Incorporating Climate Change Impacts to Contaminated Site Liability

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In many northern Canadian communities, landfill or dumpsites in small communities have not always been sited, designed or maintained to reduce potential risks of contamination to ground and surface water, the atmosphere or communities. For example, historical landfill sites are not lined, some are adjacent to water bodies or coasts while others contain waste products from unauthorized dumping and/or uncontrolled access. Many of the risks posed by these sites are expected to increase further under climate change.

Similar to other Arctic infrastructure, a typical assumption from the past was that permafrost and its mostly predictable active layer could be considered impermeable and suitable for waste containment as a barrier, dam or liner. But, with warming winter and summer temperatures, the depths of the active layer has grown thicker and ice within the permafrost has been thawing. As this warming continues or even accelerates under a changing climate, it is important to consider their potentially increasing risks to legacy contaminated sites. Some of the impacts from warming permafrost and a deeper active layer, combined with enhanced snowfall, snowmelt and rainfall events, include contamination from new and changed surface runoff patterns, increased risks for breaches in embankments or liners, if present, and potential loss of access to the site. Other impacts include changes in the seasonality of the rainfall and snowmelt, more extreme high temperatures, changes in ground refreezing and thawing cycles and new storm tracks, intensities and wind patterns, all influencing risks and approaches for remediation of contaminated sites.

In early 2021, Dillion Consulting Limited delivered a contaminated site risk framework for the Government of Nunavut that included a site survey guide and tools to help the Territory and its communities assess their current and changing risks for ongoing, legacy or potentially contaminated sites. The aim was to support the assessment of risks for these sites and to prioritize remediation efforts for the next 25 years or so. Community surveys, climate inputs, as well as the latest climate change professional analyses and mapping tools were incorporated into the package. The ongoing and future climate hazards included climate-related permafrost thaw as well as more abrupt permafrost degradation, precipitation changes important for stability and mobilization of contaminants along with coastal site risks from sea levels, storm surges and erosion implications.

While the climate change lens on contaminated site frame work was developed with permafrost in mind, the effects of climate change are similarly observed in our more southern communities - increased precipitation and changing landscapes. It is important to consider the impacts of these increased climate change risks to contaminated sites (infrastructure, and shifts to the conceptual site model) as well as new opportunities in decisions for contaminated (and waste storage) sites, and in decisions on the best options for future contaminated site management.

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Indra is a Partner at Dillon Consulting Limited, where she practices in the Winnipeg, Manitoba office as a hydrogeochemist. At Dillon, she has served in a range of roles including Account Manager, Technical Group Strategist, and Operations Team Manager, and she is currently a member of Dillon's Board of Directors.

She holds a Ph.D. in Civil Engineering from Queen's University, is a Professional Engineer (PEO), and a Chartered Chemist (ACPO). Prior to joining Dillon, Indra was a postdoctoral hydrogeochemist in the Department of Geology at the State University of New York (SUNY), University at Buffalo. Indra's professional and research interests are in the fate, transport, and remediation of hydrophobic organic contaminants (HOCs).

Indra's research has been published in the Journal of Contaminant Hydrology, Journal of Environmental Management, Science of the Total Environment, and Geosynthetics International. Her research has also been presented at the meetings of the American Geophysical Union, the Geological Society of America, and at specialist meetings on subsurface characterization, cold-region contamination and the remediation of chlorinated compounds.

Indra is also an Adjunct Professor in the University of Manitoba's Department of Civil Engineering, and has guest-lectured at SUNY-University at Buffalo and Queen's University on contaminant hydrology and PCB remediation.