

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

Summary:

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.

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.

The field demonstration is proposed to take place at the Canadian High Arctic Research Station (CHARS) in Cambridge Bay, Nunavut. Cambridge Bay is the closest community to the proposed field activities. The field deployment and monitoring of biofilters is planned between March 2027 to March 2028. The biofilters and equipment will be disassembled around April 2028.

Methods

In the first phase in 2026, we will design and optimize biofilter systems using native Arctic plants and effective filter media through laboratory and greenhouse experiments at the University of Guelph. The most promising biofilter designs will then be tested at a demonstration site at or near CHARS in Cambridge Bay and monitored across Arctic seasons from 2027 to early 2028.

During field monitoring, locally sourced wastewater will be applied to the biofilters, and treated effluent will be collected to assess performance. A portion of the effluent and selected plant samples will be transported to the University of Guelph for laboratory analysis. Any remaining effluent will be returned to the original wastewater facility or an approved local disposal site, following local guidelines. Plant performance will also be monitored during the experiment.

The project will involve a research team, CHARS staff, and local community partners. Only small experimental biofilter units and monitoring equipment will be installed. The biofilters and equipment will be removed at the end of the experiment in early 2028. Travel and transport of materials will use existing airline routes and facilities.

Knowledge sharing

We will share project plans, progress, and results throughout the study with local communities and relevant partners in Nunavut. We plan to visit CHARS at least once per year and engage through meetings, workshops, and field demonstration activities. Project findings will be shared through plain-language summaries, technical reports, presentations, and academic publications.

We are committed to timely communication and to sharing results in ways that are useful and accessible to Nunavut partners.