

PREVENTING PERMAFROST DEGRADATION



PER-MA-FROST
GROUND THAT REMAINS FROZEN FOR AT LEAST TWO YEARS

PERMAFROST MAP

- CONTINUOUS
- EXTENSIVE DISCONTINUOUS
- SPORADIC DISCONTINUOUS



MUCH OF THE NORTH'S INFRASTRUCTURE IS BUILT ON AND SUPPORTED BY PERMAFROST

PERMAFROST DEGRADATION CAN LEAD TO DISTRESS AND DAMAGE ON EXISTING STRUCTURES

TAKE CARE OF YOUR PERMAFROST

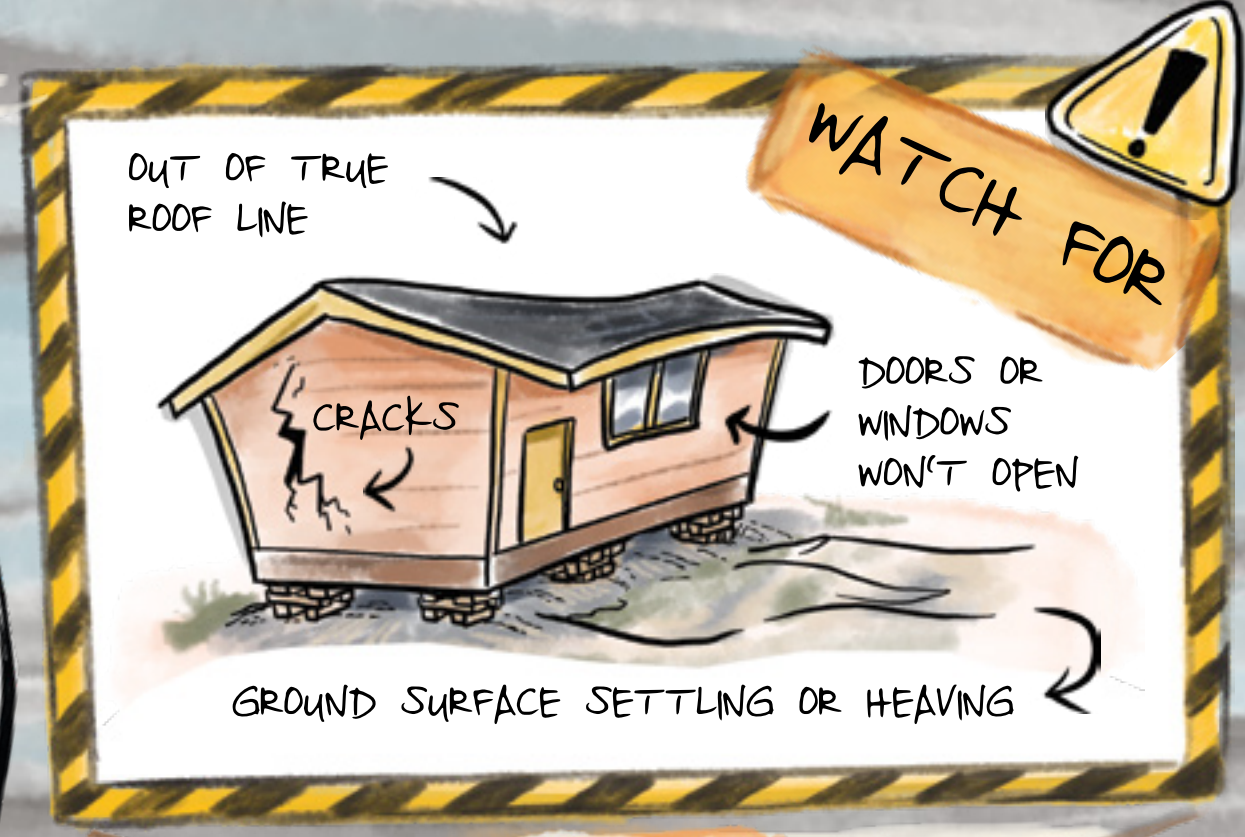
DO THIS:

- ✓ Snow cleared not insulating the ground
- ✓ Gravel pad graded keeps water away
- ✓ Skirting open and unobstructed wind can flow through
- ✓ Shade provided but it doesn't obstruct or cause snow drifting

NOT THIS:

- ✗ No shade on south side shade protects permafrost from the sun's heat
- ✗ Drifted snow it insulates and prevents frost from cooling the ground
- ✗ Blocked air flow caused by closed skirting, storing stuff under house, nearby shed
- ✗ Water flowing towards house pooling water damages permafrost

KEEP IT COOL DOWN THERE &



IS IT?

THAW SETTLEMENT

- 1 Surface water may accumulate
- 2 Bowl like depression
- 3 Cracks worsen year round
- 4 Settlement may slow in winter

FROST HEAVE

- 1 Could be encouraged by heat from the building and poor ventilation
- 2 Expansion of water during the freezing process
- 3 Movement of water from unfrozen soil to freezing ground
- 4 Cracks that open and close throughout the year, most noticeable in winter

HAVE A MONITORING PLAN

Inspect your foundation and document findings

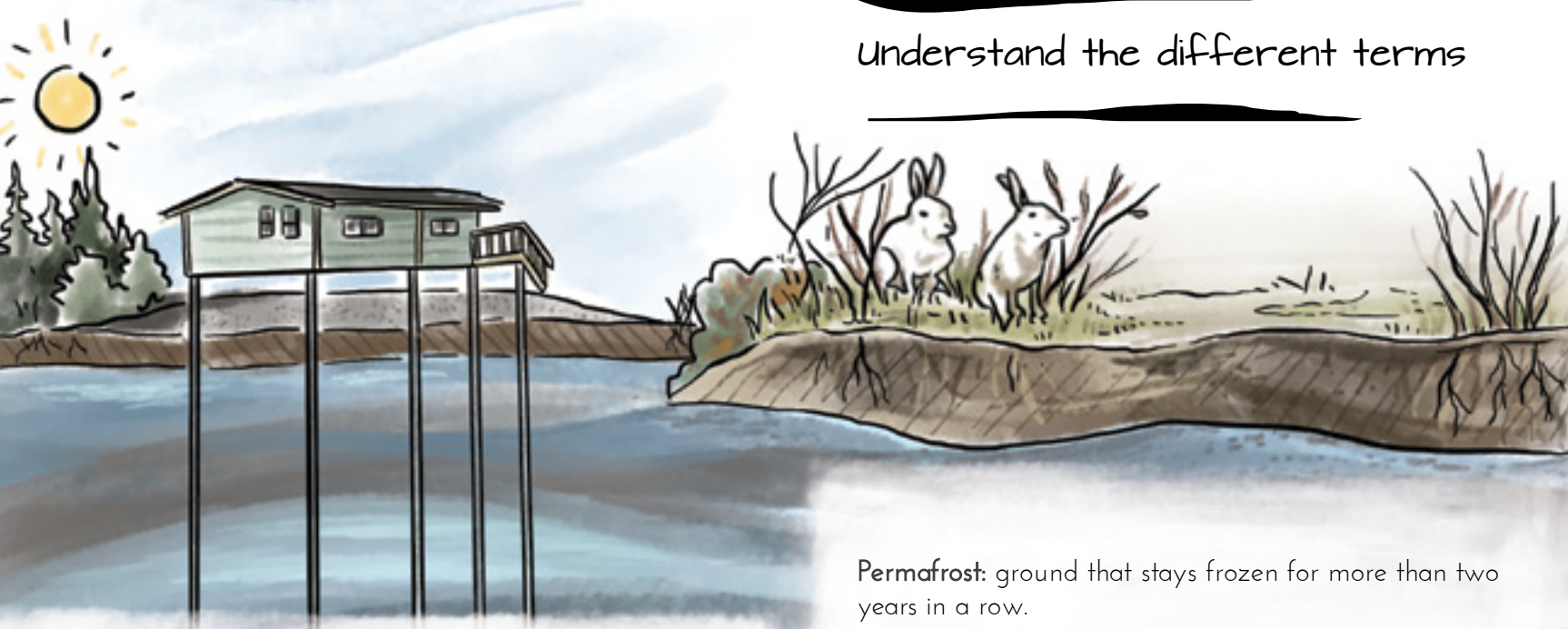
BE PROACTIVE

Take steps to preserve permafrost beneath or adjacent to infrastructure

REMEMBER

Once it starts, permafrost degradation is difficult and expensive to stop

GOAL: STABILIZE FOUNDATION BEFORE EXPENSIVE AND EXTENSIVE DAMAGE OCCURS



WHAT IS PERMAFROST?

Understand the different terms

Permafrost: ground that stays frozen for more than two years in a row.

Active layer: layer of ground on top of permafrost that freezes in the winter and thaws in summer.

Thaw sensitive permafrost: ground that settles when it thaws because it has more moisture (as ice) than it can hold.

Thaw stable permafrost: ground that does not settle when it thaws.

Thaw settlement: happens when ice in ground thaws and the water drains away.

Frost heave: ground that pushes up or out because the water in it freezes and expands.

This is a user-friendly outline of CAN/CSA S501-14: Moderating the effects of permafrost degradation on existing building foundations.

USE THIS GUIDE TO:

- * Understand permafrost
- * Detect signs of thaw under a building
- * Carry out practices to reduce thawing
- * Learn how to protect permafrost

Ecology North developed this guide for building owners and maintainers, community decision makers, and contractors across the north.

CLIMATE CHANGE

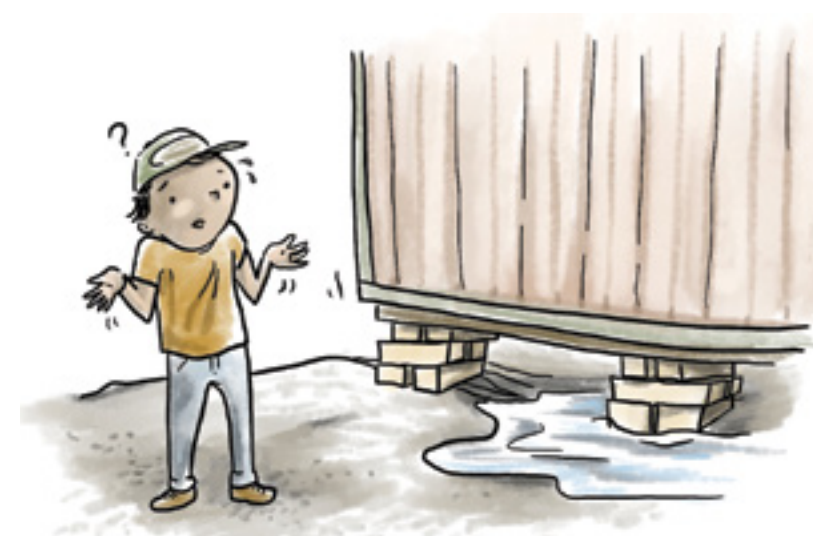
Direct effects on permafrost

In the north, climate change is causing warmer winters, longer summers, and more variable precipitation.

These changes lead to permafrost thaw, increasing depth of the active layer, and result in damage to infrastructure that relies on frozen ground.

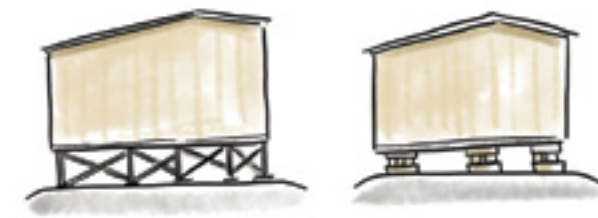
Many northern buildings sit on thaw sensitive permafrost. Northerners are noticing more impacts on buildings and more damage to infrastructure that relies on frozen ground.

We know climate change will continue to have increasingly dramatic effects in the North. There are ways to help reduce impacts on buildings, to prevent things from getting worse.

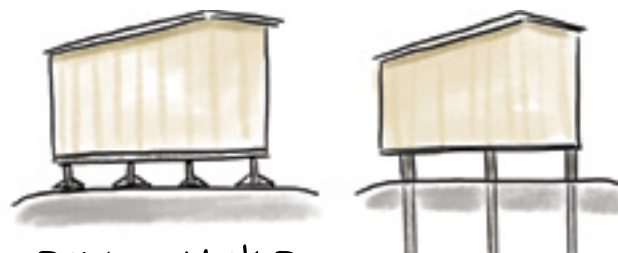


BUILDING FOUNDATIONS

Keep permafrost in mind



SPACE FRAME PAD & WEDGE



SCREW JACKS PILES

DESIGN BUILDINGS TO:

- * Prevent permafrost from thawing
- * Reduce impacts of thawing permafrost

Different types of building foundations are designed and built for different situations. They vary in cost, effectiveness, and maintenance requirements. Understanding your foundation type and how it works and needs to be maintained is important to adapt to permafrost thaw and frost heave.

WHAT AFFECTS THAW?

Climate and weather

TEMPERATURE:

The warmer it gets under a building, the more permafrost will thaw.



SUN:

The relentless summer sun warms the ground and thaws permafrost.



WATER:

Water is very effective at transferring heat from the surface into the ground.



SNOW:

Snow insulates the ground. It prevents cold winter air from recharging permafrost.



WIND:

Wind helps permafrost by evaporating moisture in summer and blowing away snow in winter. Wind can help thaw permafrost if it blows snow to an area where it builds up, such as low ground, around an object, or against a wall.



TIPS TO PREVENT THAW

Keep permafrost dry and cold

- * Keep the ground cool in summer
- * Allow cold to enter the ground in winter
- * Limit heat and keep air flowing

- * Shade south sides of buildings
- * Use vegetation, mulch, even skirting
- * Do not disturb the natural vegetation

- * Direct drainage away from buildings
- * Remove snow piles before they melt
- * Proper eavestroughs and long downspouts

- * Clear snow from around building all winter
- * Remove snowdrifts that are stopping air flow

- * Promote airflow under buildings in winter
- * Remove vegetation that limits wind
- * Use mesh, not solid skirting
- * Don't store things under or beside building



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SITE INVESTIGATION

Monitor throughout the construction and life of building

GENERAL INFO

- * Building design and history
- * Local permafrost conditions
- * Drainage and water conditions
- * Climate change and extreme weather events

BUILDING DATA

- * Damage/cracks
- * Roof/floor lines out of true
- * Ground settling or heaving
- * Damage to water/sewage systems
- * Surface drainage
- * Ice damming
- * Building levels

SUB-SURFACE DATA

- * Soil characteristics
- * Depth to permafrost
- * Amount of ground ice
- * Ground temperature



SIGNS OF PROBLEMS

Permafrost thaw; Frost heave

Both permafrost thaw and frost heave have similar symptoms (see list below) but they are caused by different processes, and typically happen at different times of year. Understanding what is happening to your building will help you to address the root cause.

WATCH FOR:

- * Cracks in drywall
- * Sticky doors and windows
- * Cracks in foundation
- * Settlement and heaving of building
- * Floors or roof lines out of true

PERMAFROST THAW

Thaw tends to be a long-term problem where ice-rich permafrost melts more each year and causes settling.

- * Cracks or problems get worse year-after-year
- * Changes are most visible in summer or fall

FROST HEAVE

Is generally caused by water in the ground freezing in the winter, expanding and pushing foundations up.

- * Cracks open and close throughout the year
- * Changes are most noticeable in winter

SERIOUS PROBLEMS

Ask for help

LEVEL THE BUILDING

Depending on foundation type, it might be possible to adjust the building. Do this every year.

INSTALL GROUND INSULATION

Communities with permafrost that is at or below -4°C, on average, can consider insulating the ground from the heat of a building with gardens, mulch, or gravel.

INSTALL REFRIGERATION DEVICES

Mechanized refrigeration or thermosyphons can be very effective at preserving permafrost, but hard to do under existing buildings.

REPLACE OR CHANGE FOUNDATION

It might be possible to move to a new foundation, such as screw jacks, piles, or a space frame, or to a new location that is on thaw stable permafrost.

ABANDON AND DEMOLISH

Only if the building is dangerous and can't be fixed.



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