

Integrity of drilling waste sumps, Mackenzie Delta area, Northwest Territories

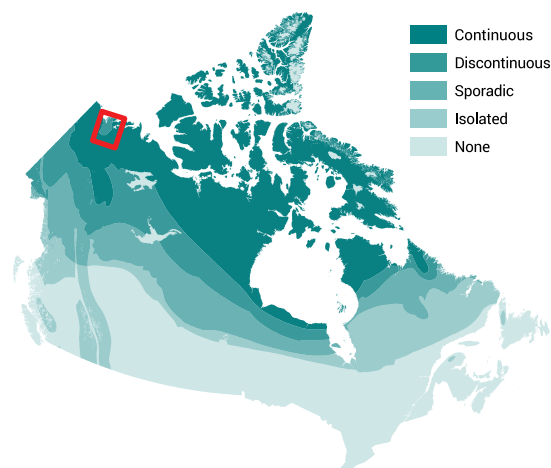
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Keywords: Sumps, drilling waste, Mackenzie Delta.



Study location: Mackenzie Delta.

This research advances our ability to assess contaminant migration from drilling waste sumps in permafrost regions, particularly in response to climate-induced permafrost degradation. This is essential for understanding environmental risks in the Arctic, where warming could exacerbate sump containment failures, leading to potential ecological impacts. The Inuvialuit Regional Corporation, industry and the territorial government may use the research to assist monitoring of sumps within the region and assess the risk they pose to the environment.

Research summary

In 1960–2005, over 220 sumps were constructed in Mackenzie Delta and adjacent uplands to contain used drilling muds within permafrost. Past records were compared with current field data at 12 sites to investigate the dispersion of contaminants around the sumps under a warming climate. Electromagnetic surveys by EM-31 determined ground conductivity on and off the sumps. The surveys were complimented by ICP-MS analysis of soil samples to determine concentrations of Na, Cl and K at the sites. Three sites, one in the uplands and two in the delta appeared to be holding the saline fluids in place; elsewhere there was little difference in conductivity on and off the sumps. The principal contributor to the performance of these sumps was age. The centres of younger sumps showed a distinct region of elevated conductivity, whereas the older features had similar conductivity on the sump and in surrounding ground.

Taking action

Next steps should focus on continuous monitoring of sumps. Techniques such as electrical resistivity tomography can provide vertical profiles of subsurface resistances, aiding in identifying zones of potential fluid migration. Additional sampling at depths of 2–5 meters around sump areas may calibrate the EM-31 signal to define the extent of contaminant

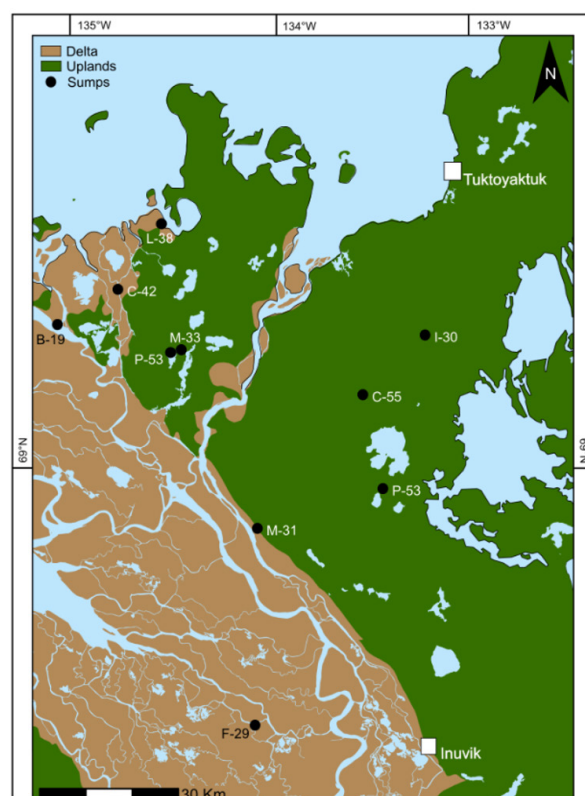


Figure 1. Study area including locations of sumps. Mallik L-38 site contains three delta sumps indicated.



Figure 2. The EM-31 in use at Taglu C-42.

spread. High-resolution drone surveys, including LiDAR, can be used to document surface changes, such as vegetation growth and cap subsidence. Collaboration with Inuvialuit agencies is essential to establish long-term site management strategies.

Corporation and the Government of the Northwest Territories. Field assistance from Kasandra Kuptana (IRC) and Jennifer Humphries (Aurora Research Institute) was crucial to the project's success.

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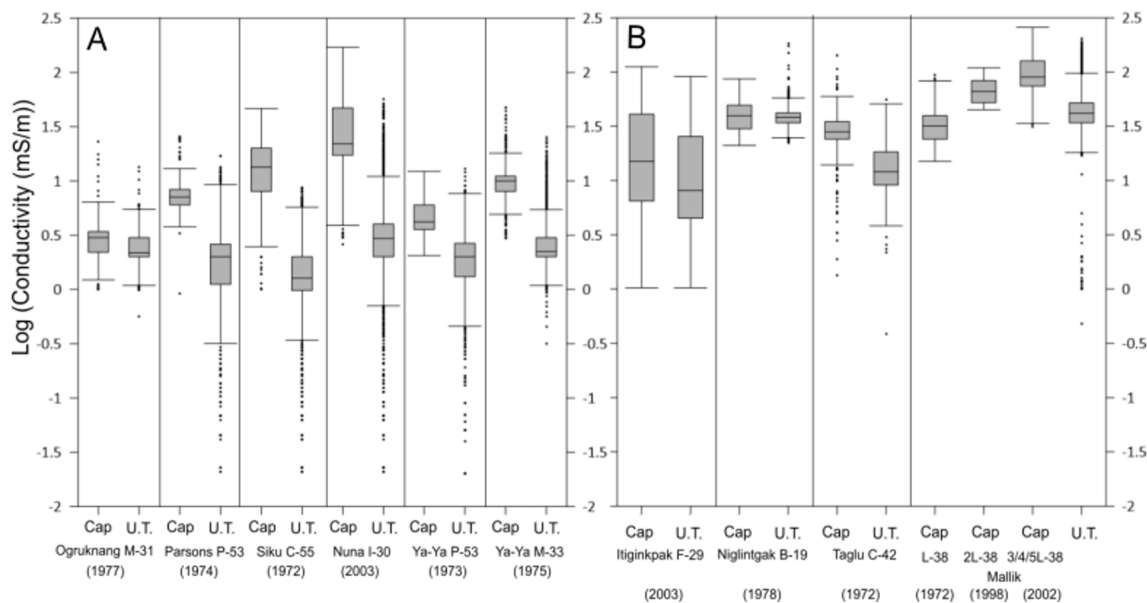


Figure 3. Distribution of ground electrical conductivity measurements with a log transformation applied to the data for the sump caps (cap) and undisturbed terrain (U.T.) in mS m⁻¹ at (A) Delta and (B) Upland sumps. Data collected in August 2022.

Connections to other projects

4 **5** This project is part of Theme 5 - *Adaptation to permafrost thaw* and relates to Theme 4 - *Hazards and impacts associated with permafrost thaw*.

Partners, team members and support

The research was enriched by the collaboration of dedicated partners and team members, including the Sumps Technical Working Group, the Inuvialuit Regional

References

Landriau, R., Burn, C.R., Ensom, T., and Klengenberg, C., (2024) 'Performance of five drilling waste sumps, Mackenzie Delta, western Arctic Canada', in Beddoe, R. and Karunaratne, K. (eds.) 12th International Conference on Permafrost Proceedings. 12th International Conference on Permafrost, 16-20 June 2024, Whitehorse, Yukon, Canada. Available at: <https://doi.org/10.52381/ICOP2024.146.1>

