



NIRB Application for Screening #126460

Arctic Water Solutions: Harnessing Native Northern Plants for Nature-Based Wastewater Treatment in Canada's Arctic

Application Type: New

Project Type: Scientific Research

Application Date: Thursday, July 30, 2026

Period of operation: from 2027-04-01 to 2028-03-01

Project Proponent: Wenxi Liao
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DETAILS

Non-technical project proposal description

English: Who: University of Guelph. Project lead: Dr. Wenxi Liao, co-lead: Dr. David McCarthy, co-PIs: Dr. Shadman Khan, Dr. Marc Habash, Dr. Jacqueline Goordial. Why: Northern communities across Canada's Arctic rely heavily on simple sewage lagoons that have limited wastewater treatment capacity. Conventional wastewater treatment plants are often impractical in these regions due to extreme cold conditions. Nature-based biofilters have demonstrated effective removal of nutrients, pathogens, and emerging contaminants in cold regions. However, more research is needed to adapt these systems using local plant species and suitable filter materials so that they are environmentally compatible, culturally appropriate, and resilient to Canada's Arctic conditions. What: This project will develop and optimize low-cost, scalable, and climate-adapted biofilters for wastewater treatment in Canada's Arctic, while protecting native plant species and enhancing ecosystem services. The project is important for Northern communities because it offers an effective, affordable, and locally relevant wastewater treatment solution that is informed by local knowledge and community input. Approximately six pilot-scale biofilter systems near the triplex at CHARS to evaluate wastewater treatment performance and plant health under Arctic conditions from 2027 to early 2028. Wastewater will be pumped from the triplex sewage holding tank into a temporary storage tank and then to the biofilters for treatment. Treated effluent will drain from each biofilter into a separate collection container. After effluent samples have been collected, the remaining treated effluent will be pumped back into the sewage holding tank in the triplex. Therefore, no wastewater or treated wastewater will be discharge to the ground in the experiment. Wastewater treatment assessments will be conducted only when the graduate students are present at CHARS. During these periods, the students will closely supervise the biofilters to ensure safe operation and promptly address any issues. Wastewater will not be introduced into the biofilters when the students are not on site. During unattended periods, the biofilters will be irrigated with tap water, as needed, to support plant survival and growth. Native Arctic plant species, such as mastodon flower and Arctic willow, will be collected locally under the appropriate permit and transplanted into the biofilters. Fewer than 20 plants in total will be collected. The biofilters will be instrumented with environmental and water quality sensors, including soil moisture, turbidity, pH, and electrical conductivity sensors, to continuously monitor system performance. Sensors and biofilters will be monitored graduate students and CHARS staff. The project will involve a collaborative research team, CHARS staff, and local community partners. All biofilters and sensors will be removed at the end of the project in early 2028. Personnel and research materials will be transported using existing commercial airline services and CHARS facilities. No vehicles will be required to support on-site research activities. Where: The field demonstration is proposed to take place at CHARS in Cambridge Bay, Nunavut. When: The field deployment and monitoring of biofilters is planned between March 2027 to March 2028. The biofilters and equipment will be disassembled around June 2028.

French: N/A

Inuktitut: N/A

Inuinnaqtun: University of Guelph. Dr. Wenxi Liao, Dr. David McCarthy, Dr. Shadman Khan, Dr. Marc Habash, Dr. Jacqueline Goordial. Ukiuqtaqtumi nunallaat Kanatami tamaat ihariagiplugu atuqpagait anaqnut kuvviit ikittut kuvvikunik imaqmik halummaqhitiigit. Nutaatqiyat kuvvikunik imaqmik halummaqhitiit amihuiqtuqhutik ihuaqutaunngittut hapkunani aviktuqhimayunit qaayuqnaqpallaamut. Maniraqmiutanik halummaqhitiit ihiriitkutut ilittuqhitiivaktuq ahivaiyunik niqittianik, halumailrunik, nuivalliyullu halumailruit qaayuqnaqtumi aviktuqhimayuni. Kihimi, qauyihaihimmaqtughat ihuaqhaiyaamik havauhiqnik atuqhutik nunallaarmiut nauttianginnik ihuaqtuniklu ihiriitkutanik taimaa avatinut naammagiamik, ilitquhinut ihuaqtughat, hakugiktughallu Kanatam Ukiuqtaqtuanit qaayuqnaqtumi. Una havaaghaq hanayauhimayuq ihuaqhailutiklu akikittunik, qauyiharnaqtunik, hilaullu-nakuuhihimayunik ihiriitkutut kuvvikunik imaqmik halummaqhitiit Kanatam Ukiuqtaqtuanit, munariplugit nauttiat ihuaqhivaalliriamiklu uumayunut ikayuutighat. Havaaghat aghuurnaqtut Ukiuqtaqtumi nunallaanut tuniqhihimakkamik ihuaqtunik, akikittunik, nunallaarmiunullu ihuaqtunik kuvvikunik imaqmik halummaqhitiigahq naunaiyaqhimayut nunallaarmiut qauhimayatuqainit nunallaarmiullu uqauhiinit. Hivulliqni havaanginnit 2026-mi, hanayaghaliuqniaqtugut ihuaqhailugulu ihiriitkutaq atuqhugit maniraqmiutat Ukiuqtaqtumiu nauttiangit ihuaqtumiklu ihiriitkutaqmik

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Personnel

Personnel on site: 4

Days on site: 90

Total Person days: 360

Operations Phase: from 2027-04-01 to 2027-07-01

Operations Phase: from 2027-04-01 to 2028-03-01

Closure Phase: from 2028-03-01 to 2028-06-01

Post-Closure Phase: from to

Activities

Location	Activity Type	Land Status	Site history	Site archaeological or paleontological value	Proximity to the nearest communities and any protected areas
Cambridge Bay	Researching	Crown	We plan to work near Canadian High Arctic Research Station (CHARS)	N/A	Approximately 1.5 km between CHARS and Hamlet of Cambridge Bay

Community Involvement & Regional Benefits

Community	Name	Organization	Date Contacted
Cambridge Bay	We are currently working with staff at CHARS. We visited Cambridge Bay in July this year to discuss the project plan with local community members and staff at CHARS. Many members supported this project. The project application is associated with the field work planned for 2027-2028.	CHARS	2026-07-14

Authorizations

Indicate the areas in which the project is located:

Kitikmeot

Authorizations

Regulatory Authority	Authorization Description	Current Status	Date Issued / Applied	Expiry Date
Nunavut Water Board	We have contacted NWB and they have confirmed that we do not need to apply for a permit/licence with NWB for this project.	Not Yet Applied		
Government of Nunavut, Department of Environment	We also plan to apply for a permit/licence with Government of Nunavut - Department of Environment after our first visit to Cambridge Bay.	Not Yet Applied		
Nunavut Research Institute	We are in the process of preparing the permit application. The fieldwork associated with this project is planned for 2027. We visited Cambridge Bay and engaged with local community members in July 2026 and will incorporate their feedback into our application. We plan to submit the permit application by September 2026.	Not Yet Applied		

Project transportation types

Transportation Type	Proposed Use	Length of Use
Air	Materials will be transported using airlift	

Project accomodation types

Other,

Material Use

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

Equipment Type	Quantity	Size - Dimensions	Proposed Use
Biofilter	6	100 cm high and 60 cm in diameter, with an estimated total volume of approximately 210 L	We propose to install approximately six pilot-scale biofilter systems near the triplex at CHARS to evaluate wastewater treatment performance and plant health under Arctic conditions. Each biofilter will contain native Arctic plants and layered biofilter media composed of sand, gravel, and/or biochar.

Detail Fuel and Hazardous Material Use

Detail fuel material use:	Fuel Type	Number of containers	Container Capacity	Total Amount	Units	Proposed Use
No	hazardous	0	0	0	Kg	All the samples will be shipped to the laboratory at the University of Guelph for analysis. No hazardous material and chemicals will be used in the field.
No	fuel	0	0	0	Kg	No fuel will be used for this project.

Water Consumption

Daily amount (m3)	Proposed water retrieval methods	Proposed water retrieval location
0	The proposed project will not take water from the region. We have consulted the permit manager at the Nunavut Water Board, who confirmed that the proposed project does not require a licence from them.	N/A

Waste

Waste Management

Project Activity	Type of Waste	Projected Amount Generated	Method of Disposal	Additional treatment procedures
Researching	Other, wastewater	Small volume	No disposal is needed. Wastewater will be pumped from the triplex sewage holding tank into a temporary storage tank and then to the biofilters for treatment. Treated effluent will drain from each biofilter into a separate collection container. After effluent samples have been collected, the remaining treated effluent will be pumped back into the sewage holding tank in the triplex. Therefore, no wastewater or treated wastewater will be discharge to the ground in the experiment. Wastewater treatment assessments will be conducted only when the graduate students are present at CHARS. During these periods, the students will closely supervise the biofilters to ensure safe operation and promptly address any issues. Wastewater will not be introduced into the biofilters when the students are not on site. During unattended periods, the biofilters will be irrigated with tap water, as needed, to support plant survival and growth.	N/A

Environmental Impacts:

This project is funded through Polar Knowledge Canada (POLAR). As described in the project summary, the proposed research aims to evaluate the wastewater treatment performance of vegetated biofilter systems. Wastewater will be pumped from the triplex sewage holding tank into a temporary storage tank and then to the biofilters for treatment. Treated effluent will drain from each biofilter into a separate collection container. After effluent samples have been collected, the remaining treated effluent will be pumped back into the sewage holding tank in the triplex. Therefore, no wastewater or treated wastewater will be discharge to the ground in the experiment. The proposed work is expected to pose minimal environmental

risk. Wastewater treatment assessments will be conducted only when the graduate students are present at CHARS. During these periods, the students will closely supervise the biofilters to ensure safe operation and promptly address any issues. Wastewater will not be introduced into the biofilters when the students are not on site. During unattended periods, the biofilters will be irrigated with tap water, as needed, to support plant survival and growth. These measures will minimize environmental impacts while ensuring safe and responsible handling of wastewater throughout the project. We consulted the Nunavut Water Board and were informed that no permits or licences are required from the NWB for the proposed project.

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

Description of Existing Environment: Biological Environment

Description of Existing Environment: Socio-economic Environment

Miscellaneous Project Information

Identification of Impacts and Proposed Mitigation Measures

The proposed work is expected to pose minimal environmental risk. Wastewater samples will be handled, stored, and transported using appropriate containment and biosafety procedures to minimize the risk of spills, releases, or exposure. Only the volume of wastewater necessary for experimental application and analysis will be used. Any excess treated or untreated wastewater will be returned to the originating wastewater treatment facility or other approved local disposal locations in accordance with local guidelines and operational requirements. These measures will minimize environmental impacts while ensuring safe and responsible handling of wastewater throughout the project. We consulted the Nunavut Water Board and were informed that no permits or licences are required from the NWB for the proposed project.

Cumulative Effects

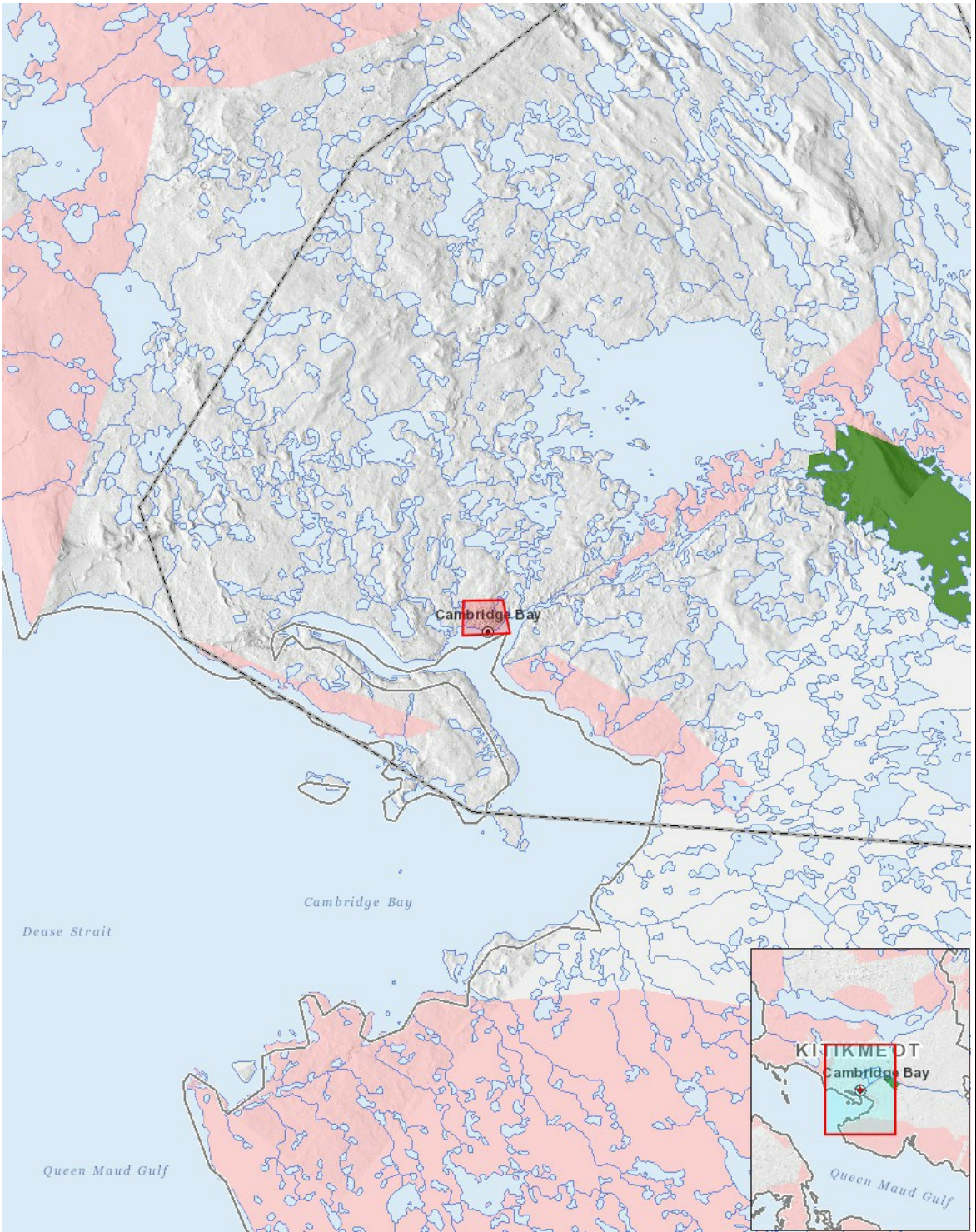
Impacts

Identification of Environmental Impacts

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

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

Project Location



List of Project Geometries

1	polygon	Cambridge Bay
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