

**Demande de la CNER faisant l'objet d'un examen préalable #125765**  
**Mueller's Ice Cap ice core**

[illegible]

Inuinnaqtun: n/a (Project is solely in North Baffin, closest communities are Resolute Bay and Grise Fiord)

Operations Phase: from 2023-03-26 to 2024-08-25

## Activités

| Emplacement   | Type d'activité                              | Statut des terres | Historique du site  | Site à valeur archéologique ou paléontologique  | Proximité des collectivités les plus proches et de toute zone protégée  |
|---|--|-------------------|---|---|---|
| Area of Muller ice cap which we will survey--we plan to camp and drill an ice core at one point in this area. | Scientific/International Polar Year Research | Crown             | The centre of Muller Ice Cap has, to our knowledge, been visited only by scientists. There were scientific surveys performed from 1959-1962 by McGill University. The site has a weather station installed by Queen's University in 2021. | Although Inuit have inhabited Axel Heiberg Island in the past, the available evidence suggests that was far from our proposed site, near the east coast of the island and not on the ice cap. Our proposed site has no known archaeological value, and is more than 50 km from the closest archaeological sites near Buchanan Lake. | Axel Heiberg Island is currently uninhabited. The proposed site is about 50 km from the Napaqtulik/Napurtulik Proposed Territorial Park. It is about 440 km from Grise Fiord and 580 km from Resolute Bay, the two nearest communities. |

### Engagement de la collectivité et avantages pour la région

| Collectivité | Nom   | Organisme             | Date de la prise de contact |
|--------------|---|-----------------------|-----------------------------|
| Grise Fiord  | Marty Kuluguqtup, Senior Administrative Officer | Hamlet of Grise Fiord | 2022-07-06                  |

## Autorisations

Indiquez les zones dans lesquelles le projet est situé:

North Baffin

### Autorisations

| Organisme de régulation          | Description des autorisations  | État actuel     | Date de l'émission/de la demande | Date d'échéance |
|----------------------------------|--|-----------------|----------------------------------|-----------------|
| Office des eaux du Nunavut       | We have forwarded the NPC conformity description to NWB and are in the process of applying for a Type B license. | Not Yet Applied |                                  |                 |
| Institut de recherche du Nunavut | We are preparing an application for a Research License, and will be submitting that application shortly.         | Not Yet Applied |                                  |                 |

### Project transportation types

| Transportation Type | Utilisation proposée   | Length of Use |
|---------------------|--|---------------|
| Air                 | We will reach the site by Twin Otter from Resolute and Eureka  |               |
| Land                | On site, we will use snowmobiles for surveying. We will use two snowmobiles pulling sleds to do this work. |               |

### Project accomodation types

Temporary Camp

## Utilisation de matériel

Équipement à utiliser (y compris les perceuses, les pompes, les aéronefs, les véhicules, etc.)

| Type d'équipement      | Quantité | Taille – Dimensions | Utilisation proposée   |
|------------------------|----------|---------------------|--|
| Drill                  | 1        | 1x2x6 m             | Needed to drill an ice core through Mueller Ice Cap. Drill designed to recover a 4 inch diameter core in 1-2 meter sections. Will also be used to recover a small sample of rock beneath the ice.                    |
| Ice-penetrating radar  | 1        | 2x2x2 m             | Needed to determine optimal site to drill. Will be driven across the surface of the ice behind a snowmobile in order to measure ice thickness and layering in the ice.   |
| Snowmobile             | 2        | 1x1x2 m             | Used for moving around the ice cap and towing radar.   |
| Basler or Twin Otter   | 1        | 21x29x5 m           | Transportation from Eureka or Resolute to the ice cap.   |
| Large tents            | 3        | 8x4x5 m             | Shelter while drilling, eating, working, etc.  |
| Personal tents         | 12       | 2x2x1 m             | Sleeping during work.  |
| Generator              | 3        | 1x1x2 m             | 2 gasoline and 1 diesel generator, used to power radar, drill, and camp.   |
| Ice core analysis unit | 1        | 0.5x0.5x0.5m        | Used to measure some basic properties of the ice while we are on the ice cap (the majority of analyses will take place back in a laboratory). This analysis melts ice, with no waste other than the resulting water. |

## Décrivez l'utilisation du carburant et des marchandises dangereuses

| Décrivez l'utilisation de carburant : | Type de carburant | Nombre de conteneurs | Capacité du conteneur | Quantité totale | Unités | Utilisation proposée   |
|---------------------------------------|-------------------|----------------------|-----------------------|-----------------|--------|--|
| Propane                               | fuel              | 5                    | 100                   | 500             | Lbs    | Cooking, heating tents.  |
| Gasoline                              | fuel              | 3                    | 205                   | 615             | Liters | Power snowmobiles and small generators.  |
| Diesel                                | fuel              | 30                   | 205                   | 6150            | Liters | Power 12 kW generator for ice-core drilling. Approximately 2000 hours at 3 L/hr. |
| Estisol 140                           | hazardous         | 48                   | 205                   | 9840            | Liters | This is a chemical, but is generally considered non-                             |

|  |  |  |  |  |  |   |
|--|--|--|--|--|--|---|
|  |  |  |  |  |  | hazardous. It will be used as fluid to fill the drill hole. |
|--|--|--|--|--|--|---|

**Consommation d'eau**

| <b>Quantité quotidienne (m3)</b> | <b>Méthodes de récupération de l'eau proposées</b>  | <b>Emplacement de récupération de l'eau proposé</b>   |
|----------------------------------|---|---|
| 0                                | Drinking water will be obtained by melting hand-shoveled snow. We plan to collect ice-core samples and snow samples using ice-core drills (0.15 m3/day drinking water, 0.1 m3/day science samples). | Drinking-water snow will come from the surface of Muller Ice Cap. Scientific samples will be collected from the surface of the ice cap and from the subsurface. |

# Déchets

## Gestion des déchets

| Activités du projet | Type des déchets                 | Quantité prévue | Méthode d'élimination   | Procédures de traitement supplémentaires  |
|---------------------|----------------------------------|-----------------|---|---|
| Camp                | Déchets combustibles             | 9800 L          | We plan to leave the drill liquid, which is a generally safe chemical, in the borehole. This allows future scientists to access the hole if additional measurements are desired. Leaving the fluid like this is standard practice in ice-core drilling, including in sensitive areas. Since the fluid is contained in the hole, and only rises to a level where the ice is impermeable, it does not leak out. At this remote site, there is no risk of it affecting drinking water or impacting wildlife. | The hole will have a cap/casing on top, which prevents anything from getting in and liquid from leaking away. |
| Camp                | Eaux grises                      | 15 cubic meters | Sump in glacier, buried after use.  | n/a   |
| Camp                | Déchets non combustibles         | 3 cubic meters  | All non-human camp waste will be flown out.   | n/a   |
| Camp                | Eaux usées (matières de vidange) | 2 cubic meters  | We plan to leave only urine in a sump in the glacier.   | Feces will be flown out in buckets.   |

## Répercussions environnementales :

Potential water quality impacts stem from the drill fluid and from fuel use. Drill fluid is needed to keep the hole open during drilling. Leaving this fluid in the hole is standard practice including in sensitive areas (e.g., it is allowed under our permit in the Northeast Greenland National Park). The fluid will be contained in the hole, is not hazardous, and allows for future scientists to make additional measurements if desired. The impact will be mitigated by ensuring that fluid remains within the hole; while safely encased in the hole, the fluid will not harm water quality. Given the distance from the nearest communities, there is no risk of the drill fluid affecting people. The choice of a non-hazardous fluid is a backup in case the fluid escapes, for example due to climate change destabilizing the ice cap. Risk of fuel spills will be mitigated through the use of berms for all drums, and sufficient spill kits for cleanup; we will fly out any contaminated cleanup materials. There will be some noise from aircraft, generators, and snowmobiles; we will mitigate these effects by eliminating extra flights, using small generators only when needed, and driving at low speeds. Negative impacts on polar bears will be mitigated by minimizing scents in camp and bring non-lethal deterrents in addition to firearms; we expect no other biological impacts. We hope for a positive economic impact by employing a community member for work in our camp during 2024.



# **Additional Information**

**SECTION A1: Project Info**

**SECTION A2: Allweather Road**

**SECTION A3: Winter Road**

**SECTION B1: Project Info**

**SECTION B2: Exploration Activity**

**SECTION B3: Geosciences**

**SECTION B4: Drilling**

**SECTION B5: Stripping**

**SECTION B6: Underground Activity**

**SECTION B7: Waste Rock**

**SECTION B8: Stockpiles**

**SECTION B9: Mine Development**

**SECTION B10: Geology**

**SECTION B11: Mine**

**SECTION B12: Mill**

**SECTION C1: Pits**

**SECTION D1: Facility**

**SECTION D2: Facility Construction**

**SECTION D3: Facility Operation**

**SECTION D4: Vessel Use**

**SECTION E1: Offshore Survey**

**SECTION E2: Nearshore Survey**

**SECTION E3: Vessel Use**

## **SECTION F1: Site Cleanup**

## **SECTION G1: Well Authorization**

## **SECTION G2: Onland Exploration**

## **SECTION G3: Offshore Exploration**

## **SECTION G4: Rig**

## **SECTION H1: Vessel Use**

## **SECTION H2: Disposal At Sea**

## **SECTION I1: Municipal Development**

### **Description de l'environnement existant : Environnement physique**

The proposed site is near the highest point of Muller Ice Cap. This portion of the ice cap is relatively flat with a surface elevation of 1600-1800 m. To the east, the ice cap slopes away gently to land-terminating glaciers. The site is bordered on the west by mountains, with some of the icecap draining through large outlet glaciers that transect the mountain range. Satellite radar data indicate that the ice in the area is moving less than 3 m/yr, with low enough strain rates that crevasses are not expected (and no crevasses are visible in satellite images of the study area). Airborne radar data indicate that the ice is 500-800 m thick in the area, and is underlain by relatively steep topography underneath. The geology directly beneath the site is unknown, but the exposed rock to the west suggests that it is underlain by folded and faulted Triassic and Tertiary sedimentary rocks of the Sverdrup Basin. The site is far enough from the mountains to the west and flat enough that neither rockfall nor avalanches are possible. The site is near the hydrological divide between eastern and western Axel Heiberg Island, and directly on the ice divide between the east and west. Satellite data (from laser altimeters and photogrammetry) indicate that higher areas of the site (<1800 m) have a nearly stable surface elevation at present, with changes in glacier thickness that are indistinguishable from zero. Areas between 1600 and 1800 m are thinning at up to 10 cm/yr. There is substantial thinning of the glaciers that drain the ice cap in all directions (over 1 m/yr at places), suggesting that the proposed site will experience large changes over the coming decades as its outlets retreat and thin. The site is entirely in the dry-snow portion of the accumulation area of the ice cap (i.e. the annual snowfall has sufficient capacity to accommodate the annual melt in its pores). Ground-based observations from 1959-1960 and satellite radar data indicate that there are very few days with substantial snowmelt each year at this site, though this is also likely to change due to a warming climate. The elevation is such that no melt ponds form, although some are seen much lower down on the icecap. This site is well removed from sensitive areas. Because it is on top of the ice cap, we expect no interaction with flora or fauna. The site is 50 km from the site of the Napaqtulik/Napurtulik Proposed Territorial Park, which has a unique fossil forest. It is over 50 km from the archaeological sites near Buchanan Lake on the eastern part of Axel Heiberg Island.

### **Description de l'environnement existant : Environnement biologique**

The proposed site is all on top of the ice cap and largely devoid of life. There is no vegetation on the ice cap. While some mammals and birds are seen regularly on glaciers, the location of our site away from the ice edge means that there are no food sources for animals near where we plan to work, and thus animal encounters are unlikely. There are four species under the Species at Risk Act whose nominal range includes Axel Heiberg Island: polar bears, Peary caribou, ivory gulls, and the islandica subspecies of Red Knots. Since the site is away from the ocean, at high elevation, and on ice, we expect that Polar bears do not regularly occupy the study site, though it is possible that they occasionally visit. According to the species' recovery plan, community information and surveys agree that the primary Peary Caribou sites on Axel Heiberg Island are east and south of the ice cap, and the migrate from there to the southeast. Environment and Climate Change Canada indicates that they do not generally enter the interior of the ice cap. While the ivory gull range map includes Axel Heiberg Island, Environment and Climate Change Canada indicates no known nesting areas or critical habitat on the island. The gulls nest in a variety of locations, but have not been observed to nest on glaciers or ice caps. According to Environment and Climate Change Canada, Red Knots generally nest in dry south facing areas near water, which are not found at our site. When not nesting, they favor coastal areas, which again do not overlap with our site. In short, while the large-scale maps indicate that four species at risk have ranges that include Axel Heiberg Island, more detailed

information shows that only polar bears might ever go to the interior of the ice cap. We expect such visits to be very infrequent due to the lack of food on the ice cap.

### **Description de l'environnement existant : Environnement socio-économique**

The site is far from the closest communities; 440 km from Grise Fiord and 580 km from Resolute Bay. From consultations between our collaborators and community members, the large distance means that this is not an important hunting/fishing area for residents of Grise Fiord and Resolute Bay given the large distance from the communities. The nearest other people are at the McGill Arctic Research Station and Eureka; the McGill station is closest at about 50 km away, and we do not expect our work to have any negative impact on those scientists. Some tourism has taken place in the sounds east of Axel Heiberg Island; this is 75 km from our proposed site. Some tourism reaches the fossil forests 50 km from our site. Besides being distant from other human uses, the site is entirely on the ice cap at high elevation so it is a second step away from areas of socioeconomic importance. The site contains no archaeologically significant areas, and is more than 50 km from the known sites on the eastern part of Axel Heiberg Island. There is no currently protected area in the region, and the proposed site is 50 km from the Napaqtulik/Napurtulik Proposed Territorial Park.

### **Miscellaneous Project Information**

A safety data sheet for the drilling fluid, indicating low risk to human health, is attached.

### **Identification des répercussions et mesures d'atténuation proposées**

The measurements on the core in the field will not leave any chemicals, and the radar operates at frequencies not hazardous for human or animal life, so there should be no impact from making the measurements themselves. The primary impact will be the ice-core borehole, which will contain the drill fluid needed to keep the hole open during drilling. Leaving this fluid in the hole is standard practice including in sensitive areas, since it is difficult to remove and it allows future scientists to return and measure deformation and temperature (e.g., it is allowed under our permit in the Northeast Greenland National Park). The fluid will be contained in the hole, is not hazardous, and allows for future scientists to make additional measurements if desired. The impact will be mitigated by ensuring that fluid remains within the hole and that the hole is clearly marked; while safely encased in the hole, the fluid will not harm water quality. Given the distance from the nearest communities, there is no risk of the drill fluid affecting people. The choice of a non-hazardous fluid is a backup in case the fluid escapes, for example due to climate change destabilizing the ice cap. Risk to water quality from fuel spills will be minimized by keeping all drums within temporary plastic berms. We have already requested cleanup kits and berms from the Polar Continental Shelf Project. Any contaminated cleanup materials will be flown out. There will be some noise from aircraft, generators, and snowmobiles. This noise will have minimal impact because of the location of the work at the centre of the ice cap. We will further mitigate these effects by eliminating extra flights, using small generators and running them only when needed, and driving at low speeds. We think it most likely that we will have no impact on wildlife, since there is generally little life on the ice cap. However, interaction with a polar bear is possible but unlikely. The negative impacts of a possible polar bear encounter will be mitigated by minimizing scents in camp (storing food in sealed containers as much as possible, cooking away from sleeping tents) and bring non-lethal deterrents (bear bangers and spray) in addition to firearms. We hope for a positive economic impact by employing a community member for work in our camp during 2024.

### **Répercussions cumulatives**

The ice cap has only seen sporadic scientific work over the last 65 years, and to our knowledge there have only been two visits to our study area during the last few decades. The last time people camped within the study area was in 1962. We thus expect no cumulative impacts on the ground. The project will add a small number of flights to the cumulative aircraft operations in the area, but since the total number of flights is still small we expect the cumulative effect to be low. To the extent possible, we will maximize space on flights and minimize cargo so that there are no more aircraft movements than strictly necessary to complete the work.

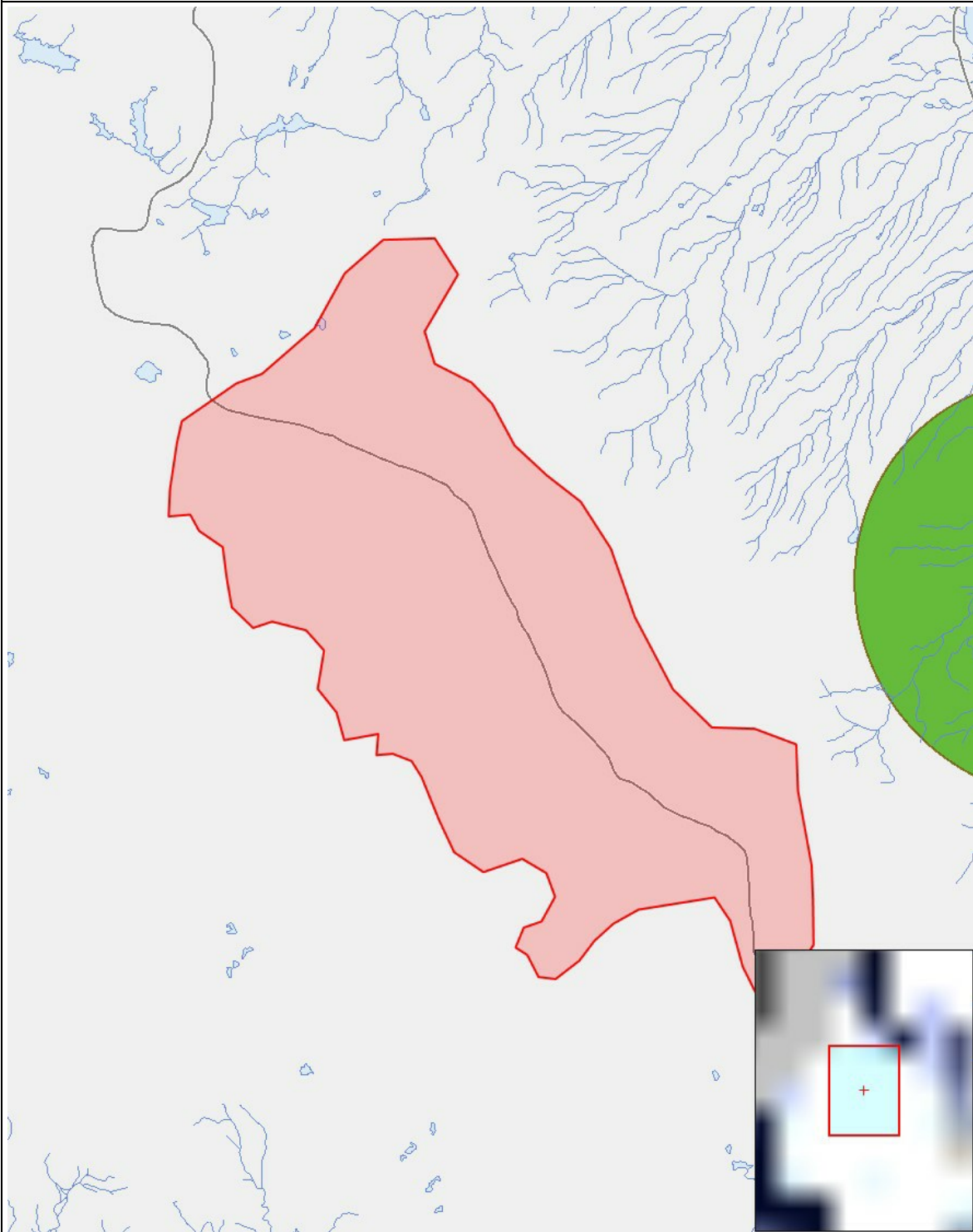
# Impacts

## Identification des répercussions environnementales

|  | PHYSICAL | Designated environmental areas | Ground stability | Permafrost | Hydrology / Limnology | Water quality | Climate conditions | Eskers and other unique or fragile landscapes | Surface and bedrock geology | Sediment and soil quality | Tidal processes and bathymetry | Air quality | Noise levels | BIOLOGICAL | Vegetation | Wildlife, including habitat and migration patterns | Birds, including habitat and migration patterns | Aquatic species, incl. habitat and migration/spawning | Wildlife protected areas | SOCIO - ECONOMIC | Archaeological and cultural historic sites | Employment | Community wellness | Community infrastructure | Human health |
|--|----------|--------------------------------|------------------|------------|-----------------------|---------------|--------------------|---|-----------------------------|---------------------------|--------------------------------|-------------|--------------|------------|------------|--|---|---|--------------------------|------------------|--|------------|--------------------|--------------------------|--------------|
| Construction                                 |          |                                |                  |            |                       |               |                    |   |                             |                           |                                |             |              |            |            |  |   |   |                          |                  |  |            |                    |                          |              |
| -  |          | -                              | -                | -          | -                     | -             | -                  | -   | -                           | -                         | -                              | -           | -            | -          |            | -  | -   | -   | -                        | -                | -  | -          | -                  | -                        | -            |
| Exploitation                                 |          |                                |                  |            |                       |               |                    |   |                             |                           |                                |             |              |            |            |  |   |   |                          |                  |  |            |                    |                          |              |
| Scientific/International Polar Year Research |          | -                              | -                | -          | -                     | -             | M                  | -   | -                           | -                         | -                              | -           | -            | M          |            | -  | M   | -   | -                        | -                | -  | P          | -                  | -                        | -            |
| Désaffectation                               |          |                                |                  |            |                       |               |                    |   |                             |                           |                                |             |              |            |            |  |   |   |                          |                  |  |            |                    |                          |              |
| -  |          | -                              | -                | -          | -                     | -             | -                  | -   | -                           | -                         | -                              | -           | -            | -          |            | -  | -   | -   | -                        | -                | -  | -          | -                  | -                        | -            |

(P = Positive, N = Négative et non gérable, M = Négative et gérable, U = Inconnue)

## Site du projet



## Liste des géométries de projet

- |   |         |   |
|---|---------|---|
| 1 | polygon | Area of Muller ice cap which we will survey--we plan to camp and drill an ice core at one point in this area. |
|---|---------|---|