



Water Meets Seismic Lines: It's Complicated

Lelia Tuffner

Athabasca University

Scott Ketcheson, Maria Strack, Greg McDermid



UNIVERSITY OF
CALGARY



AU Hydrology

An aerial photograph of a vast forest landscape. The forest is dense and green, with some areas showing signs of disturbance or clearing. Three semi-transparent, rounded rectangular boxes are overlaid on the image, each containing a word in white serif font. The box labeled 'Carbon' is positioned in the upper center, 'Water' is in the lower left, and 'Wildlife' is in the lower right. The background shows a mix of evergreen and deciduous trees, with some bare trees visible in the cleared areas.

Carbon

Water

Wildlife

An aerial photograph of a forest landscape. A large, irregularly shaped area of forest has been cleared, revealing a light brown, sandy or silty ground. This cleared area is situated in the upper right portion of the image. To the left of this cleared area, there is a small, dark, irregularly shaped pond or wetland. The surrounding forest is dense and green, with some areas showing signs of disturbance or thinning. The overall scene suggests a natural area undergoing some form of management or restoration.

Carbon

Wildlife

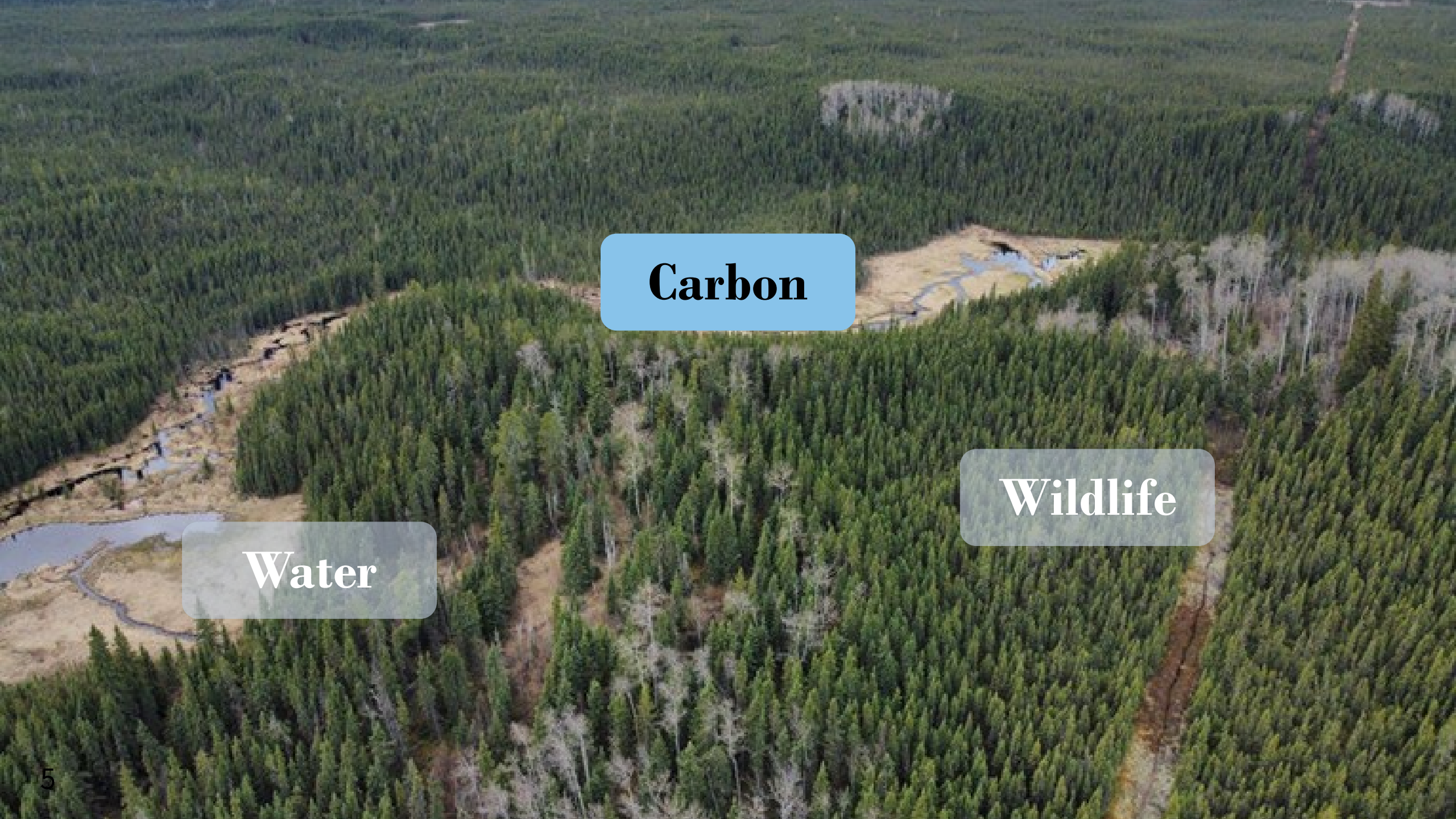
Water

An aerial photograph of a forest landscape. A clear-cut area, where trees have been removed, is visible in the upper center and left. A stream flows through this clear-cut area. The surrounding forest is dense and green. Three semi-transparent text boxes are overlaid on the image: 'Carbon' in the upper center, 'Water' in the lower left, and 'Wildlife' in the lower right.

Carbon

Water

Wildlife

An aerial photograph of a forest landscape. A large, irregularly shaped clearcut area is visible in the upper right, showing exposed soil and some dead trees. A stream flows through the clearcut area, winding its way towards the bottom left. The surrounding forest is dense and green. Three text boxes are overlaid on the image: 'Carbon' in a blue box at the top center, 'Water' in a grey box at the bottom left, and 'Wildlife' in a grey box at the bottom right.

Carbon

Water

Wildlife



Well Site

Seismic Line

Pipeline

Seismic Line

Well Pad

Harvest Area

Road

Well Site

Road

Seismic Line

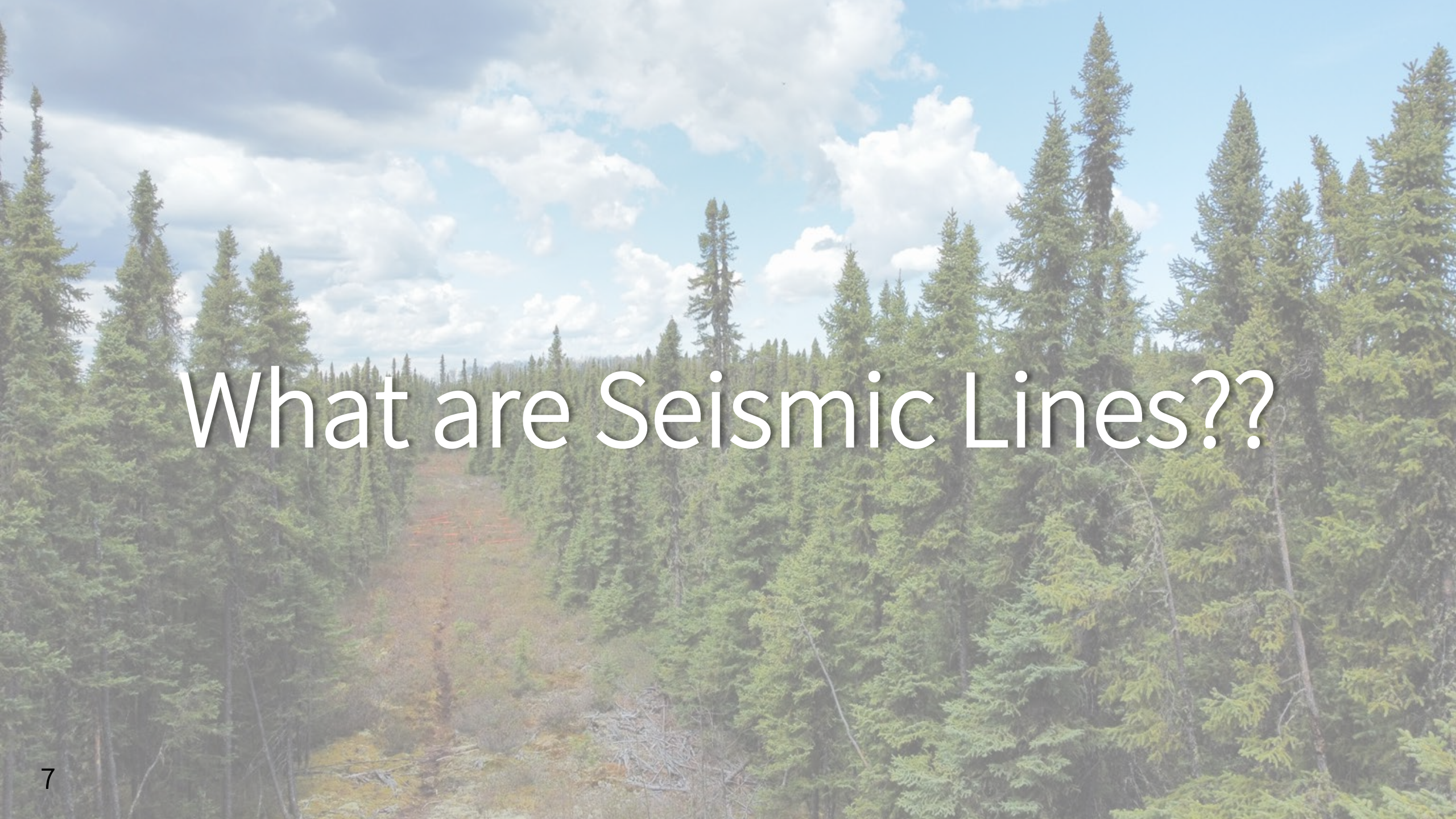
Seismic Line

Well Site

Well Pad

Pipeline



A photograph of a dense forest of tall evergreen trees, likely spruce or fir, under a bright blue sky with scattered white clouds. The trees are in the foreground and middle ground, creating a sense of depth. The text "What are Seismic Lines??" is overlaid in the center in a large, white, sans-serif font.

What are Seismic Lines??



BOREAL ECOSYSTEM RECOVERY & ASSESSMENT

Maint

Species

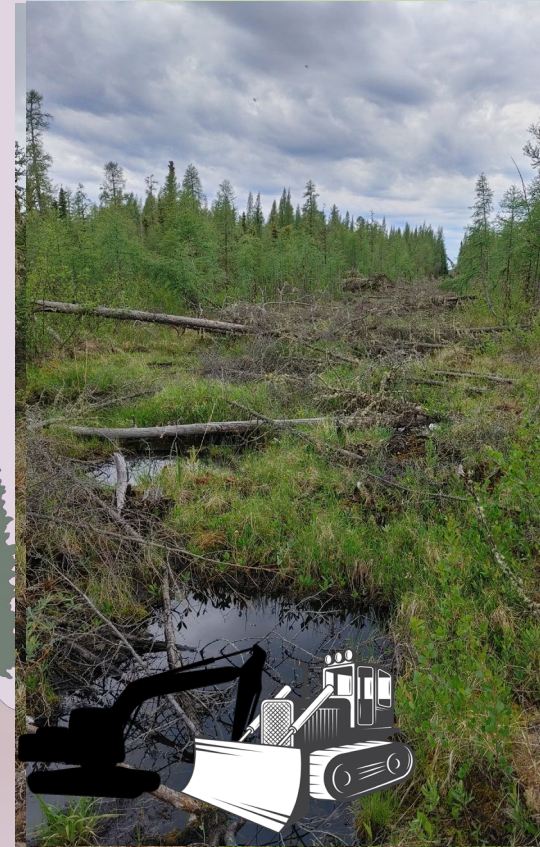
Wide

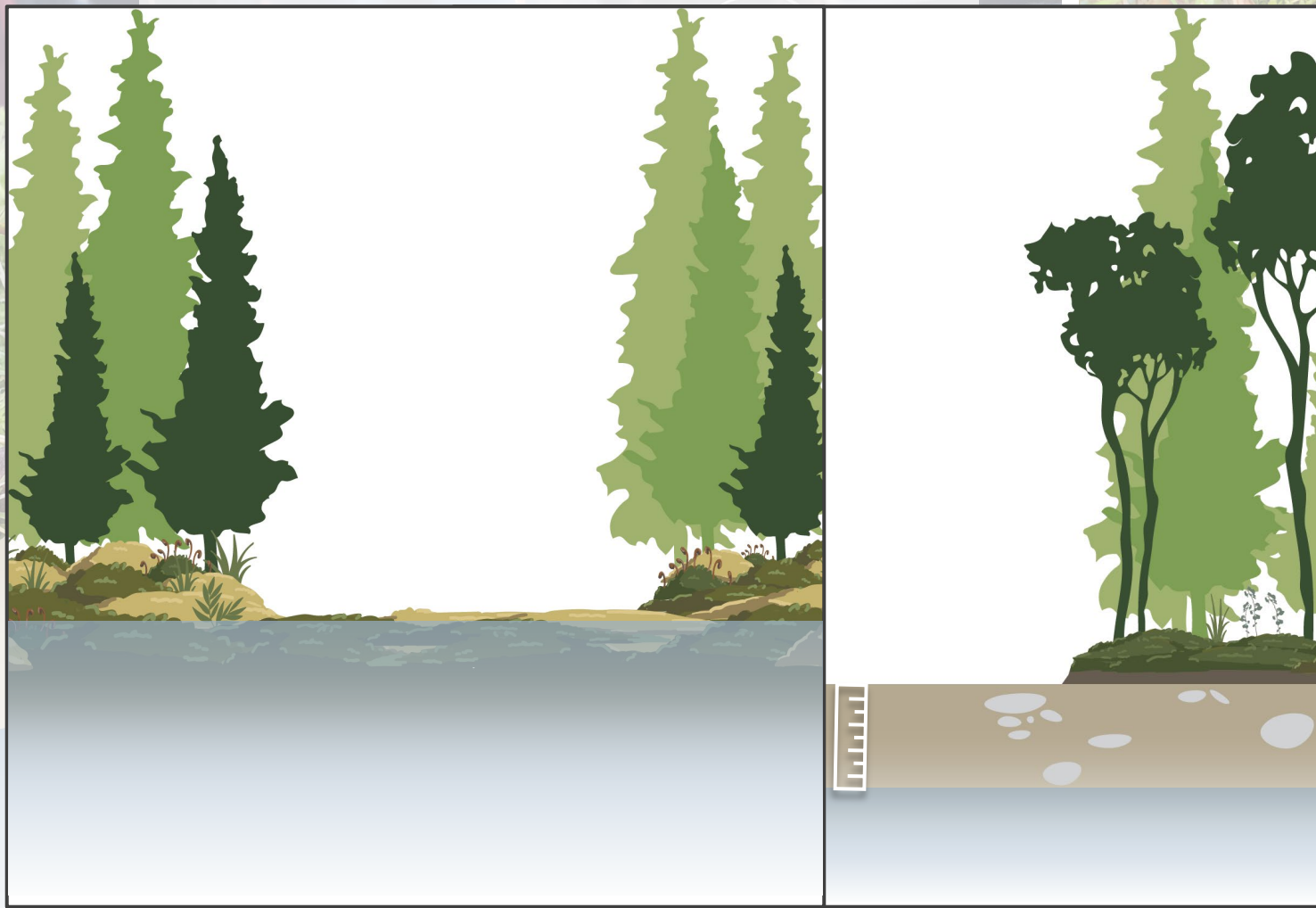
Uplands

Narrow

Wide

Narrow Uplands





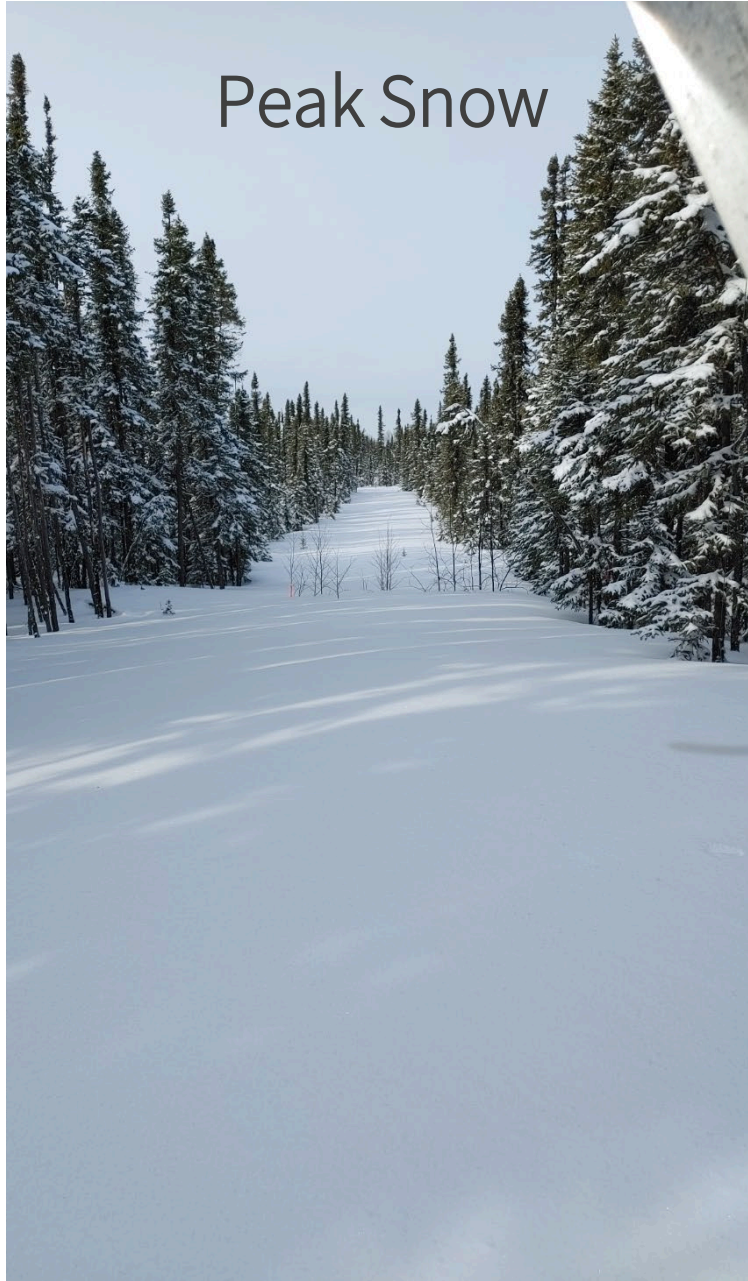




Summer



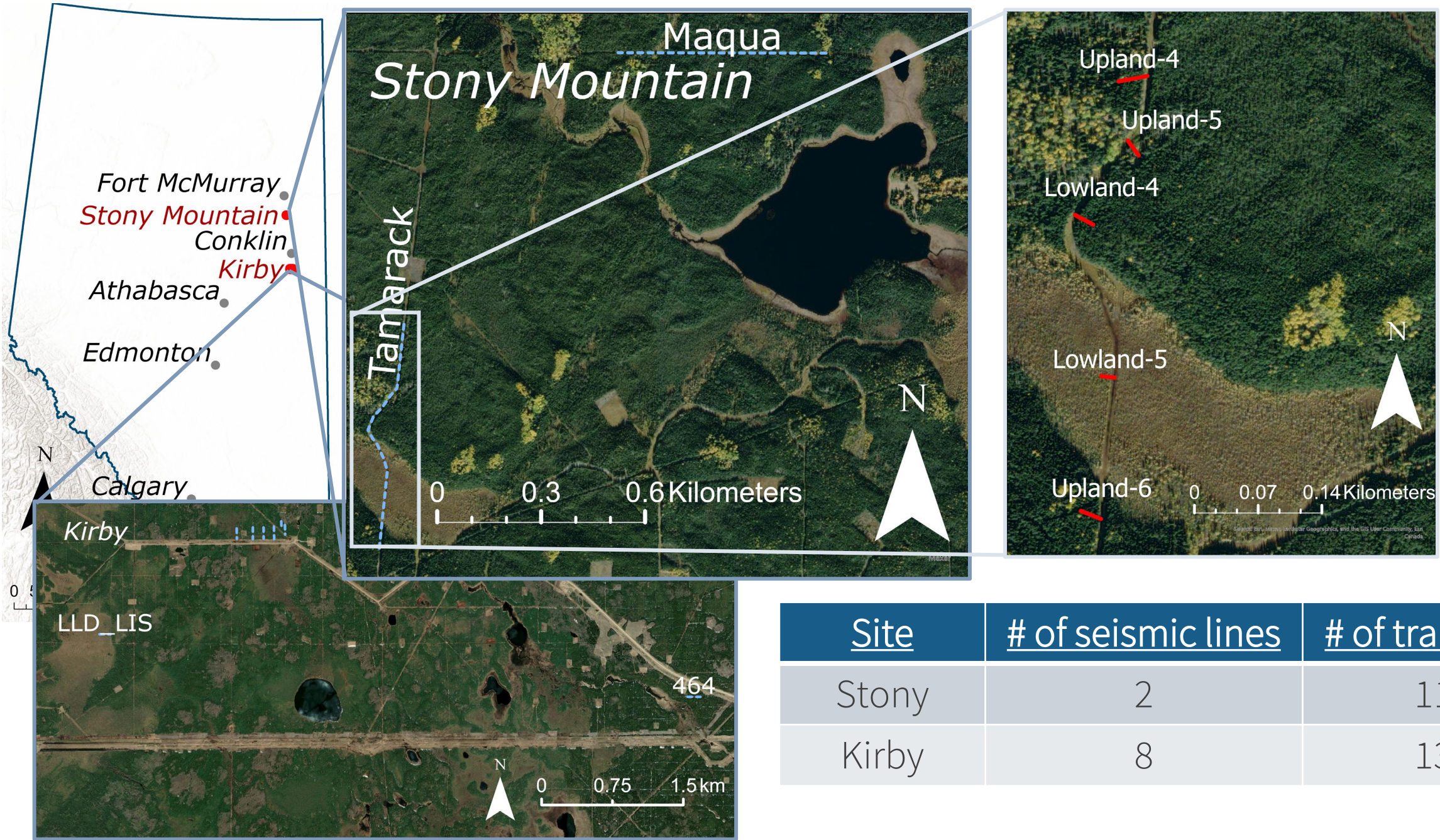
Peak Snow



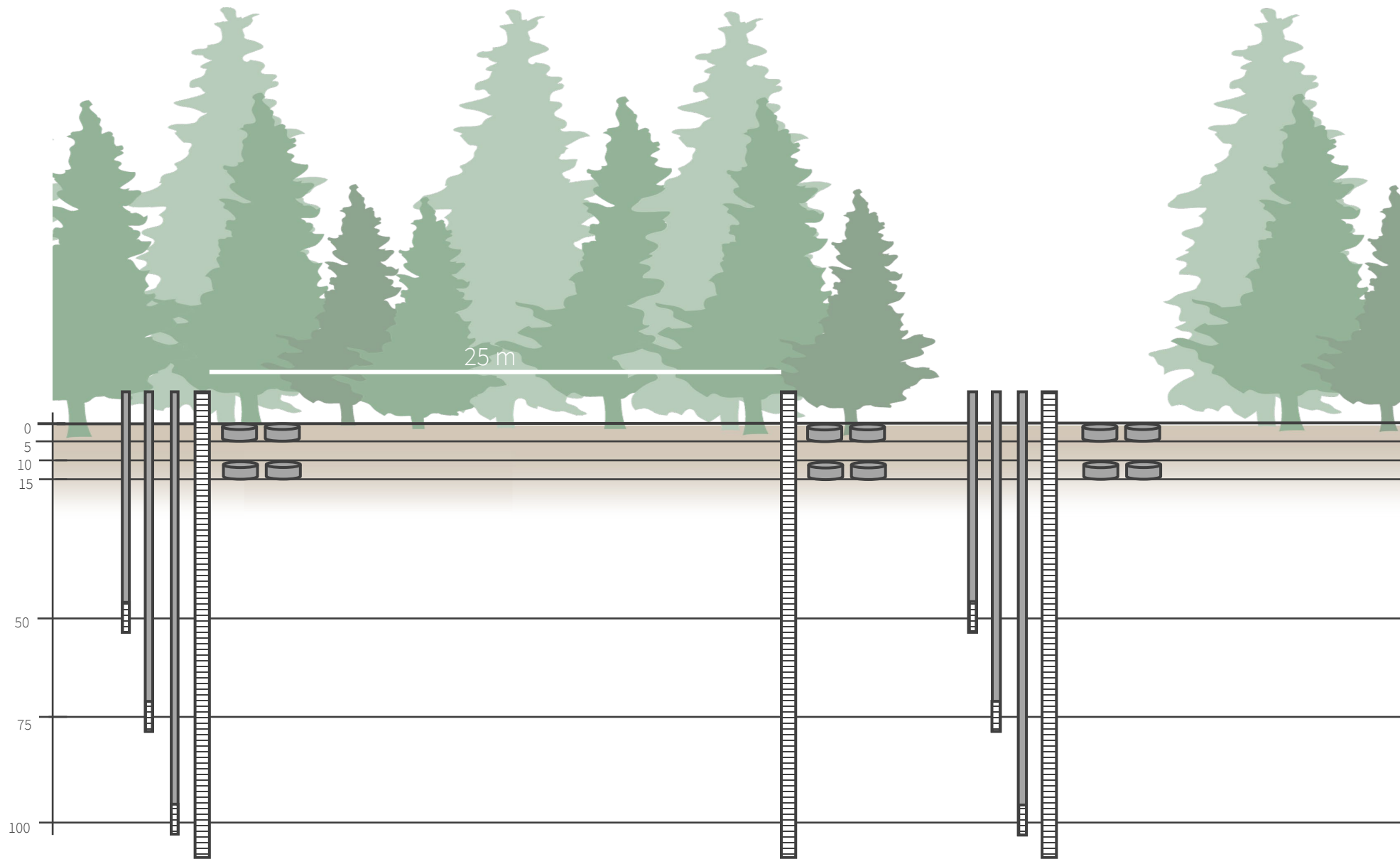
Snow Melt



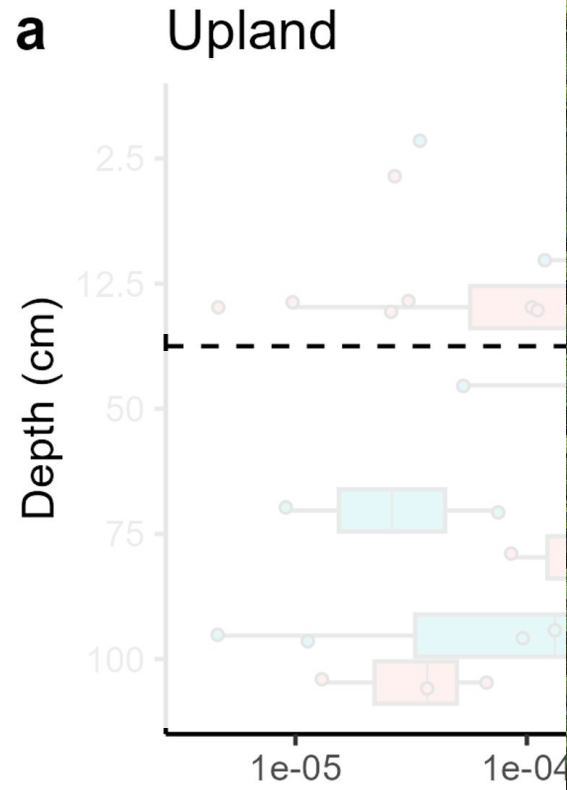




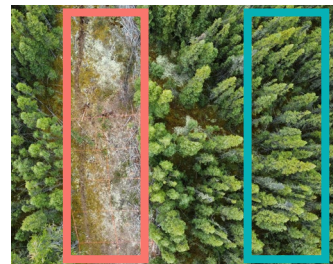
<u>Site</u>	<u># of seismic lines</u>	<u># of transects</u>
Stony	2	11
Kirby	8	13

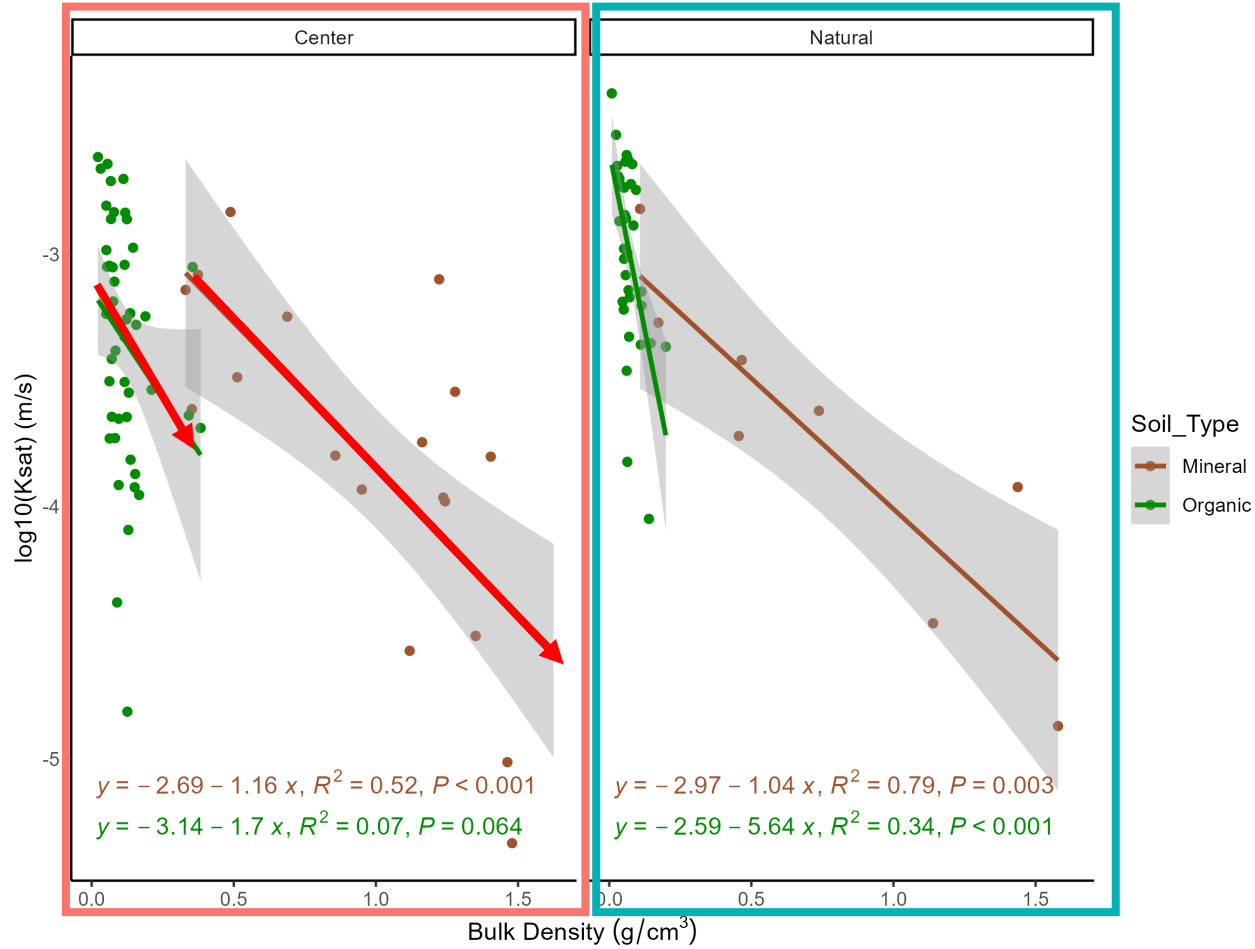


Soil samples at
 3 wells
 each well
 3 piezometers
 Surface: 0-5 cm
 50, 75 and 100
 Rooting zone:
 10-15 cm



Hydraulic
activity
d on
ines





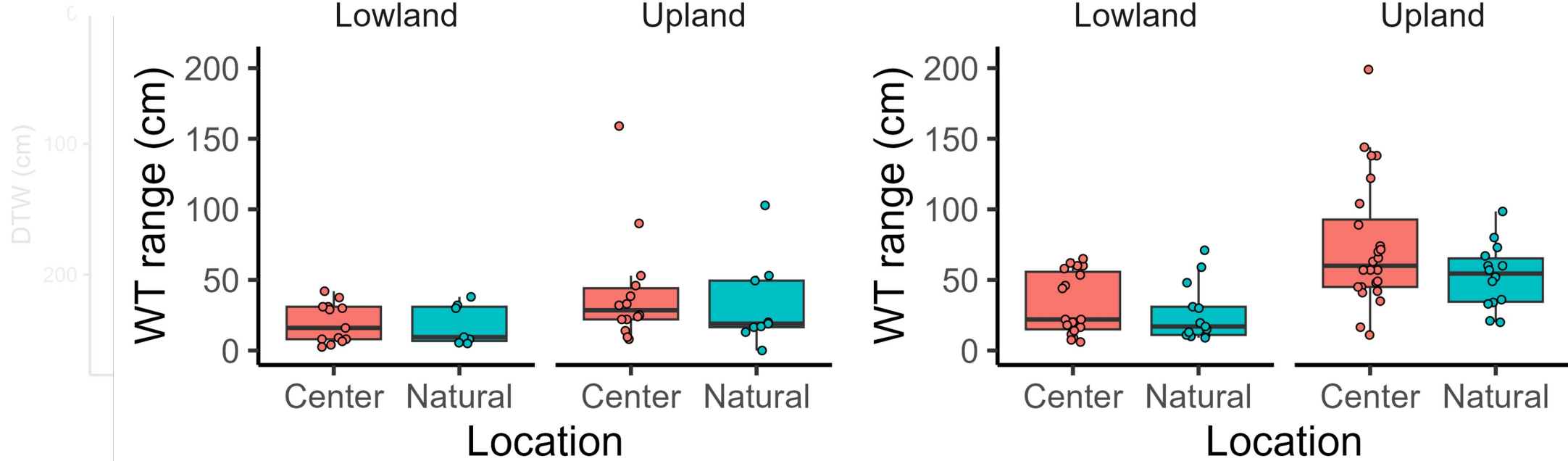
Saturated hydraulic conductivity decreases as bulk density increases



2021

2022

a



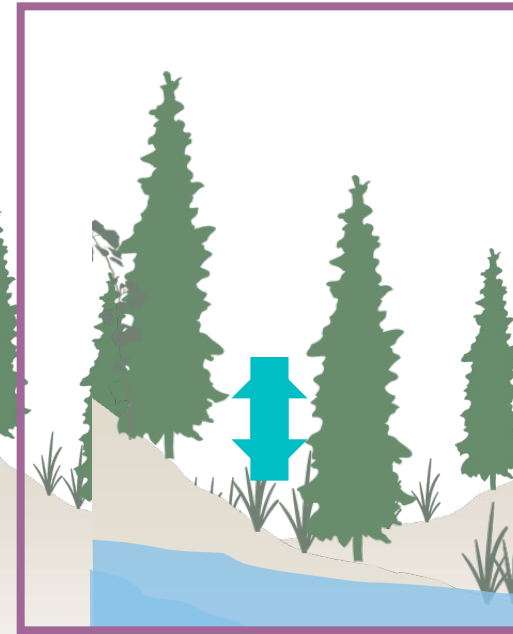
Water table
variation (range)
increased on
seismic lines

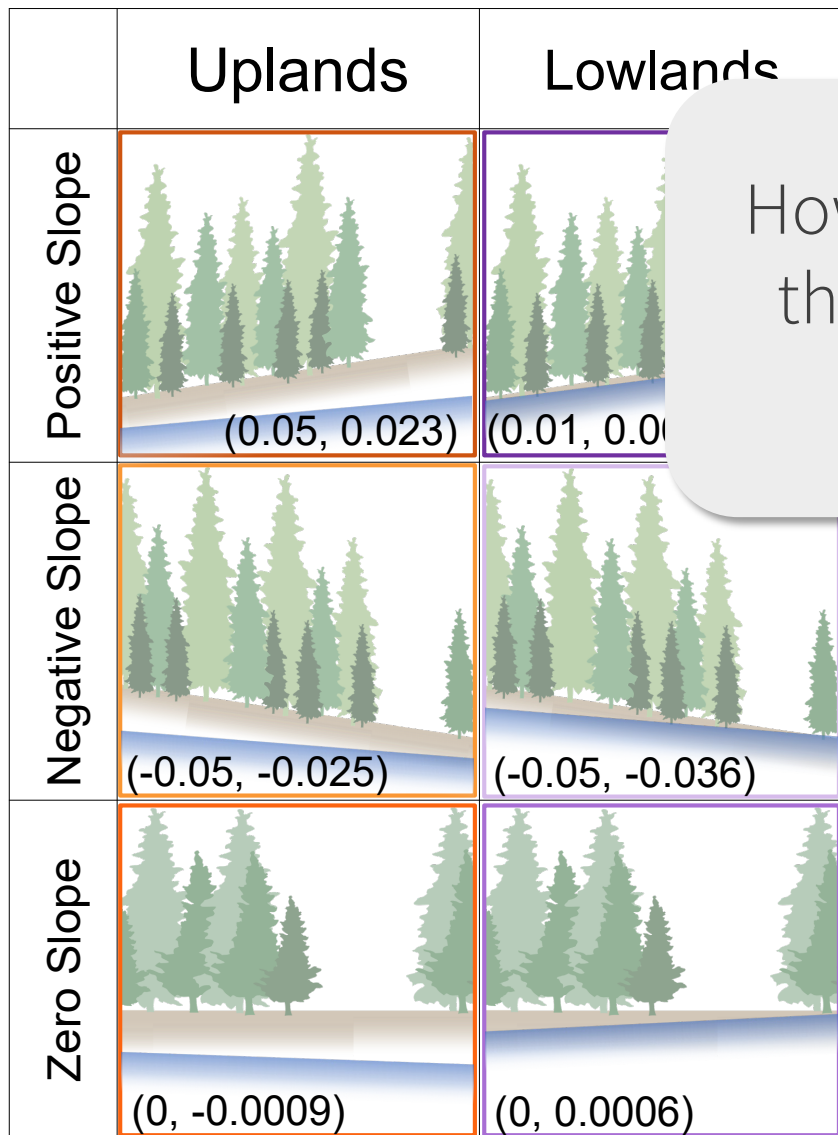


Saturated Hydraulic Conductivity

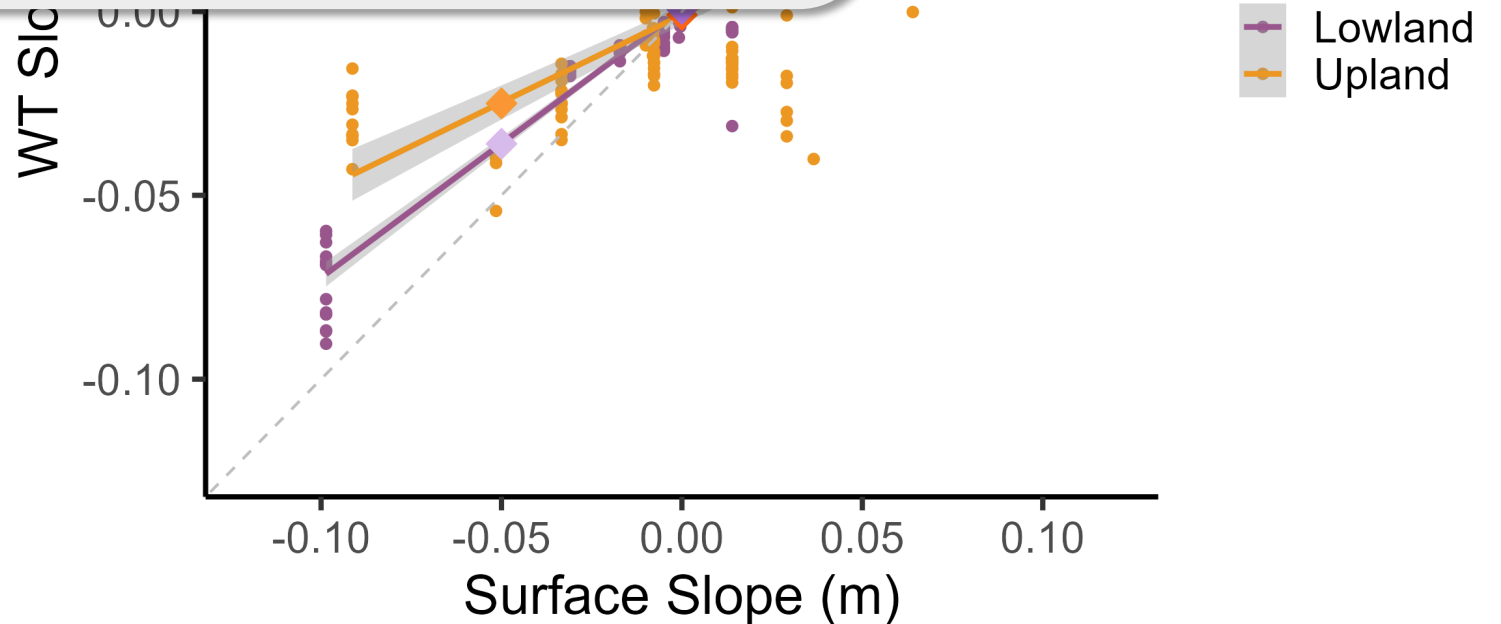
Uplands

Lowlands





How is water table affected by the surface: dependence on seismic line presence?



Surface topography matters more for water table configuration than seismic line presence



March 2022

Depth on line,
natural

Weight
measured at key
locations

Ecosite

Line Width

Orientation

Snow Depth

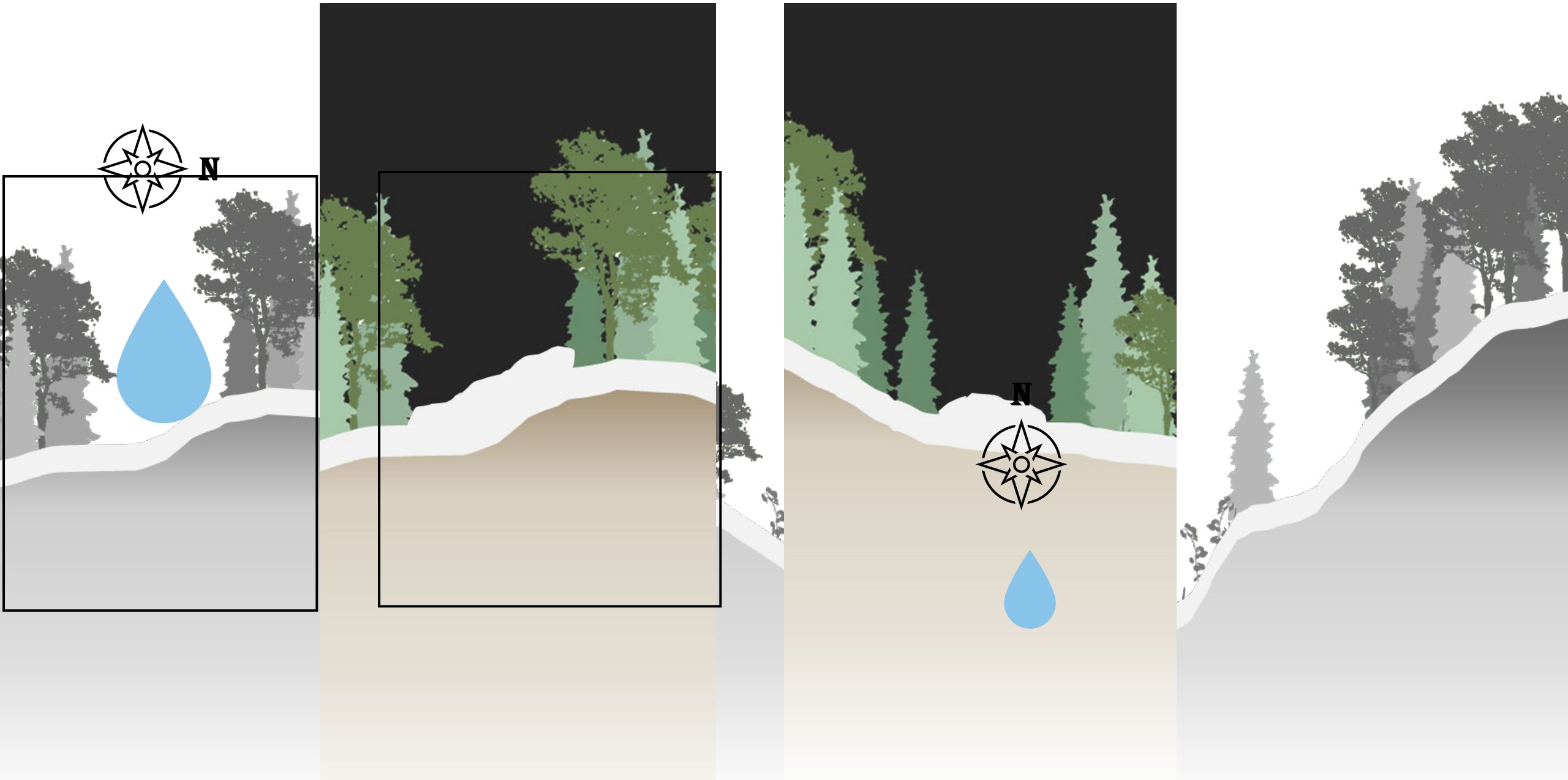
Snow Density

SWE

$$\text{Difference} = \text{Seismic line} - \text{Natural}$$

Snow water
equivalent higher
on seismic lines







It's Complicated

Key Takeaways

- Soil properties and water table position are altered on seismic lines
- Meso-topography matters more for water table position than seismic line presence
 - Seismic lines alter snow accumulation

Special thanks goes to Jennifer Attema, Tori Green-Harrison, Hannah Ponsonby, Jasper Koch, Colette Shellian, Maverick Fong, Xue Yan Chan, Nataša Popovič, Samantha Jang, Austin Zabel, Jennifer Fliesser, Brian Newton and Maryam Bayatvarkeshi





Lelia Tuffner

lweiland@athabascau.ca

 Lelia Tuffner

auhydrology.com

beraproject.org

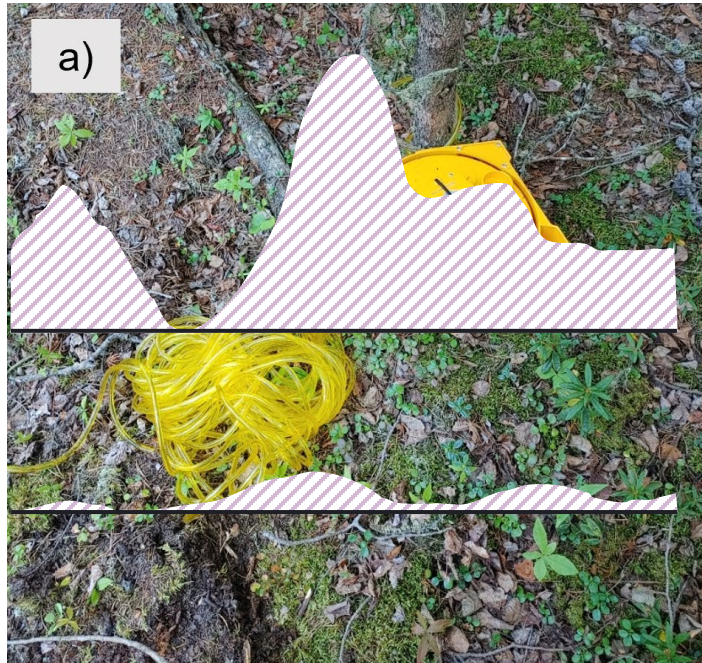
 Athabasca University
Hydrology Research Group

Questions?

Key Points

Soil and snow properties
impacted by line presence

Local topographic context is
important

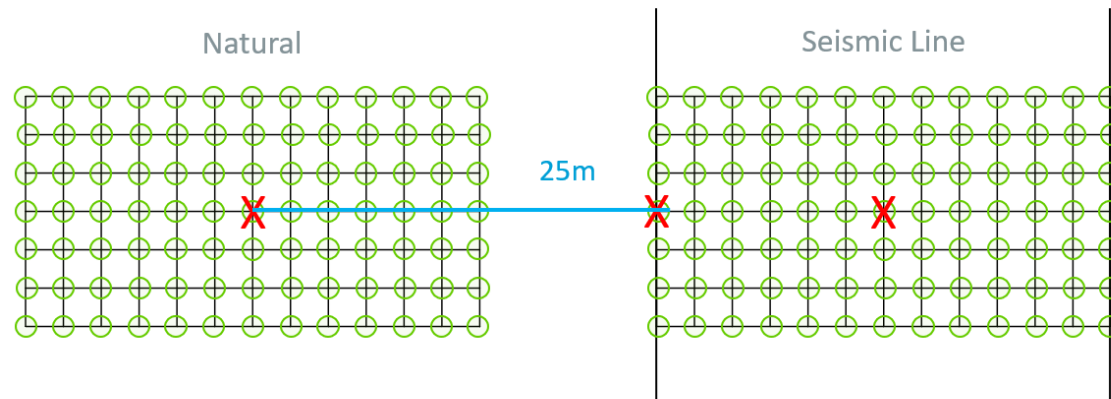


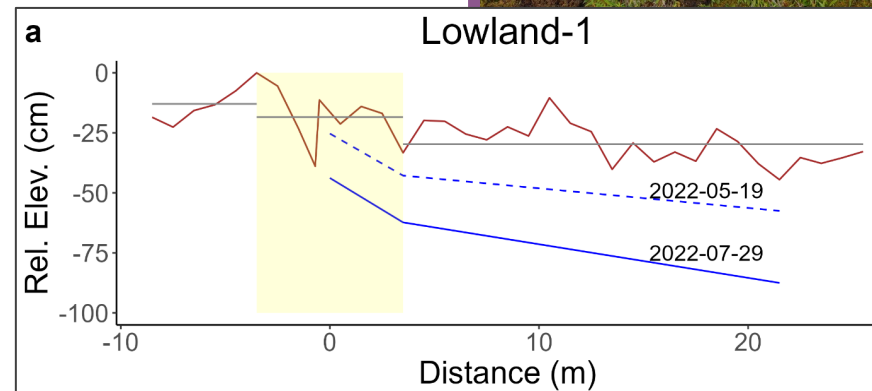
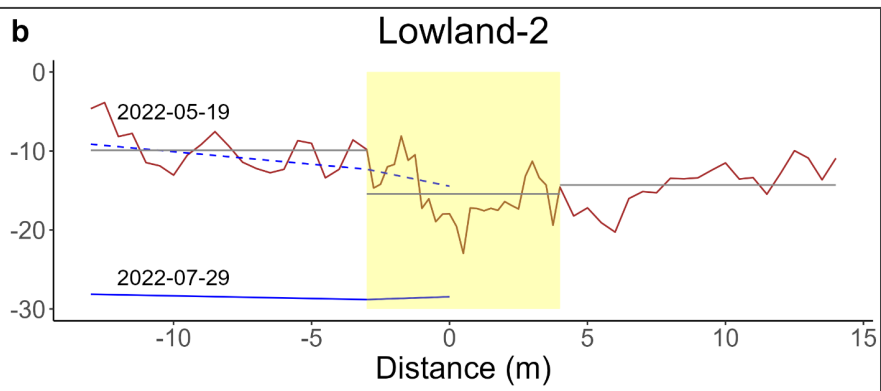
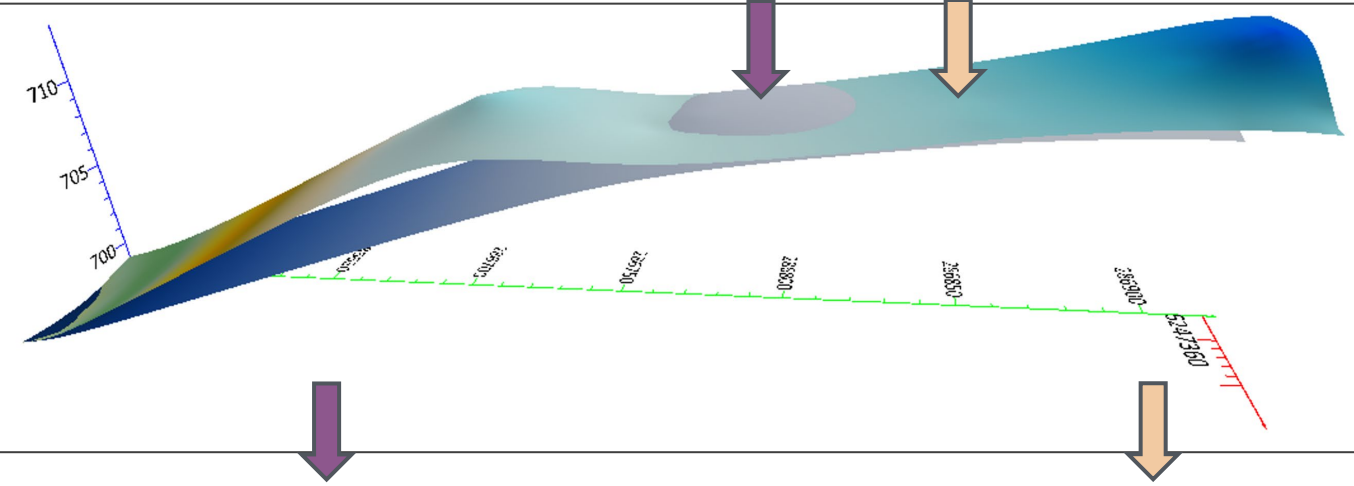
A'

Altimeter measures relative elevation changes

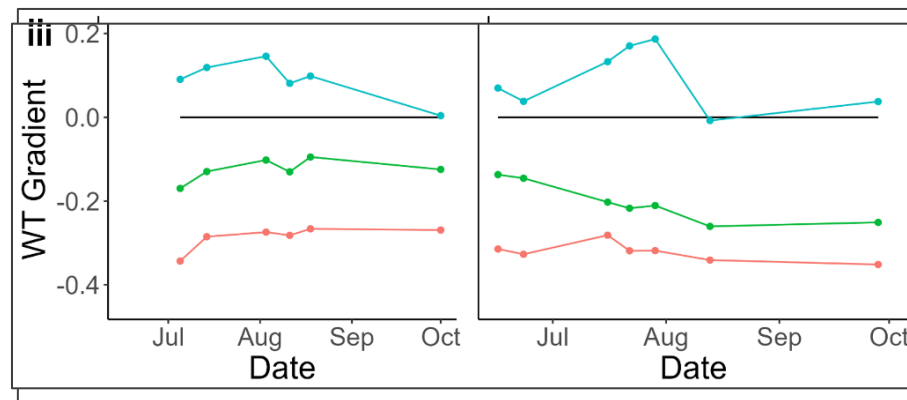
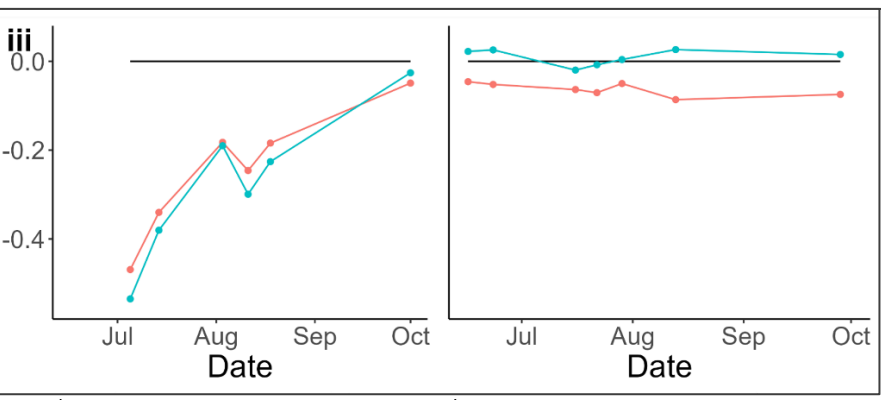
Every 50 cm in a grid (7x3 m)

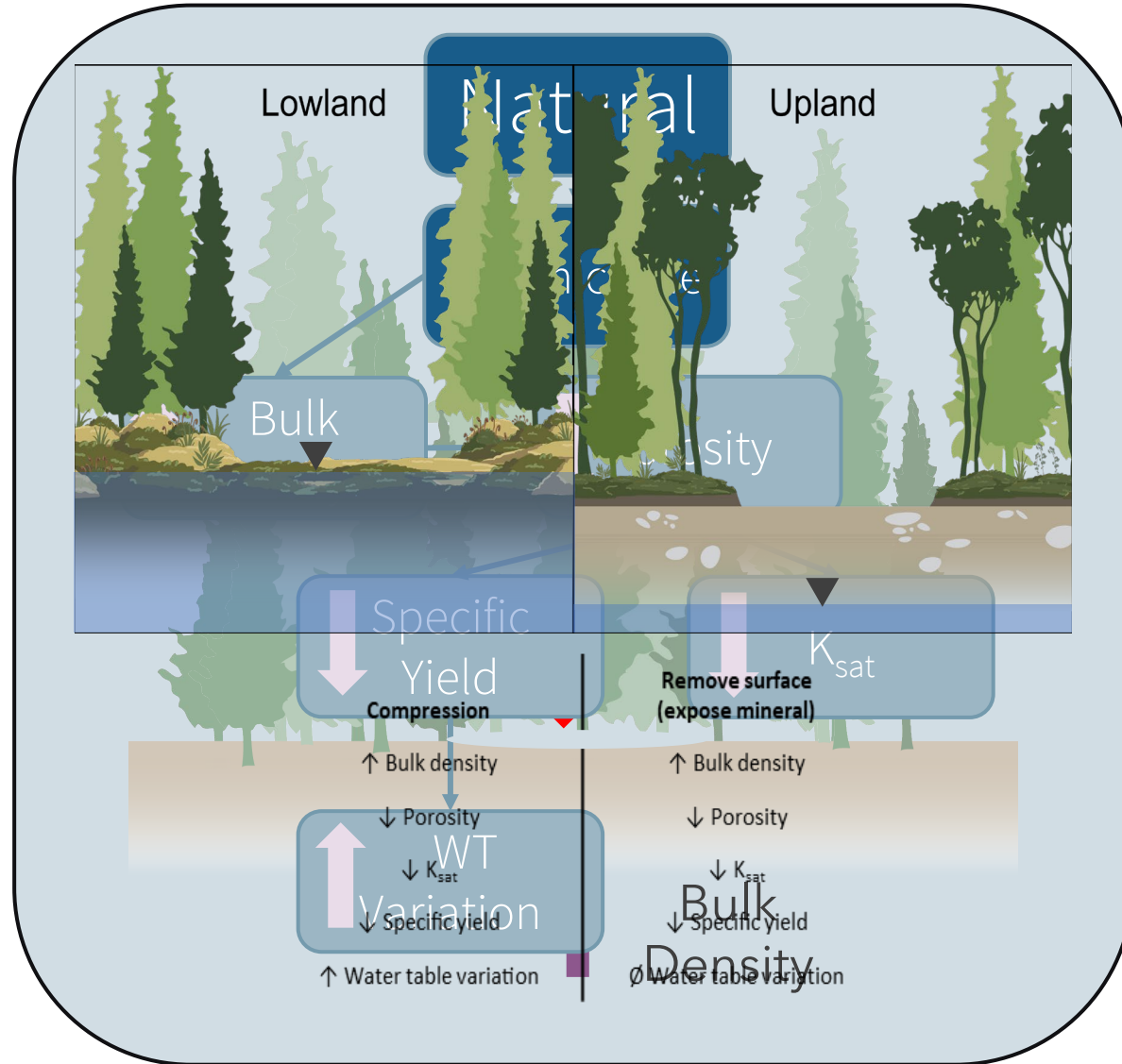
Along a transect

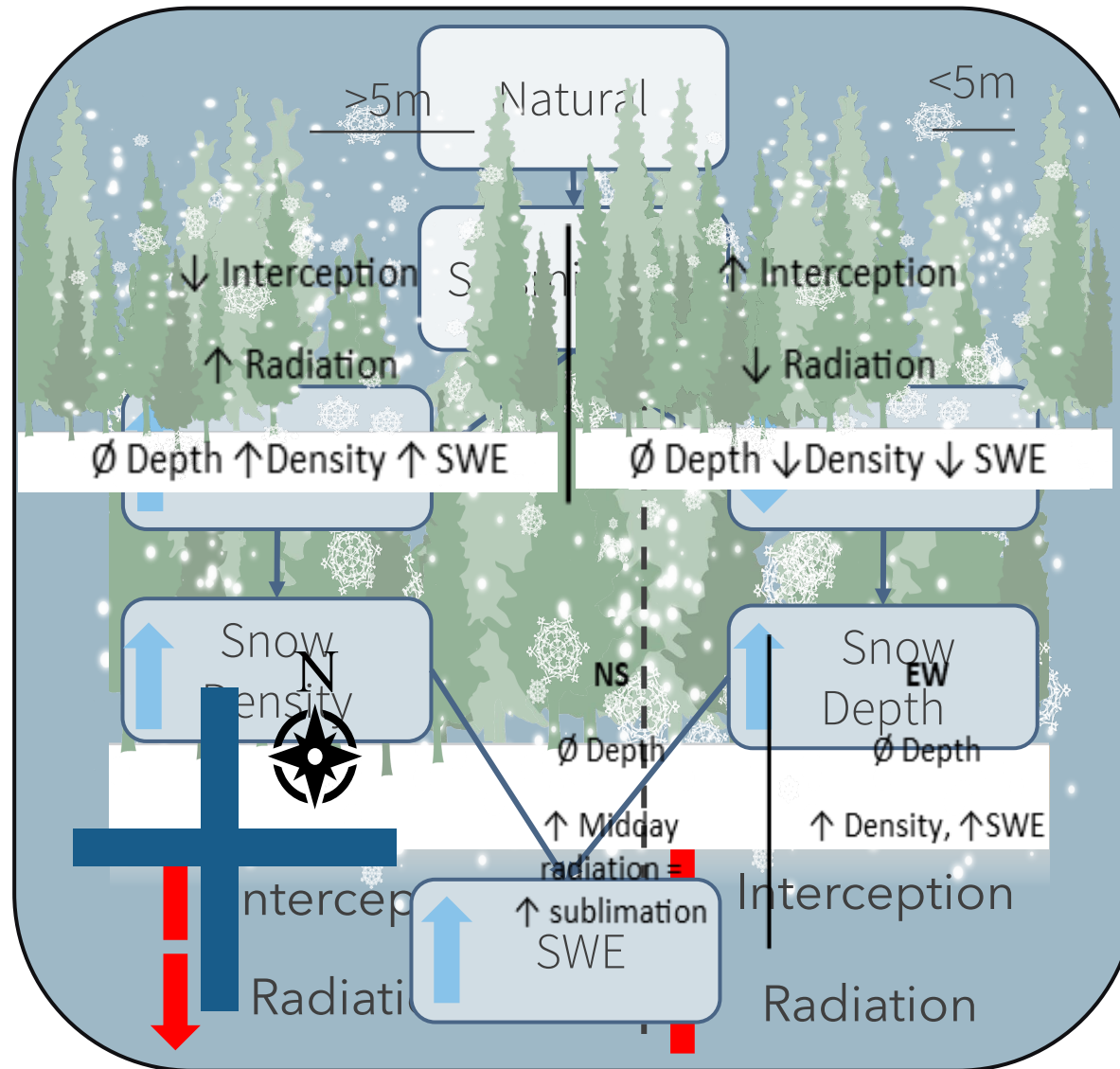




WT trends inconsistent
Same ecosite type –
varying effects









Soils



Hydrology

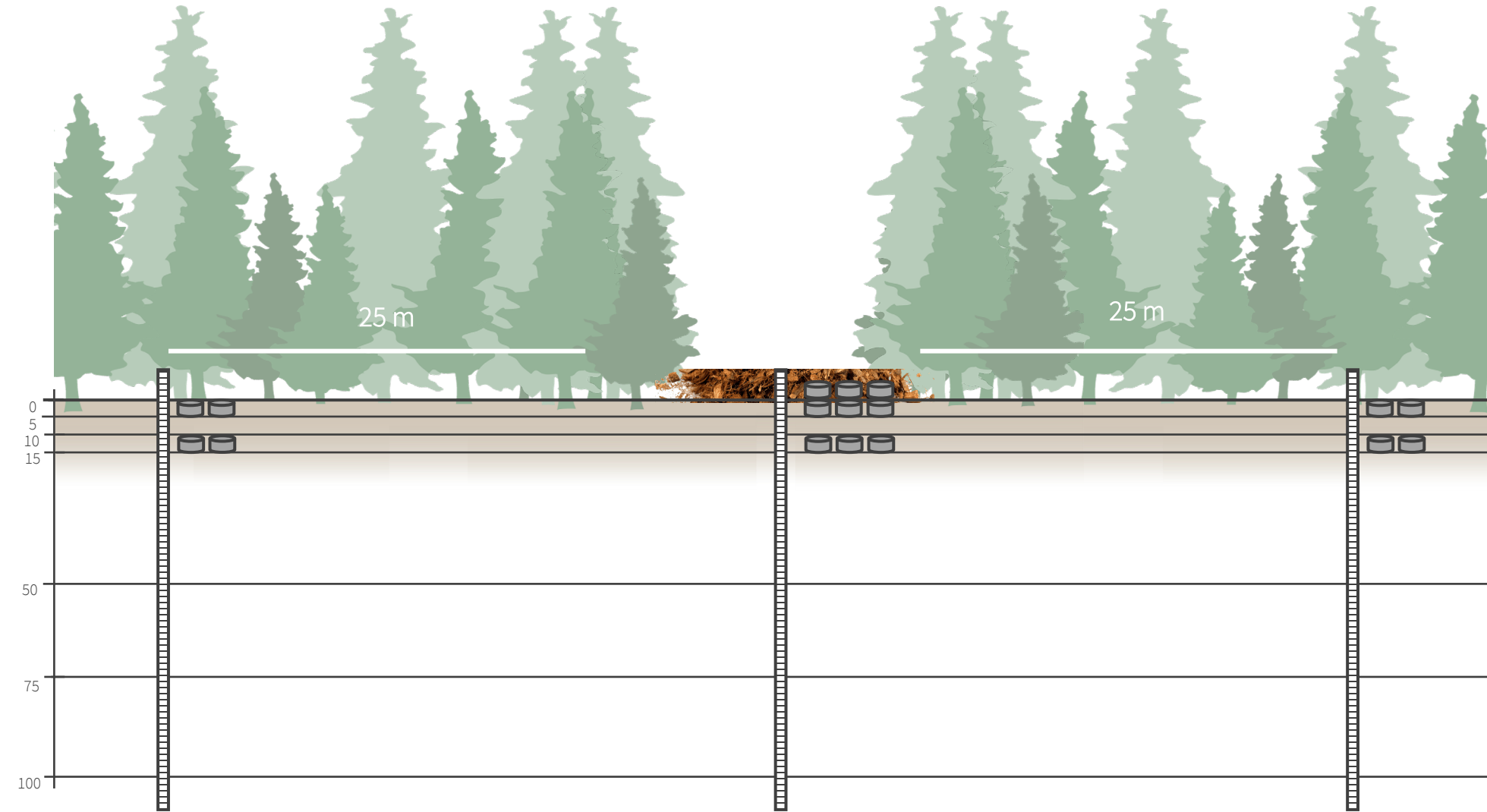
Low Impact

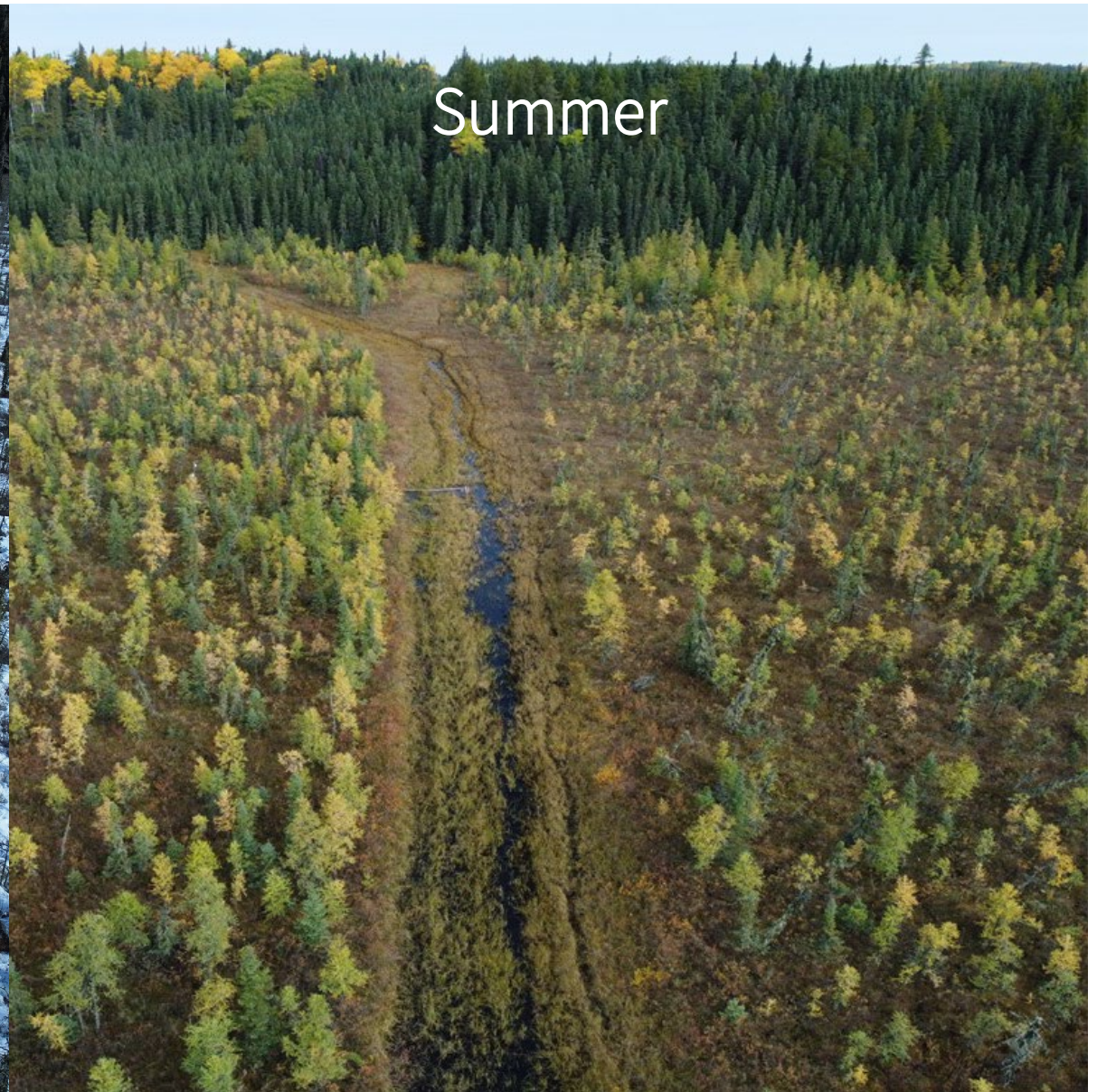
3 wells

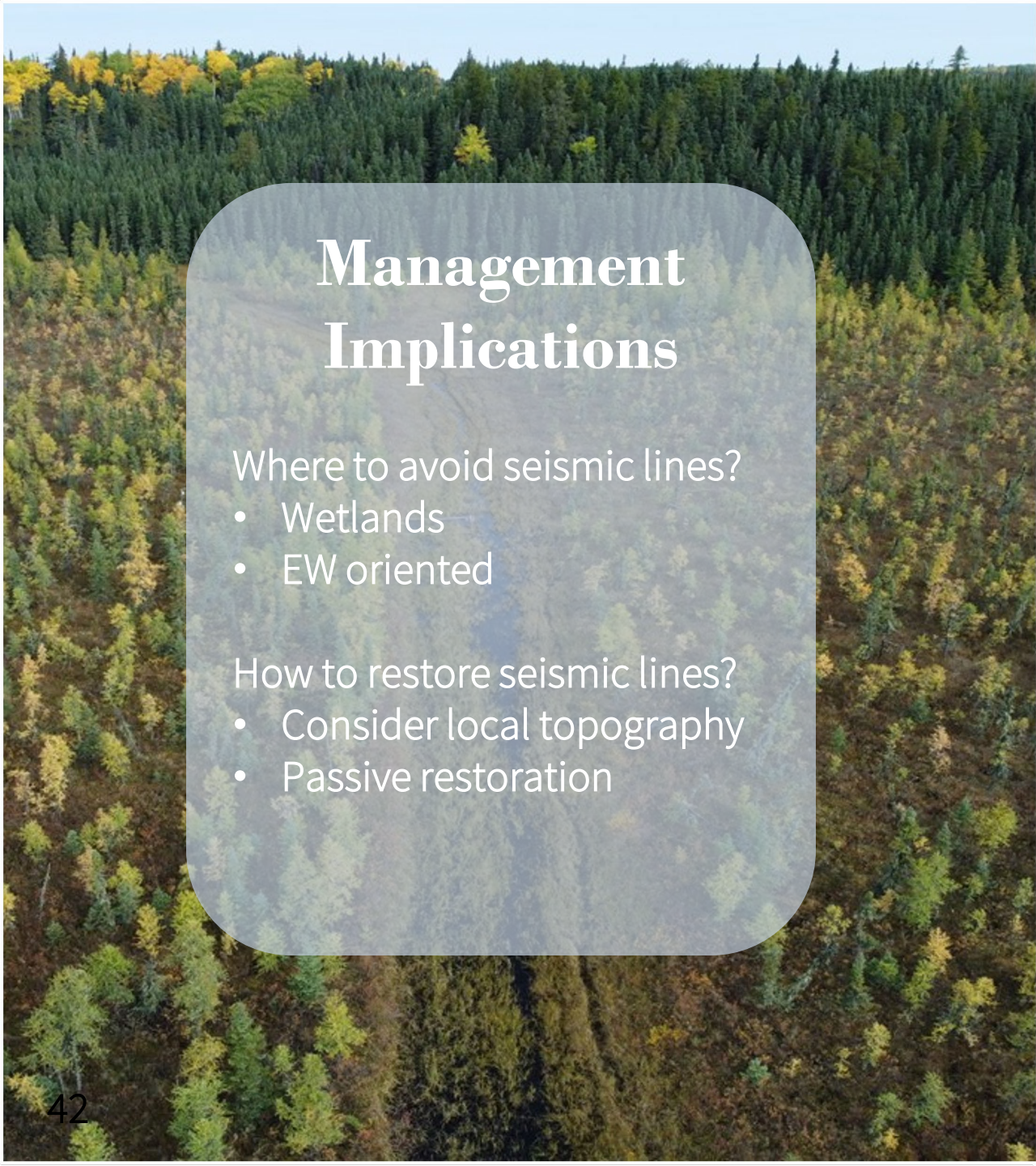
Soil Samples at each well

Triplicate at
center (Mulch, 0-5 &
10-15)

Duplicate in
natural (0-5 & 10-15)





An aerial photograph of a forest. The trees are mostly green, but there are patches of yellow and orange, suggesting autumn. The forest is dense and covers a large area.

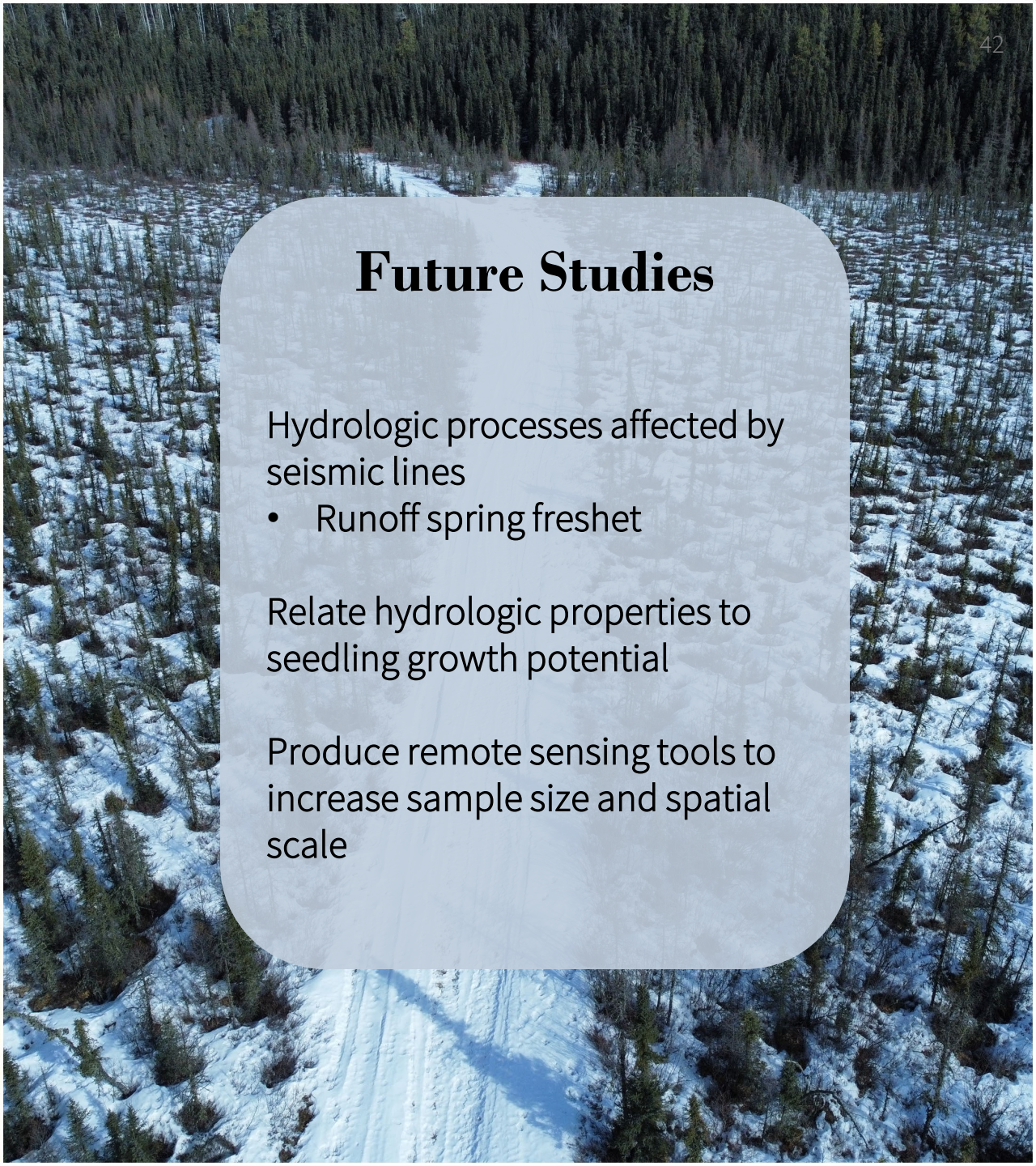
Management Implications

Where to avoid seismic lines?

- Wetlands
- EW oriented

How to restore seismic lines?

- Consider local topography
- Passive restoration

An aerial photograph of a snowy forest landscape. The ground is covered in snow, and there are many small, dark evergreen trees scattered across the area. In the background, there is a denser forest of taller trees.

Future Studies

Hydrologic processes affected by seismic lines

- Runoff spring freshet

Relate hydrologic properties to seedling growth potential

Produce remote sensing tools to increase sample size and spatial scale