Science Societies

Can soil-based treatment systems be used for community wastewater treatment in the Arctic?

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Groundwater sampling campaign (October 2023). Dr. Rob Jamieson and PhD student Lindsay Johnston collect water from monitoring wells around the trench for analysis of

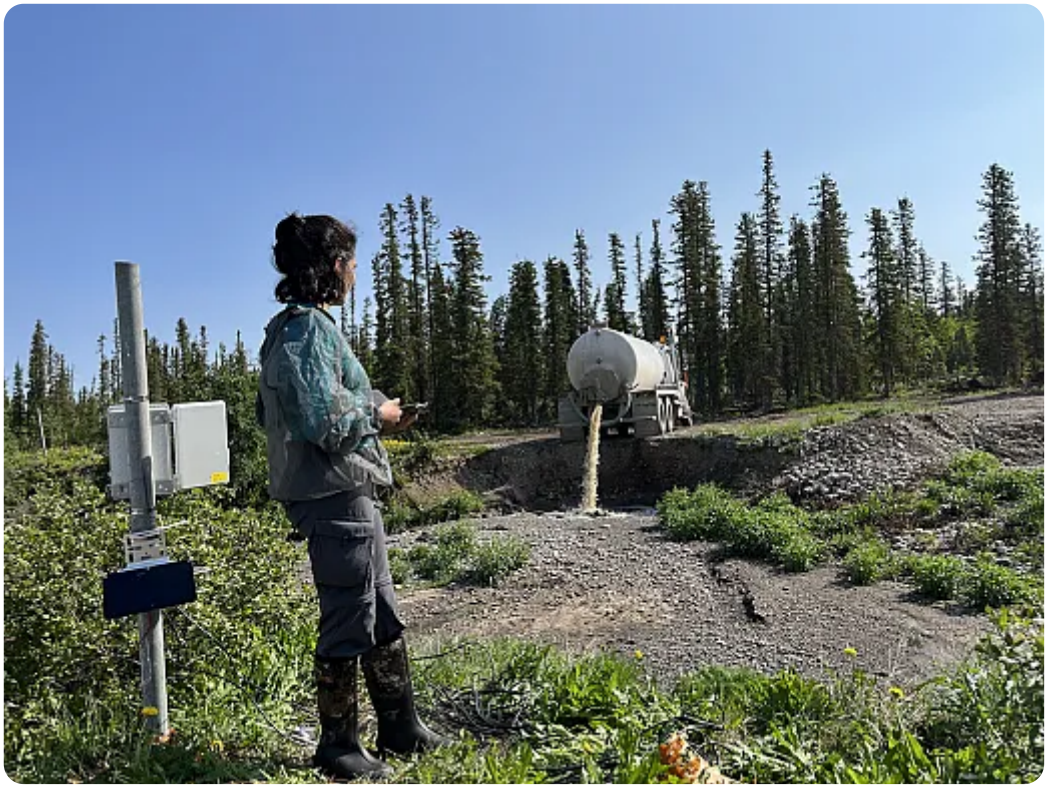
inorganics, nutrients, and microbiological parameters. Photo courtesy of Débora Boratto.

Wastewater treatment in the Arctic faces many challenges related to the remoteness of the communities, cold climate, permafrost, and scattered populations. These extreme conditions, combined with logistical and financial limitations, have also resulted in a critical lack of data regarding the performance of wastewater treatment systems currently used in many remote northern communities.

To address this knowledge gap, scientists from Dalhousie University collaborated with the Government of the Northwest Territories in Canada to investigate a rapid infiltration basin in Fort Good Hope, a community of around 600 people. There, domestic wastewater is collected by trucks, discharged directly into an infiltration trench, and percolates quickly through a permeable soil.

The research team conducted fieldwork and modelling investigations to evaluate the performance of the system. This included water sampling campaigns, analysis of soil microbial communities and continuous monitoring of soil moisture and temperature at multiple locations and depths in the vadose zone beneath the trench.

The study revealed that rapid infiltration basins can successfully treat wastewater in Arctic climates, provided key site conditions are met. The team found that freeze-thaw cycles and cold-adapted bacteria impact performance, highlighting that guidelines developed in non-arctic regions may not be transferrable and that tailored, region-specific design and operational strategies are required.



Wastewater truck discharges into an infiltration trench during the summer (June 2023). Master's student Débora Boratto collects readings from a solar-powered datalogger, which records data from five 90-cm-long soil moisture and temperature profiling probes installed inside and around the trench. Photo courtesy of Rob Jamieson.

Dig deeper

Boratto, D., Huang, Y., Johnston, L., Lake, C., Somers, L., Kurylyk, B., & Jamieson, R. C. (2026). Hydrological and microbial dynamics in an Arctic wastewater infiltration system. *Vadose Zone Journal, 25,* e70078. https://doi.org/10.1002/vzj2.70078

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