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An Evaluation of Cumulative Effects Assessment in the Northwest Territories

by

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CERTIFICATE OF COMPLETION OF PROJECT

FOR THE UNIVERSITY OF CALGARY

MASTER OF SCIENCE DEGREE IN SUSTAINABLE ENERGY DEVELOPMENT

The undersigned certifies that he has read, and recommends to the Sustainable Energy Development Program (SEDV) for acceptance, the Project Report entitled "An Evaluation of Cumulative Effects Assessment in the Northwest Territories," submitted by Nelson Debogorski, in partial fulfilment of the requirements for the degree of Master of Science in Sustainable Energy Development.

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ABSTRACT

This study investigates cumulative effects assessment (CEA) in the context sustainable development and the resulting impact on barren-ground caribou (Rangifer tarandus groenlandicus) in the Northwest Territories (NWT). This research attempts to gain insight into the role of CEA in the sustainability of this species and answer the question; has CEA been applied in NWT to adequately mitigate the impact of development on barren-ground caribou? CEA completed for five projects situated in the NWT are analysed and ranked based on an evaluation matrix developed for the study. The research findings determined that CEA in the NWT may not contribute substantive value to promote sustainability of the caribou. The CEAs evaluated did not demonstrate best practices as reported in the CEA literature, additionally the cumulative effects of development in all projects evaluated was reported as negligible. CEA practice requires re-examination and methodological development to achieve its goal to promote sustainable development.

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LIST OF ABBREVIATIONS

BCRP - Bathurst Caribou Range Plan

CEA - Cumulative Effect Assessment

CEAA - Canadian Environmental Assessment Agency

CEQ - Council on Environmental Quality

CIMP - Cumulative Impact Monitoring Program

EIA - Environmental Impact Assessment

EMP - Environmental Monitoring Program

EAR - Environmental Assessment Report

GIS - Geographical Information System

GNWT - Government of the Northwest Territories

NGO - Non-Government Organization

NWT - Northwest Territories

SEDV - Sustainable Energy Development

THEP - Taltson Hydro Expansion Project

TOR - Terms of Reference

MVEIRB - Mackenzie Valley Environmental Review Board

MVRMA - Mackenzie Valley Resource Management Act

REE - Rare Earth Element Mine

RWED - Resources Wildlife and Economic Development

TEK - Traditional Ecological Knowledge

VEC - Valued Ecological Component

WKSS - West Kitikmeot Slave Study

CHAPTER 1. INTRODUCTION

1.1 Background

This Capstone Project will be an evaluation of the application of Cumulative Effects Assessment (CEA) in the Environmental Impact Assessment (EIA) process, completed for projects located in the Northwest Territories (NWT). A review of leading CEA guidance documents and literature was undertaken, in order to determine how ideal application of CEA is defined. Using the barren-ground caribou (Rangifer tarandus groenlandicus) as the valued ecosystem component (VEC), the Project will compare CEA on barren-ground caribou, included in five environmental impact assessments (EIA) carried out in the NWT, to CEA best practices. Once the performance of CEA application in the NWT is determined the project research question, "has cumulative effects assessment been applied in NWT to adequately mitigate the impact of development on barren-ground caribou?", can be answered. In addition**,** areas where there may be a CEA deficiency will be identified, and recommendations for improvement based on research will be provided.

CEA has been a mandatory component of the EIA process in Canada since 1995 (Duinker & Greig, 2006). It involves assessing the environmental impact of past, present and future activities on a regional level. The practice of CEA has continuously improved over the past two decades but there are still issues concerning best practice. The VEC studied here, the barren-ground caribou in the NWT, in addition to the woodland caribou in Alberta, have had major decreases in population levels (Toth, 2019) (McLoughlin, Dzus, Wynes, & Boutin, 2003). The Bathurst Caribou Herd, the predominant herd in the NWT, has seen their numbers decrease from 472,000 in 1982 to 8,200 in 2018 (GNWT, n.d.a). CEA is made for receptors like the caribou, when your

range covers huge spaces of land like the caribou, you are impacted by multiple sources of development in combination with each other.

The decrease in barren-ground caribou populations is important for indigenous people in the NWT. Hunting bans have recently been placed on the animals restricting even indigenous people from harvesting (d'Entremont, 2020). For a group that refers to themselves as "caribou people" not being able to practice this traditional land use activity has been a detriment for the community. Hunting the caribou is a rite of passage for young indigenous hunters and for the first time in their history they are being denied this right.

1.2 Multi-Disciplinary Aspects of Project

This project is multidisciplinary in nature and will focus on three major aspects: energy, environment, and policy. The energy aspect will be fulfilled by the inclusion of the original Taltson Hydro Expansion Project (THEP) and the Nachalacho Rare Earth Element (REE) Mine EIAs in the study design. Additionally, as there are plans for a renewed THEP and subsequent EIA, the findings of the review will aim at providing a path forward for improved inclusion of CEA in the forthcoming EIA.

The environment aspect will be satisfied by focusing on CEAs conducted for the barren-ground caribou VEC in the five EIAs completed in the NWT: Ekati, Snap Lake, and Gahcho Kué Diamond Mines, THEP and the Nachalacho REE Mine. This exercise will provide a critical evaluation of the CEAs completed on the caribou and determine whether their application was effective in addressing cumulative impacts of development on the caribou. If they were unsuccessful the reasons will be flushed out and identified allowing for improvement of inclusion of CEA in EIAs located in the barren-ground caribou's range going forward. The Slave

Geological Province All Weather Access Road is planned for development within the next 5 years and cuts right through the middle of the Bathurst Caribou Herd's range. It will undoubtably carry with it an impact on the herd and the learnings from the evaluation will be useful for application in the EIA that will accompany the project.

The third aspect of policy will be satisfied as the report will determine how CEA has been applied in EIAs conducted in the NWT. Then it will compare its application to CEA best practice allowing for determination of strengths, shortcomings, and/or failures. The expectation is to provide NWT policy makers with a tool that will assist in better understanding of opportunities to improve inclusion of CEA in EIA and increase its effectiveness as a process for encouraging sustainability.

CHAPTER 2. LITERATURE REVIEW

2.1 Cumulative Effects Assessment

2.1.1 A Brief Background of CEA

CEA has become an increasingly important part of EIA since formal processes were established in North America. However, despite growing knowledge and guidance documents outlining how CEA should be conducted, its practice remains challenging. Part of the issue stems from the convention of treating earlier published works on the subject as authoritative and drawing from them the definition of CEA to guide work, regardless that early definitions could be considered weak and in need of reassessment (Duinker, Burbidge, Boardley, & Grieg, 2013). Other sources of this issue lie in the complexity of EIA and CEA especially in the areas of defining impacts, baseline, scale and significance (Foley, et al., 2017).

The concept of CEA appeared in the 1970's when regulators determined that the impact of proposed projects could not be fully understood without assessing a project in relation to its location and the surrounding activities. In the USA, the terminology "cumulative effects" was first seen in the official guideline documents of the Council on Environmental Quality (CEQ) in 1973. In Canada, the no longer existent, Canadian Environmental Assessment Research Council, initiated the development of early conceptual policies in CEA (Duinker, Burbidge, Boardley, & Grieg, 2013). The period from 1980 through the 1990s saw EIAs in Canada and the USA increasingly take into consideration cumulative effects of projects in reports. The catalyst for the formalization of the process was the appearance of litigation aimed at the insufficiency of CEA inclusion in EIA reports. Legal proceedings initiated by plaintiffs challenged the lack of guidelines for outlining a process to accurately assess CEA in EIA. To address this policy gap

the CEQ in the USA and Canadian Environmental Assessment Agency (CEAA) in Canada developed instructional guidance for inclusion of CEA in EIA (IAIA, 2020).

In a study conducted in 2006 it was found that CEA was not being applied effectively in Canada. Essentially the study describes a total failure of CEA in Canada and the practice being given no more than a token position in EIA. The authors point to 6 main flaws in the practice: conducting CEAs within project EIAs, the focus being on achieving project approval versus promoting sustainability, general confusion regarding ecological thresholds, separating cumulative effects from project impacts, poor analysis of cumulative effects by professionals, and a problematic approach for the inclusion of future projects (Duinker & Greig, 2006).

CEA inclusion in Canadian EIA is guided by the latest technical guidance document *Assessing Cumulative Environmental Effects under the Canadian Environmental Assessment Act, 2012 Interim Technical Guidance Document Version 2* (CEAA, 2018). This is the third installment of the guide, which has built on the earlier versions, one released in 2014 (CEAA, 2015) and the original guide for CEA in Canada, the *Cumulative Effects Assessment Practitioners Guide*, that was commissioned by Environment Canada in 1999 (Hegmann, et al., 1999).

2.1.2 CEA Methodology

As mentioned above, the major steps to completing a CEA in Canada have endured three installments of technical guidance documents from the Canadian Environmental Assessment Agency (CEAA), and are the same as what was laid out in the original practitioner's guide in 1999: 1. Scoping, 2. Analysis, 3. Mitigation, 4. Significance, and 5. Follow-up (Hegmann, et al., 1999; Duinker & Greig, 2006; CEAA, 2015; CEAA, 2018). The Mackenzie Valley Environmental Impact Review Board (MVEIRB) is the regulatory authority responsible for EIA

in the NWT. The *MVEIRB Environmental Impact Assessment Guidelines* provide basic suggestions for completing a CEA and refers proponents to two documents for detailed guidance: 1. the CEAA Practitioners Guide and 2. the *Cumulative Effects Assessments in the Inuvialuit Settlement Region: A Guide for Proponents* (Environmental Impact Screening Committee and the Environmental Impact Review Board) (MVEIRB, 2004). A review of the CEA process as outlined in Hegmann, et al. (1999), Hegmann, Lloyd, Sloan, Green, & Fabijan (2002), MVEIRB (2004), and CEAA (2018) has been completed and is documented below.

2.1.2.1 Scoping

Scoping is a stage setting exercise that determines what should be included or excluded when assessing cumulative effects and impacts on VECs. Its overarching goal is to select which VECs will pass through the scoping step into the analysis step. CEAA (2018) lays out the criteria for deciding whether a VEC will be included in a CEA. If a VEC is determined to have residual environmental impacts stemming from the designated project assessed in the EIA it must be included in the CEA process. Residual impacts are impacts that persist after mitigation measures have been applied. The VEC must be included even if the residual impacts are predicted not to be significant. The judgement criteria focus' on the presence of residual impacts in isolation from their level of significance. The VECs are then placed in the context of temporal and spatial boundaries with other developments selected (beyond the designated project) which could cause an impact on them. Within that context a practitioner then must decide if the VEC is likely to be affected by past, present of future activities within the spatial and temporal boundaries. If those VECs will not be affected, they are not carried into step 2, if they are affected then they move forward to the analysis step. The Scoping process is subdivided into identifying VECs, setting the spatial boundaries, setting the temporal boundaries, and selecting other developments.

Identifying VECs

The VECs relevant to the CEA will be a subset of the VECs considered for project effects. The list will be comprised of those VECs which after application of mitigation measures experience a persistent residual impact regardless of the significance. The term environment in the Mackenzie Valley Resource Management Act (MVRMA) includes biophysical, socio economic and cultural components (MVEIRB, 2004). Therefore, it is important to note that VECs selected could be characterized as solely social or cultural in addition to ecological VECs (MVEIRB, 2004). In the context of northern Canada important VECs could come from concerns regarding any impacts on wildlife, wildlife habitat, and wildlife harvesting (Hegmann, Lloyd, Sloan, Green, & Fabijan, 2002). Selecting VECs is a paramount step in focussing the CEA.

Spatial Boundaries

CEAA (2018) requires selection of spatial boundaries follow 1 of 5 methodologies or some combination of them:

a. VEC centered,
b. Ecosystem centered,
c. Activity centered,
d. Administrative, political, or other human-made; and
e. Other options that can be rationalized.

The VEC centered approach is considered the optimal method for selection of boundaries as it draws the most relevant area specific to VECs selected for the CEA. Ultimately though it is the responsibility of the CEA practitioner to determine how the boundaries

are drawn and provide documentation with a reasonable rational for the chosen spatial boundary for each identified VC.

Temporal Boundaries

When considering what temporal boundaries to select it is important for practitioners to understand the potential perseverance and variation from the norm of cumulative effects being evaluated. CEAA (2018) requires selection of temporal boundaries follow 1 of 4 methodologies or some combination of them:

1. VEC centered,
2. Ecosystem centered,
3. Activity centered, and
4. Other options that can be rationalized.

The activity centered methodology is meant as an informative piece to one or more of the other methods and should not be used in isolation. Once again it is the responsibility of the CEA practitioner to determine how the boundaries are drawn and provide documentation with a reasonable rational for the chosen temporal boundary for each identified VEC.

Other Developments

This is where other developments, besides the designated project, are selected for inclusion in the CEA. The other activities selected will be all those, that in addition to the designated project, pose an effect on the VECs chosen in the identifying VECs section and fall within the spatial and temporal boundaries. These activities are not limited to current activities but also those that have occurred in the past and will occur in the future.

The most challenging part of this process is deciding what future developments to include as it requires the use of assumptions and predictions with varying levels of accuracy (MVEIRB, 2004). CEAA (2018) outlines how to select other developments to include in the CEA with specific trigger situations. Future developments for inclusion should be selected if they are certain to proceed (e.g. regulatory approval received) or reasonably foreseeable (e.g. public notice given) based on the situations outlined in CEAA (2018). Next, practitioners must decide which past and present activities pose an impact on the VECs. This is a more precise process than making considerations for the future. The primary method involves conducting a literature review of the historical record, reports, traditional ecological knowledge (TEK) and other sources. Detailed documentation describing the activities selected and rational for their selection needs to be provided.

2.1.2.2 Analysis

This part of the CEA is where the effects of the designated project in combination with the effects of the other developments are predicted. CEAA (2018) provides two preferred methods to achieve this goal. One of which is to use reference cases similar to the situation being analyzed to allow for prediction of cumulative effects. Another is deploying qualitative or quantitative models to predict cumulative effects. This is typically done using computer-based systems. Other methods can also be deployed as long as they can be justified and explained using clear scientific rational. In the NWT The Cumulative Impact Monitoring Program (CIMP) is a valuable source of data that practitioners should consider when forming their method for cumulative effects impact predictions (MVEIRB, 2004). It is important for practitioners to consider that some cumulative effects may be additive in nature while others, due to the synergy between several

activities impacting VECs simultaneously, could have impacts several magnitudes of significance higher (CEAA, 2018).

Data Collection

Having the ability to access pertinent data associated with the other past, present and future physical activities is crucial to completing a thorough and accurate analysis. In the NWT CIMP data is a particular resource that should be drawn upon. Practitioners can ensure an effective and efficient data collection exercise if they enter the process with a good understanding of:

- The methods they will employ to conduct their analysis,
- Having a clear picture of how data will be used in the analysis, and
- Ensuring the data that is collected will be sufficient for the scale of the CEA (CEAA, 2018)

The level and rigor of analysis should be comparable to the likely magnitude of the cumulative effect expected to be experienced (Hegmann. et al., 2002).

2.1.2.3 Mitigation

The overarching goal of mitigation is to determine and develop responses to adverse cumulative impacts, which will effectively temper their influence, so they are no longer an issue. Where mitigation measure cannot be used to alleviate impacts other considerations should be made such as compensation (CEAA, 2018). For example, in the Alberta oil sands developers have been reclaiming seismic lines, in parallel with project construction and operation, as a way to replace and compensate lost caribou habitat that is being taken up by project activities. When developing mitigation strategies, it is important for an examination of the effectiveness, feasibility and cost

of the impact responses and document that information in the CEA (Hegmann., et al., 2002). The primary characteristic of cumulative effects is that they come from more than one source. Therefore, in some cases regulators can direct organizations other than the developer to be involved in the mitigation process. However, all impacts that originate from the developer's actions must be addressed by them (MVEIRB, 2004).

2.1.2.4 Significance

At this point in the process the level of significance associated with the impacts identified on VECs, in the analysis step, with mitigation measures applied, need to be defined (CEAA, 2018). When defining significance from a cumulative effects lens, one must understand the capacity of a VEC to buffer the residual impacts, before experiencing modification to its state, that cannot be recovered from (Hegmann, et al., 1999).

The prospect of the cumulative effects occurring is dependent on two principles: probability of occurrence; and scientific certainty. The literature suggests slotting the likelihood into one of four categories: None (0% chance of occurrence), low (<25% chance of occurrence), moderate (25% - 75 % chance of occurrence) and high (>75% chance of occurrence) (Hegmann, et al., 1999).

Evaluating Significance

Conclusions reached regarding the level of significance of cumulative effects on VECs must be clearly rationalized and scientifically defendable. Significance is tied to the likelihood of the impacts occurring and if their occurrence is likely they must be considered according to the *Canadian Environmental Assessment Act.* One way to reach a significance outcome is to answer a series of questions laid out in the guidance:

1. Has there been an escalation in the activities explicit effect in synergism with effects of other activities?
2. Is the emergent effect unsatisfactory?
3. Is the effect perpetual?
4. If not perpetual, what sort of timeframe is required for restoration from the effect? (Hegmann, et al., 1999)

Interpretation

An important thing to remember is that even though a project specific impact on a particular VEC was found to be insignificant the cumulative effect could still pose a significant impact. The determination of significance is dependent on these key influences:

- Are thresholds exceeded?
    - When thresholds are exceeded for a VEC and the exceedance is continuing the effect is usually significant.
- Was mitigation effective?
    - As mitigation success decreases significance of the effect increases.
- The extend of the study area.
    - Larger study areas can dull strong effects.
- Piecemeal input of effects of other activities.
    - Significance can decrease as significance of more substantial actions elevate
- Corresponding level of impact of the effects of other activities.

    - As the level of contribution of an action lessens the significance can lessens.
- Scarcity of species
    - As species become more scarce significance can increase.
- Level of local effects from designated project
    - As local effects become less impactful significance can decrease.
- Weight of change compared to background conditions
    - If effects fluctuate within the background setting significance can decrease.
- Production of induced activities
    - As induced activities accelerate the significance can accelerate.
- Level of existing disturbance
    - If the surroundings are already heavily disturbed significance can decrease (Hegmann, et al., 1999)

Thresholds

Thresholds in CEA are levels that if exceeded a cumulative effect will become an issue. Thresholds can be expressed in many forms, the key thing to understand is that they are influenced by both science and societal values. To gain insightful results from a CEA there is a need for thresholds to act as a reference point against cumulative effects arising from past, present and future development. In practice, established thresholds for contaminants that affect human health are readily available and exist through a myriad of regulations and guidelines. However, in other areas the effectiveness of CEA is hampered by a lack of

thresholds. This characteristic especially applies to the terrestrial element of the environment. In the instances where no established thresholds exist it is largely left up to professional judgement and expertise to determine appropriate thresholds (Hegmann, et al., 1999).

Uncertainty

The uncertainty factor present for predicting cumulative effects is greater than what is experienced in the regular EIA process. This is a result of increased breadth and depth of timelines and study area under consideration. Hegmann et al. (2019) provides four recommendations to deal with uncertainty in a CEA:

1. Operate under the precautionary principal when making conclusions. In other words, ensure your conclusions are conservative in nature landing on the high side of estimations (Hegmann, Lloyd, Sloan, Green, & Fabijan, 2002).
2. Good record keeping of all assumptions made, data issues, and accuracy of data quality.
3. Prescription of mitigation responses to address negative effects and monitoring measures followed by subsequent assessment of effectiveness to ensure positive outcomes.
4. Application of framework designed to gauge results from monitoring activities and provide reactionary follow-up where issues are identified.

2.1.2.5 Follow-Up

Follow-up is important as it allows for confirmation of conclusions in the assessment and for an appraisal of the performance of mitigation measures deployed. Follow-up involves monitoring programs and the production of an environmental management framework which strives for a cycle of continuous improvement. The focus of the proponent will be on their particular contribution to cumulative effects (Hegmann, et al., 1999; MVEIRB, 2004). Hegmann et al., (2002) itenitified lack follow-up as one of the issues limiting the effectiveness of CEA. Three specific situtaions are idenitifed where follow-up is required:

- The environmental effects of the other actions are not understood with absolute certainty,
- Determination of the pathway of cumulative effect is not based on an established process, rathe it is based on a new methodology, and
- The mitigation measures deployed to address the cumulative effects are not proven approaches and their effectiveness is uncertain (Hegmann, et al., 1999).

2.2 Barren-Ground Caribou as a Valued Ecological Component

The barren-ground caribou are a member of the deer family. Relative to boreal caribou and northern mountain caribou, the barren-ground caribou are smaller with shorter legs. There are nine barren-ground caribou herds located in the NWT: Porcupine, Tuktoyaktuk Peninsula, Cape Bathurst, Bluenose-West, Blue-Nose East, Bathurst, Beverly, Ahiak and Qamanirjuag. The average weight of females is 85 – 135 kg and males 100 – 140 kg (NWT Species at Risk, n.d.).

The barren-ground caribou have the longest terrestrial migration of any mammal and travel 1200 km in a season (Joly, et al., 2019). The spring migration north begins in March, the pregnant

cows proceed the barren and the bulls. Along the Arctic coast calving occurs early in June. Autumn migration takes place in late October and coincides the annual rutting event (Chan-McLeod, White, & Russell, 1999). The habitat required for barren-ground caribou is shaped by the animal's need to forage. This is driven by the caribou's yearly breeding event and the energy requirements relative to the short vegetation growth season in the north. The caribou consume a wide variety of grasses, sedges, shrubs, and forbs. They select their food based on the phase of plant growth rather than having any particular favourite variety. Fluctuations in characteristics across the northern environment, such as, snow cover, plant growth, and parasite and predation risk, make a large annual range of several hundred thousand km^2 necessary for the caribou. In the summer caribou try and select habitats that will decrease vulnerability to insect nuisance while still having the opportunity to gather high quality forage. They can travel up to 26 km per day to avoid mosquitos, bot and warble flies (Chan-McLeod, White, & Russell, 1999).

The majority of herds spend their winter in the boreal forest while a minority endure in the tundra. The tundra portion of the caribou's range is largely undisturbed by human activities. The boreal forest portion has suffered some fragmentation due to fires and human activities. The barren-ground caribou are considered a keystone species in the north for their prominent role in ecosystems and importance to First Nations that inhabit the area (COSEWIC, 2016).

Barren-ground caribou habitat has been coming under increasing pressure as governments open up access for mineral resource development. Previously numbering millions of individuals caribou populations have decreased by over 70% in northern Canada over the last 20 years. As some herd populations reach what could be a breaking point, the contribution of greater human activities to the problem has become a more important point of scrutiny. The Bathurst Herd

population has declined particularly sharply and considering key areas of their summer and fall range are now inhabited by mining exploration and development projects that have boomed since the 1990's, it is no surprise (Parlee, Sandlos, & Natcher, 2018). All of the major diamond mines constructed in the NWT, which comprise the vast majority of development over the last 20 years, are situated in the Bathurst Herd range.

TEK and western scientific studies have indicated that that caribou herds in North America have varied largely in numbers over the last several thousand years. Fluctuations in weather and food quality and quantity on summer and calving ranges are the most relevant factors affecting the population in most herds. It is thought that the Bathurst herd decline since 1986 is due to weather effects, for example years with late spring or poor summer vegetative growth. The cause of the Bathurst Caribou Herd decline can mainly be attributed to this natural cycle that has occurred several times in the past (Adamczewski, et al., 2009). However, several studies have been conducted attempting to determine other contributing factors.

Two such studies found that climate change has been exerting an influence. Average temperatures in the north have warmed by a factor of two when compared to the earth as a whole. Climate change has impacted caribou habitat year over year and over the long term. The peak calving date is the day on which 50% of cows give birth. Peak calving date in some years has been delayed by changes in habitat conditions, primarily the start date of the vegetation growing season, as a result of climate change, leading to population decline. It was found that for every 1-day postponement of peak calving date there was a 2-3% reciprocal contraction in the birth rate of the Bathurst Caribou Herd (Wenjun Chen, 2018). The influence of climate change in September and October was found to be positive. As a result of increase temperatures snow

that would usually be present during the migration south was found to be mostly absent. This allows caribou to preserve energy that would have be deployed to navigate a snowy route and rather use it to forage and buildup fat reserves for the winter months. However, this benefit was determined to be superseded by the increase of magnitude and duration of insect harassment during the summer months. The period from June 5 to August 10 is a critical period for survival and development of the caribou. Especially in June and July when females are nursing their young and energetic needs are peaking. There is a need for good habitat absent of predators and abundant in sustenance to allow for optimal conditioning during this period. However, it is during this period insect harassment is going to continue to increase leading to caribou in feeble condition by the time autumn arrives (Brotton & Wall, 1997).

Wildfires play a role in the caribou abundance equation. TEK and western science both indicate that caribou presence in recently burned areas is less frequent than mature forests, even though unburned patches of forage exist within these areas. This leads to a change to migration routes and winter range use by the caribou. Therefore, when a large area is burned the carrying capacity of the range can decrease. However, wildfires also have a beneficial impact on the caribou habitat. As spruce forests become older, they create an abundance of shade in the understory, which decreases lichen production, the primary winter forage for caribou. Thus, wildfires are necessary to stimulate the growth of lichens in these areas (ENR, 2019).

In 2019 the Government of the NWT (GNWT) began a pilot program awarding $1650 for harvesters that killed a wolf in a designated area from the Bathurst Herd range. Scientists believe the program is politically motivated and little evidence exists suggesting that culling the wolf population will lead to a recovery in caribou numbers (Bird, 2019). A study conducted in 2016

(Klaczek, Johnson, & Cluff, 2016) investigated wolf-caribou population dynamics to try and determine the extent to which predation was impacting caribou populations. It was found that as the Bathurst Herd decreased in size, it contracted its summer range closer to the summer calving ground. As these changes took place lower occurrence of wolf pup recruitment and higher incidence of den abandonment were observed concurrently. So rather than seeing a decrease in caribou populations due to predation the opposite was observed, where lower caribou numbers led to a decrease in the densities of wolves in the area. Therefore, the data gathered suggests that declines in caribou regulate dependent wolf populations.

The influence of industrial development has played a part in the complex interaction of factors leading to the caribou population decline. Since the 1990's, in their summer range, the Bathurst caribou herd has been exposed to the construction and operation of two adjacent open pit diamond mines, Diavik and Ekati. During mid-July and mid-October caribou location data was collected using aerial surveys and collared animals. This data was then input into a statistical model which showed that diamond mining operations exhibited a 11-14 km area of influence that caribou avoid. Authors of the study speculate that caribou avoidance of the area may be linked to fine dust deposition from mining activities (Boulanger, Poole, Gunn, & Wierzchowski, 2012). The 2000 Ekati Diamond Mine Wildlife Effects Monitoring Program found that caribou behavior was significantly influenced by mining activities. It was shown that caribou spent 15% less time feeding within 7 kms of the mine footprint compared to areas outside this zone (BHP, 2000). Data driven demographic modelling of the Bathurst herd found that trends in herd size are overly sensitive to changes in female adult survival. The hunter harvest of caribou was noted as one of the likely reasons for the recent accelerated decline (2006 - 2009) of the caribou population. The study also indicated that effects from the mines were limited and unlikely a major contributing

factor in the decline of the Bathurst Caribou Herd (Boulanger, Gunn, Adamczewski, & Croft, 2011).

The Bathurst Caribou Herd population is at critically low numbers, any additional pressure could lead to the inability for the herd to recover. Thus, it is of high importance that new development and its impact on the herd's range is considered in a cumulative fashion. All possible mitigative actions should be taken to ensure the herd's survival. Thus, the importance of reviewing the state of CEA in EIA in the NWT and providing recommendations for improvement of the practice.

CHAPTER 3. METHODOLOGY

3.1 CEA Evaluation Matrix Development

To develop a set of evaluation criterion for assessment of CEA inclusion in EIA several pre-existing reports and guidance documents were used. Two reports that previously assessed the inclusion of CEA in EIA were particularly insightful. Baxter, Ross, & Spaling (2001) reviewed 12 EIAs of various project types in locations across Canada attemping to get a sense of how CEA was being applied across the country. Layher (2017) looked into how CEA was being applied in 5 energy projects in Alberta and if its application was assisting in promoting sustainability of the woodland caribou. Both these studies seperated their evaluation criteria into the same major categories used for delininating the CEA process: scoping, analysis, mitigation, significance and follow-up. Therefore, the same was done in this paper. Those studies along with the guidance documents, *Cumulative Effects Practitioners Guide* (Hegmann, et al., 1999) and *Assessing Cumulative Environmental Effects under the Canadian Environmental Assessment Act, 2012 Interim Technical Guidance* (CEAA, 2018), were used to develop the 14 CEA evaluation questions applied in this research.

3.1.1 Evaluation Matrix Weighting Index

The evaluation matrix provided a weight for each criterion being evaluated. The weight assigned to each criterion was determined based on how the CEA in the EIA evaluated fulfilled the best practice process described in Section 2.12. Weights assigned were on a scale of 0 to 3 and each of these grades indicate how well the CEA performed as described by:

GRADE 0 – NOT INCLUDED: A grade of 0 is assigned in instances where the criterion was not included or addressed in the CEA.

GRADE 1 – LESS THAN STANDARD PRATICE: A grade of 1 was given where some attention was given to the criterion mentioned, but not in a material way, and not to the level that would demonstrate standard practice.

GRADE 2 – STANDARD PRACTICE: A grade of 2 indicates that the material provided in the CEA included some of the criteria, was completed at a minimum level and would be considered to meet standard practice.

GRADE 3 – BEST PRACTICE: A grade of 3 was reserved for examples where the information included in the CEA satisfied the criteria in its entirety or even went beyond what was prescribed in the guidance documents. The term best practice was selected as it is commonly used to denote exemplary practice in EIA literature (Baxter, Ross, & Spaling, 2001).

In Layher (2007) scores from each CEA step (scoping, analysis, mitigation, significance, and follow-up) were totaled and averaged to provide an overall score for each EIA assessed. A score equal or above 2 indicated that the EIA had included CEA at a satisfactory level. A score below 2 indicated that the EIA did not include CEA at a satisfactory level and was considered poor practice. This same averaging scheme, used to provide an overall grade for each EIA assessed, is employed in this research project. In addition to the completed evaluation matrix for each EIA assessed, there will be a detailed written review to augment the findings from the matrix and further describe and explain the results.

3.2 EIA Project Selection

Development of large projects in the NWT that require regulated EIA are not common. This is evidenced by the fact that only 40 assessments have been completed by the MVEIRB between 1999 and 2020 (MVRB, 2020). Based on temporal limitations of this research paper it was determined that 5 projects would be chosen for evaluation. The selection criteria that were used in determining which projects to include are as follows:

1. The project must pose an environmental threat on the barren-ground caribou;
2. The project must be located in the NWT;
3. Project must have taken place post 1995 when CEA became a mandatory part of EIA in Canada.
4. Required documentation could be obtained given the time constraints.
5. Energy related projects that satisfied the above criteria were given priority for evaluation (Taltson and Nachalacho).
6. Professional judgement of author was used to choose next three largest in scope projects relative to others assessed in the NWT that also satisfied the above criteria.

The five projects selected for CEA evaluation are:

- THEP, Nachalacho REE Mine,
- Ekati Diamond Mine Expansion,
- Snap Lake Diamond Mine and
- Gahcho Kué Diamond Mine.

These projects have been selected as they satisfied the selection criteria outlined above. As discussed in the introduction the THEP will be conducting a new EIA in the near future.

Findings from this project will be useful in improving CEA inclusion and practice in that EIA going forward.

Table 1 – Projects Selected for Evaluation.

Project Name	**Year**	**Proponent**	**Description**
Ekati Diamond Mine Expansion	2000	BHP Billiton	Expansion of diamond mine to include three new kimberlite pipes.
Snap Lake Diamond Mine	2002	De Beers	New diamond mining operation.
Taltson Hydro Expansion	2009	Dezé Energy	Expansion of hydroelectricity plant with accompanying 270 km transmission line.
Gahcho Kué Diamond Mine	2010	De Beers	New diamond mining operation.
Nachalacho REE Mine	2011	Avalon Ventures	New Rare Earth Element Mine.

(*Source: Debogorski, 2020*)

3.3 Evaluation Procedure

The evaluation of the five CEAs selected were completed exclusively by the author. CEAs were evaluated by comparing how they were conducted versus the CEA methodology outlined Section 2.1. 2.. Grades were assigned to each CEA by populating the evaluation matrix found in Appendix A. CEA's were fully evaluated prior to moving onto subsequent CEA's. The evaluation followed the step by step process shown below:

1. Initial review of the EIA to understand how CEA fit into each assessment.
2. Initial review of CEA.

3. Second review of CEA, population of evaluation matrix, and note taking on key aspects for comment.
4. Assignment of grades and generation of commentary on CEA key aspects where critique warranted.

Chapter 4. RESULTS

4.1 BHP Ekati Diamond Mine Sable, Pigeon, Beartooth Pipe Expansion – 2000

The BHP Ekati Expansion Project CEA was conducted separately from the project EIA and considered the project's impacts within the context of the region's overall regional development of the existing and reasonably foreseeable activities. The impacts on caribou were determined by looking at several different scenarios and then deciding if a significant change would occur. It was predicted that cumulative impacts would not cause a measurable effect of any significance on the caribou (BHP, 2000).

The selection of other developments, besides the designated project, for inclusion in the CEA was comprehensive. The MVEIRB TOR required the inclusion of four major projects. However, as seen in Table 2 the proponent took the initiative to include 16 other developments in the CEA. This included small scale temporary outfitter camps in the CEA. This rigorous project list and inclusion of other developments is seen as a CEA best practice.

Table 2 - Other Developments Included in CEA.

MVEIRB Required Developments	**Developments Included in CEA**
1. Ekati Diamond Mine 2. Diavik Diamond Mine 3. Echo Bay Mines Winter Road 4. Lupin Mine	1. Ekati Diamond Mine 2. Diavik Diamond Mine 3. Echo Bay Mines Winter Road 4. Lupin Mine 5. Windspear Exploration Camp 6. Tahera Resources Exploration Camp 7. RWED Daring Lake Research Station 8. 12 Outfitter Camps 9. Community of Snare Lake

(*Source: BHP, 2000*)

The CEA study area for the caribou VEC was delineated using an impressive method. Caribou wearing satellite collars were mapped from 1997 – 2000; this data was augmented with wildlife baseline data from 1994 – 1996 and wildlife monitoring from 1997 – 1999 to determine highly accurate caribou migration corridors which were adopted as the CEA study area. Figures 3.7-2 to 3.7-4 from the Sable, Pigeon, Beartooth Pipe Expansion Environmental Assessment Report show the study area selected (BHP, 2000).

BHP has a lengthy operating history in the NWT, as they have been in the area since 1991 when they started conducting environmental work for the original Ekati EIA application. This allowed them to draw upon baseline information from prior work, including primary data drawn from wildlife monitoring programs for CEA analysis (BHP, 2000).

The follow-up section of the CEA is particularly strong. The proponent set the goal of having, "zero wildlife mortality associated with mining activities" (BHP, 2000). They planned to achieve this by implementing an adaptive Environmental Management Plan (EMP). As part of that plan, a wildlife monitoring program was committed to, for confirmation of the effectiveness of the EMP and to allow for early identification of any emerging concerns. Emerging concerns would

then be addressed using adaptive management strategies. The proponent committed to support of cumulative effects monitoring through financial contributions to the West Kitikmeot Slave Study Society (WKSS). The WKSS is a partnership of Indigenous and environmental organizations, governments and industry established to provide the information base necessary to examine effects of development within the region (GNWT, n.d.b).

In the 1999 Diavik Comprehensive Study Report a regional cumulative effects management framework was recommended to address future development in the region. The initiative received support from aboriginal groups, public, NGO's and BHP. At the time the proponent actively participated in this process (BHP, 2000).

4.2 DeBeers Snap Lake Diamond Mine - 2002

The DeBeers Snap Lake CEA was conducted separately from the project EIA and considered the project's impacts within the context of the region's overall development of the existing and reasonably foreseeable activities. The impacts on caribou were determined by looking at several different effects and then grading their magnitude and environmental consequence. It was predicted that cumulative effects carried a negligible magnitude and a low environmental consequence (De Beers, 2002).

The study area used for the caribou CEA was the Bathurst caribou annual home range. This is the desired approach from CEAA (2018) as it focuses on characteristics of the VECs movements when selecting study area boundaries. Traditional knowledge and information from female caribou fitted with satellite collars indicates that annual home range size varies among years (De

Beers, 2002). So, although the selection of the study area was done using an acceptable method it did not go above and beyond established standards.

The temporal boundaries used in the CEA covered the pre-construction phase of the project through to clean-up and the final year of effectiveness monitoring from 2003 – 2028. This is considered an activity centered method for setting temporal boundaries. CEAA (2018) states several reasons why this is not the desired approach:

1. Timeframes for activities may not align with environmental effects on caribou; and
2. Does not reflect the natural variation of caribou over time and their dynamic response to the effects from current or past activities.
3. Potential for stretching boundaries to far into the past or future causing the need for extra work to complete the analysis and introduction of greater uncertainty.

Rather, similar to the setting of spatial boundaries, for a VEC like caribou, a VEC or ecosystem centered approach is optimal for setting temporal boundaries (CEAA, 2018).

The scoping in of wildlife VECs, specifically caribou, for inclusion into the CEA was done in an effective manner. The migration movements and annual/ seasonal home ranges for wildlife VECs, determined to have a residual effect from project activities, were mapped out. These areas were then compared to the locations and incremental effects of other activities included in the CEA, to determine if those activities would impact the VECs. A CEA was determined to be needed for a wildlife VEC if a linkage of one parameter was valid. It was correctly identified that all of the other activities included in the CEA would influence caribou (De Beers, 2002).

Other developments included in the CEA Table 3 was done at a minimum. As noted in the caribou literature review the hunter harvest has been identified as one of the reasons for the

caribou population decline (Boulanger, et al, 2011). The communities of Wekweèti (175 km from Snap Lake) and Lutselkè (174 km from Snap Lake) should have been included as their hunting activities pose an incremental effect on the caribou. In addition, in 2005 De Beers would start the regulatory process for the Gahcho Kué diamond mine (80 km from Snap Lake). Given the planning and investment that goes into these projects it is likely that De Beers would have been aware of this project at the time.

Table 3 - Other Developments Included in CEA.

Development	**Distance from Snap Lake (km)**
Snap Lake Diamond Mine	-
Ekati Diamond Mine and expansion	119
Diavik Diamond Mine	102
Tahera Diamond Mine	268
Lupin Gold Mine	242
Tibbitt-Contwoyto winter road	22.5

(*Source: De Beers, 2002*)

The analysis portion of the CEA fulfilled the basic requirements of CEA. When discussing the impacts of direct habitat loss, the CEA made some misleading assertions. Several studies are cited as stating' "critical thresholds for declines in bird and mammal species occur between 10% and 60% of original habitat (De Beers, 2002)." Rather than separating out the specific thresholds for the specific species this range is compared against all of terrestrial species' habitat loss experienced as justification for a negligible effect. In the authors opinion this is lazy reporting. However, the assessment makes a good precautionary assertion when weighing the duration of habitat loss making consideration for uncertainty in time for reclamation. This is due to reclamation techniques that are unproven in northern Canada (De Beers, 2002). The majority of the analysis section is qualitative in nature as there is a lack of data from some of the other

developments. CEAA (2018) does not limit CEA to either qualitative or quantitative analysis so this is an acceptable practice. Although In some instances the CEA makes assumptions that suit a simple approach rather than precision. For example, when making an exposure estimate for chemical contaminates of concern for caribou the assessment presumes that they spend equal time within the zone of influence of each development. This is despite having access to radio collar data showing the movement of caribou over several seasons (De Beers, 2002). The Lupin Gold Mine was left out of the toxicity assessment for caribou. De Beers (2002) stated that Lupin Gold Mine could not be included because of a lack of defensible chemicals of concern data. CEAA (2018) recognizes that data availability for CEA is challenging in some cases, but a reasonable attempt should be made to locate or generate data for the assessment. Using analogs could have provided some data to include the Lupin Gold Mine in the toxicity assessment. This information would have been useful in generating a more accurate CEA and would have helped inform future environmental assessments in the region.

The CEA reports that the probability that caribou will experience cumulative effects is high but their environmental consequence is low. Specific impacts identified on caribou are habitat fragmentation, habitat loss and project related mortality. De Beers addresses its own contributions to these impacts through mitigation measures presented in the main EIA document. CEAA (2018) states that a developer must mitigate their own contributions to cumulative effects and De Beers does address this. With regards to significance DeBeers is instructed by the MVEIRB to refrain from providing significance conclusions in their CEA and they would have the final say on those conclusions, so this step is not addressed in the CEA, but as this is an instruction from the regulator it has been rated as standard practice in the evaluation. Follow-up activities were constructed in accordance with Hegmann, et al. (1999).

4.3 Dezé Energy Corp. Taltson Hydro Expansion – 2009

The Dezé Snap THEP CEA was conducted in parallel with the project EIA and considered the project's impacts within the context of the region's overall development of the existing and reasonably foreseeable activities. Cumulative effects were analyzed and their impact on persistence of caribou abundance, persistence of caribou distribution, and persistence of traditional and non-traditional harvesting opportunities were determined. The incremental and cumulative changes from the Project and other developments were not anticipated to have a significant effect (Dezé Energy Corp, 2009).

The scoping step was mostly executed in a manner that fully satisfied the requirements of CEAA (2018) protocol. To compile the project inclusion list, a database containing the type and location of previous, existing, and reasonably foreseeable projects was compiled from an extensive collection of reputable sources (government, NGO's and private organizations). The full array of incremental effects from the other developments was identified clearly and included small scale disturbances such as fuel storage areas, communications installations, and temporary staging areas, that could have been rationalized out of the CEA. The temporal boundaries were set taking into consideration the operation, decommissioning and abandonment of activities, and the spatial boundaries were set using a VEC centered approach, as suggested by CEAA (2018), using the Bathurst Caribou herd 4 seasonal ranges as the study area. One major flaw observed was the scoping out of increased access leading to increased caribou harvesting. It was determined this would only pose a minor effect on caribou abundance and was therefore not included in the CEA. Given that part of the project design is a 270 km right of way (ROW) cutting through the middle of previously inaccessible caribou range, in the authors opinion, this aspect should have been included in the CEA (Dezé Energy Corp, 2009).

The analysis of cumulative effects was completing using acceptable methods that were well explained and considered good practice by CEAA (2018). GIS mapping was used to assess direct disturbance on the caribou study area and understand its impact in the context of the northern migration, post calving, rut, and winter ranges (Dezé Energy Corp, 2009). GIS information was used in conjunction with RAMAS 5.0 modeling software designed to link GIS data with a metapopulation model for population viability analysis (RAMAS GIS, 2020). The proponent does a good job justifying the use of this method stating that, "existing software allows for transparency," in the analysis (Dezé Energy Corp, 2009).

The mitigation and follow-up steps in the CEA were found to be below CEA standards. Mitigation of cumulative effects was not addressed but this is reflective of the significance determination which showed there would be no significant cumulative effects. However, given the uncertainty which is inherent in cumulative effect assessment monitoring to confirm the conclusions in the assessment should have been proposed. No proposal for monitoring with the goal of verification of CEA conclusion was included.

4.4 De Beers Gahcho Kué – 2010

The Gahcho Kué Project used a scenario method that looked at baseline case (past), application case (present), and future case to assess the regional cumulative effects and how they combine with the residual effects from Gahcho Kué. The CEA was done in parallel with the EIA. The analyses for the baseline and application cases were mainly a quantitative exercise while the future case was qualitative. It was found that the cumulative impacts from the project would not have a significant negative influence on the resilience and persistence of caribou populations and on use of caribou by people for traditional purposes (De Beers, 2010).

The study area selected for CEA on caribou was an area of best practice. The Project area is situated inside the seasonal range of the Bathurst Caribou Herd, so this area should be included at a minimum. However, the project footprint exists on the periphery of the Ahiak and Beverley Herds ranges. The study area selected included all three herds seasonal ranges, capturing the maximum spatial extent of effects from the Project and other developments on the caribou (De Beers, 2010). This is considered a VEC centered approached by CEAA (2018) This is the primary option recommended, as it allows for the most meaningful spatial boundaries to be drawn for the VECs identified in the CEA.

The process for determining other projects for inclusion in the CEA was completed in a methodical and well described manner. To compile the project inclusion list, a database containing the type and location of previous, existing, and reasonably foreseeable projects was compiled from an extensive collection of reputable sources (government, NGO's and private organizations) (De Beers, 2010). The process followed CEAA (2018) Section 1.4 Examining physical activities that have been carried out, as prescribed.

The analysis section included areas of strength and weakness. The CEA uses a misleading threshold value to support its conclusion that cumulative direct disturbance would have negligible influence on the abundance of caribou. De Beers (2010) states that, "For the Bathurst and Ahiak herds, the cumulative direct disturbance to each seasonal range from the Project and other previous, existing and future developments in the area is predicted to be less than or equal to 1.7% relative to reference conditions. This change is well below the 40% threshold value identified by numerous studies for habitat loss as being associated with declines in bird and mammal species." Given the unique characteristics of the northern environment and the barren

ground caribou using a generalized threshold for birds and mammal species may not be best practice.

The analysis set out to determine key metrics using well described methods and sophisticated tools, such as geographical information systems. These metrics related to habitat loss, habitat fragmentation, energetics, fecundity, etc. were then used as inputs for a computer model. The model assessed the viability of the caribou population by considering the pressures applied by the various activities. CEAA (2018) lists the use of predictive models as one of the preferred methods for determining cumulative effects by simulating future conditions and determining the response of VEC's to cumulative effects.

Mitigation is effectively addressed in the Gahcho Kué Wildlife Effect Mitigation and Management Plan (WEMMP). The goal of the plan is to reduce Project-related effects to wildlife abundance and distribution. Hegmann, et al. (1999) states, "Mitigating a local effect as much as possible is the best way to reduce cumulative effects." The WEMMP achieves this by including considerations for:

- Applying lessons from previous operators;
- Inclusion of traditional knowledge;
- Implementing mitigation and management actions that address the effects identified in the assessment; and
- Including consideration for continued review of actions and applying adaptive management principles where required (De Beers, 2010).

The determination of significance was clearly stated and defensible based on the methods used. The methods were appropriate and sophisticated. The uncertainties that area present in these

types of analysis were handled as laid out in the Cumulative Effects Assessment Practitioners Guide (Hegmann, et al., 1999).

The Gahcho Kué Wildlife Monitoring Program (WEMP) has been developed in line with the goals and guidance presented in Hegmann, et al. (1999). The WEMP will test the impact predictions with the hopes of reducing the level of uncertainty associated with the predictions. This information will also be fed into the Environmental Management System to allow for continuous improvement of environmental management strategies, with the use of adaptive management principles (De Beers, 2010).

4.5 Avalon Rare Metals Inc. Nachalacho Rare Earth Element Project - 2011

During the scoping step it was determined that for all VEC's, after mitigation measures were applied, the residual environmental effect from the Project were anticipated to be negligible and insignificance. Additionally, environmental effects characterized were largely bound to the localized footprint and immediate study area of the Project. However, the regulatory agency MVEIRB, in the TOR, required Avalon to complete a CEA. The Nachalacho Rare Earth Element Project CEA was conducted separate from the Project EIA and considered the project's impacts within the context of the region's overall development of the existing and reasonably foreseeable activities. (Avalon Rare Metals, 2011).

The study area selected for the CEA on caribou was done in a manner that satisfied requirements fully. The CEA study area for caribou used the Bathurst Caribou Herd range, this is VEC centered approach, and is a preferred method as recommended by CEAA (2018). With regards to the other developments included in the CEA this was seen as an aspect that could be improved.

Without any reasonable justification three of the region's largest developments were left out of the project inclusion list (Diavik, Ekati and Snap Lake) (Avalon Rare Metals, 2011).

The CEA did a good job rationalizing the negligible cumulative impact associated with the project on caribou. Although the Project is located in the caribou range their presence in the area is sparse at best. Baseline work conducted did not detect any caribou pellet groups during 64 wildlife habitat assessment surveys. However, six incidental observations of caribou presence were detected during the assessment process (5 pellet groups and 1 antler shed) (Avalon Rare Metals, 2011). Based on these observations assuming only occasional visitation by barren-ground caribou to the area is reasonable, in the authors opinion.

Mitigation and follow-up are two steps from the CEA that have not been dealt with in a manner considered acceptable by standards. The mitigations offered with regards to cumulative effects is nothing more than a bullet list of responses. A formalized wildlife environmental management plan with consideration for adaptive management would be more appropriate. Considering the predicted lack of residual effects from the project the proponent should have proposed a follow-up plan to confirm those predictions. However, the CEA is void of a monitoring program discussion concerning the caribou VEC (Avalon Rare Metals, 2011).

4.6 CEA Evaluation Results

The evaluation findings are presented in 2 different formats. First, each project is broken down by the five accepted major aspects required in CEA: scoping, analysis, mitigation, significance, and follow-up. Each of the aspects is assigned a grade based on the average of all the grades from the questions in that aspect. Second, each project is given an overall grade which is the

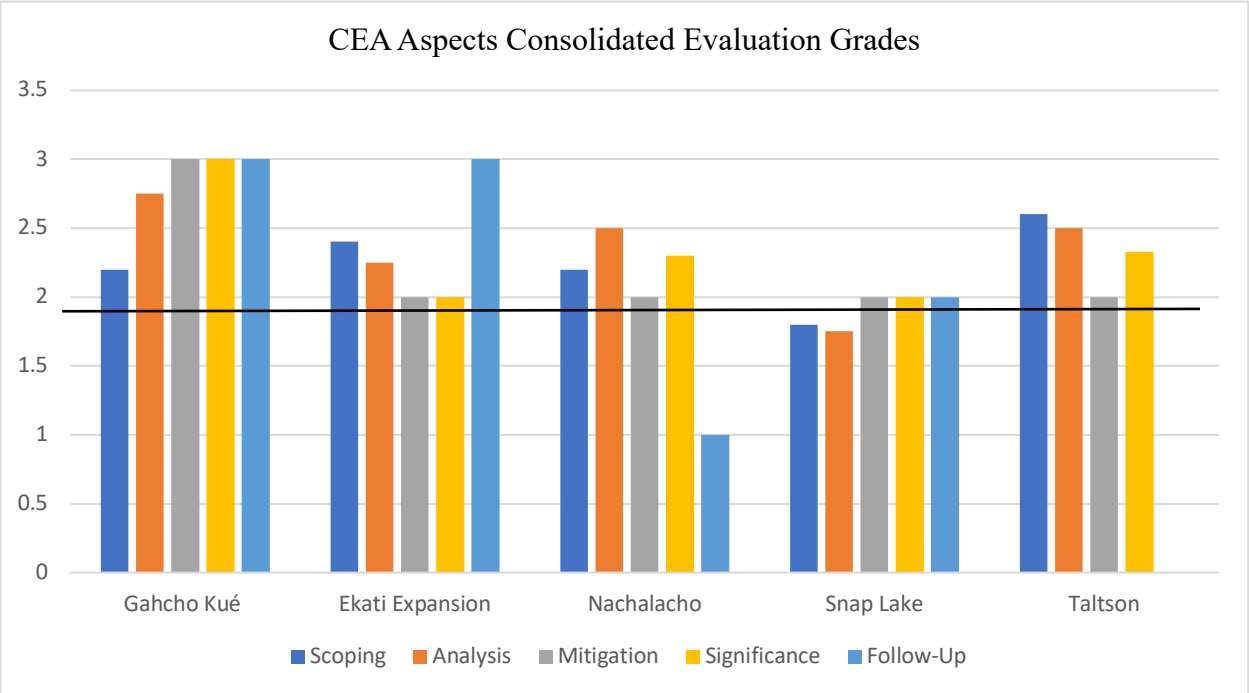
average value of the 5 aspects in that CEA. A detailed breakdown of the grades for each CEA evaluated can be viewed in Appendix B.

A value below 2 is considered below standard practice. Anything equal to 2 is considered standard practice and anything above 2 is considered best practice.

Figure 1 depicts the projects performance given for each CEA aspect. A line was set across Figure 1, at the grade of 2, which is considered Standard Practice.

Ekati Expansion achieved standard practice or above standard practice for all of the aspects. Snap Lake failed to achieve standard practice grades in the scoping and analysis aspects. THEP achieved standard practice and above standard practice except for follow-up which was missing. Nachalacho similar to Taltson and was below standard in the follow-up aspect. Gahcho Kué was the most complete CEA evaluated and adhered to the evaluation criteria to the highest degree achieving above normal grades for all steps.

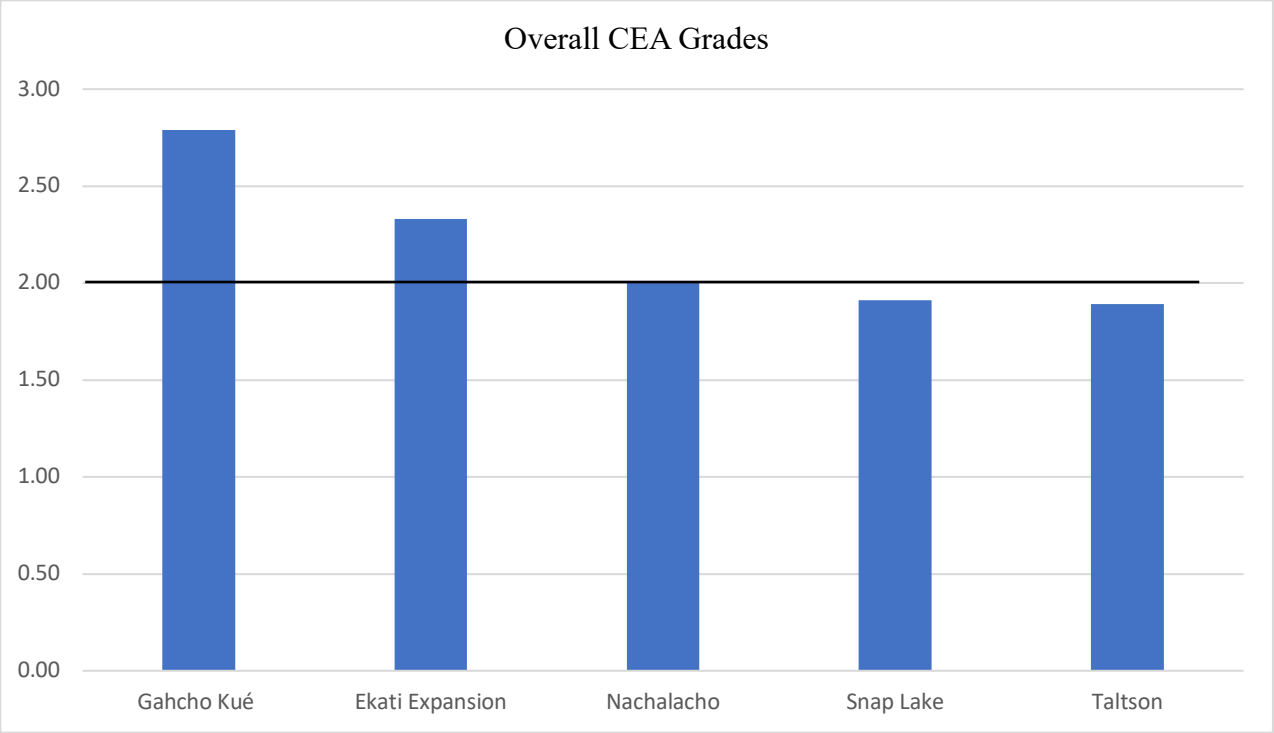
Figure 1 – Major Steps of CEA Average Grades for each Project



(Source: Debogorski, 2020)

An overall CEA grade was determined for each project reviewed. The overall grade was determined by finding the average grade of the five major steps in CEA (scoping, analysis, mitigation, significance, and follow-up). The overall grades by project are shown in Figure 2. The indicator line situated at 2 denotes a grade of standard practice. Three of the 5 CEAs reached the standard practice level including Ekati, Gahcho Kué and Nachalacho. Snap Lake and Taltson were in the below standard category. Snap Lake was evaluated below standard practice in the scoping and analysis steps. The Taltson project was below standard due to the missing follow-up.

Figure 2 – Overall Average Grades for each Project



(Source: Debogorski, 2020)

CHAPTER 5. DISCUSSION

Some of the projects evaluated conducted the EIA and CEA concurrently (THEP and Gahcho Kué) this may be considered below standard practice because there is a need to develop a distinct approach to the CEA from the EIA. While the two assessments, project EIA and CEA, are connected, they require unique considerations and approaches. When CEAs and EIAs are conducted concurrently the distinct considerations of the CEA can become convoluted (Baxter, et al., 2001).

The common practice in determination of cumulative effects impact on caribou habitat is to compare the entire caribou range to the area of habitat disturbed. Given the Bathurst Caribou Herd's massive range of 400,000 km^2 (Parlee et al., 2018) the cumulative effect of habitat disturbance is effectively diluted and does not produce an impact of any significance for any of the projects reviewed. There could be value in representing this data in a different manner.

There is a lack of consistency in methods used for CEA in the NWT. This likely stems from a lack of detailed guidance at the territorial level. The NWT MVEIRB Environmental Impact Assessment Guidelines only briefly cover CEA in a three-page appendix.

In the Snap Lake and Gahcho Kué CEA's a misleading threshold value is used to justify and support conclusions of no significant cumulative effect on caribou abundance due to habitat disturbance. Several studies are cited as stating' "critical thresholds for declines in bird and mammal species occur between 10% and 60% of original habitat and therefore given that <40% of the caribou habitat has been disturbed no significant cumulative effect on caribou abundance will be experienced due to habitat disturbance (De Beers, 2002; De Beers, 2010). This statement

may over – generalize the impact and should not be applied to the barren-ground caribou as this species has specific environmental conditions and unique ecosystem requirements.

Four of the five CEAs reviewed used a strictly activity centered approach when setting the temporal boundaries for their CEAs (Ekati Expansion, Snap Lake, Taltson, Gahcho Kué and Nachalacho). CEAA (2018) suggests that this technique can be used to assist in the setting of the temporal boundaries buy should not be used unilaterally. The guideline gives several reasons why this should not be done:

1. Timeframes for activities may not align with environmental effects on caribou; and
2. Does not reflect the natural variation of caribou over time and their dynamic response to the effects from current or past activities.
3. Potential for stretching boundaries to far into the past or future causing the need for extra work to complete the analysis and introduction of greater uncertainty.

Commitment to adaptive management techniques to respond to increased understanding regarding the impacts of cumulative effects on caribou discovered through wildlife monitoring programs on the larger projects (Ekati Expansion, Snap Lake, Gahcho Kué) was a positive observation. However, lack of adaptive management considerations in the energy related projects (THEP and Nachalacho) was considered below standard practice. Given the uncertainties inherent in CEA's proponents should be committing to adaptive management strategies as a way of supporting the precautionary principle as suggested by Hegmann, et al., (1999). The THEP which introduces a 270 km ROW right through the middle of previously inaccessible caribou range seemed particularly in need of an adaptive management program. The hunter harvest has been identified as one of the predominant pressures on the caribou leading to their population

decline (Boulanger et al., 2011). It may be a faulty assumption to believe that erecting barriers to block access to the ROW, and creating a policy that bans its use by the public, would stop all hunters from taking advantage of the new access to caribou for harvest.

CHAPTER 6. CONCLUSION

6.1 Recommendations

Based on the research and analysis completed in this report the following recommendations are suggested.

- Ensure CEAs are conducted separately from EIAs and make considerations for unique scoping, study boundaries, mitigation and follow-up based on applicable characteristics in the CEA.

- Detailed geographical information is available on caribou movements from radio collar data collected over a decade from 1996 - 2005 (Gunn, D'Hont, Williams, & Boulanger, 2013). Using this detailed GIS data to create a standardized CEA study area with greater resolution for the caribou VEC, to remove the dilution effect, would be a valuable exercise and could result in more accurate impact significance predictions. Three tiers of caribou range could be developed such as high, moderate and low caribou occupied range, to provide more insight into the cumulative impact of development on caribou habitat. In addition, areas where natural disturbance events have removed habitat, wildfires in particular, should be included when making conclusions on impact significance.

- The NWT should begin the process of creating their own made in the NWT cumulative effects assessment guidelines unique to the region and representative of its values and goals. This would address the issue around inconsistencies in methodologies used for conducting CEA in the NWT. Additionally, discussion on how CEA could be used as a

vehicle for implementation of the Bathurst Caribou Range Plan (BCRP) could be a useful exercise.

- Research into a barren-ground caribou habitat disturbance threshold that can be used to conclude on impact significance. The BCRP makes a similar recommendation suggesting research should be directed toward approaches for establishing a range-wide land disturbance indicator (ENR, 2019). This will lead to more accurate significance predictions and address the use of inapplicable threshold values that have been applied by proponents in the past.

- Development of policy to protect caribou habitat should take place. This approach could follow a cap on disturbance similar to the cap on greenhouse gas emissions in the oil sands. Progressive reclamation planning is another mechanism that can encourage maintenance of caribou habitat on the landscape. Proponents should be required to provide progressive reclamation plans during the regulatory process, that aim to remove areas of disturbance when they are no longer needed for project activities, rather than waiting until the end of the project life.

- Temporal boundaries should be set using more than just the activity centered approach, which seems to be the norm in CEAs conducted in the NWT. Regulators should ensure that proponents use the activity centered approach as an informative piece in setting the boundaries, in conjunction with the VEC centered, ecosystem centered or another approved method as directed by CEAA (2018).

- Consider Legislation requiring mandatory monitoring for the caribou VEC to confirm CEA significance predictions and ensure success of mitigation measures deployed. Given the near extirpation of the Bathurst Caribou Herd this is a reasonable precaution that should be taken by developers in the region.

6.2 Limitations and Future Work

With regards to limitations, the major one was tight time constraints which only allowed for 5 projects to be included in the evaluation. Additionally, only proponent Environmental Assessment Reports (EARs) were reviewed. Regulator decision reports and associated documentation were not reviewed. It would have been interesting to include more projects over a longer time horizon and the regulator decision reports. Initially, I wanted to include the Diavik Diamond Mine EIA, but as it was conducted in 1996 it was unavailable online and my attempts to gain access to the document from Rio Tinto and the CEAA were unfruitful. I wanted to use GDP data to rank the projects in the project selection step to ensure the projects with the largest scope where chosen, but that data was not available, so I had to rely on my professional judgement.

Going forward research into more useful tools for predicting impact significance on barren-ground caribou would be beneficial, especially a barren-ground caribou specific habitat disturbance threshold value. In addition, research into a tiered approach for looking at caribou study areas would be good to gain greater perspective when concluding on impact significance.

6.3 Conclusion

To conclude, regardless of the CEA short comings, all of the projects reviewed in this research project received regulatory approval. My research project supports the findings by Baxter et al.

(2001) in that there is a focus on getting regulatory approval versus promoting strong environmental sustainability through using CEA best practices.

None of the CEAs reviewed found cumulative impacts of significance on the barren ground caribou VEC and therefore may have limited value in the growing literature that is suggesting this species may need protection. The state of the art in CEA may be improved through enhanced regulatory guidance, understanding and oversight pertaining to CEA application in the NWT. There is a need for reflection on the current CEA implementation and a movement toward a more regionally focused CEA method of assessing and approving projects. This could be beneficial for protecting the health of barren-ground caribou populations in the region.

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APPENDIX A

Table 4 - Blank Evaluation Matrix

	Evaluation Criteria	GRADE
QUESTION	**SCOPING**	
1	Has the full array of regional incremental effects been identified, in addition to local effects from the proposed project?	
2	Is the CEA study area suitable for the caribou VEC?	
3	Are the boundaries of the CEA well defined and described?	
4	Have developments outside of the project in question both past and, certain and reasonably foreseeable future activities been established?	
5	Have the effects of other developments been established?	
	AVERAGE GRADE	
	ANALYSIS	
6	Are the potential cumulative effect impacts for caribou defined?	
7	Are incrementally additive effects on the caribou VEC determined and assessed with a rigor of analysis that matches the likely significance of the effect?	
8	Have the methodologies that have been used to assess cumulative effects been adequately justified?	
9	Was the data used in the analysis appropriate and gathered using good methods or from reputable sources?	
	AVERAGE GRADE	
	MITIGATION	
10	With regards to the caribou VEC, has a suitable plan been proposed that will mitigate the cumulative effects identified?	
	AVERAGE GRADE	
	SIGNIFICANCE	
11	Are conclusions regarding the significance of impacts clearly stated and defensible?	
12	Are the methods used to determine the significance appropriate?	
13	Has uncertainty of significance been handled as laid out in the Cumulative Effects Assessment Practitioners Guide?	
	AVERAGE GRADE	
	FOLLOW-UP	
14	Has a follow-up plan for the caribou VEC, including monitoring and environmental management measures, with the goal of verifying the CEA and evaluating the effectiveness of mitigation, been devised?	
	AVERAGE GRADE	
WEIGHTING INDEX	0 – Not Included; 1 – < Standard; 2 – Standard; 3 – Best Practice	
OVERALL GRADE:		

(*Source: Debogorski, 2020*)

APPENDIX B

Table 5 - Evaluation Matrix Rio Tinto Ekati Sable, Pigeon and Beartooth Pipes Expansion

	RIO TINTO – EKATI SABLE, PIGEON AND BEARTOOTH PIPES EXPANSION (2000)	GRADE
QUESTION	**SCOPING**	
1	Has the full array of regional incremental effects been identified, in addition to local effects from the proposed project?	2
2	Is the CEA study area suitable for the caribou VEC?	3
3	Are the boundaries of the CEA well defined and described?	2
4	Have developments outside of the project in question both past and, certain and reasonably foreseeable future activities been established?	3
5	Have the effects of other developments been established?	2
	AVERAGE GRADE	2.4
	ANALYSIS	
6	Are the potential cumulative effect impacts for caribou defined?	2
7	Are incrementally additive effects on the caribou VEC determined and assessed with a rigor of analysis that matches the likely significance of the effect?	2
8	Have the methodologies that have been used to assess cumulative effects been adequately justified?	2
9	Was the data used in the analysis appropriate and gathered using good methods or from reputable sources?	3
	AVERAGE GRADE	2.25
	MITIGATION	
10	With regards to the caribou VEC, has a suitable plan been proposed that will mitigate the cumulative effects identified?	2
	AVERAGE GRADE	2
	SIGNIFICANCE	
11	Are conclusions regarding the significance of impacts clearly stated and defensible?	2
12	Are the methods used to determine the significance appropriate?	2
13	Has uncertainty of significance been handled as laid out in the Cumulative Effects Assessment Practitioners Guide?	2
	AVERAGE GRADE	2
	FOLLOW-UP	
14	Has a follow-up plan for the caribou VEC, including monitoring and environmental management measures, with the goal of verifying the CEA and evaluating the effectiveness of mitigation, been devised?	3
	AVERAGE GRADE	3
WEIGHTING INDEX	0 – Not Included; 1 – < Standard; 2 – Standard; 3 – Best Practice	

OVERALL GRADE: 2.33

(Source: Debogorski, 2020)

Table 6 - Evaluation Matrix DeBeers Snap Lake

	DEBEERS – SNAP LAKE (2002)	GRADE
QUESTION	**SCOPING**	
1	Has the full array of regional incremental effects been identified, in addition to local effects from the proposed project?	2
2	Is the CEA study area suitable for the caribou VEC?	2
3	Are the boundaries of the CEA well defined and described?	2
4	Have developments outside of the project in question both past and, certain and reasonably foreseeable future activities been established?	1
5	Have the effects of other developments been established?	2
	AVERAGE GRADE	1.8
	ANALYSIS	
6	Are the potential cumulative effect impacts for caribou defined?	2
7	Are incrementally additive effects on the caribou VEC determined and assessed with a rigor of analysis that matches the likely significance of the effect?	2
8	Have the methodologies that have been used to assess cumulative effects been adequately justified?	2
9	Was the data used in the analysis appropriate and gathered using good methods or from reputable sources?	1
	AVERAGE GRADE	1.75
	MITIGATION	
10	With regards to the caribou VEC, has a suitable plan been proposed that will mitigate the cumulative effects identified?	2
	AVERAGE GRADE	2
	SIGNIFICANCE	
11	Are conclusions regarding the significance of impacts clearly stated and defensible?	2
12	Are the methods used to determine the significance appropriate?	2
13	Has uncertainty of significance been handled as laid out in the Cumulative Effects Assessment Practitioners Guide?	2
	AVERAGE GRADE	2
	FOLLOW-UP	
14	Has a follow-up plan for the caribou VEC, including monitoring and environmental management measures, with the goal of verifying the CEA and evaluating the effectiveness of mitigation, been devised?	2

	AVERAGE GRADE	2
WEIGHTING INDEX	0 – Not Included; 1 – < Standard; 2 – Standard; 3 – Best Practice	
OVERALL GRADE: 1.91		

(Source: Debogorski, 2020)

Table 7 - Dezé Energy Taltson Hydro Expansion

	DEZÉ ENERGY – TALTSON HYDRO EXPANSION (2009)	**GRADE**
QUESTION	**SCOPING**	
1	Has the full array of regional incremental effects been identified, in addition to local effects from the proposed project?	1
2	Is the CEA study area suitable for the caribou VEC?	3
3	Are the boundaries of the CEA well defined and described?	3
4	Have developments outside of the project in question both past and, certain and reasonably foreseeable future activities been established?	3
5	Have the effects of other developments been established?	3
	AVERAGE GRADE	2.6
	ANALYSIS	
6	Are the potential cumulative effect impacts for caribou defined?	2
7	Are incrementally additive effects on the caribou VEC determined and assessed with a rigor of analysis that matches the likely significance of the effect?	3
8	Have the methodologies that have been used to assess cumulative effects been adequately justified?	3
9	Was the data used in the analysis appropriate and gathered using good methods or from reputable sources?	2
	AVERAGE GRADE	2.5
	MITIGATION	
10	With regards to the caribou VEC, has a suitable plan been proposed that will mitigate the cumulative effects identified?	2
	AVERAGE GRADE	2
	SIGNIFICANCE	
11	Are conclusions regarding the significance of impacts clearly stated and defensible?	3
12	Are the methods used to determine the significance appropriate?	3
13	Has uncertainty of significance been handled as laid out in the Cumulative Effects Assessment Practitioners Guide?	1
	AVERAGE GRADE	2.33
	FOLLOW-UP	

14	Has a follow-up plan for the caribou VEC, including monitoring and environmental management measures, with the goal of verifying the CEA and evaluating the effectiveness of mitigation, been devised?	0
	AVERAGE GRADE	0
WEIGHTING INDEX	0 – Not Included; 1 – < Standard; 2 – Standard; 3 – Best Practice	
OVERALL GRADE: 1.89		

(Source: Debogorski, 2020)

Table 8 - Evaluation Matrix DeBeers Gahcho Kué

	DEBEERS – GAHCHO KUÉ (2010)	**GRADE**
QUESTION	**SCOPING**	
1	Has the full array of regional incremental effects been identified, in addition to local effects from the proposed project?	2
2	Is the CEA study area suitable for the caribou VEC?	3
3	Are the boundaries of the CEA well defined and described?	2
4	Have developments outside of the project in question both past and, certain and reasonably foreseeable future activities been established?	2
5	Have the effects of other developments been established?	2
	AVERAGE GRADE	2.2
	ANALYSIS	
6	Are the potential cumulative effect impacts for caribou defined?	3
7	Are incrementally additive effects on the caribou VEC determined and assessed with a rigor of analysis that matches the likely significance of the effect?	3
8	Have the methodologies that have been used to assess cumulative effects been adequately justified?	3
9	Was the data used in the analysis appropriate and gathered using good methods or from reputable sources?	2
	AVERAGE GRADE	2.75
	MITIGATION	
10	With regards to the caribou VEC, has a suitable plan been proposed that will mitigate the cumulative effects identified?	3
	AVERAGE GRADE	3
	SIGNIFICANCE	
11	Are conclusions regarding the significance of impacts clearly stated and defensible?	3
12	Are the methods used to determine the significance appropriate?	3
13	Has uncertainty of significance been handled as laid out in the Cumulative Effects Assessment Practitioners Guide?	3

	AVERAGE GRADE	3
	FOLLOW-UP	
14	Has a follow-up plan for the caribou VEC, including monitoring and environmental management measures, with the goal of verifying the CEA and evaluating the effectiveness of mitigation, been devised?	3
	AVERAGE GRADE	3
WEIGHTING INDEX	0 – Not Included; 1 – < Standard; 2 – Standard; 3 – Best Practice	
OVERALL GRADE: 2.79		

(Source: Debogorski, 2020)

Table 9 - Evaluation Matrix Avalon Nachalacho Rare Earth Elements Mine

	Avalon Rare Metals Inc. Nachalacho Project (2011)	**GRADE**
QUESTION	**SCOPING**	
1	Has the full array of regional incremental effects been identified, in addition to local effects from the proposed project?	1
2	Is the CEA study area suitable for the caribou VEC?	3
3	Are the boundaries of the CEA well defined and described?	3
4	Have developments outside of the project in question both past and, certain and reasonably foreseeable future activities been established?	2
5	Have the effects of other developments been established?	2
	AVERAGE GRADE	2.2
	ANALYSIS	
6	Are the potential cumulative effect impacts for caribou defined?	3
7	Are incrementally additive effects on the caribou VEC determined and assessed with a rigor of analysis that matches the likely significance of the effect?	3
8	Have the methodologies that have been used to assess cumulative effects been adequately justified?	2
9	Was the data used in the analysis appropriate and gathered using good methods or from reputable sources?	2
	AVERAGE GRADE	2.5
	MITIGATION	
10	With regards to the caribou VEC, has a suitable plan been proposed that will mitigate the cumulative effects identified?	2
	AVERAGE GRADE	2
	SIGNIFICANCE	
11	Are conclusions regarding the significance of impacts clearly stated and defensible?	3
12	Are the methods used to determine the significance appropriate?	3

13	Has uncertainty of significance been handled as laid out in the Cumulative Effects Assessment Practitioners Guide?	1
	AVERAGE GRADE	2.3
	FOLLOW-UP	
14	Has a follow-up plan for the caribou VEC, including monitoring and environmental management measures, with the goal of verifying the CEA and evaluating the effectiveness of mitigation, been devised?	1
	AVERAGE GRADE	1
WEIGHTING INDEX	0 – Not Included; 1 – < Standard; 2 – Standard; 3 – Best Practice	
OVERALL GRADE: 2.00		

(*Source: Debogorski, 2020*)