

# NWT Environmental

## Research Bulletin (NERB)



### NWT Cumulative Impact Monitoring Program (NWT CIMP)

A source of environmental monitoring and research in the NWT. The program coordinates, conducts and funds the collection, analysis and reporting of information related to environmental conditions in the NWT.

### NWT Environmental Research Bulletin (NERB)

A series of brief plain language summaries of various environmental research findings in the Northwest Territories. If you're conducting environmental research in the NWT, consider sharing your information with northern residents in a bulletin. These research summaries are also of use to northern resource decision-makers.

## Ground temperatures and thermokarst in the North Slave Region

Air temperatures in northern Canada are rising at a rate of three to four times that of the global average. Ground temperatures in permafrost respond to changes in air temperatures on a seasonal and annual basis. Permafrost can also warm due to surface disturbances that alter soils, vegetation, drainage or snow cover. Impacts of a warming climate and disturbance can include thermokarst, which is settling of the ground surface caused by thawing of ice-rich permafrost. Consequently, permafrost thaw can have an effect on the natural environment and on the planning, construction and maintenance of infrastructure such as roads and buildings in the North.

### Why is this research important?

Permafrost in the North Slave Region is typically present within fine-grained soils that are ice-rich. Such permafrost can have a high sensitivity to warming and thawing, such as can occur following fire or construction activities. With nearly half of the population (>21,000 people) of the Northwest Territories residing in the area, knowledge of ground temperatures and thermokarst is highly relevant.

### What did we do?

Ground temperatures were monitored under a range of natural conditions to examine evidence of ground temperature warming and to assess the influence of various environmental factors on permafrost conditions. Air photo mapping, remote sensing and LiDAR (light detection and ranging) techniques have also been used to identify and map ice-rich terrain and thermokarst in the region.



Ground temperatures measured by Peter Morse at a range of natural sites indicating a warming trend close to surface. (Photo: S. Wolfe)

## What did we find?

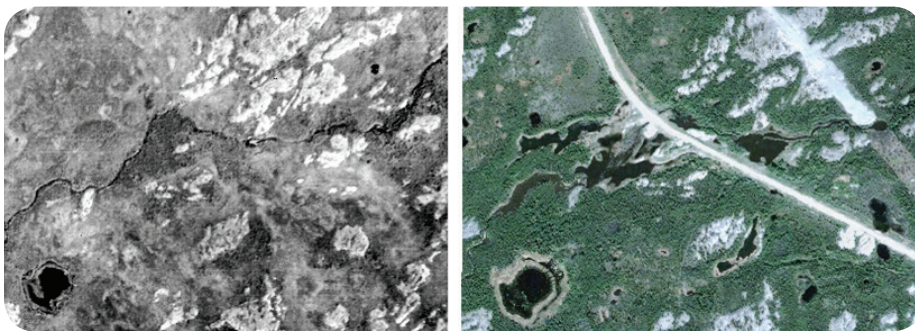
- Permafrost in this region is associated with forests located on fine-grained soils and underlies more than 60% of such areas.
- Ground temperatures are rising and permafrost is thawing in response to climate warming.
- Widespread thermokarst development has caused extensive pond formation and lake expansion.
- Thermokarst has also occurred due to removal of materials for development activities such as highway construction.

## What does this mean?

Permafrost is much more extensive in the North Slave Region than previously thought and this is highly relevant to northerners. Permafrost provides a foundation for terrestrial ecosystems and infrastructure. Its integrity is being weakened by increasing air temperatures and this climate change effect is worsened by disturbances such as highway construction and forest fires. As a result, thermokarst in this region has affected ecosystems through changes to drainage patterns and infrastructure through increased maintenance costs. The implications of changing permafrost conditions are critically important for future sustainable land use and development decisions that relate to economic and development activities and traditional land-use practices.

### What are permafrost and thermokarst?

Permafrost refers to ground that remains below 0°C throughout the year. Above the permafrost is an active layer that thaws each summer. The active layer can increase during warm summers or with disturbance. This may lead to the thaw of permafrost and to thermokarst in ice-rich areas. Thermokarst is settling of the ground surface caused by thawing of ice-rich permafrost.



Thermokarst development (a change from land to water) over a 60-year period, near Northwest Territories Highway 3. At some locations the water body is entirely new and at others the water body has increased in size.

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## References and citations

Morse, P.D., Wolfe, S.A., Kokelj, S.V., Gaanderse, A.J.R. 2015. The Occurrence and Thermal Disequilibrium State of Permafrost in Forest Ecotopes of the Great Slave Region, Northwest Territories, Canada. Permafrost and Periglacial Processes. DOI 10.1002/ppp.1858

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