



NIRB Application for Screening #126179

Assessing the ecological risk associated with critical mineral extraction and low-sulfur fuels in Northern ecosystems

Application Type: New

Project Type: Scientific Research

Application Date: Wednesday, April 23, 2025

Period of operation: from 2025-04-13 to 2025-09-15

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DETAILS

Non-technical project proposal description

English: Global climate change presents a unique problem in that the poles (i.e., Arctic and Antarctic) are warming at an accelerated rate compared to more temperate latitudes. As a consequence, permafrost in Arctic regions is softening, and sea ice coverage is declining, allowing for increased shipping activities, oil and gas extraction, mineral mining, and tourism, all with the potential to release contaminants into the environment. Cambridge Bay and Port Iqaluit are particularly susceptible to increased metal contaminants from intensified mineral extraction in these areas and oil-based contaminants from increased shipping traffic and vessel movement. Furthermore, the use of low-sulfur fuels is becoming more common in the Arctic to reduce air pollution from these increased activities. However, these newer fuels have different chemical properties, and their effects on cold-adapted Arctic organisms are not well understood. In addition, current water quality guidelines are based on sensitivities of animals from more temperate latitudes. As a result, these guidelines do not account for the specific environmental factors associated with cold water environments and ecosystems, nor reflect the sensitivity of Arctic species to pollutants. Therefore, we want to improve protocols to protect Northern ecosystems from human-associated disturbances. This research aims to find out whether or not Arctic species are more sensitive to pollutants than the temperate species currently used to set water quality standards. By doing so, we hope to develop better guidelines that specifically protect Arctic environments. This project aims to understand Arctic organisms' sensitivity to two types of toxicants: metal contaminants (copper, zinc, cobalt, nickel, and lithium) and oil-related chemicals (including perfluoroalkyl and polyfluoroalkyl substances (PFAS) and other substances from low-sulfur fuels). We will expose three types of organisms found in the Arctic to these toxicants of interest using Arctic-relevant concentrations under Arctic-relevant conditions (e.g., temperature, water chemistry). By testing different concentrations of exposure, we aim to identify the most vulnerable species and expand our knowledge to help communities, stakeholders, and policy-makers protect the Arctic environment. Sea-ice algae, copepods, and *Daphnia* (water fleas) will be collected in and around Cambridge Bay, NT. Specifically, algae and copepods will be collected in May 2025 from the sea ice between Cambridge Bay and the Dease Strait, while *Daphnia* and water samples will be collected in August from Greiner Lake. The exposures in May will last three weeks, while those in August will take five weeks. All experiments will be safely contained within CHARS labs, and water used in tests will be treated before disposal to remove any harmful substances. Different cleaning methods, such as biochar filtration, chelating resins, and activated charcoal, will be used to remove metals and chemicals, ensuring that no potentially harmful contaminants are released into the environment during the research project. After the exposures have been completed, the organisms will be shipped back to Quebec City (Institut national de la recherche scientifique; INRS) and/or Edmonton (University of Alberta) for further studies to look at how these contaminants build up over time and affect Arctic organisms over more extended time frames. This fieldwork is part of a 3-year NSERC Alliance grant and a 3-year DFO grant; throughout the tenure of the grant, community engagement will occur to communicate our research with the residents of Cambridge Bay. The project team will conduct community meetings and presentations each year of the project. These events will include demonstrations of the equipment used in the proposed studies as well as updates on the research project outcomes and information about the current status and policy surrounding critical minerals. During our field sampling, we plan on having a member of the local hunters and trappers organization (HTO) with us to make sure that we are supporting the local community while also learning directly from community members. Finally, we plan on participating in community feasts with the local HTO to build further connections with the local indigenous community.

French: Not required since work is only being completed in Cambridge Bay.

Inuktitut: Not required since work is only being completed in Cambridge Bay.

Inuinnaqtun: Hilaqyuaqmi hilap allanguqnia hatqiqtai ayyikkutaittut ihuitnit tapkuat qangani ataanilu (naunaipkutariplugu, Ukiurtaqtuq tamnalu Antarctic) uunakpaliayut kayumiktumik hutqiknia uunaqpalliqlinut nalaanit. Piplugit, qiqumainnaqnit Ukiurtaqtuq avikhimani qahuvalliqut, tariuplu hikua hikuhimani ikiklivalliliqtut, pipkaqhugu umiaqpait huliniit, uqhuqyuaq kaasitlu amuyauni, havikhat uyarakhiuqni, pulaaraqututlu, tamaqmik pilaqinut hatqiqni halumailrut ilavalliqlinut umiaqpait aulani umiaqpaitlu aulani. Iqaluktutiak tamnalu Tulakvik Iqaluit piniqhamik piyaulat ilagiqni haviit halumailrut ingattaqyumininit havikhat amuyuani

tahapkunani inaitni uqhuqyuanutlu halumaiqnit avatainut. Hulivalliq, atuqni pukkituq sulfur uqhuqyuat atuqpaliqtauplutik Ukiurtaqtumi mikhigiaqhugit hilamut halumaiqnit tahapkuat ilagiqni huliniit. Kihimik, tahapkuat nutangutqiyat uqhuqyuat pilgit allatqinik avugiyauvaktut piqaqnit, tapkuat aktuanit qayurnaqniqui atuliqnit Ukiurtaqtuq piqarutai kangiqhimayauttiangitni. Ilagiplugitlu, taty imaq nakuunia hivulirutai piplogu ikpigilaqnit angutikhat uunaqniuvalliqninut nalaanitnit. Piplogu tamna, tahapkuat hivulirutit pihimaitai tapkuat taihimayut avatiliqutit pityutai piqatai niglamayuni imaq avatait uumatyutitlu, pingitailu tapkunanga ikpigilaqni Ukiurtaqtuq uumayut halumailrut. Taimaittumik, nakuuhivallirumayavut havariyaqaqtai hapumminit Ukiurtaqtuq uumatyutai tapkunanga inungnit piqatai ulapihautit. Una naunaiyaut piniaqhimagyuq naunaiqni piyakhai uvaluniit pingittaq Ukiurtaqtuq uumayut ikpigilaqniqhauni halumaittunut tapkuat uunaqni uumayut taty atuqtauyut ihuaqhini imaq nakuunia atuqpaknit. Taimailuqhugu, niriuktugut pivaliatitni nakuutqiyamik hivulirutai taihimayut hapumminia Ukiurtaqtuq avatai. Una havanguyuuq piniaqhimagyuq kangiqhini Ukiurtaqtuq uumayuvallu ikpigilaqni malruk qanurittuni tuqunait: haviit halumailrut (copper, zinc, cobalt, nickel, tamnalu lithium) tamnalu uqhiqyuq turangani avugiyauvaktut (ilautitlugit perfluoroalkyl tamnalu polyfluoroalkyl hunaunit (PFAS) ahiilu hunat talvanga pukkituq sulfur uqhuqyuat). Hatqiqniaqtavut pingahut qanurittuni uumayuvallu nalvauyut Ukiurtaqtumi tahapkuat tuqunait piyauyumayut atuqhugu Ukiurtaqtuq turangayut katiqhuqnit qanuritnit (naunaipkutariplugu, uunaqni, imaq avigiyauttaqni). Uukturaqhugit allatqit katiqhuqnit hatqiqni, pinahuaqtavut naunaiqni amihuniqhat qanurillat uumayut attaqtuhiqiaqnilu ilihimanivut ikayuqni nunaliuyut, piqatauyut, maligaliuqtut hapummini Ukiurtaqtuq avatigiyai. Tariup hilkua aqayait, uugavallu, tapkuatlu Daphnia (imaqmi kumavauit) katitauniat talvani avataanilu Ikaluktutiak, NT. Taiplugu, aqayait uugavallu katitauniat talvani Qiqaiyaluarvia 2025 talvanga tariup hikua akungani Ikaluktutiak tamnalu Dease Strait tariunga, pititlugu Daphnia imaqlu naunaiyaqni katitauniat talvani Niqiliqivik talvanga Ikaluktutiak (Greiner Tahiq). Tapkuat hatqiqni talvani Qiqaiyaluarvia atukhaqniat pingahunik havaguhit, tapkuatlu Niqiliqivik atuqniat tallimat havaguhit. Tamaita uuktugauyut piniat hivuranaittumik hiamaktailini ilauni Kanatamiuni Quttiktuq Ukiuqtartuq Naunaiyivik (CHARS) naunaiyavit, imaqlu atuqnia uukturaqni halumaqhagauniat iqaqniahaqlugit ahivaqni kitutliqak hivuranaqtut hunat. Allatqit halumaqtiqni pityuhit, tapkuatut uumani iqalukpit halumaqhautit, haviknut nipittaqni, huliplitiklu paulgit, atuqniaqni ahivaqni havit avigiyauyutlu, atuqpiaqhugit atulaitni hivuranaqtut halumailrut hatqiumani avatigiyauyunut atuqtitlugu naunaiyainit havanguyuuq. Kinguagut hatqiqnit iniqtiqniagut, tamna uumayuvallu aulaqtitauniat talvunga Quebec City (Institut national de la recherche scientifique; INRS) tamnalu/uvaluniit Edmonton (Universityngal Alberta) hulivalliq naunaiyautit takuni qanuq tahapkuat halumailrut piruqhaqtut akuniuyuuq aktuanilu Ukiurtaqtuq uumayuvallu amihuvalliqni uiguni pivikhiat havagutai. Una havakvikni ilagiya 3 ukiut NSERC Katutyiqatai manikhat tamnalu 3 ukiut DFO-kut manikhat; atuqhugu havaqatigini manikhat, nunalikni piqatigikni atuqniat tuhaumatyutit naunaiyainivut piqatigini nunaliuyut Ikaluktutiak. Tamna havanguyuuq havaqatigit havariniaqtai nunalikni katimanit hatqiqtaunit ukiuq tamaat havanguyumut. Tahapkuat huliniit ilaqaqiat takukhautitni hanalrutit atuqni uuktutini naunaiyautit tapkualuttauq nutanguqnit naunaiyainiq havanguyuuq qanuritnit tuhagakhatlu tapkuninga taty qanuritnit maligaitlu avataini atuqpiarialgit havikhait. Atuqtitlugu maniqami naunaiyautit, parnaktugut pihimani ilauyut nunalikni angutikhaliqiyit (HTO) piqatiginivut atuqpiariangi ikayuqtavutlu nunalikni nunaliuyuuq huli ilitni nanminiq nunalikni ilaayunut. Kingullipamik, parnaktugut piqatauniq nunaliuyumi niriqatigiknit piqatigiplugit nunalikni HTO-kut piruqhaqpalliqni atatyutai nunalikni nunaqaqaqtut nunaliuyut.

Personnel

Personnel on site: 8

Days on site: 65

Total Person days: 520

Operations Phase: from 2025-04-13 to 2025-09-15

Activities

Location	Activity Type	Land Status	Site history	Site archaeological or paleontological value	Proximity to the nearest communities and any protected areas
Lake where Cambridge Bay drinking water is taken from	Sampling sites	Municipal	Site was chosen as a potential collection location for water to look at metal contaminants in the drinking water that feeds Cambridge Bay	N/A	This sampling site is ~2km North of Cambridge Bay
Outflow of sewage lagoon, leading into river/bay	Sampling sites	Municipal	Site was chosen as a potential collection location for water collection to look at metal contaminants flowing into the bay from the Cambridge Bay sewage lagoon.	N/A	Outflow of Sewage lagoon is ~1.3km Northwest of Cambridge Bay
Downstream of sewage lagoon, closest to outflow	Sampling sites	Municipal	Site was chosen as a potential collection location for water collection to look at metal contaminants just outside of the sewage lagoon outflow, in the bay outside of the town.	N/A	Downstream of Sewage lagoon, close to outflow is ~1.25km Northwest of Cambridge Bay
Downstream of sewage lagoon, intermediate distance	Sampling sites	Municipal	Site was chosen as a potential location for water collection to look at metal contaminants downstream of the sewage lagoon outflow, in the bay outside of town.	N/A	Downstream of Sewage lagoon, intermediate to outflow is ~1km Northwest of Cambridge Bay
Downstream of sewage lagoon, longest distance	Sampling sites	Municipal	Site was chosen as a potential location for water collection to look at metal contaminants farthest downstream from sewage lagoon outflow, but in close proximity to town.	N/A	Downstream of Sewage lagoon, farthest from outflow is ~0.9km Northwest of Cambridge Bay
Greiner Lake site for Daphnia collection	Sampling sites	Municipal	This lake was chosen for water flea collection because of previous work outlining the food web dynamics (Grosbois, G., M. Power, M. Evans, G. Koehler, and M. Rautio. 2022. Ecosphere 13(1):e03881. 10.1002/ecs2.3881) and sediment core analysis of ecological changes over time in this water body (Kivila, E., Rantala, M., Antoniades, D., Luoto, T., Nevalainen, L., Rautio, M. 2022. CATENA 211:105969. 10.1016/j.catena.2021.105969).	N/A	Greiner Lake is 12 km North of Cambridge Bay and 5km West of Ovayok Territorial Park
Cambridge	Sampling	Municipal	This site was chosen due to its	N/A	Collection area

Bay Sea-ice associated algae collection and copepod collection area	sites		proximity to Cambridge Bay, while still containing sea ice that can be cored for algae. Ice-algae eating copepods will also be collected under the ice.		is ~2km Southeast of Cambridge Bay and 14km Southwest of Owayok Territorial Park
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Community Involvement & Regional Benefits

Community	Name	Organization	Date Contacted
Cambridge Bay	Beverly Maksagak	Ekaluktutiak Hunters & Trappers Organization	2024-09-23
Cambridge Bay	Gabriel Ferland	Viventem Science Support Agency	2024-11-18
Cambridge Bay	David Hik	POLAR Knowledge Canada	2023-08-17

Authorizations

Indicate the areas in which the project is located:

Authorizations

Regulatory Authority	Authorization Description	Current Status	Date Issued / Applied	Expiry Date
Nunavut Research Institute	Applied for a Research License to conduct the proposed research around Cambridge Bay	Applied, Decision Pending		
Fisheries and Oceans Canada	Applied for a License to Fish for Scientific Purposes, but only to have DFO approval for the research. We will not be collecting any fish or fish tissue for this year.	Applied, Decision Pending		
Government of Nunavut, Department of Environment	Applied for a Nunavut Wildlife Research Permit due to the collection of algae and small crustaceans (copepods and Daphnia).	Applied, Decision Pending		
Nunavut Water Board	Applied for Approval for the use of Water or Deposit of Waste Without a License due to the low volume of water (0.024 m ³ /day) we are expecting to use.	Applied, Decision Pending		
Hunters and Trappers Associations/Organizations	Approved for the proposed research from the Ekaluktutiak Hunters & Trappers Organization (see letter of support)	Active	2025-04-01	2026-10-01

Project transportation types

Transportation Type	Proposed Use	Length of Use
Air	Researchers will take flights from southern Canada (Edmonton, Waterloo, Quebec City) to Cambridge Bay	
Water	Researchers will travel across ice sheets outside of Cambridge Bay to collect sea ice algae & copepods, and potentially via boat to	

	collect Daphnia on Greiner lake if necessary in August	
Land	Researchers will travel across land to Greiner Lake for collection of Daphnia	

Project accomodation types

Other,

Material Use

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

Equipment Type	Quantity	Size - Dimensions	Proposed Use
Skidoo	2	317cm x 102.4cm x 109.5cm	Skidoos to travel to field sites in Cambridge Bay for May algae/copepod collection. Supplied by Viventem.
Seawater Pumps	2	33cm x 12.7cm x 16.5cm	Pump to collect seawater for rearing of algae and copepods. Supplied by Viventem.
Kovacs Ice corer	1	200cm x 15cm x 15cm	Ice corer to collect a sample of the sea ice in order to sample the algae growing underneath
Ice Auger	1	121cm x 39.04cm x 29.67cm	Auger used to make a hole in the ice for collection of seawater and copepods. Supplied by Viventem.
Umbrella Plankton Net	1	28cm x 28cm x 200cm	Plankton net to collect copepods under the sea ice for May fieldwork.

Detail Fuel and Hazardous Material Use

Detail fuel material use:	Fuel Type	Number of containers	Container Capacity	Total Amount	Units	Proposed Use
Gasoline	fuel	6	20	120	Liters	Fuel for skidoos, will only require ~15L per week for collection of organisms.
Sodium hydroxide (NaOH)	hazardous	1	1	1	Kg	0.1 kg of solid pellets. Used for pH correcting water for experiments in the lab at CHARS. Stored in a plastic container, double bagged, when in solution it will be stored in a fume hood cabinet with other corrosive materials, inside a plastic bin. This chemical will not leave the lab facility at CHARS.

Ethanol	hazardous	1	1	1	Liters	500 mL, used for sanitization of work stations and equipment in the lab at CHARS. Contained in plastic container, double bagged, stored in a fume hood cabinet with other corrosive materials, inside a plastic bin. This chemical will not leave the lab facility at CHARS.
Nitric Acid (HNO ₃)	hazardous	4	1	4	Liters	Acid used for dissolving metals in exposure waters and cleaning glassware in the lab at CHARS. Contained in plastic container, double bagged, stored in a fume hood cabinet with other corrosive materials, inside a plastic bin. This chemical will not leave the lab facility at CHARS.

Water Consumption

Daily amount (m3)	Proposed water retrieval methods	Proposed water retrieval location
0	Saltwater (May; ~50L)/freshwater (August; ~50L) collected from sampling sites via pump or bucket. Water will be brought to Canadian High Arctic Research Station for culturing organisms.	May – Sea-ice associated algae collection and copepod collection area; August – Greiner lake

Waste

Waste Management

Project Activity	Type of Waste	Projected Amount Generated	Method of Disposal	Additional treatment procedures
Researching	Hazardous waste	40 L	5% v/v acid bath (prepared in ultrapure water) will be neutralized with acid-neutralizing powder (Calcium carbonate), then the pH of the solution will be checked to confirm neutral pH (pH = 7). Water will then be disposed in the sink under flowing water.	No additional treatment procedures
Researching	Other, Metal-spiked freshwater	3 L per metal, 15 L total for freshwater	We will generate up to 12 L of metal-spiked freshwater with about 100-500 µg/L of Co, Cu, Zn and Ni (environmentally relevant levels). These metals will be removed from the freshwater by complexation with an ion-exchange resin (chelex type), using a batch method that has been optimized to efficiently remove metal from water since the 60s. Following this treatment, the resin will be filtered out of the water (and brought to Edmonton) while the metal-free water will be disposed down the sink at CHARS, under flowing tap water.	We will generate up to 3L of freshwater contaminated with lithium. This monovalent metal will have a relatively low affinity for the chelex resin, so the above-mentioned removal technique is not optimal. This 3 L wastewater will be shipped from CHARS to Edmonton for disposal.
Researching	Other, Metal-spiked seawater	6.6 L per metal, 33 L total for seawater	We will generate up to 26 L of metal-spiked seawater with about 100-500 µg/L of Co, Cu, Zn and Ni (environmentally relevant levels).	We will generate up to 6.6L of seawater contaminated with lithium. This monovalent metal will have a relatively low affinity for the chelex resin, so the

			These metals will be removed from the seawater by complexation with an ion-exchange resin (chelex type), using a batch method that has been optimized to efficiently remove metal from seawater since the 60s. Following this treatment, the resin will be filtered out of the water (and brought to Quebec) while the metal-free water will be disposed down the sink at CHARS, under flowing tap water.	above-mentioned removal technique is not optimal. This 6.6 L wastewater will be shipped from CHARS to Quebec for disposal.
Researching	Other, Fuel-spiked seawater	6.6 L of fuel-spiked seawater	Exposure water will be treated with activated charcoal to remove fuel, then both water and charcoal will be shipped back to the University of Alberta for disposal	No additional treatment procedures

Environmental Impacts:

Environmental impacts of this study are expected to be minimal due to toxicant exposures occurring in controlled laboratory environments in small volumes of water at the Canadian High Arctic Research Station (CHARS). Experiments will utilize increasing concentrations of metals (Nickel, Copper, Zinc, Cobalt, Lithium) and low sulfur fuel oil (including oil co-contaminants such as antioxidant, surfactants and per- and - Polyfluorinated Substances (PFAS)) to identify the sensitivity of Arctic animals (sea-ice algae, copepods, and water fleas) to potential increases in aquatic concentrations. High concentrations of toxicants in exposure water will be used during this experiment and nitric acid baths used to clean glassware/plasticware between experiments. Therefore, mitigation measures will be utilized to reduce potential pollution of Nunavut waters. After exposures, water will be treated with biochar and chelex resin treatment to remove dissolved metals before disposing water down sinks under flowing water. Biochar will be shipped to Edmonton (University of Alberta) or Quebec City (INRS) for appropriate disposal. For oil exposures, water will be treated with activated charcoal to reduce concentrations and/or shipped back to Edmonton for disposal. Additionally, nitric acid bath will be neutralized with acid-neutralizing powder, then the pH of the solution will be checked to confirm neutral pH (pH = 7). Water will then be disposed in the sink under flowing water.

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 of Existing Environment: Physical Environment

The sampling for this project will take place in two different physical environments. The first will be sampling on the sea ice of the Cambridge Bay inlet area in May 2025. This sampling will occur on the ice sheet ~2km Southeast of Cambridge Bay and 14km Southwest of Ovayok Territorial Park. The exact location of our sampling will be determined when we are already in the field and based on sea ice conditions, safety, appropriateness, and wildlife observations to minimise disruption. Our local team, Viventem, will be guiding this research and helping inform where the sampling sites should be. The area of the proposed sea-ice sampling is not within any known sensitive marine habitat areas, recreational areas, or heritage sites. The second sampling area will be in Greiner Lake in August 2025. Greiner Lake is a shallow basin lake (average depth 3-5m and maximum depth of 12m) with an area of 47 km². It is located ~5km from Ovayok Territorial Park, and 12km North of Cambridge Bay. The lake is covered with 2m of ice in winter, and the open water period is 2 months between early July and mid-September, aligning with our proposed sampling period. 40% of the lake is <2m deep, allowing sampling close to the shoreline to minimise potential disruption. The sampling at Greiner Lake will not disturb any designated park areas or heritage sites. Greiner Lake is used for fishing and contains Arctic char, lake whitefish, and lake trout. Our local guide, Viventem, will ensure our zooplankton sampling does not disturb fishing or subsistence practices. There have been some archaeological sites within the area, looking at historical settlements. However, these are mainly along the Ekalluk River and outside the current municipal area and will not be near our sampling sites. By-law 37 of the Hamlet of Cambridge Bay on Noise Control means that there are minimal noise levels within the region, and all activities are required to reduce unnecessary or excessive noise disturbances. Neither sampling site is within the Valued Ecosystem Components of Nunavut, including Caribou ranges, seal hunting areas, and breeding grounds. All efforts will be made to respect and preserve all natural, cultural or historical resources.

Description of Existing Environment: Biological Environment

Algal samples will be collected in May 2025 from 9cm ice cores that contain sea-ice associated algae in the bottom 5cm (mainly diatoms). Sea ice is ~2m thick and will be cored using our Kovacs Ice Corer, and as few cores as possible will be used to collect sufficient algae for exposures back at CHARS (up to 12 cores). Approximately 500 individual copepods (about 1-5mm in size) will be collected in May 2025 by vertical trawl with a plankton net. The plankton net will be lowered up to 10m through a 21cm hole in the ice. Due to the infinitely small amount of water and organisms collected in relation to the vast under-ice ecosystem, the disturbance of this ecosystem will be minimal. Greiner lake sampling will occur in August along the shoreline to collect water fleas (*Daphnia* spp., estimated to be 21% of the zooplankton community) that will be present in the water column. Water fleas will be brought back to CHARS for exposures. The lake contains a large population of sea-run Arctic char (*Salvelinus alpinus*), resident lake whitefish (*Coregonus clupeaformis*), and lake trout (*Salvelinus namaycush*). However, since we are only sampling close to the shoreline, the disturbance to these fishes will be minimal. No SARA species, wildlife, or birds will be impacted by this work.

Description of Existing Environment: Socio-economic Environment

All fieldwork to sample water and our organisms will be conducted around Cambridge Bay. All exposures will be conducted inside the laboratory facility within the Canadian High Arctic Research Station (CHARS). All test waters will be fully treated prior to safe disposal (in the case of cobalt, zinc, nickel and copper-spiked waters), or shipped to Quebec or Alberta for disposal (in the case of fuel- and lithium-spiked waters). As far as we know, there are no archeologically or culturally significant sites in the project area or in adjacent area. We will not be disturbing the palaeontological component of surface and bedrock geology. We will not be impacting any land or resource use in the area and will be following community guidelines should any of our sampling impact these operations. Our water and animal sampling will be outside of the residential area and should have minimal impact on local or regional traffic patterns. However, should our equipment or techniques impact this infrastructure, we will consult with local authorities to mitigate these impacts. Our work will have no impact on human health due to the extensive treatment plan we have for handling our relatively small volumes of exposure waters after experiments in the CHARS laboratory are completed. Additionally, our field sampling will be led by a local team (Viventem) with in-depth knowledge of the local area to minimize negative impacts.

Miscellaneous Project Information

All exposures will be contained in low volumes at CHARS and none of the solutions containing contaminants will leave the laboratories at this facility. No exposure solutions (metal- or fuel-spiked water) will be brought into the field or onto the ice during sampling of organisms. Comprehensive Spill Prevention/Plan: Handling of dangerous chemicals will follow the University of Alberta Chemicals – General Safe Handling Standard Operating Procedure (SOP; UofA_Comprehensive_Spill_Prevention.docx). If any spills occur, we will follow the University of Alberta Spill remediation protocol (UofA_Comprehensive_Spill_Plan.docx). Emergency Response Plan: Attached field activities plan (Emergency_response_plan_FAP_Blewett_Arctic contaminant_2025.docx) contains information for Emergency Responses and mitigation of hazards. It also contains staff training and emergency contacts. Waste Management Plan/Program: Exposure waters containing metals will be treated with Chelex resin as per the attached SOP (Waste_management_plan_chelex_resin.pdf). Exposure waters containing oil (and oil co-contaminants) will be treated with Biochar as per the attached SOP (Waste_management_plan_biochar.docx).

Identification of Impacts and Proposed Mitigation Measures

Designated environmental areas: Will not be impacted by this project. Ground stability: Will not be impacted by this project. Permafrost: Will not be impacted by this project. Hydrology/limnology: Will not be impacted by this project. Water quality: All lab experiments will be contained in low water volumes within the laboratory facilities at CHARS and none of the waters spiked with contaminants will be used outside this facility. Saltwater and freshwater spiked with metals or fuel will be treated to remove contaminants as per the waste section of this application. We are a team of experienced lab scientists who will be following best waste management practices, so we anticipate no environmental impact from lab waste. Climate Conditions: Will not be impacted by this project. Eskers and other unique or fragile landscapes: Will not be impacted by this project. Surface bedrock and geology: Will not be impacted by this project. Sediment and soil quality: Transport to Greiner lake will be conducted via roads where possible and guided by our local team (Viventem) to take the most appropriate and least disruptive route. Tidal processes and bathymetry: Will not be impacted by this project. Air quality: Will not be impacted by this project. Noise levels: There is the potential for ice coring to produce noise pollution for local wildlife. Therefore, we will only be conducting minimum drilling activity (<1 h cumulatively in May 2025) to collect just enough algae/copepods for our lab experiments. Since we are working in a controlled laboratory environment, we will not need much biomass for our exposures. Cores will be taken at one time to prevent repeated disturbance and guided by our local team (Viventem) who have extensive experience collecting ice cores. All activities will work within By-law 37 of the Hamlet of Cambridge Bay on Noise Control to minimize noise disruption. Vegetation: We will be collecting samples of sea-ice algae from the bottom 5 cm of about 12 ice cores (9-cm in diameter), this is the minimum amount of algae for our exposures. Wildlife: Will not be impacted by this project. Birds: Will not be impacted by this project. Aquatic species: Greiner lake houses multiple cultural and subsistence species of fish. Therefore, to minimize any impact on their wellbeing, we will minimize time at the site and avoid disturbance of fish habitat. For this work, no fish will be collected. We will be collecting zooplankton (water flea or Daphnia) and water to culture them in, making sure to collect the minimum amount of water possible. Wildlife protected areas: Will not be impacted by this

project. Archaeological and cultural historic sites: Will not be impacted by this project. Employment: Our grants contain funds to hire locals to support this researcher. Therefore, we will be hiring Viventem as well as individuals from the Ekaluktutiak HTO to act as guides and support our research. Community wellness: Will not be impacted by this project. Community infrastructure: Will not be impacted by this project. Human Health: Our research will provide the basis for investigating the potential toxicological impacts of metal exposure. Overall, we hope to develop Arctic-specific guidelines for water quality that will inform future research and policy, ultimately to improve health and well-being of local Arctic communities.

Cumulative Effects

There should be minimal cumulative impacts from this research because we are visiting different sites during our two field campaigns. All exposures will be contained in low volumes at CHARS and none of the solutions containing contaminants will leave the laboratories at this facility. Additionally, we have extensive treatment protocols for removing all contaminants from our metal- or fuel-spiked water before disposal. This means that minimal environmental repercussions will occur and pollution from our exposures will be mitigated.

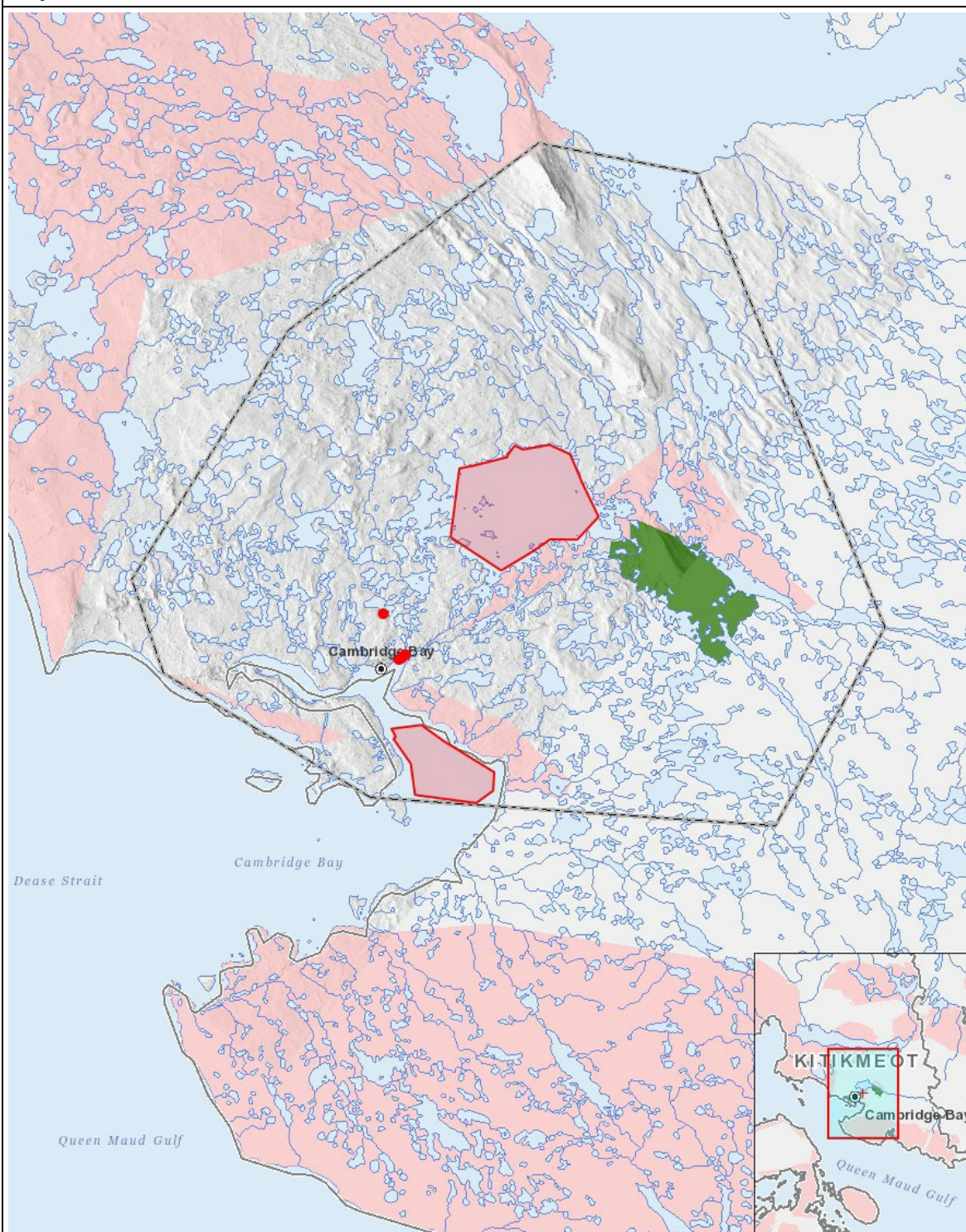
Impacts

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																									
Sampling sites		-	-	-	-	M	-	-	-	M	-	-	M		M	-	-	M	-		-	P	-	-	P
Decommissioning	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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

Project Location



List of Project Geometries

- | | |
|-----------|---|
| 1 polygon | Greiner Lake site for Daphnia collection |
| 2 polygon | Cambridge Bay Sea-ice associated algae collection and copepod collection area |
| 3 point | Outflow of sewage lagoon, leading into river/bay |
| 4 point | Downstream of sewage lagoon, closest to outflow |
| 5 point | Downstream of sewage lagoon, intermediate distance |
| 6 point | Downstream of sewage lagoon, longest distance |
| 7 point | Lake where Cambridge Bay drinking water is taken from |