prediction of 12.67 km^2. The South and North Country Rock Piles are still expected to increase in size during the remainder of operations and reclamation activities. No further expansion of the development footprint is expected during operations.

In 2020, the overall disturbance of vegetation types was at or slightly exceeded predicted levels for riparian shrub, birch seep and shrub, boulder complex, esker complex, and disturbed areas (which include areas disturbed prior to exploration activities when the ELC was developed). Seven ELC types (up from three last year) out of 12 were disturbed in 2020, heath tundra (0.06 km^2), heath boulder (0.02 km^2), heath bedrock (0.02 km^2), tussock/hummock (0.03 km^2), birch seep and shrub (0.01 km^2), shallow water (0.01 km^2), and deep water (0.01 km^2). The amount of change reported for these seven ELC types adds up to 0.16 km^2), which when added to last years total disturbance area of 11.19 km^2 equals 11.35 km^2. There is a 0.06 km^2 difference between the total loss reported by ELC type and the total disturbance reported in this year's WMR (i.e., 11.41 km^2). It is unclear where this extra 0.06 km^2 of disturbance occurred. It is

possible this is a result of rounding estimates for the report**. Please clarify this difference in disturbance area reporting. The methods applied for this part of monitoring are adequate.**

3.2 Barren-Ground Caribou

3.2.1 Habitat Loss

The 2020 WMR indicates that cumulative direct summer caribou habitat loss is 2.815 habitat units (HU), which is 0.06 HUs higher than in 2019. 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

No new data on caribou movement was presented, and no additional analyses for ZOI monitoring were completed, for the 2020 WMR. The 2020 WMR simply restates the results of DDMI's 2019 analysis of aerial survey data which concluded that no ZOI exists. The 2020 WMR states the "*analysis did not detect a ZOI, after accounting for numerous other factors such as changes in study area size, changes in overlap with the Bathurst caribou herd distribution, insect harassment, and other annual but unmeasured factors*." (DDMI, 2020, pg. 12) **Can DDMI please clarify what is meant by 'annual but unmeasured factors' and discuss how 'unmeasured factors' were incorporated in their previous analysis of the aerial survey data.**

The approach used by DDMI in 2019 to analyze the aerial survey data assumes that more individuals in an area represents stronger selection for certain environmental variables, in this case, preferred caribou habitat, in that area (Montgomery and Roloff, 2017). However, it is our opinion that DDMIs approach assumes selection rather than directly measures it. To measure selection, we recommend other approaches that utilize selection ratios (e.g., White and Gregovich, 2017). A selection ratio is the ratio of used habitat over the availability of that habitat type in an area (Manly et al., 2002). Measuring habitat use relative to the availability of that habitat on the landscape directly estimates habitat selection. The approach used by DDMI can relate caribou abundance to the amount of preferred habitat in an area (e.g., a certain distance from the mine), but given the aerial survey methods, DDMI cannot conclusively say if caribou were actually using the areas of preferred habitat at any particular distance from the mine or if they were in other types of habitat at that distance when observed during the aerial surveys. To more confidently estimate the strength of habitat selection at any distance from the mine requires understanding whether caribou are using their preferred habitats when observed and comparing that to the availability at different distances to the mine. This is ideally done using GPS collar data. The 2020 WMR restates DDMIs commitment to use collared caribou data for future ZOI monitoring. However, while we agree that using multiple types of data to monitor the ZOI is necessary, we also note this has already been done.

Peer-reviewed analyses of the aerial survey and caribou collar data using a selection ratio approach (i.e., comparing used habitat to available habitat at different distances) have already identified the presence of a ZOI around the mine (Boulanger et al., 2012; Boulanger et al., 2021). The two peer-reviewed publications by Boulanger et al. (2012; 2021) use collar data to demonstrate the existence of a ZOI around the mine, yet there is no mention of these findings in the WMR, which instead states, based on a single analysis of

aerial survey data, that there is no ZOI around the mine. We are confused why the already published analyses of caribou collar data are not discussed and why they have not been used to guide adaptive management action to date. We do not agree that a single regression analysis of the aerial survey data is sufficient to conclusively demonstrate the lack of ZOI around the mines when other analyses of collared caribou directly estimating changes in habitat selection show the presence of a ZOI. It is our opinion that all available information should be used to guide management decision-making as opposed to selective use of individual analyses. **We recommend DDMI integrate the findings of Boulanger et al. (2012; 2021), particularly regarding the analysis of collared caribou habitat selection, into the discussion of ZOI around the mine in the WMR.**

In addition, based on the published analyses showing the presence of a ZOI around the mine, **we recommend EMAB request DDMI, in collaboration with GNWT, immediately develop monitoring techniques to identify mine-related sources of sensory disturbance and new methods for monitoring caribou abundance and distribution relative to the mine whenever they are in the area.** In order to develop and implement meaningful mitigation measures to try to address the ZOI issue, the focus must shift to gathering information on covariates of mine activity (i.e., traffic volumes, noise disturbance) that can be used in ZOI models to determine whether these are important mechanisms contributing to the ZOI. It is also necessary to identify new methods to monitor caribou abundance and distribution anytime caribou are in the area, and analyses to examine the data to guide the development and implementation of appropriate mitigation measures. It is important to develop these monitoring methods now in order to try and implement mitigation during the final years of mine operations. Adequate ZOI monitoring techniques will also need to be identified so they can be incorporated into the WMMP and be available for use during closure to rigorously monitor the environmental changes associated with closing and reclaiming the mine. Boulanger et al. (2021) showed an average ZOI size of 7.2 km around the mine, this should get smaller as the mine is closed and reclaimed and the techniques need to be in place to measure that change on a timescale that allows for alterations to mitigation practices as needed.

During the 2021 SGP Wildlife Workshop, the possibility of holding a forum focussing on caribou mitigation measures was proposed. **We support this type of forum as it could be a successful avenue to adaptively manage mine-related changes in caribou movement. We encourage Indigenous community participation in the forum, particularly those already involved in caribou monitoring programs**. In addition, there appeared to be general agreement during the 2021 SGP Wildlife Workshop to increase the frequency of ZOI technical task group meetings which would discuss the use of covariates in models, the development of a caribou resource selection function (important habitat characteristics), and other issues relating to the ZOI issue. **We support this forum and recommend that actionable items from meetings be developed whenever possible to ensure that relevant advancements in managing ZOI issues are implemented in Mine monitoring programs**.

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 2020, between February 6 and November 13, observations were collected on 33 caribou groups from 0 to 15 km from the Mine. Observations far from the mine were not attempted in the winter due to human safety considerations and required changes in data collection methods (i.e., snowmobile versus helicopter) Overall, 509 caribou were observed. 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). **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 and complete statistical analyses when data permits (also see Table 1, Reference #: DDMI-WMP-11).** Exploratory results on caribou movements near mine infrastructure using sequential movements gathered from collar data were presented at the 2021 Slave Geological Provincial Wildlife Workshop. This type of information could supplement our understanding of caribou behaviour and assist in the development of appropriate mitigation measures. However, this approach may also suffer from the same limitation of current ground-based behavioural surveys in that they both have a limited sample size. Currently, due to low sample size, impacts of the Mine on caribou behaviour are not being evaluated, and as a result, any mitigation measures currently in place to minimize impacts on caribou behaviour are not being tested, Management action related to caribou behaviour is effectively at a standstill until sufficient data becomes available through the wildlife monitoring program or through other relevant research initiatives (e.g., Angus Smith M.Sc. research on caribou behaviour).

3.2.4 Incidents and Mortality

No Mine-related mortalities were reported in 2020, and one Natural Mortality was reported on East Island (one injured caribou was euthanized by ENR wildlife officers). Caribou mortality remains low, which is at or below originally predicted levels. **The methods applied for this part of monitoring are adequate.**

3.2.5 Advisory

Incidental observation of caribou ranged from 1 to 300 individuals on East Island in 2020, caribou were thought to be from the Beverly/Ahiak and Bathurst herds. There were three separate observations of 100 or more caribou away from the mine site. Overall, there were 57 incidental observations of caribou from February to November 2020. Small groups (i.e., one or two) of caribou were observed on or near the haul roads eight times, as a result, additional traffic control measures were implemented. No formal advisories or deterrent actions were issued because of the low number of caribou observed on site and the short amount of time caribou were observed near mine infrastructure. This includes the airport where caribou were seen twice in 2020.

3.3 Grizzly Bears

The 2020 WMR indicates that total direct terrestrial grizzly bear habitat loss associated with the project is 8.20 km^2, a loss of 0.18 km^2 from last year, but still 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. In 2020, of the 95 observation instances, 50 required deterrent actions and 45 did not. Five more deterrent actions were required in 2020 compared to 2019, but there were also 44 more bear observations in 2020 compared to 2019 (169 to 125). There were two bear mortalities and one relocation in 2020. A sow and a yearling cub were euthanized in September because they became habituated, entered the camp cafeteria, and posed a threat to mine personnel. There were zero mortalities or relocations in 2019. The Mine-related mortality rate over 21 years of monitoring is 0.14 bears/year, which is within the predicted range. **The methods applied for this part of monitoring are adequate**.

Hair snagging has been used previously to assess grizzly bear abundance and distribution over time as per the revised monitoring objective (GNWT, 2013). No hair snagging has been completed since 2017. 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 stated in the 2020 WMR that "*Program partners at the 2021 Slave Geological Provincial Wildlife Workshop agreed that the grizzly bear hair snagging program will no longer be completed*." (DDMI, 2020, pg. 20). We concur that the program partners determined there was no longer a need for annual hair snagging surveys, but do not recall a consensus being reached among program partners on the need for future surveys or what frequency of surveys might be sufficient. **We recommend EMAB review the meeting notes from the 2021 workshop, when made available by GNWT, before determining the appropriate frequency of future hair snagging surveys**. While annual hair snag surveys may not be required at this point to confirm population stability, given the number of reported bear observations at the mine and level of development in the region, ensuring grizzly bear populations in the area remain stable should be a goal of monitoring programs even if it is confirmed on a less frequent basis (e.g., once every five years instead of annually). **We recommend EMAB confirm with GNWT the need for and preferred frequency of hair snagging surveys moving forward.** We continue to support DDMI's involvement in the GNWT hair snagging program at a reduced frequency determined in collaboration with program partners. **However, we recommend developing triggers for reinstituting future annual hair snagging at an increased frequency (e.g., annually), for example, if the number of mortalities associated with the mine increases substantially, or if mortalities are recorded for 3 years in a row.**

3.4 Wolverine

Wolverine presence and distribution around the Mine is monitored using snow track surveys, incidental observations, and previously using hair-snagging which was last completed in 2014.

Snow track surveys for wolverine were completed in 2020. Since 2015, each winter track transect has been surveyed twice to incorporate detection probabilities in the analysis. However, in 2020, due to the COVID-19 pandemic, only one round of snow track surveys was completed. During the 2020 survey

wolverine tracks were identified at 12 of 40 transects (30% occurrence). Mean track density index was lower in 2020 (0.13 ± 0.103) than in 2019 (0.206 ± 0.115).

The hair snagging program was last completed in 2014. Analysis of the data collected between 2004 and 2015 showed that surveys could be repeated every four to six years to detect an annual population decline of 5% (Efford and Boulanger, 2018). DDMI indicates that the hair sample program will be discontinued "*as determined by program partners at the Slave Geological Province Wildlife Monitoring workshops hosted by the GNWT in February 2021*." (DDMI, 2020, pg. 28) We agree that the program partners determined that there was no longer a need for annual hair snag monitoring but do not recall a consensus being reached among program partners on discontinuing surveys all together. **We recommend following the guidance of Efford and Boulanger (2018) who recommended repeating the hair snag surveys every four to six years to confirm regional wolverine populations remain stable.**

There were 17 incidental observations of wolverines on East Island, collected over 16 days from February to December; this measure has been decreasing since 2015, which had the highest number of incidental wolverine observations with 118 that year. The 2020 WMR reported zero mortalities (same as in 2019). There was a single relocation in 2020, and a total of 35 deterrent actions (honking vehicle horn was most common deterrent action) were used during four of the 17 observations. **We recommend developing triggers for reinstituting future annual hair snagging surveys, for example, if the number of wolverine mortalities associated with the mine increases substantially, or if mortalities are recorded for 3 years in a row.**

3.5 Raptors

Monitoring of raptor nest occupancy and success was completed in 2020. Annual monitoring of occupancy and nest success was discontinued in 2010, but DDMI contributes nest monitoring data to ENR every five years, and this data was last collected in 2015. In 2020, 55 Pit Wall/Infrastructure nest surveys were completed in June and July and only two of these nests were confirmed as active. There was a rough-legged hawk nest at the south ramp of the A21 Pit and one common raven nest in the Site Services Line Up Area. There were 22 uses of deterrent action between May and July to prevent raptor nesting in the A21 Pit area. This action was focused on the pair of rough-legged hawks that still ended up nesting near the south ramp. The deterrent actions were successful in keeping a pair of peregrine falcons from nesting in the A21 Pit.

There was one mortality in 2020, a rough-legged hawk was found unresponsive on Lakeshore Boulevard and died shortly after being found. Cause of death has not been established at this time and the carcass has been sent to ENR to confirm the cause of death.

We support DDMI's continued Pit Wall/Mine Infrastructure monitoring for nesting raptors. The methods applied for this part of monitoring are adequate, no further recommendations.

3.6 Waste Management

In 2020, the total number of misdirected attractants (food and food packaging) was lower than 2019 levels in the Waste Transfer Area (WTA), the Landfill area, the A21 area, and Underground. On average the number of misdirected attractants found during inspections was 35% lower than last year. Gloves, cigarette butts, and oily rags were the most frequently misdirected waste items. Wildlife was observed on 2.4% of the WTA inspections and 1.3% of Landfill inspections. Red fox, or their sign, was the most commonly observed wildlife species, this is similar to previous years. The overall outcome of waste management appears to be positive. **The methods applied for this part of monitoring are adequate, no further recommendations.**

4.0 Closure

The review of the 2020 WMR reported herein presents the conclusions arrived at by MSES. DDMI included responses to all previous recommendations and requests (Appendix A, 2020 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 expect that future communications will lead to further clarification on several details of the 2020 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.**

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 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.**	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**.
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	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

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 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 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.**
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,**	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**

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 management measures that they have put in place to mitigate the higher than anticipated dust deposition associated the mine.**	
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.**
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 anticipated for 2017, DDMI should describe alternative plans for evaluating wolverine abundance in the study area.	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.**
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.	