



CLIMATE IMPACTS ON PERMAFROST AND INFRASTRUCTURE DEVELOPMENT

2019 Arctic Development Expo:

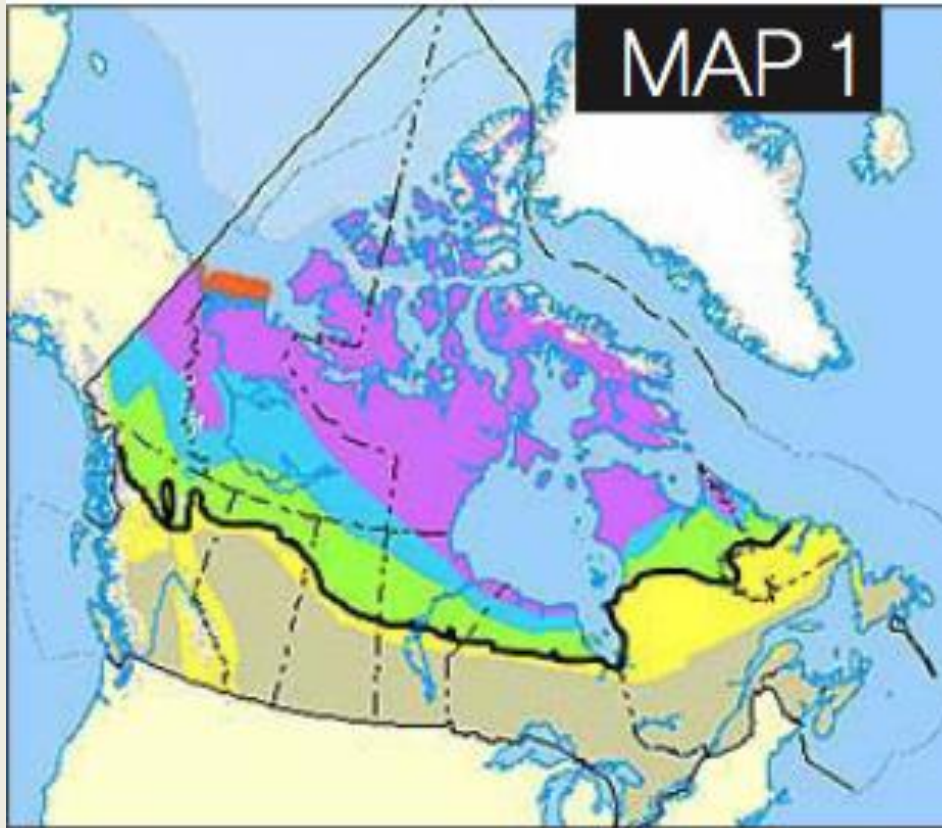
Energy Innovation and Climate










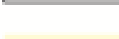
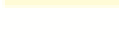
Session 2: Innovation in Action – Energy and Infrastructure

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MELTING PERMAFROST AND SITE CONDITIONS

- **The North is warming 3 times faster than the rest of the planet according to Canada's Changing Climate Report - <https://changingclimate.ca/CCCR2019/> (Commissioned by Environment and Climate Change Canada).**
- **The permafrost areas cover the entire Boreal Region of Canada as well as the Arctic tundra.**
- **Please be aware that the 1995 map by Natural Resources Canada map referenced in the paper is now out of date, in the sense that the boundaries of the continuous and discontinuous permafrost are moving north at an alarming rate, sometimes at tens of kilometers per decade because of climate warming and melting permafrost.**



-  No Permafrost
-  Subsea Permafrost
-  Isolated Patches (0 – 10%)
-  Sporadic Discontinuous (10 – 50%)
-  Extensive Discontinuous (50 – 90%)
-  Continuous (90 – 100%)
-  Water Area
-  Polar Ice Area
-  Glaciers
-  Regions outside Canada
-  Line of Discontinuous Permafrost

Permafrost in Canada

MELTING PERMAFROST AND SITE CONDITIONS



Thaw Settlement Under Buildings, Dawson City, YT

MELTING PERMAFROST AND SITE CONDITIONS



Roadway shoulder slumping and cracking due to permafrost degradation. This Yukon experience has also happened in the NWT near Yellowknife, for example.

MELTING PERMAFROST AND SITE CONDITIONS

Igloo Church Foundation Impacts



MELTING PERMAFROST AND SITE CONDITIONS

- **These climate warming trends point to permafrost engineering as being a very important discipline for designers, construction contractors, and infrastructure operators to consider.**

MELTING PERMAFROST AND SITE CONDITIONS

- **The Standards Council of Canada (SCC) has recognized through consultation with engineers and architects practicing in the North that new infrastructure design, construction and operations maintenance, as well as existing infrastructure renovation, must take the warming and melting of permafrost into account.**
- **To this end the SCC developed the Northern Infrastructure Standardization Initiative (NISI) – see <http://www.scc.ca/NISI>. There are five new standards.**

MELTING PERMAFROST AND SITE CONDITIONS

- **CAN/CSA-S500-14: Thermosyphon foundations for buildings in permafrost regions**
- **CAN/CSA-S501-14: Moderating the effects of permafrost degradation on existing building foundations**
- **CAN/CSA-S502-14: Managing changing snow load risks for buildings in Canada's North**
- **CAN/CSA-S503-15: Community drainage system planning, design, and maintenance in northern communities**
- **CAN/BNQ 2501-500 Geotechnical Site Investigations for Building Foundations in Permafrost**



MELTING PERMAFROST AND SITE CONDITIONS

Questions?