

Permafrost, climate change and northern communities



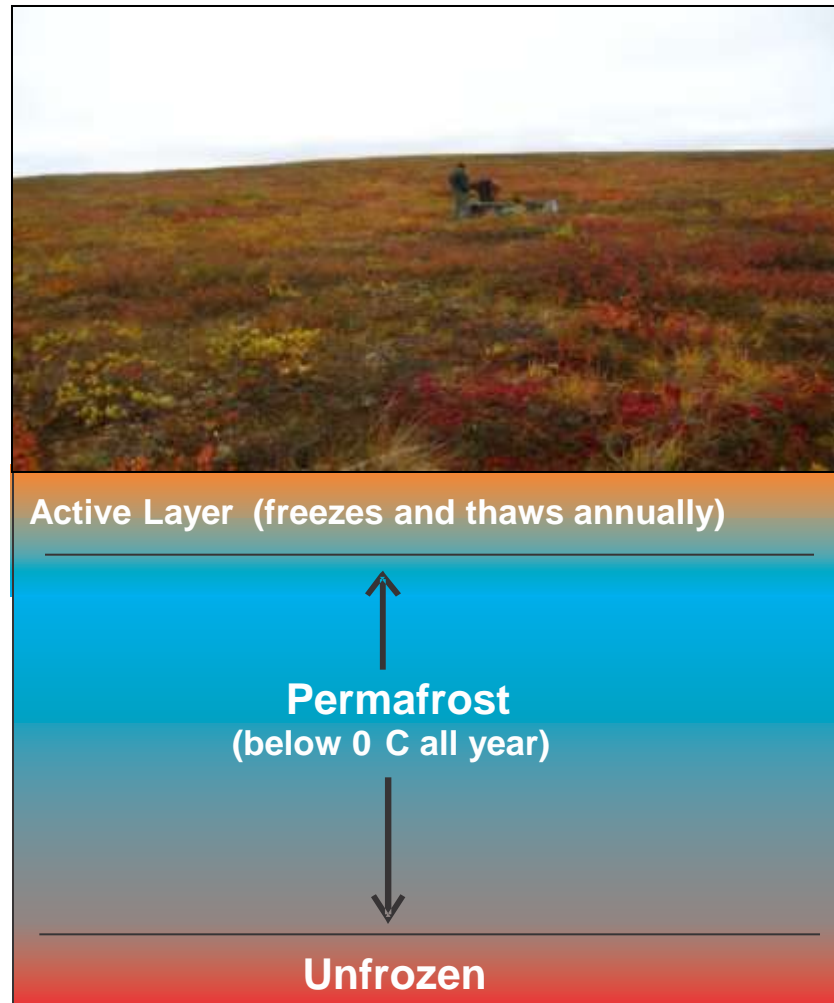
Steve Kokelj and Steve Wolfe
INAC & NRCan

Outline

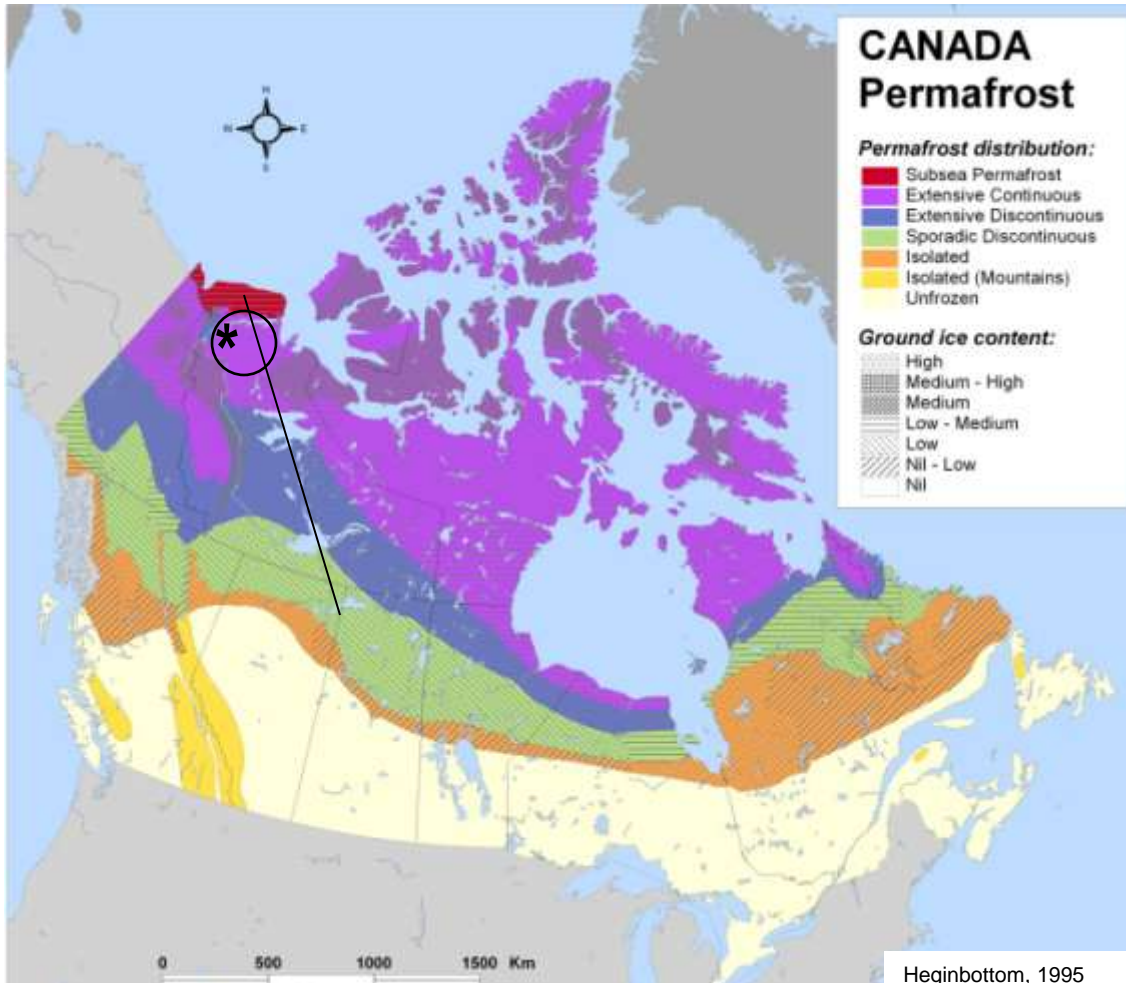
An aerial photograph of a tundra landscape. The terrain is a mix of green and brown, with numerous small, irregularly shaped blue ponds scattered throughout. The background shows a coastline with a blue sea and some rocky land.

- **What is permafrost ?**
- **Climate change and permafrost**
- **Landscape change**
- **Permafrost and communities**

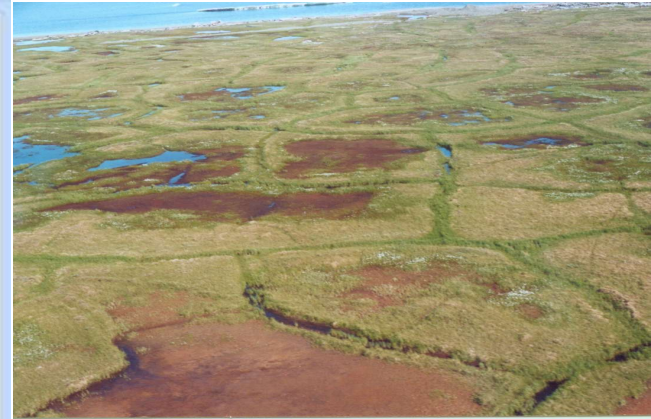
What is permafrost?



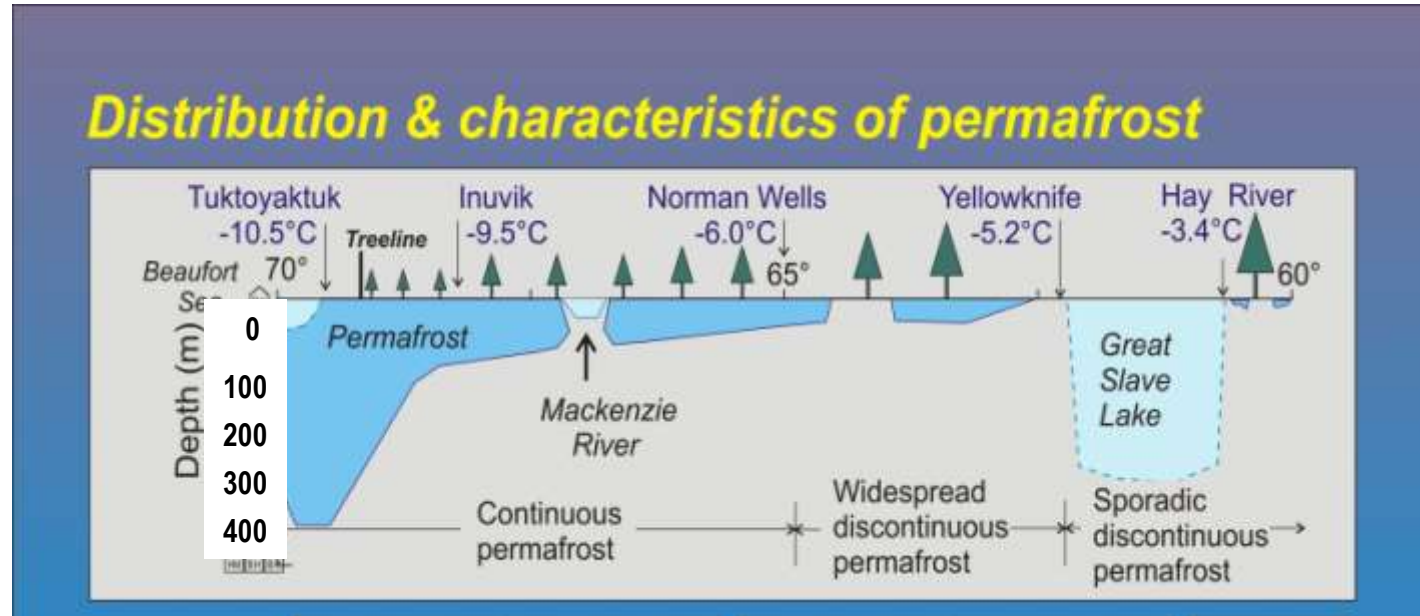
Permafrost distribution



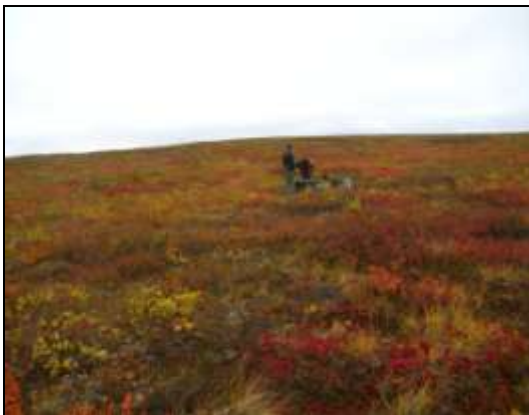
Heginbottom, 1995



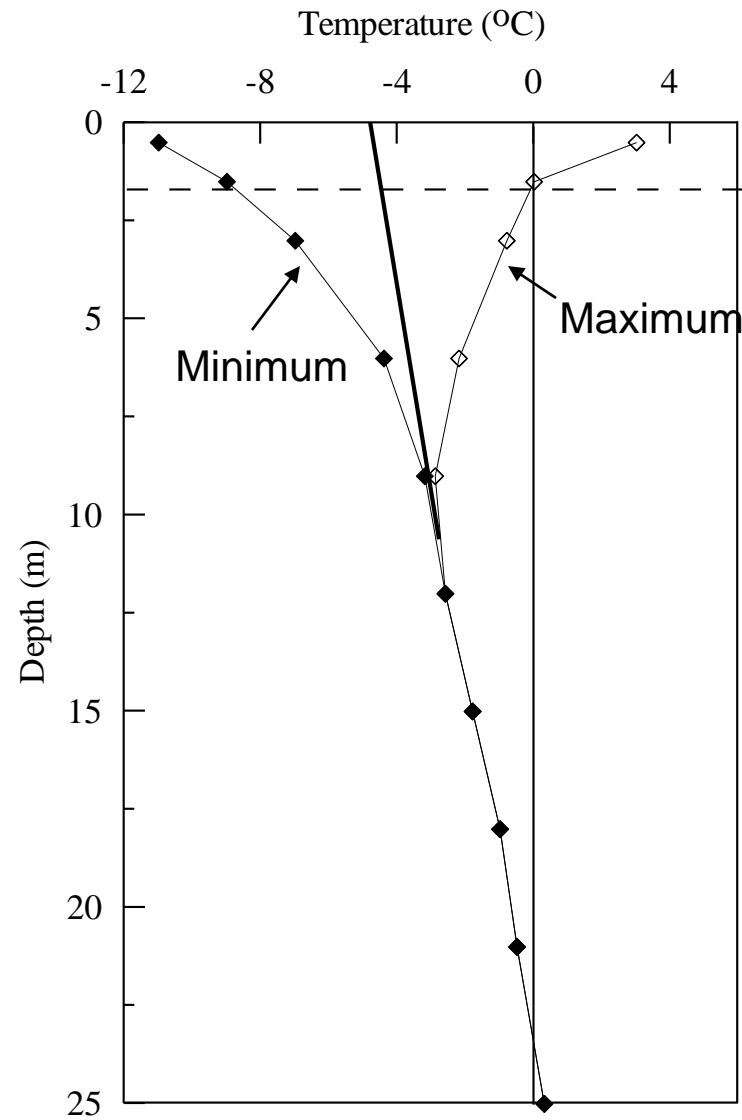
Permafrost thickness



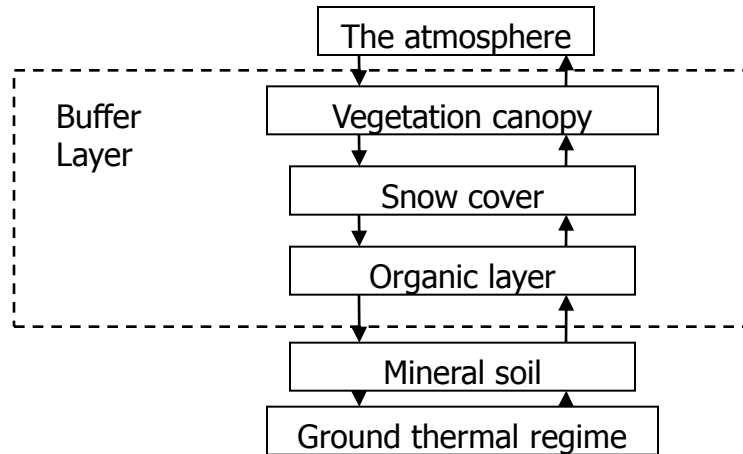
S. Wolfe, NRCan



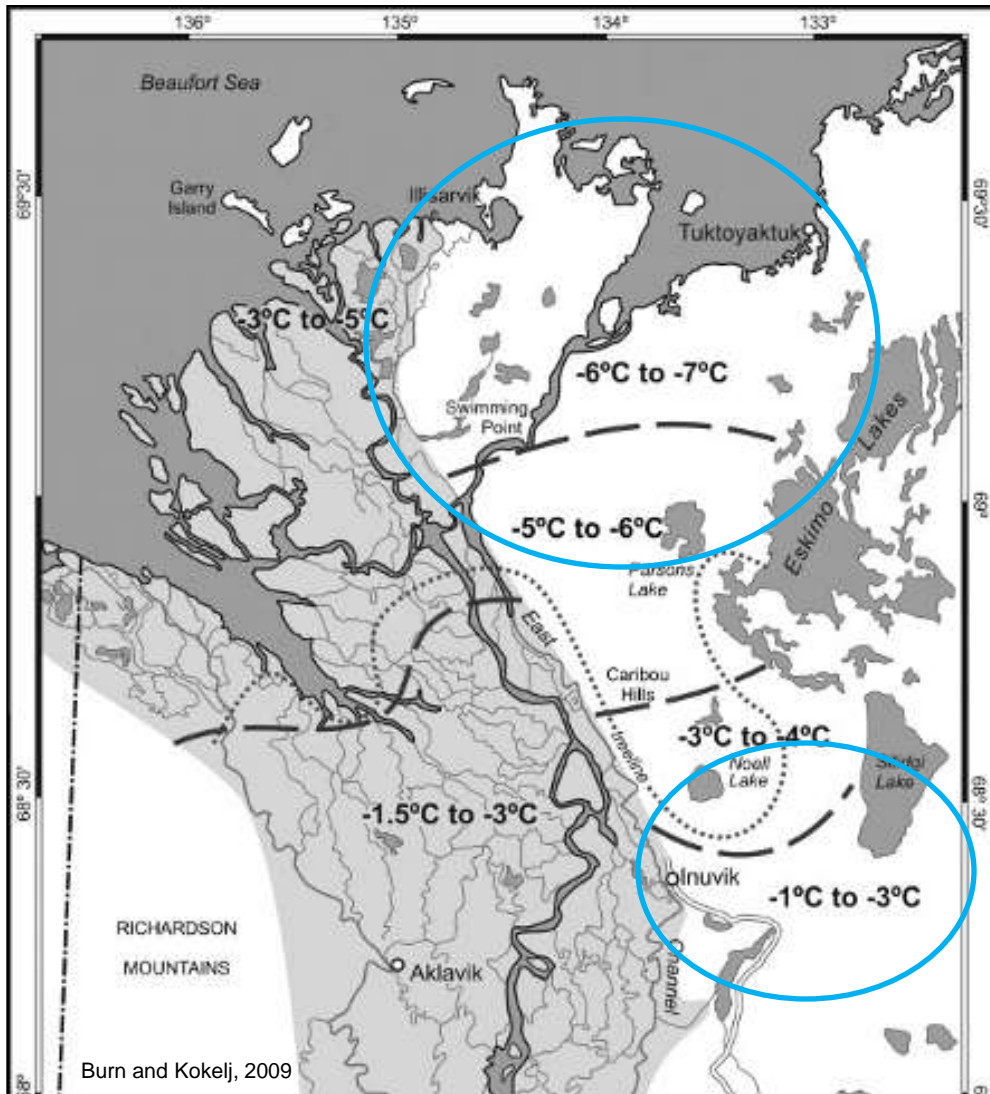
Ground temperatures in permafrost



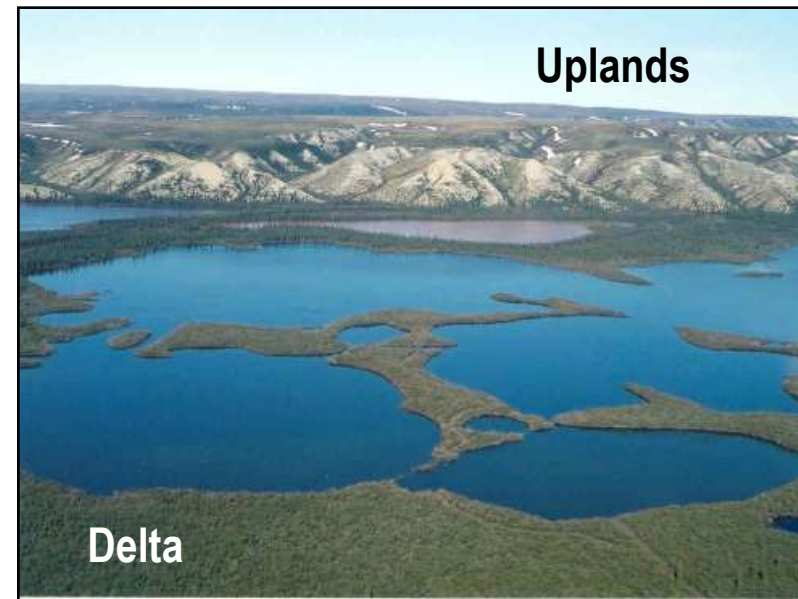
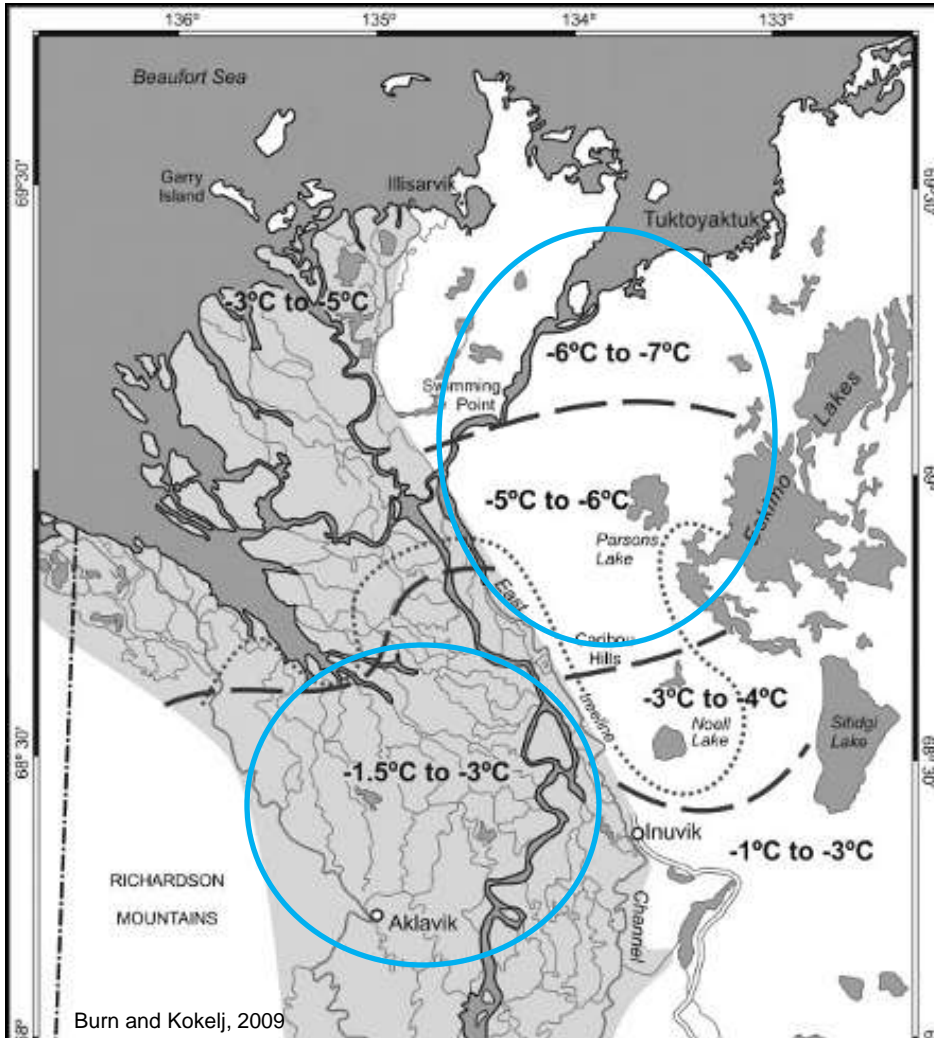
Buffer layer



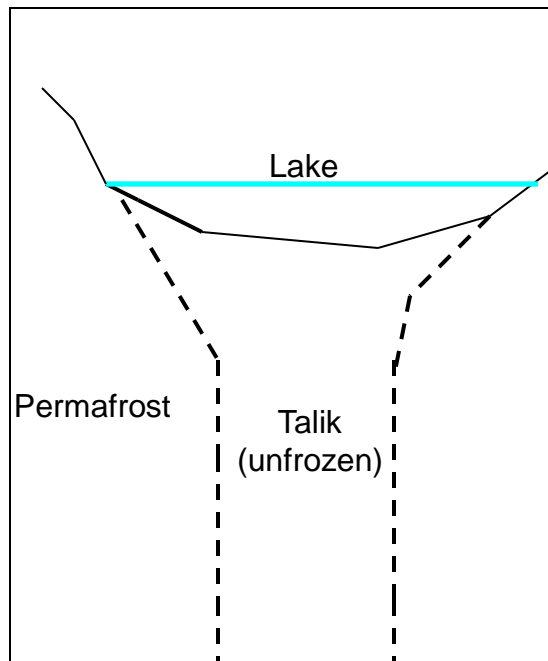
Temperature differences – Snow



Temperature differences – Water



The influence of water bodies

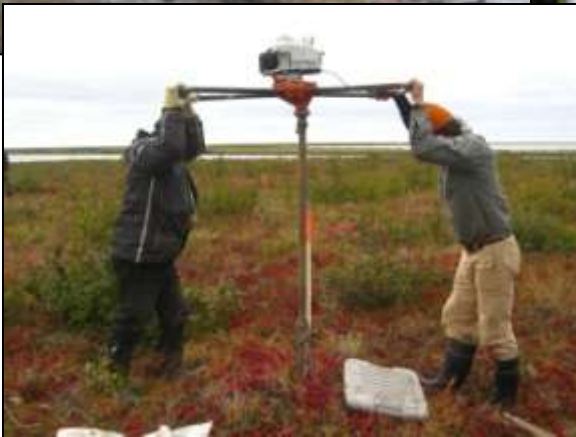


Differences in ground temperatures

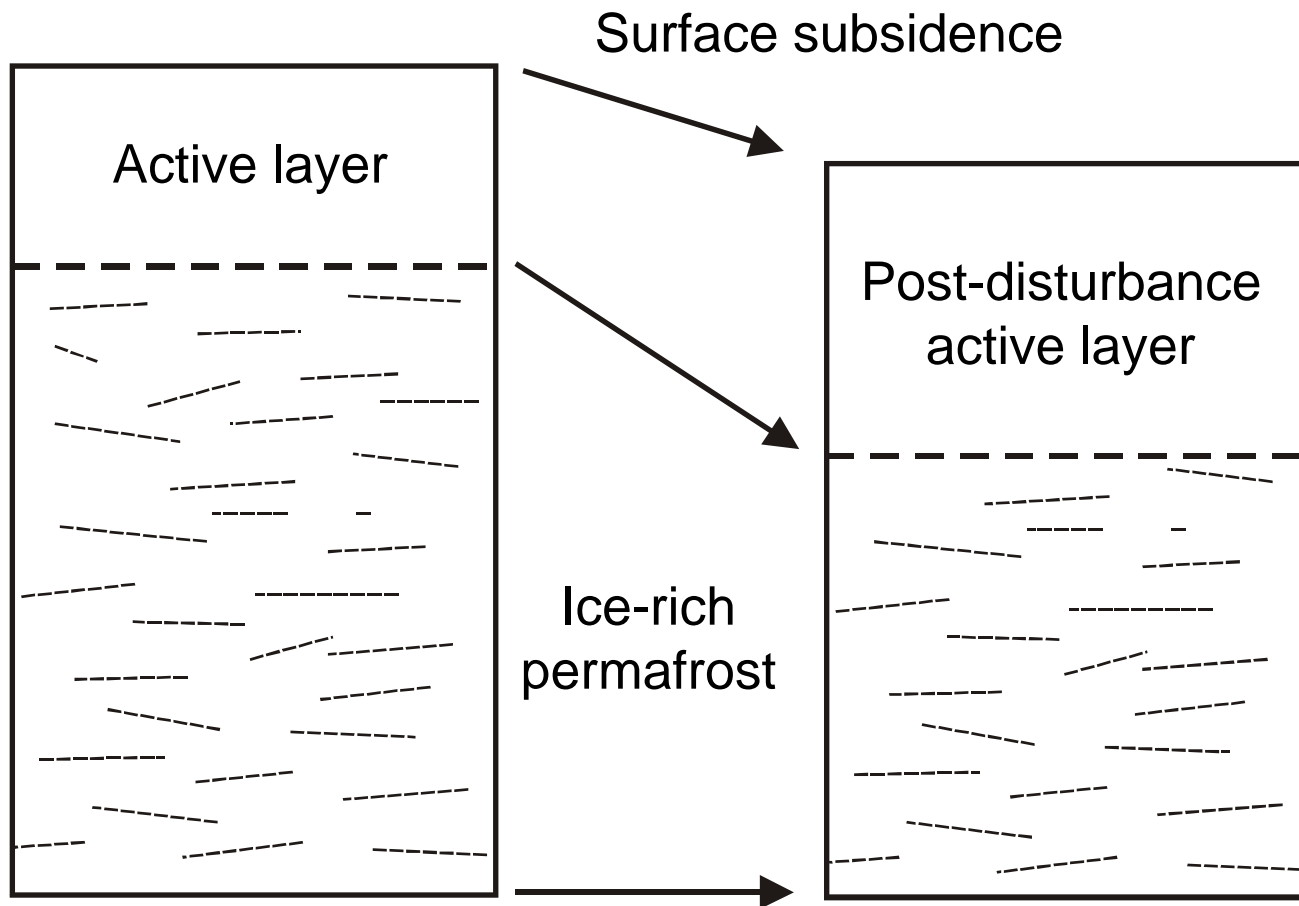
- Climate
- Vegetation
- Snow
- Soils
- Water and lakes
- *DISTURBANCE*



Ground ice



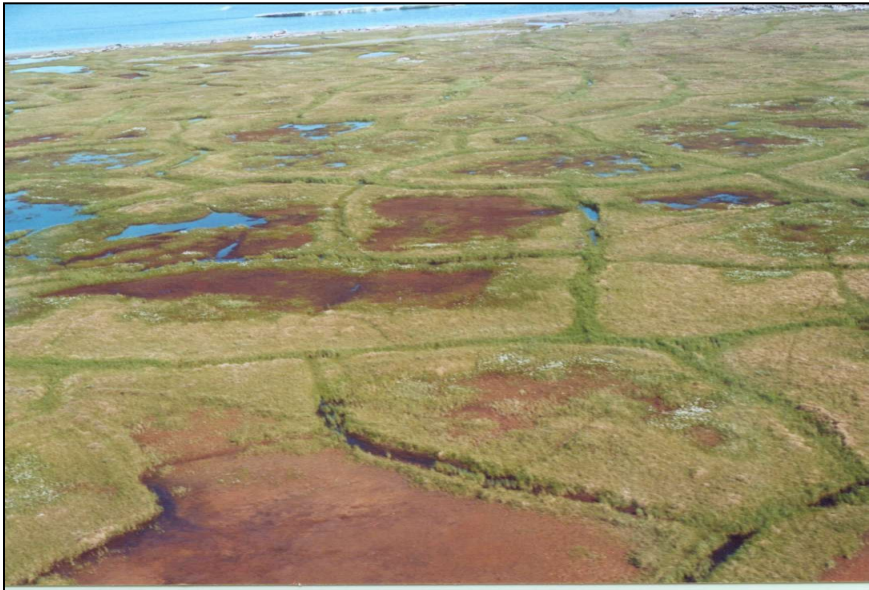
Active-layer deepening and surface subsidence



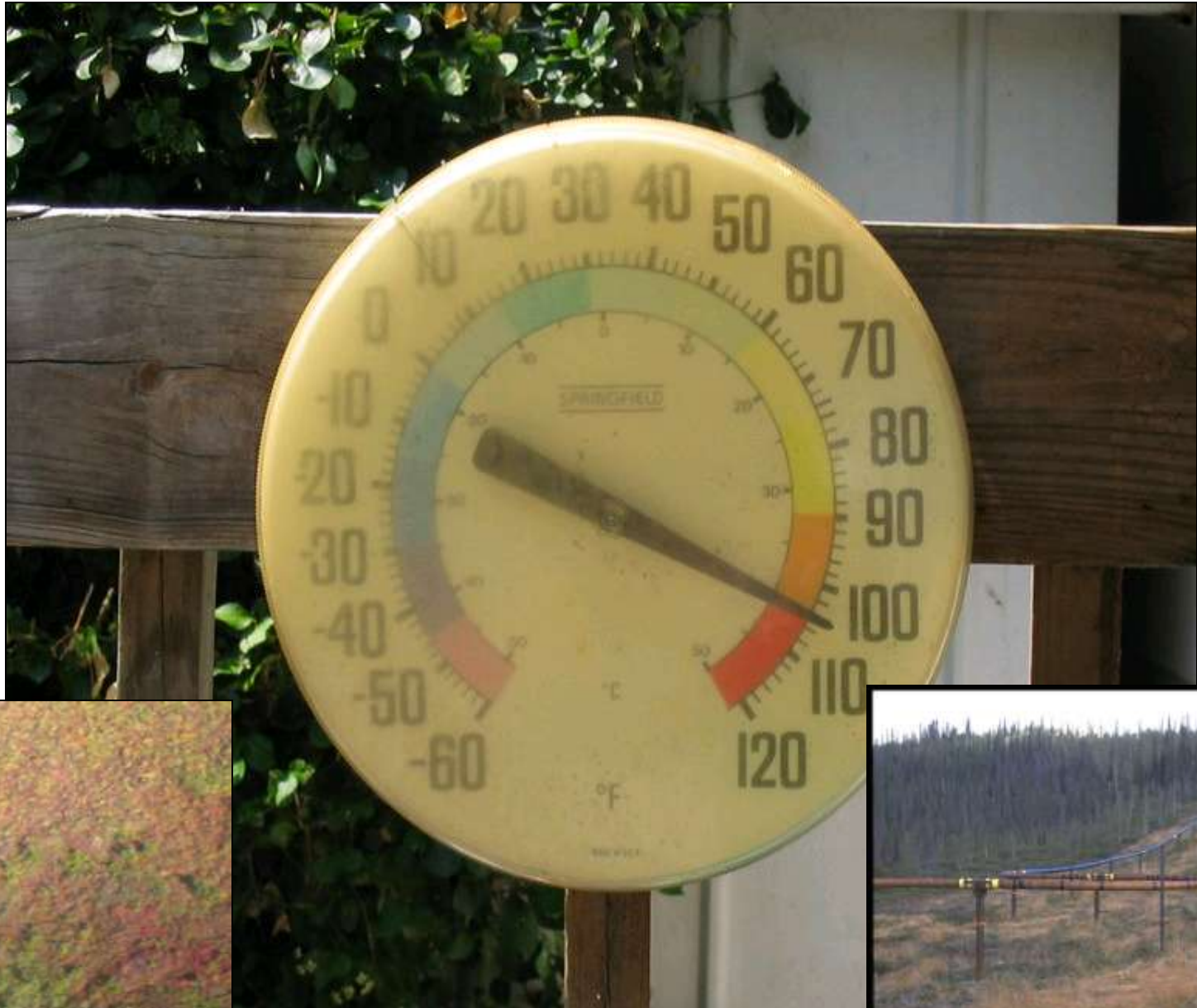
Recognizing thaw sensitive terrain



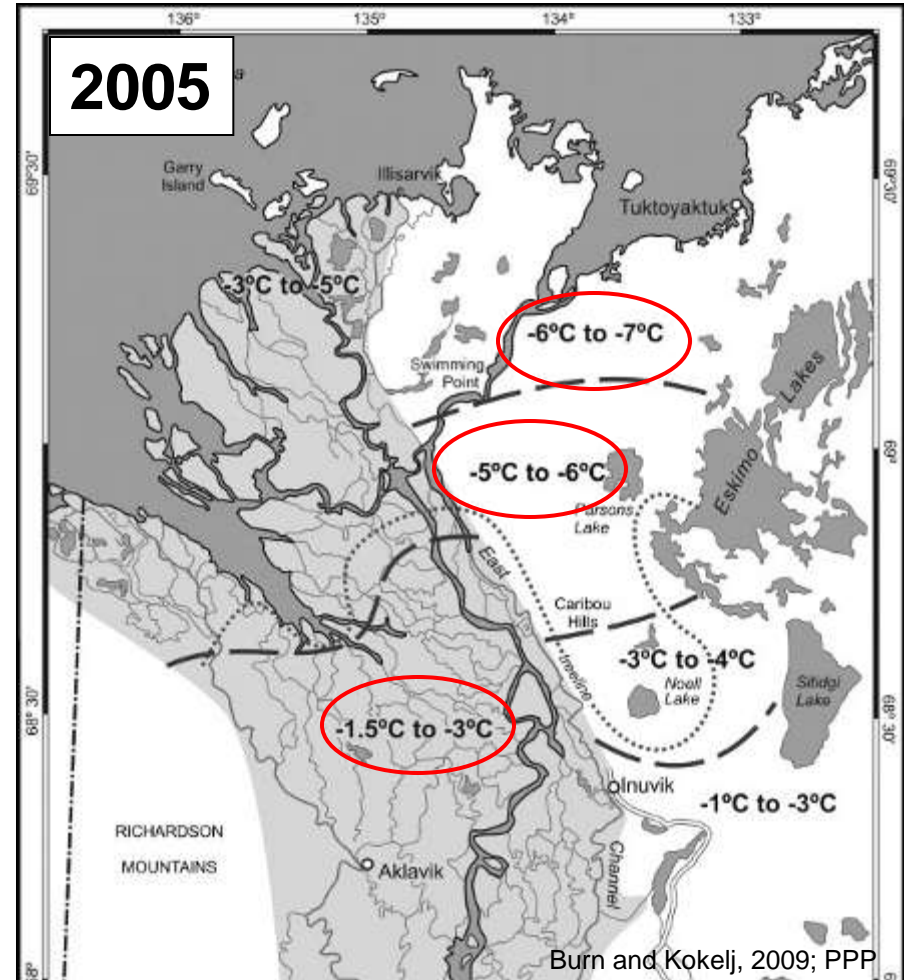
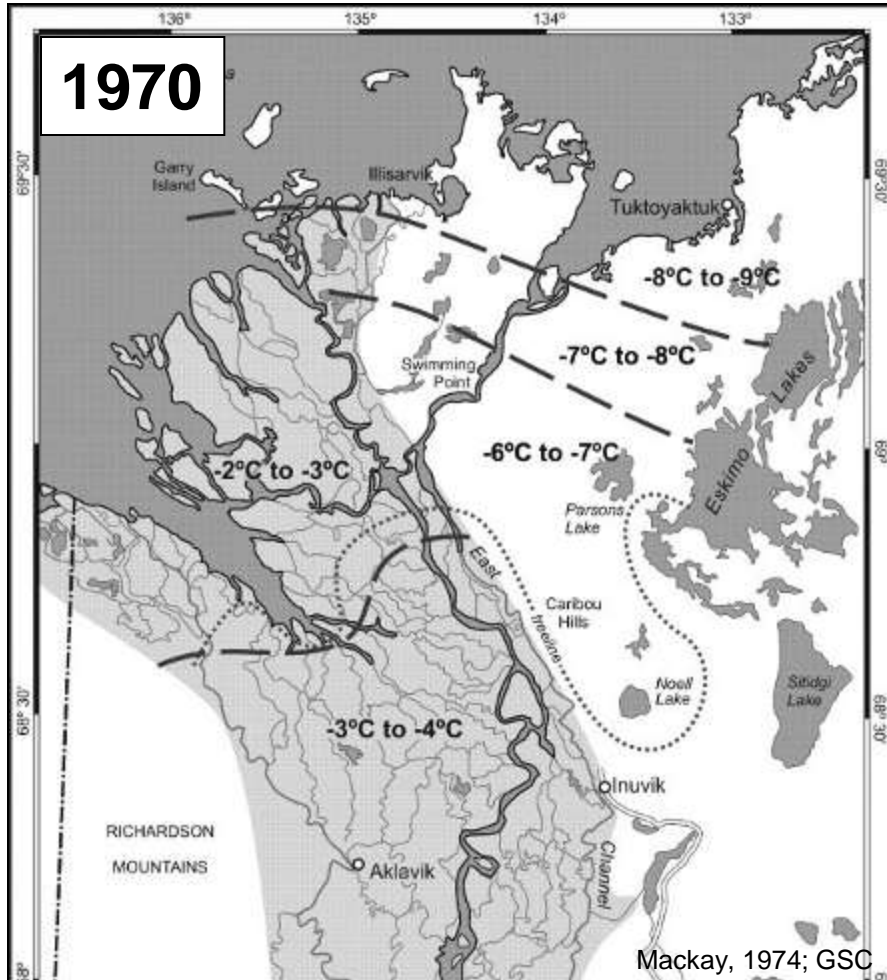
Recognizing thaw sensitive terrain



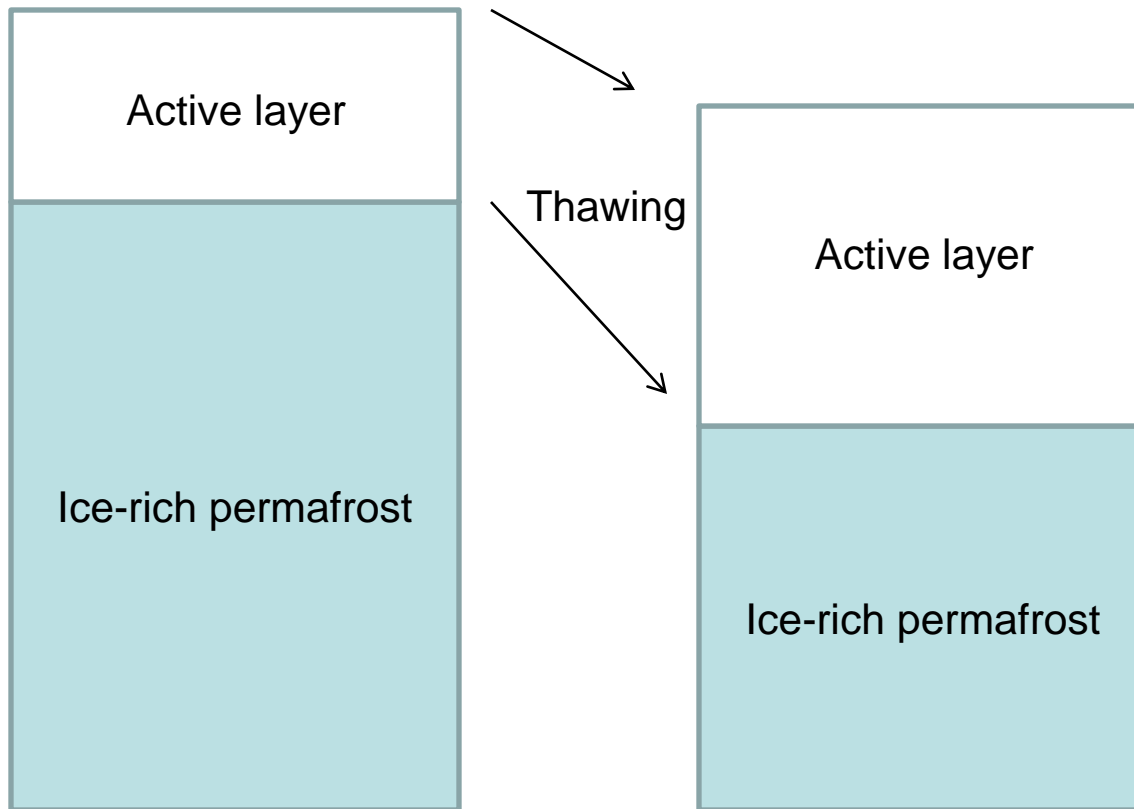
Climate warming and permafrost



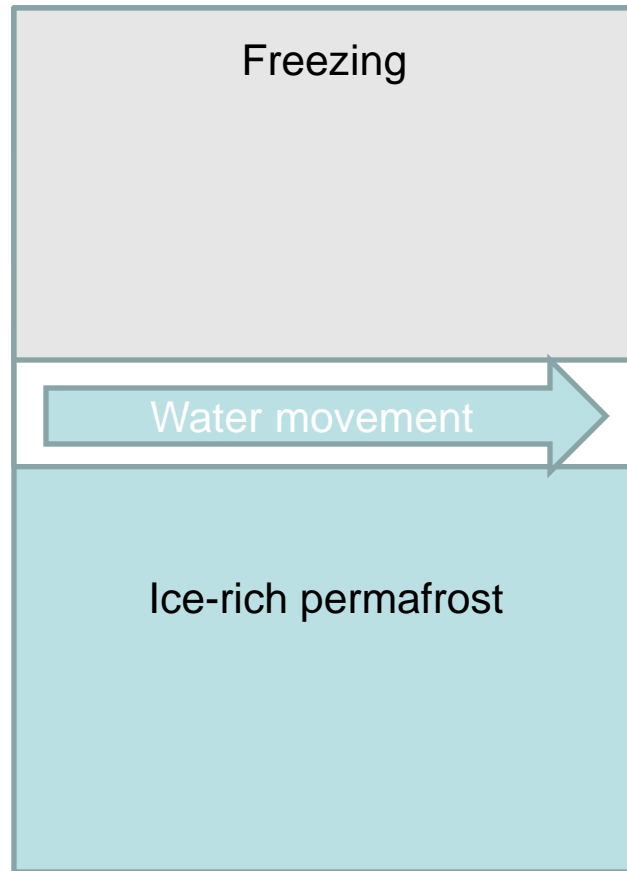
Climate warming and permafrost



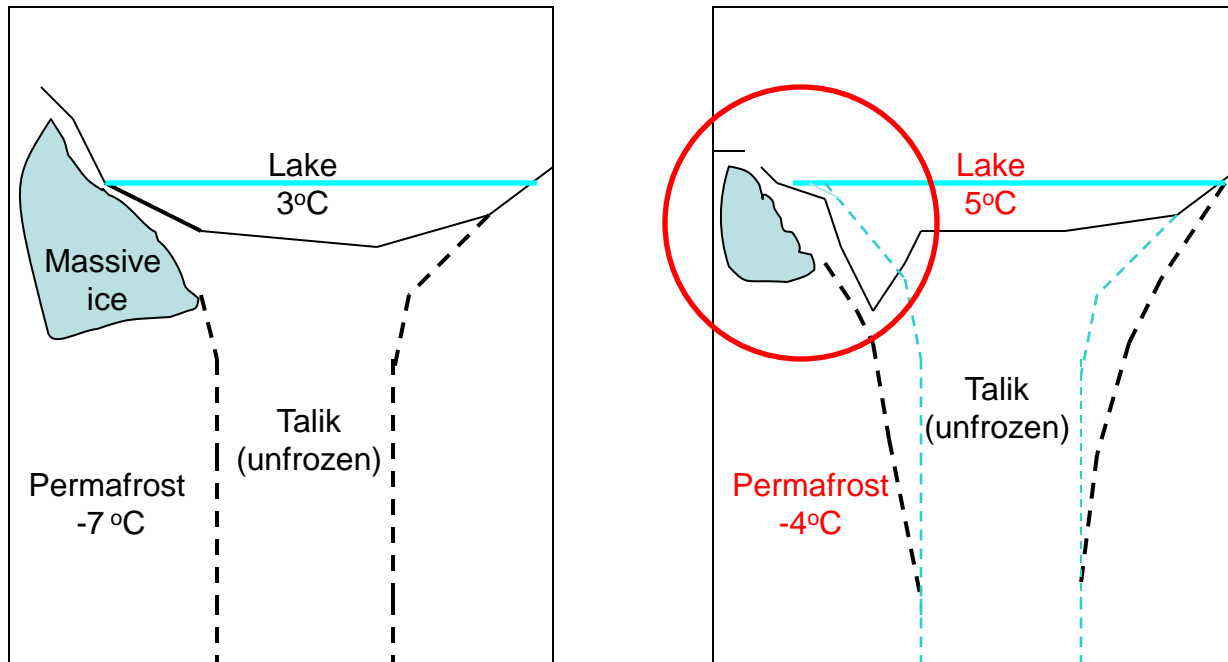
Active-layer deepening



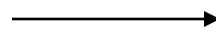
Active-layer freezeback



Shoreline instability due to warming

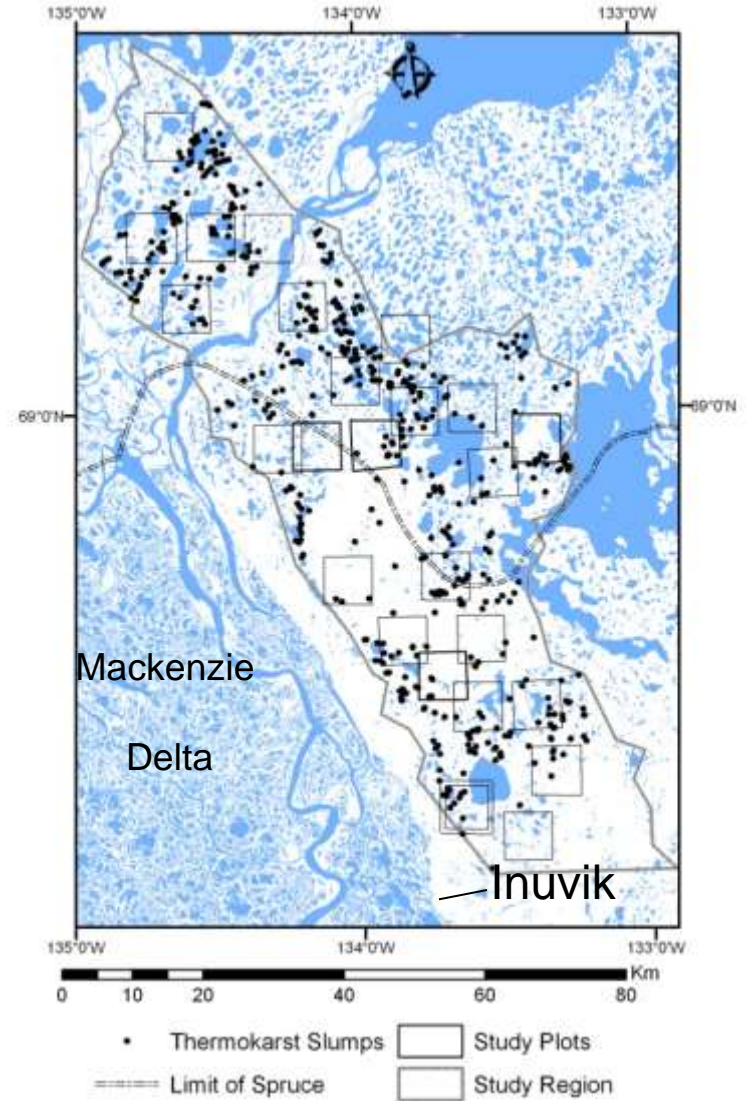


Cold permafrost



Warm permafrost

Retrogressive thaw slumps



Thermal influence of water bodies



Expect the unexpected - Mega slumps

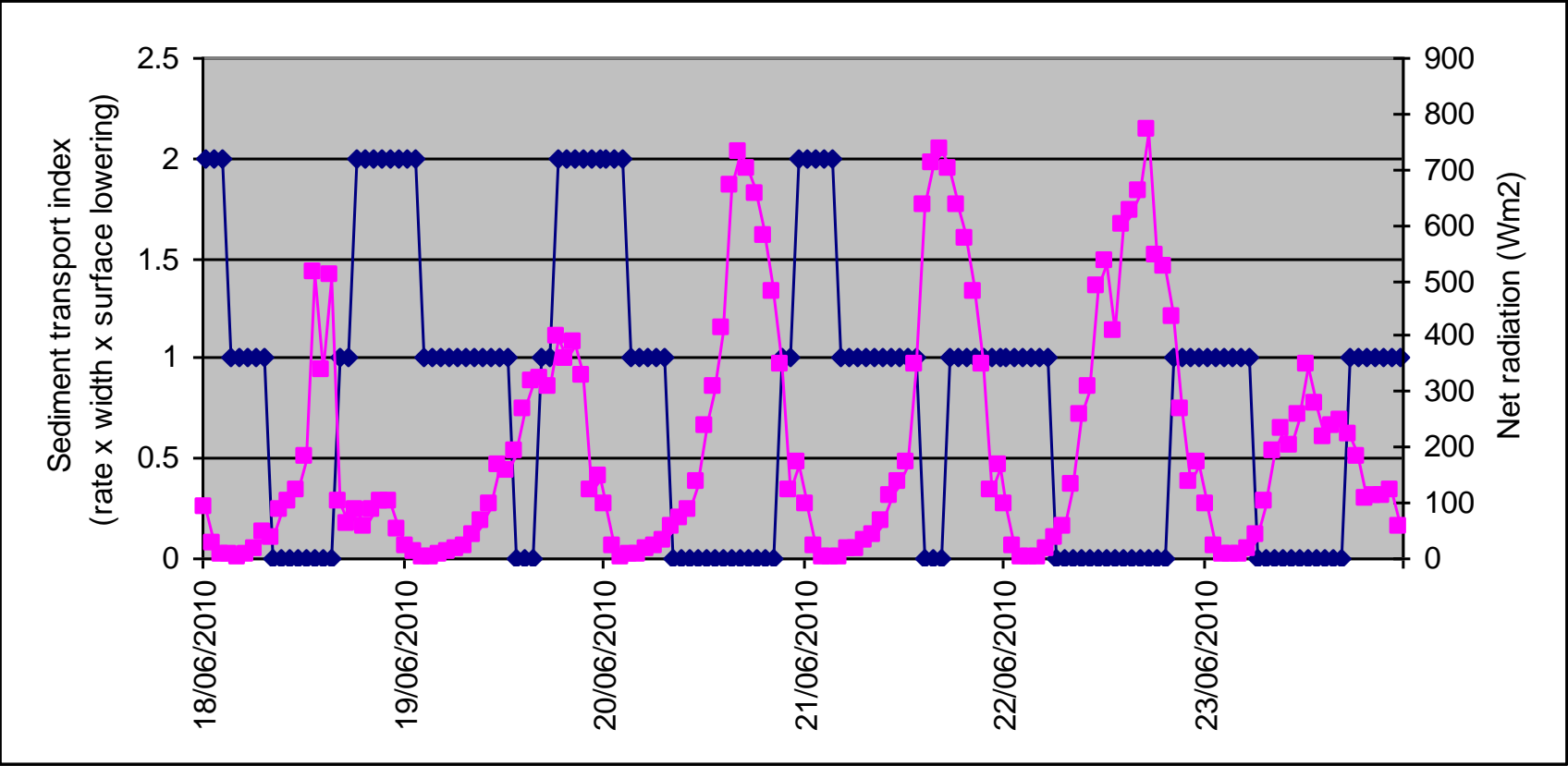




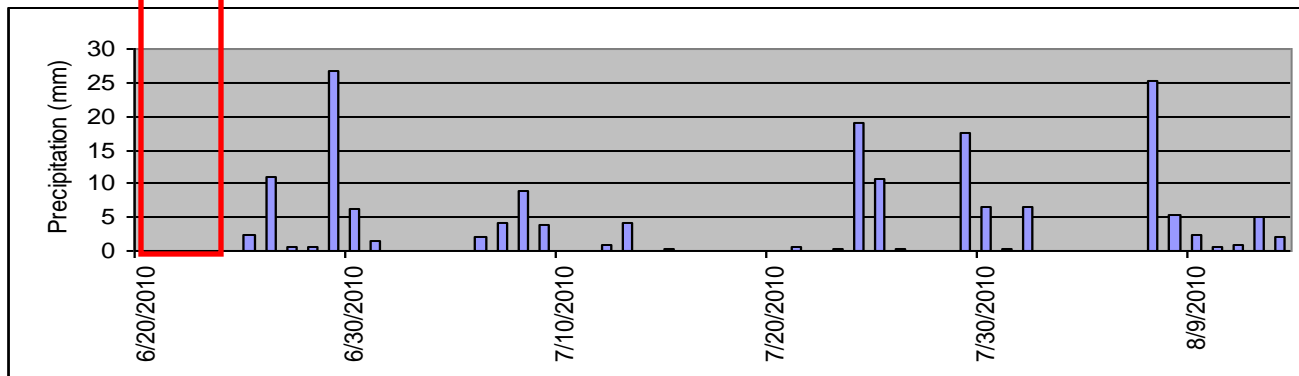
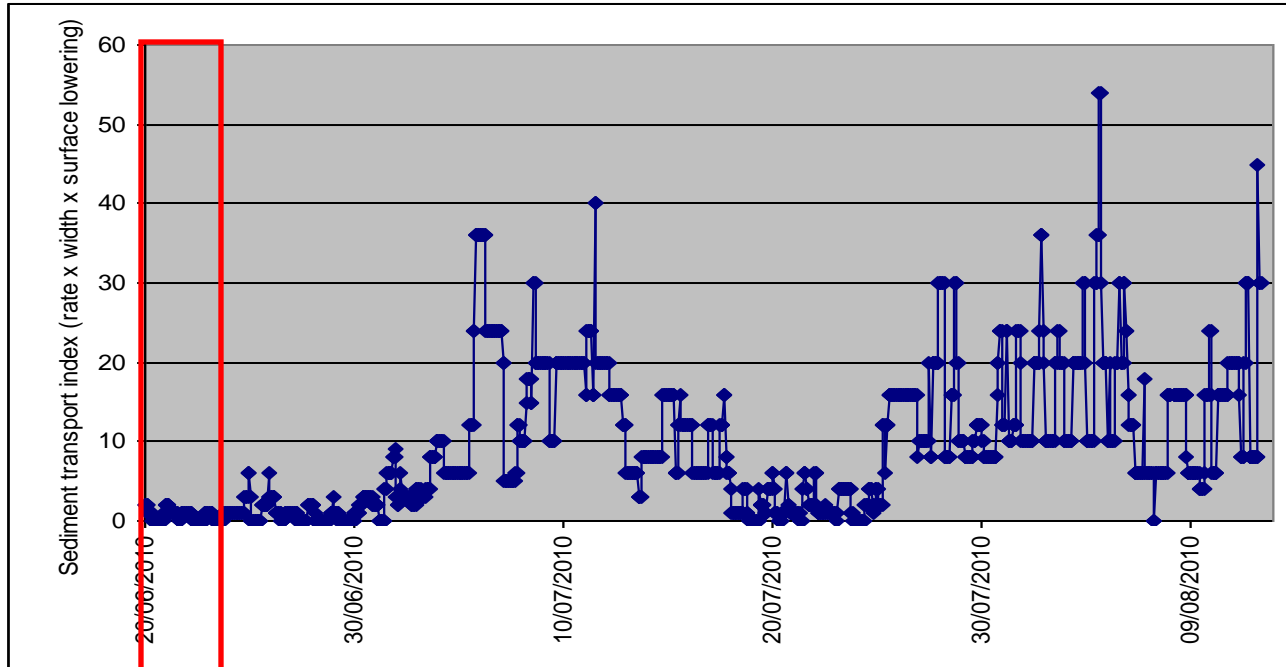
Fort McPherson

Peel River

Daily debris flow pulses - hot dry weather



Debris flow activity and rain



Infrastructure concerns



Permafrost and Environment

- Integral part of the north
- Impacted by:
 - Environmental change
 - Disturbance
 - Development
 - Climate change
- Anticipate the unanticipated
- Track change, develop the right knowledge
- Need informed decisions



Permafrost and communities

Permafrost is:

a temperature condition of the ground



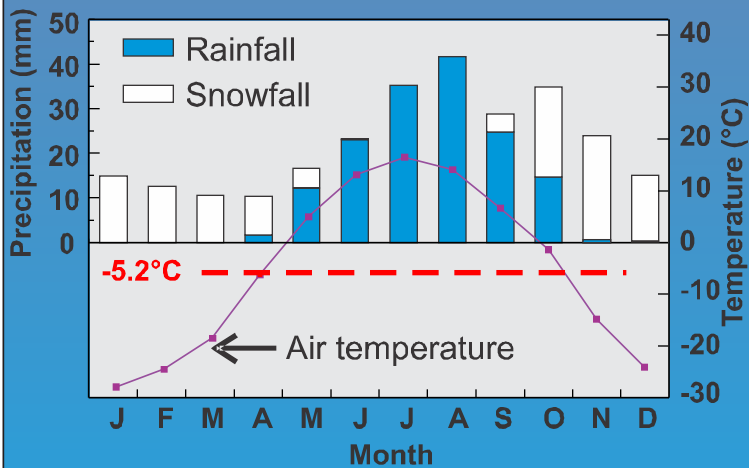
Active Layer (freezes and thaws annually)

↑
Permafrost
(below 0 C all year)

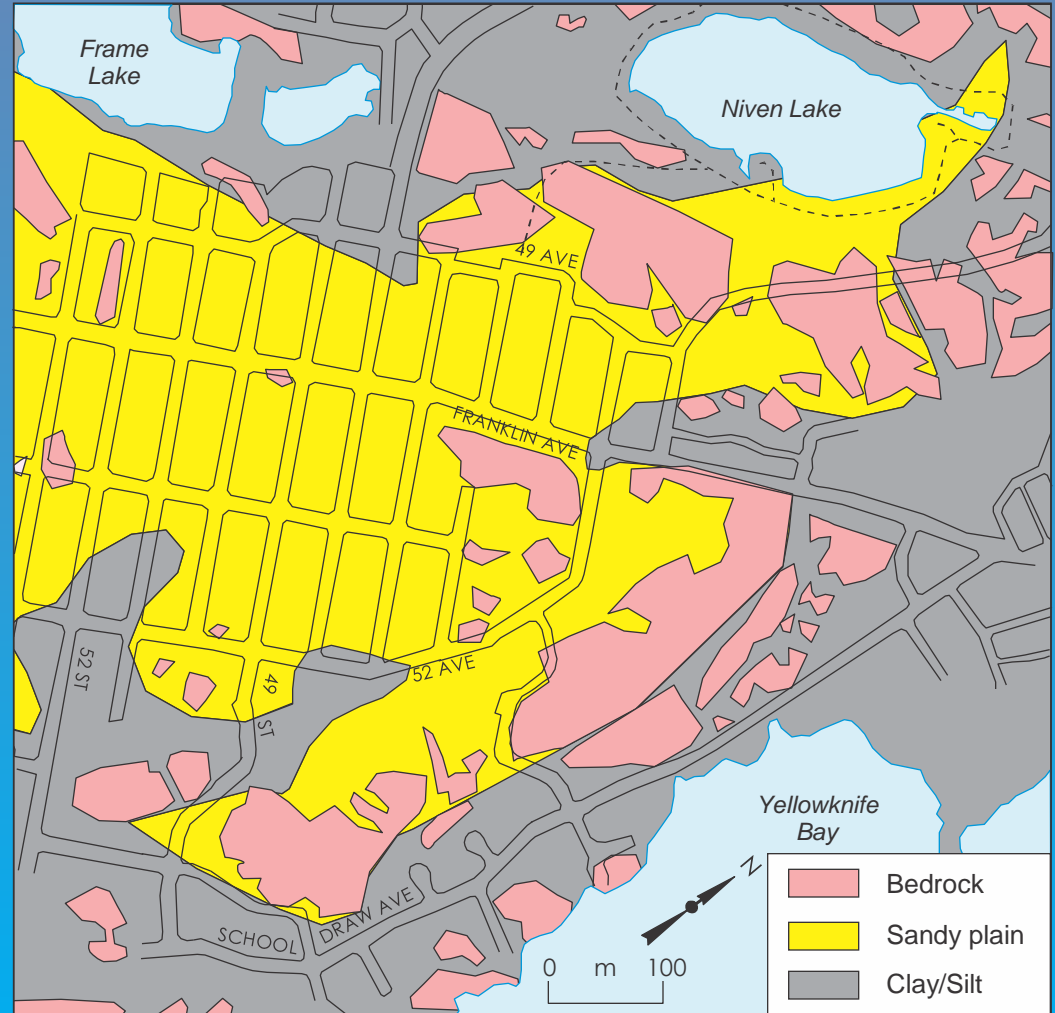
↓
Unfrozen

- defined by temperature
- soil or rock that remains below 0 C throughout the year
- potentially unstable material containing ice, that is sensitive to impacts caused by:
 - natural processes
 - human impacts
 - climate change

Permafrost is affected by: Climate and Vegetation



Geology and Surface Sediments

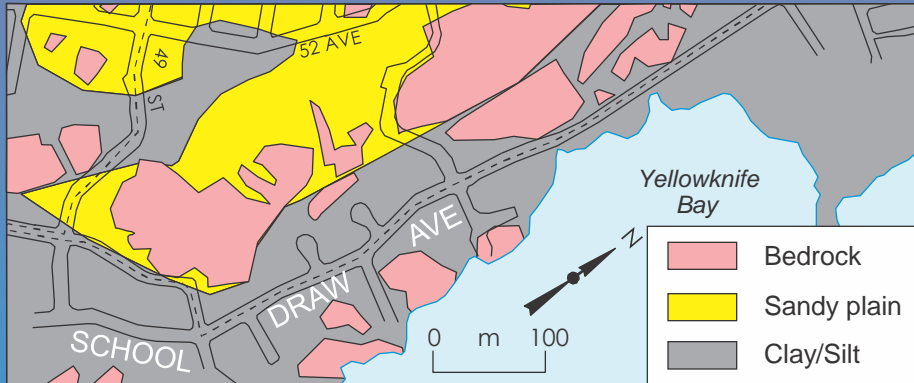


Thaw-Stable Ground ...

New Town August, 1949



... and Unstable Ground



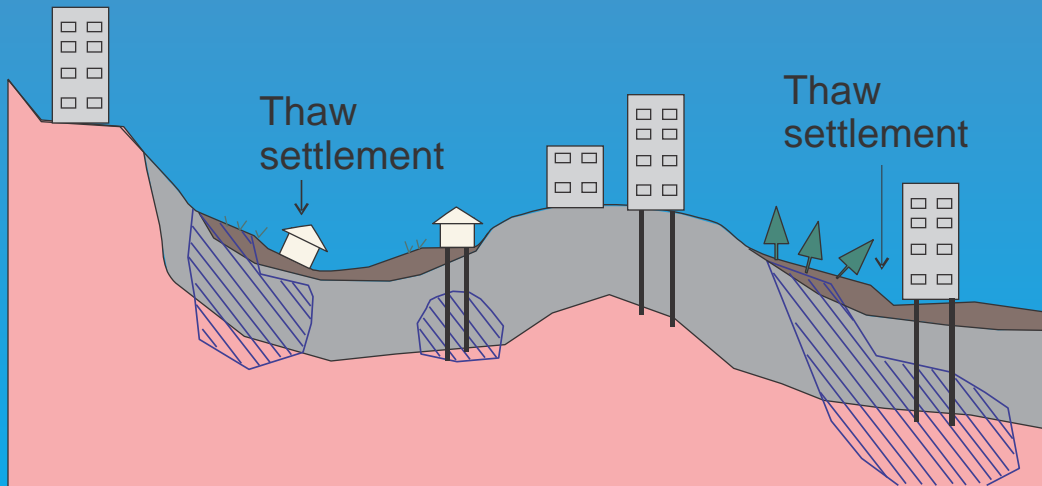
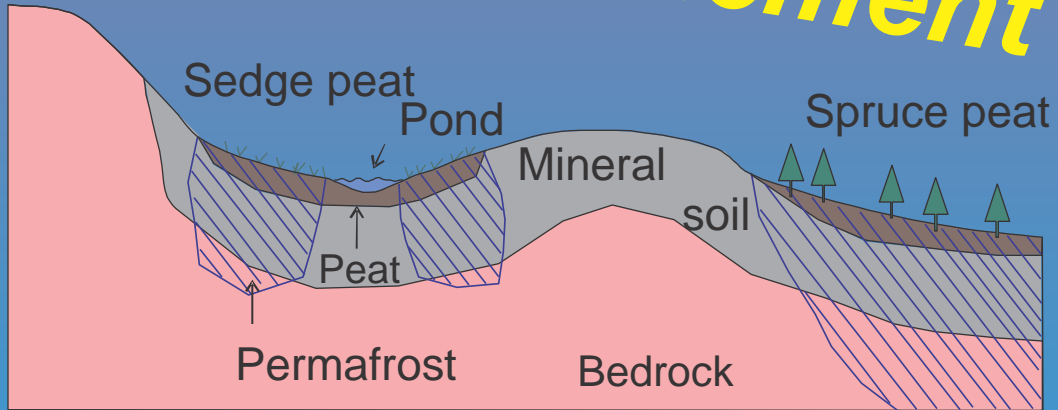
YELLOWKNIFE'S SCHOOL DRAW SUBDIVISION

FOUNDATIONS AND SOIL CONDITIONS

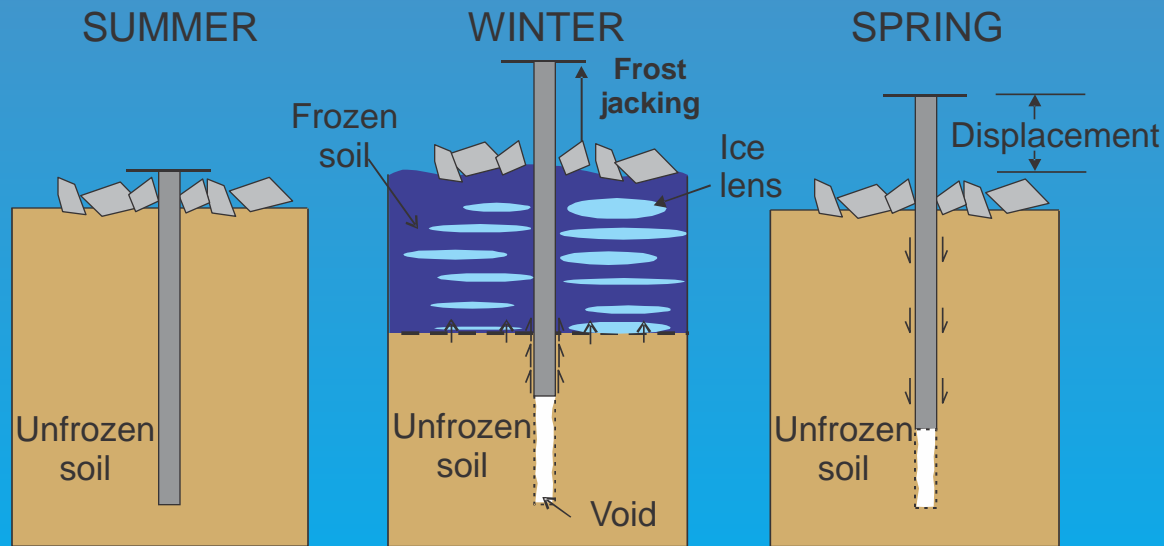
“Soil conditions throughout the subdivision are not, in all cases, suitable to the use of conventional foundation systems. The purchaser should bear this in mind when investigating and selecting his lot.”



and thaw settlement



Northern buildings



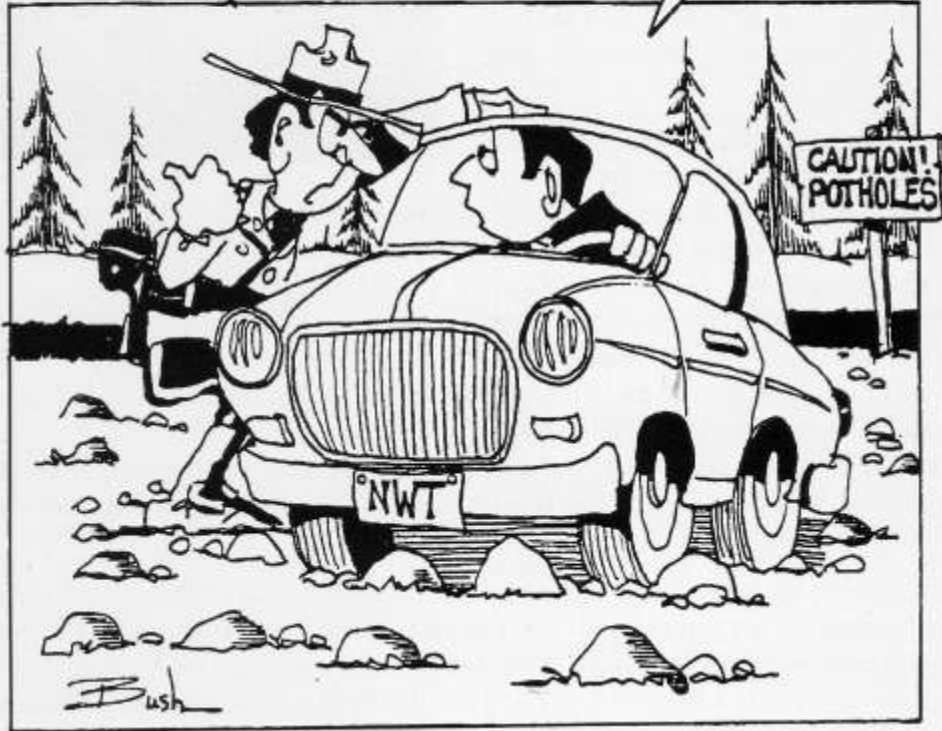
Northern utilities



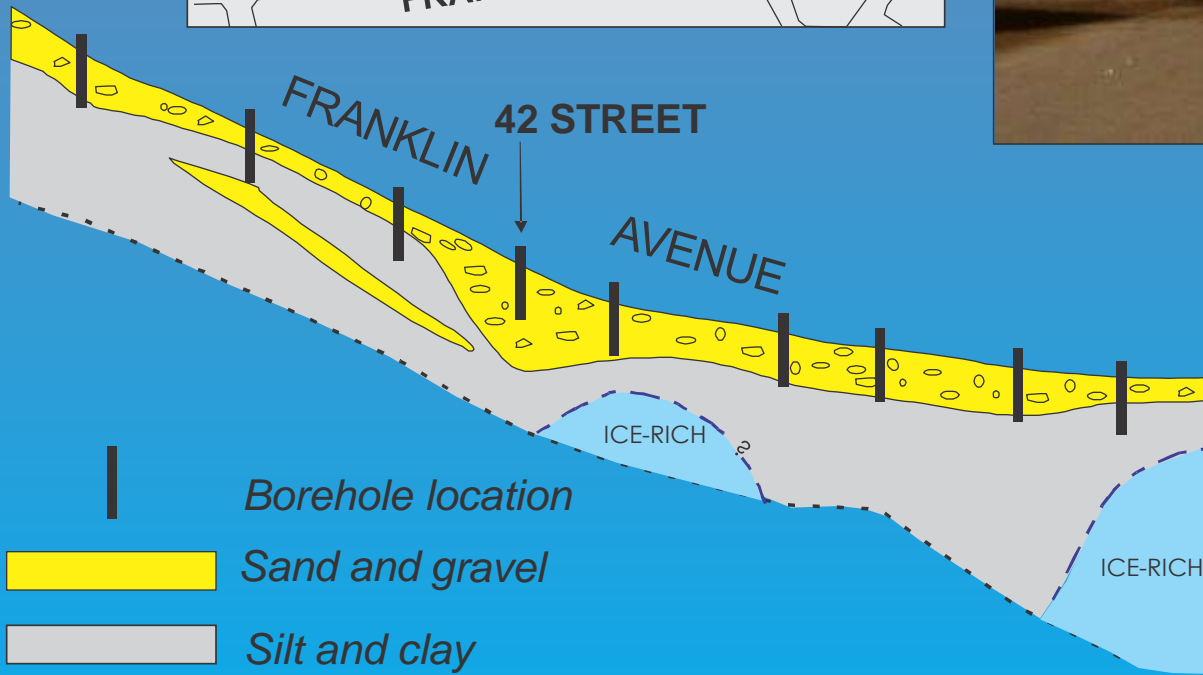
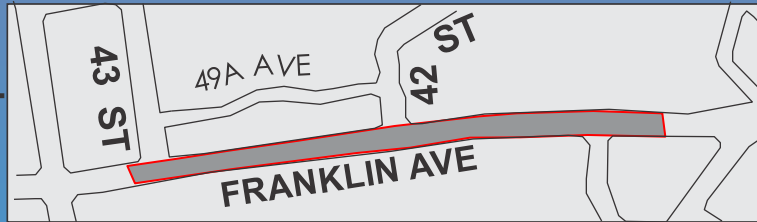
Northern roads





ANY PARTICULAR REASON YOU'RE DRIVING IN THE DITCH INSTEAD OF ON THE ROAD?

FEWER BUMPS.



Northern Roads



-  Borehole location
-  Sand and gravel
-  Silt and clay
-  Ice-rich clay



Permafrost and communities

