NIRB Project Application File No: 19YN020
University of Alberta
Impacts of Melting Tidewater Glaciers on Marine Biogeochemical Cycles

Summary of current and future consultation plans:
We will be applying for an NRI license for our 2019 field season. A copy of our application for this license is included in this NIRB application – copies in both English and Inuktitut are provided. We will also be submitting an application to the Nunavut Water Board for use of waters without a license. This will be to use waters from the ice cap for drinking water purposes. This project will also be carried out in consultation with the Hamlet of Grise Fiord. A local member of the Grise Fiord Ranger Patrol (Jimmy Qaapik) will serve as our liason with the Hamlet. We plan to hold a open meeting with the Hamlet of Grise Fiord each summer allowing us to inform the community about our annual project plans, our overall findings to date, and most importantly, to garner feedback from the Hamlet regarding the project.

Flight plans (including any planned aerial surveys): We will access the field sites on Devon Island Ice Cap and Jones Sound via twin plane provided by the Polar Continental Shelf Project (PCSP). We also plan to annually use a helicopter to access our on-ice field sites on Devon and Ellesmere islands in the summer. Part of this work will include aerial surveys of Devon Ice Cap.

Reserch methodologies to be employed:
The following research methodologies will be used:

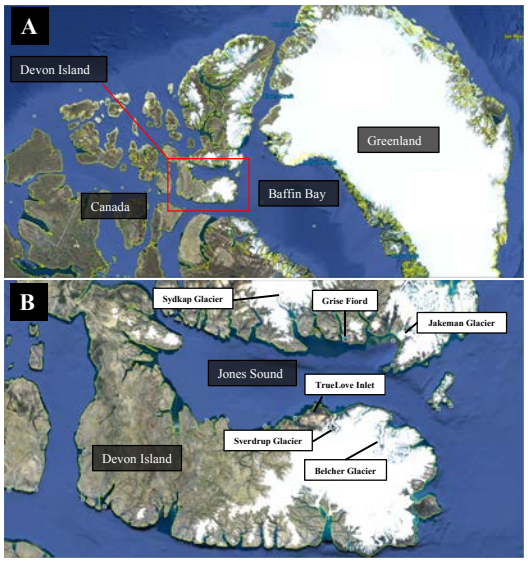
- **(i)** ***Time-lapse cameras***: Each time-lapse unit will consist of a tripod bolted into bedrock, a Nikon DSLR camera, a battery and solar panel. These systems operate year-round collecting images every hour until light becomes insufficient. We will service them and download data each spring and summer of the project.
- **(ii)** ***Ice sampling:*** Small ice samples (~1 kg each) will be collected using a chisel and hammer.
- **(iii)** ***Marine measurements:*** Measurements of ocean conductivity, temperature, pressure will be undertaken using an RBR multi-channel logger which will be profiled from the surface to ~500 m.
- **(iv)** ***Glacial meltwater and marine sampling:*** Meltwater and ocean samples will be collected in bottles and filtered on-site aboard small boats, with only the filter paper or small liquid volumes (<500 mL) sent back to the laboratory for analysis.

Mitigation plans that include indentification of potential impacts and proposed mitigation measures:
This project consists of a small scientific study requiring at maximum 6 people or less to spend approximately 1 month on-site in the field. The predicted environmental impacts will be minimal as all camps will be temporary, and all equipment, waste, and fuel drums will be back-hauled to Resolute Bay via twin otter support from the Polar Continental Shelf Project (PCSP). As such, additional mitigation measures are not anticipated to be necessary.

Waste management and spill contingency plans:
All waste (except greywater), equipment, fuel drums will be back-hauled to Resolute Bay via twin otter support from the Polar Continental Shelf Project (PCSP). Fuel drums will be handeled

and managed by twin plane/helicopter pilots only and PCSP staff. All hazadours chemicals are in a minimum quantity, and used solely to perserve water samples. Thes will be stored in a double container vessel, thus negating the possibility of any spill. For our marine-based scientific work, greywater will be disposed of at sea, offshore, via international norms. A disposal at sea permit is not required for this disposal, as disposal of sewater in Arctic Waters is currently allowed uner the Arctic Shipping Pollution Prevention Regulations. There will be no disposal of any wastes except grey water, and the grey water will not contain any oily substances. There will be no discharge of bilge water.

Images of project location (if available):



Location	Latitude	Longitude	Use
TrueLove Inlet	75°37'24.35"N	84°26'19.10"W	Temporary camp location and fuel cache location
Sverdrup Glacier	75°38'15.41"N	83° 8'3.40"W	Temporary camp location; research site location
Belcher Glacier	75°31'38.47"N	81°28'2.02"W	Temporary camp location; research site location
Sydkap Glacier	76°40'57.29"N	85°20'25.61"W	Research site location
Jakeman Glacier	76°28'8.63"N	80°48'47.32"W	Research site location
Grise Fiord	76°25'6.54"N	82°54'11.81"W	Mobilization point

NIRB Application for Screening #125462

Impacts of Melting Tidewater Glaciers on Marine Biogeochemical Cycles

Application Type:	New
Project Type:	Scientific Research
Application Date:	4/9/2019 6:28:11 PM
Period of operation:	from 0001-01-01 to 0001-01-01
Proposed Authorization:	from 0001-01-01 to 0001-01-01
Project Proponent:	Maya Bhatia University of Alberta Department of Earth and Atmospheric Sciences, 1-26 Earth Sciences Building Edmonton Alberta T6G2E3 Canada Phone Number:: 7804923428, Fax Number::

DETAILS

Non-technical project proposal description

English: The project entitled “Impacts of Melting Tidewater Glaciers on Marine Biogeochemical Cycles” (NPC File No: 149049; NIRB File No: 19YN020) is being proposed by Dr. Maya Bhatia from the Department of Earth and Atmospheric Sciences at the University of Alberta. The project location is in the Qikiqtani Region, at Devon Ice Cap on Devon Island and in Jones Sound, Nunavut. The closest community to the proposed work is the Hamlet of Grise Fiord. The project will not encroach on any protected areas. The project is intended to be multi-year, conducted annually in the spring/summer, consisting of a small party (<6 people) of scientists spending approximately 1 month in the field. The project goal is to understand how melting glaciers are exporting nutrients and sediment to the ocean and the impact of this material on regional marine primary production and biogeochemistry. To achieve this goal, we will conduct ice-based activities on Devon Ice Cap and marine-based activities in Jones Sound. Our on-ice activities will be to install, download and retrieve time-lapse cameras and pressure transducers around Sverdrup and Belcher glaciers on Devon Island Ice Cap. Equipment will be deployed at the glacier terminus, and in/around ice-marginal ponds and streams, recording (i) changes in glacier hydrology as the melt season progresses and (ii) changes in plume development at the glacier terminus. We expect seasonal changes in the glacier hydrology to correspond to the timing, magnitude, and nature of discharge events at the glacier terminus. Finally, we will also collect glacier ice and meltwater samples and process them for chemical and microbial analyses and experiments. Our marine-based activities will involve oceanic surveys from the termini of glaciers on Devon and Ellesmere Islands, measuring changes in seawater conductivity, temperature, and pressure. This work will be conducted from small boats, consisting of a private sailboat and/or boats provided by the Grise Fiord Ranger Patrol group. Seawater samples in Jones Sound will also be collected to measure marine chemical and microbial properties. Collectively, the new knowledge generated by this project has valuable long-term implications by providing understanding of the drivers of marine production at the base of the food web in this region, as well as broader scale marine carbon cycling, and the susceptibility of these drivers to climate change. Field access will be provided by twin otter from the Polar Continental Shelf Project (PCSP), Resolute Bay to Grise Fiord. From Grise, we will board a private sailboat and/or Grise Fiord Ranger Patrol Group boats. To conduct our on-ice work we will travel to Truelove Inlet on Devon Island by boat. Travel on the ice cap will be achieved by helicopter/on foot. In some years, a temporary camp (party of 2 and the helicopter pilot) may be established at TrueLove Inlet for a few days, where we will meet the helicopter (provided by PCSP) in preparation for our airborne and on-ice sampling work. In other years, a temporary camp (<10 tents) may be established on the ice cap for a few weeks. All temporary camps will be dismantled seasonally at the conclusion of our annual field season. All fuel drums cached at TrueLove Inlet to support the helicopter work will be removed by PCSP at the end of the field season. All equipment not needed for subsequent field seasons will be removed annually. Some equipment and fuel needed for subsequent years may be cached on the northern margin of the ice cap. All equipment and cached materials will be removed at the end of the project. There should be no need for restoration as camp sites on land will be minimally used, avoid any plant development by being situated on bedrock, and all equipment on the ice/bedrock can be easily removed. The Hamlet of Grise Fiord is surrounded by melting tidewater glaciers. Local indigenous knowledge indicates that waters near the termini of these glaciers are biologically productive. The community has expressed interest in understanding the impacts that climate change and enhanced glacial melting in particular are having on the regional marine ecosystem. This project is being undertaken in collaboration with the Hamlet and the Geological Survey of Canada, who have been long-term partners to monitor the acceleration of glacier melt in this region. Data generated by this study will be used in student theses, research publications, public talks, and climate change assessment reports. Data will also be made available of the Hamlet of Grise Fiord. Ultimately, data will be deposited in a public data repository. Results will be communicated through annual reports to the Nunavut Research Institute and Nunavut Climate Change Center, and summaries of research results to Grise Fiord and Resolute Bay communities in Inuktitut and English. NRI will receive copies of published articles.

French: N/A

Inuktitut: ᐱᓕᓇᐊᖏᔪᐊᖅᑐᖅ ᑕᐃᔨᐅᔨᖅ “ ᐊᐅᒃᐸᓕᐊᓂᖏᒐ ᐊᐅᔨᐃᑦᑐᑦ ᑕᓇᐅᖅᑭᑦᑐᖅ ᐊᐅᒃᐸᓕᓕᐊᔪᑎᑎᔨᖏᑦᓗ” (NPC File No: 149049; NIRB File No: 19YN020) ᑐᒃᓂᖅᑕᑕᐅᔨᖅ ᓄᒃᑦᖅ ᒪᐃᔨ ᐸᑎᐊ Dr. Maya Bhatia ᐃᖅᑲᓇᐃᔨᖅᐃᖏᓂᓂ ᐅᓇᓕᓇᓂᖅᔪᑦ ᓭᓇᐃᓐᓇᓕᓇᓂᖅᔪᓕᓐᓂ ᖃᑲᐅᔨᖅᓂᖅᔪᑦ ᐃᓕᓐᓂᐊᖅᐱᒃᔨᐊᖅᖁ ᐊᐅᓕᐳᑦ. ᖃᑲᐅᔨᐃᐅᔨᖅ ᓄᓇᖏᑦ ᖃᑭᑦᑕᓗᒃᑭᒥ, ᑕᓕᓗᑭᑎᓂ ᐊᐅᔨᐃᑦᑕᖏᓂ. ᐱᓕᓇᐊᖏᔪᐊᖅᑐᖅ ᖃᓂᒋᔨᖏᓂᓇᖏᔪᖅ ᓄᓇᓕᐅᔨᖅ ᐊᐅᓭᐃᑦᑕᖅ. ᐱᓕᓇᐊᖏᔪᐊᖅᑐᖅ ᐃᓗᐊᓂᒃᓴᔨᐊᖏᑦᑕᖅ ᓴᙵᔨᐅᓭᒪᔨᒥ. ᐱᓕᓇᐊᖏᔪᐊᖅᑐᖅ ᐊᖏᔪᒪᓴᒃᓄᑦ, ᐊᖏᔪᒍᒪᑦ ᖃᐅᔨᖅᑲᑦᓴᓂᑎᒃ ᐅᐱᖅᑭᒃᓴᑦ. ᐃᓄᐊᑭᑐᖅ ᐃᓄᒋᑎᒃᓄᑦ (<6 people) ᑭᒃᓕᓭᓂᐊᖅᑎᑎᐅᔨᑦ ᑕᖅᑭᒥᒃ ᐊᑕᐅᓭᖅᑎᒃ ᒪᖅᑮᑭᒃᓂᒃᓗ ᐃᓕᓐᓂᑦ ᖃᐅᔨᖅᓴᖅᓄᒃ. ᑐᖅᑏᐅᔨᖅ ᖃᐅᔨᖅᓴᓂᔪᑦ ᑐᑭᓯᐊᖅᑕᒪᖅᓯᒪᔪᑦ ᐊᐅᒃᐸᓕᓕᐊᔪᖅ ᐊᐅᔨᐃᑦᑐᑦᑕ ᓇᒃᖁᐊᖅᓯᒪᔨᓂᒃ ᐊᓪᓇᐅᓕᒪᔨᔪᑎᓂᒃ ᐊᒪᒪᓗ ᑲᑎᕆᔨᖅᓴᓂᒃ ᐊᓪᓇᐅᓕᒪᔨᔪᑎᓂᒃ ᑕᓇᐅᖅᑎᑦᓂᓗ ᑕᓇᐅᖅᔪᓂᖅᓂᓗᓐᓂ. ᑐᖃᓐᓇᐅᔨᖅ ᐱᓇᓱᐊᓂ,

ᓂᐊᒥ ᓄᓕᖅᓴᓂ ᖃᐅᔨᓴᖅᑕᕐᓄᐊᕐᔪᑦ ᐊᐅᔾᔨᐊᑦᑐᖅᓴᓂ ᑕᓪᓕᑭᓂ ᐊᒻᒪᓗ ᑕᓗᐅᖅᓴᓂ ᑲᖏᕐᕿᑦ. ᓂᐊᒋᓐᓄᑦ ᓄᓕᖅᓴᓂ ᐃᓕᓂᔾᔪᑦ, ᖃᕆᔨᐅᔾᔭᒃᑯᑦ ᐃᓕᐅᕐᖃᖅᑕᑦ ᐊᒻᒪᓗ ᐊᔾᔨᓕᐅᕐᖃᖅᑕᕐᓂᒃᓯᒪᔾᔪᑦ ᖃᕆᔨᐅᔾᔭᒃᑯᑦ ᐊᒻᒪᓗ ᓇᖏᓂᒪᓂᖅᓴᓂᒃ ᖃᐅᔨᔨᑭᑎᑦ ᐊᐅᔾᔨᐊᑦᑐᖅᓴᓂ Sverdrup ᐊᒻᒪᓗ Belcher ᑕᓪᓕᑭᑎᐅᐅᑦ ᐊᐅᔾᔨᐊᑦᑐᖅᓴᓂ. ᖃᐅᔨᔨᑭᑎᑦ ᐃᓕᓴᐅᖅᑕᕐᓄᐊᕐᔪᑦ ᐊᐅᔾᔨᐊᑦᑐᔪᒥ ᓄᓕᖅᓴᓂ, ᐊᒻᒪᓗ ᑕᓯᕐᖅᑭᓂ ᐊᐅᖅᓂᓂᓂ ᓂᐲᖅᓴᓂ, ᑎᑎᕋᐅᓕᖅᑐᑦ (1) ᐊᓯᓪᓚᕐᓚᐊᑦ ᓄᓕᐅᓂᖅᓱᓕᑦ ᐊᐅᓚᕐᓚᐊᑎᓪᓗᒍ ᐊᒻᒪᓗ (2) ᐊᓯᓪᓚᓂᐅᔾᔨᑦ ᐱᓕᕐᓚᐊᓂᖅᑭᑦ ᐊᐅᓚᕐᓚᐊᑎᓪᓗᒍ ᑭᖅᓚᖅᓴᓂᑦ ᐊᐅᔾᔨᐊᑦᑐᓗᒃ ᐊᐅᔾᔨᐊᑦᑐᔪᒥ ᐊᐅᔾᔨᐊᑦᑐᓗᒃ ᐊᐅᔾᔨᐊᑦᑐᖅᓴᓂ. ᓄᓕᐅᑭᔾᔪᑦ ᓄᓕᐅᓂᖅᓱᓕᑦ ᐊᐅᔾᔨᐊᑦᑐᔪᒥ ᐊᐅᔾᔨᐊᑦᑐᓗᒍ ᐊᖏᔪ ᐃᓗᑎᒃᓂᖅᓱᓗ ᐊᒻᒪᓗ ᖃᓄᖅ ᐱᔾᔨᓪᓚᕐᓚᐊᖃᖅᑕᕐᓕᖅᓴᒋᑦ ᑭᓄᖅᓴᓂᖅᓱᓗ ᐊᒻᒪᓗ ᐊᐅᒃᓂᓂᔪᒥ ᐃᒥᖅᓴᒃ ᐊᒻᒪᓗ ᐃᓗᓗᓴᖅᓴᓂᑐᒍᒪ ᖃᐅᔨᔨᑭᑎᑦ ᐊᐅᔾᔨᐊᑦᑐᓗᒍ ᐊᐅᔾᔨᐊᑦᑐᖅᓴᓂ. ᑕᓪᓕᑭᒥ ᖃᐅᔨᔨᑭᓂᐅᔾᔨᑦ ᑭᓄᖅᓴᓂ ᐊᐅᔾᔨᐊᑦᑐᖅᓴᓂ, ᖃᐅᔨᔨᑭᑎᑦ ᐊᐅᔾᔨᐊᑦᑐᖅᓴᓂ ᐃᓚᓂᑦ, ᐅᖃᓂᖅᓱᓗ ᐊᒻᒪᓗ ᓇᖏᑦ ᐱᓴᕐᓚᐊᖃᖅᑕᕐᓕᖅᓴᒋᓚᒃ. ᑕᓪᓕᑭᒥ ᖃᐅᔨᔨᑭᑎᑦ ᐊᐅᔾᔨᐊᑦᑐᖅᓴᓂ ᐃᓚᓂᑦ ᐅᑭᐅᖅᑐᑦ ᐅᒥᐊᔪᒃ ᐊᑐᔨᑦᓯᓗᒍ ᐊᐅᓚᕐᓚᐊᑎᑦ. ᑕᓪᓕᑭᒥ ᖃᐅᔨᔨᑭᓂᐅᔾᔨᑦ ᐅᓂᒃᓴᓂᖅᓱᓗ ᐊᐅᔾᔨᐊᑦᑐᖅᓴᓂ. ᑕᓪᓕᑭᒥ ᖃᐅᔨᔨᑭᓂᐅᔾᔨᑦ ᐃᓚᓂᑦ ᐊᐅᔾᔨᐊᑦᑐᖅᓴᓂ, ᐅᖃᓂᖅᓱᓗ ᐊᒻᒪᓗ ᐅᑭᐅᖅᑐᑦ ᐅᒥᐊᔪᒃ ᖃᐅᔨᔨᑭᓂᐅᔾᔨᑦ ᐊᐅᔾᔨᐊᑦᑐᖅᓴᓂ. ᑕᓪᓕᑭᒥ ᖃᐅᔨᔨᑭᓂᐅᔾᔨᑦ ᐅᑭᐅᖅᑐᑦ ᐅᒥᐊᔪᒃ ᖃᐅᔨᔨᑭᓂᐅᔾᔨᑦ ᐊᐅᔾᔨᐊᑦᑐᖅᓴᓂ. ᑕᓪᓕᑭᒥ ᖃᐅᔨᔨᑭᓂᐅᔾᔨᑦ ᐊᐅᔾᔨᐊᑦᑐᖅᓴᓂ, ᐅᖃᓂᖅᓱᓗ ᐊᒻᒪᓗ

Activities

Location	Activity Type	Land Status	Site history	Site archaeological or paleontological value	Proximity to the nearest communities and any protected areas
Ice-free regions of Devon Island	Camp	Crown	Truelove lowlands has been the site of a research station in the past.	N/A	Closest community is Grise Fiord. We will only be establishing a temporary 4-day camp here while we conduct a helicopter reconnaissance survey.
Sydkap glacier and terminus area	Marine Based Activities	Marine	N/A	N/A	Closest community is Grise Fiord. We will be conducting measurements and taking samples from small boat based operations.
Devon Ice Cap between Sverdrup and Belcher glaciers	Scientific/International Polar Year Research	Crown	Devon Ice Cap is monitored through Natural Resources Canada National Glaciology Program by the Geological Survey of Canada	N/A	Closest community is Grise Fiord (located across Jones Sound). We will be flying over the region in a helicopter to photograph the ice cap and outlet glaciers.
Belcher glacier and terminus and surrounding area	Scientific/International Polar Year Research	Crown	Devon Ice Cap is monitored through Natural Resources Canada National Glaciology Program by the Geological Survey of Canada.	N/A	Closest community is Grise Fiord (located across Jones Sound). We will be flying over Belcher glacier and its terminus. We will deploy time-lapse cameras and pressure transducers around the glacier to understand its hydrology.
Sverdrup glacier and terminus and surrounding area	Scientific/International Polar Year Research	Crown	Devon Ice Cap is monitored through Natural Resources Canada National Glaciology Program by the	N/A	Closest community is Grise Fiord (located across Jones Sound). We will be flying over Sverdrup glacier and its terminus. We will deploy

			Geological Survey of Canada		time-lapse cameras and pressure transducers around the glacier to understand its hydrology.
Western Devon Island Ice Cap	Scientific/International Polar Year Research	Crown	Devon Ice Cap is monitored through Natural Resources Canada National Glaciology Program by the Geological Survey of Canada	N/A	Closest community is Grise Fiord (located across Jones Sound). We will be flying over the region to photograph the ice cap and outlet glaciers.

Community Involvement & Regional Benefits

Community	Name	Organization	Date Contacted
Grise Fiord	Jimmie Qaapik	Grise Fiord Ranger Patrol Group	2019-01-03

Authorizations

Indicate the areas in which the project is located:

North Baffin

Authorizations

Regulatory Authority	Authorization Description	Current Status	Date Issued / Applied	Expiry Date
Nunavut Water Board	An application will be made the NWB for use of waters without a licence.	Not Yet Applied		
Nunavut Research Institute	An application will be made after screening by the NIRB.	Not Yet Applied		

Project transportation types

Transportation Type	Proposed Use	Length of Use
Air	We will take a twin plane from resolute bay to Grise Fiord; We will also use a helicopter to conduct work on Devon Island Ice Cap.	
Water	We will conduct small boat operations from Grise Fiord using a sailboat and/or boats provided by the Grise Fiord Ranger Patrol Group.	

Project accomodation types

Temporary Camp

Community

Other,

Material Use

Equipment to be used (including drills, pumps, aircraft, vehicles, etc)

Equipment Type	Quantity	Size - Dimensions	Proposed Use
Sailboat	1	15.3 m x 4.20 m	Travel within Jones Sound and marine-based scientific activities
Twin Otter	1	15.77 m x 2.0 m	Travel to and from field site. Provided by the Polar Continental Shelf Project.
Helicopter	1	12.9 m x 3.14 m	Travel to and from field sites, and air surveys of field site. Provided by the Polar Continental Shelf Project.

Detail Fuel and Hazardous Material Use

Detail fuel material use:	Fuel Type	Number of containers	Container Capacity	Total Amount	Units	Proposed Use
Aviation fuel	fuel	5	55	275	Gallons	Fuel for twin plane and helicopter. PCSP will determine each year the amount of fuel required for transport to the field site, and will coordinate fuel storage and drum (container) clean up upon completion of the field season.
Gasoline	fuel	4	10	40	Liters	Held on-board sailboat; fuel for outboard motors and generators.
Diesel	fuel	4	1125	4500	Liters	Held on-board sailboat in 250, 1450, 1450, and 1350 L tanks. Max fuel consumption is 160 L max per day. Fuel safety protocol and spill equipment on-board: valves to isolate a leak, anti-dispersive product, fire extinguishers.
Hydrochloric Acid (UN 1789)	hazardous	1	1	1	Liters	Used to preserve water samples and clean tubing. All quantities will be shipped up and returned according to

						hazardous material regulations. No chemicals will be left or disposed of on-site or in Nunavut.
Methanol (UN 1230)	hazardous	1	1	1	Liters	Used to preserve water samples. All quantities will be shipped up and returned according to hazardous material regulations. No chemicals will be left or disposed of on-site or in Nunavut.
70% Ethanol (UN 1170)	hazardous	1	1	1	Liters	Used to clean (sterilize) equipment. All quantities will be shipped up and returned to according to hazardous material regulations. No chemicals will be left or disposed of on-site or in Nunavut.

Water Consumption

Daily amount (m3)	Proposed water retrieval methods	Proposed water retrieval location
0	1. For ice-cap based work, water will be retrieved via bucket.	1. glacier surface

Waste

Waste Management

Project Activity	Type of Waste	Projected Amount Generated	Method of Disposal	Additional treatment procedures
Camp	Combustible wastes	0	To minimize the impacts of our research activities every effort is made to keep the camp clean, all scientific equipment and solid waste is backhauled to Resolute Bay, and water consumption is minimized. All scientific equipment will be removed at the end of the project, and all fuel drums will be removed.	N/A
Marine Based Activities	Greywater	100 L	For marine-based work, all grey waste water will be stored in holding tanks on-board and then discharged offshore via international norms. There will be no excess fuel disposal.	N/A
Scientific/International Polar Year Research	Hazardous waste	0	All hazardous chemicals will be shipped to and from Resolute Bay and our field sites with the appropriate Dangerous Goods paperwork. Efforts are made to ship the absolute minimum concentrations of chemicals required for the scientific research. No hazardous chemicals will be disposed of or left at the field sites or in Nunavut. All chemicals will be shipped back to Alberta with appropriate Dangerous Goods paperwork.	N/A
Camp	Non-Combustible wastes	0	To minimize the impacts of our research activities every effort is made to keep the camp clean, all scientific equipment and solid	N/A

			waste is backhauled to Resolute Bay, and water consumption is minimized. All scientific equipment will be removed at the end of the project, and all fuel drums will be removed.	

Environmental Impacts:

This project consists of a small scientific study requiring at maximum 6 people or less to spend approximately 1 month on-site in the field. The predicted environmental impacts will be minimal as all camps will be temporary, and all equipment, waste, and fuel drums will be back-hauled to Resolute Bay via twin otter support from the Polar Continental Shelf Project (PCSP). As such, additional mitigation measures are not anticipated to be necessary.

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

We plan to use a private small sailboat and/or small boats provided by the Grise Fiord Ranger Patrol Group (see letter). The sailboat we will hire (the Vagabond: https://vagabond.fr/en/) is a 47 ft sailing vessel , crewed by a family of 4, previously used as a marine platform to launch small scientific operations from. As the proponent of this scientific work, we will ensure that any private vessel hired has all the required permits to conduct the scientific work described here in this project application. Details of materiel use and waste use are provided in those sections of this application. Boats provided by the Grise Fiord Ranger Patrol Group will be managed / captained directly by them.

SECTION H2: Disposal At Sea

N/A: a disposal at sea permit is not required for this project since we are not disposing of any dredged material, excavated material or fish waste at sea. The Arctic Shipping Pollution Prevention Regulations currently allow for the discharge of human waste generated aboard a ship as per international norms. There will be no disposal of any wastes except grey water, and the grey water will not contain any oily substances. There will be no discharge of bilge water.

SECTION I1: Municipal Development

Description of Existing Environment: Physical Environment

This project will focus on research sites on Devon Island Ice Cap and in Jones Sound. This project does not encroach on any protected areas. It will not involve any work in the Nifjutiqavvik National Wildlife Area around Coburg Island in Lady Ann Strait.

Description of Existing Environment: Biological Environment

Land-based work for this project will occur on Devon Ice Cap on Devon Island. Devon Island is uninhabited and the ice cap is devoid of wildlife. Marine-based work for this project will occur in Jones Sound, which encompasses the traditional harvesting grounds of the Hamlet of Grise Fiord. As such, this project is being undertaken in collaboration with the Hamlet (see letter from the mayor of Grise Fiord), and will utilize small boats (e.g. a sailboat or boats provided by the Grise Fiord Ranger Patrol Group).

Description of Existing Environment: Socio-economic Environment

The closest community to the proposed project is the Hamlet of Grise Fiord. The Hamlet of Grise Fiord is surrounded by melting tidewater glaciers. The community has expressed interest in understanding the impacts that climate change and enhanced glacial melting in particular are having on the regional marine ecosystem. This project is being undertaken in collaboration with the Hamlet and the Geological Survey of Canada, who have been long-term partners to monitor the acceleration of glacier melt in this region. Jones Sound encompasses the traditional harvesting grounds of the Hamlet of Grise Fiord.

Miscellaneous Project Information

Please see supporting documents including: Project Map, Latitude and Longitude coordinates of locations listed in this application, requested supplemental supporting documentation, and letters of support for the project from the Mayor of Grise Fiord and a provisional contract from the Grise Fiord Ranger Patrol Group.

Identification of Impacts and Proposed Mitigation Measures

The positive impacts of this project is that it will provide employment opportunities to the residents of Grise Fiord . This will involve hiring the Rangers to conduct over-winter sampling as well as potentially field assistants / guides from the Hamlet. Another positive impact is that the project will offer further insight to the Hamlet of Grise Fiord about the impacts of melting glaciers on the marine ecosystem.

Cumulative Effects

The proposed project will have negligible environmental impact owing both to its small size and the types of work proposed. The small scientific party (<6), minimal time spent in the field (maximum 1-2 months), establishment of only temporary (not permanent) camps, and complete removal of equipment and waste at the seasonal conclusion of each field season ensures a negligible environmental impact. Finally, the scientific work to be done will be non-invasive, involving the deployment of cameras or small pressure transducers, which will be rock-bolted and easily removed at the conclusion of the field season. Water sampling will be limited to chemical and microbial analyses - involving small volumes (< 10L maximum) that are filtered/processed on-site. Cumulatively the project will provide valuable information to scientists and the Hamlet of Grise Fiord about the effects of climate change, and in particular glacial melt, are having in the region, and provide opportunities to involve community members from Grise Fiord in the research.

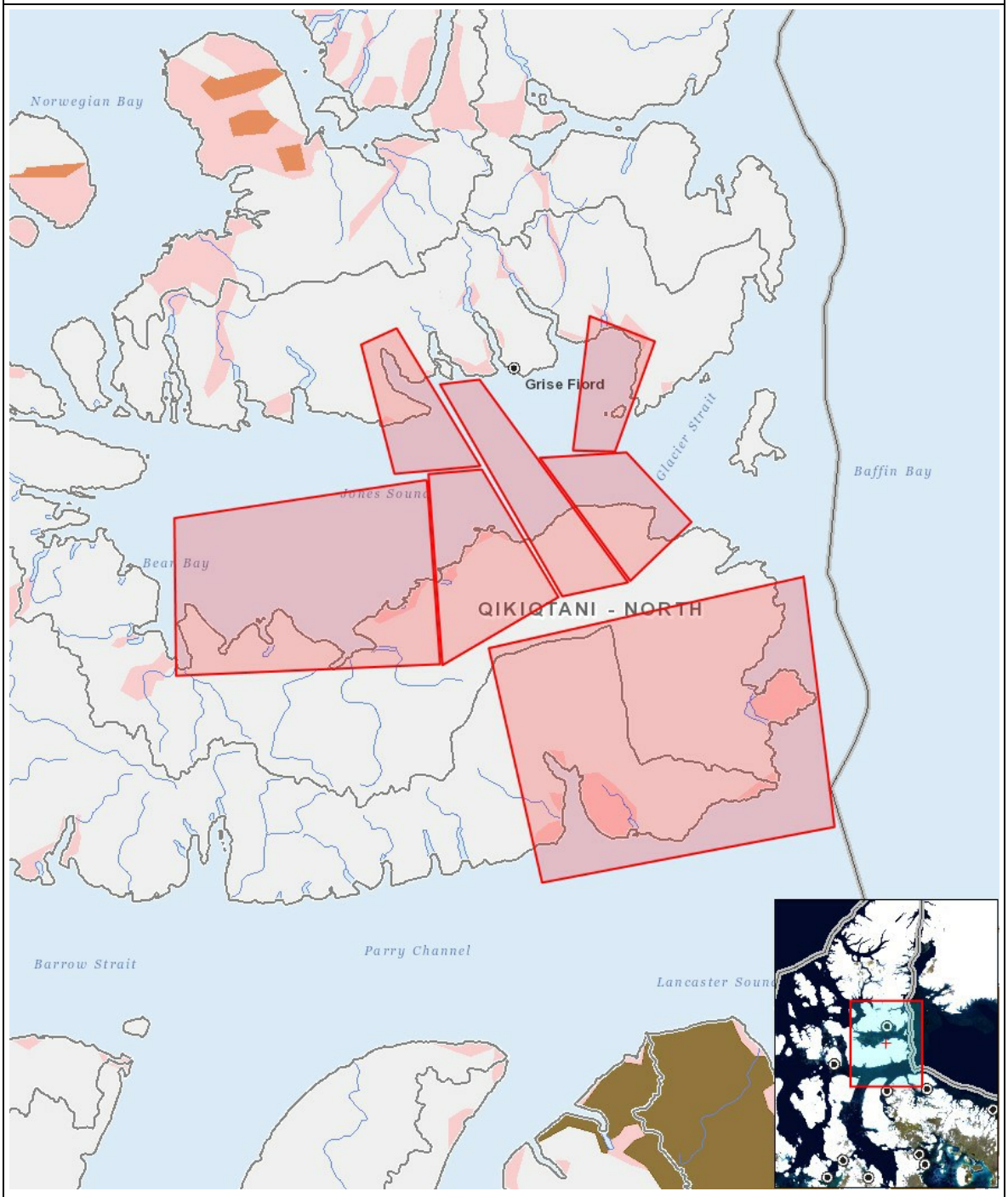
Impacts

Identification of Environmental Impacts

	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																									
-		-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-		-	-	-	-	-
Operation																									
Camp		-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-		P	-	-	-	-
Scientific/International Polar Year Research		-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-		P	-	-	-	-
Decommissioning																									
-		-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-		-	-	-	-	-

(P = Positive, N = Negative and non-mitigatable, M = Negative and mitigatable, U = Unknown)

Project Location



List of Project Geometries

1	polygon	Ice-free regions of Devon Island
2	polygon	Sydkap glacier and terminus area
3	polygon	Devon Ice Cap between Sverdrup and Belcher glaciers
4	polygon	Belcher glacier and terminus and surrounding area
5	polygon	Sverdrup glacier and terminus and surrounding area
6	polygon	Western Devon Island Ice Cap
7	polygon	Jakeman glacier terminus and surrounding area