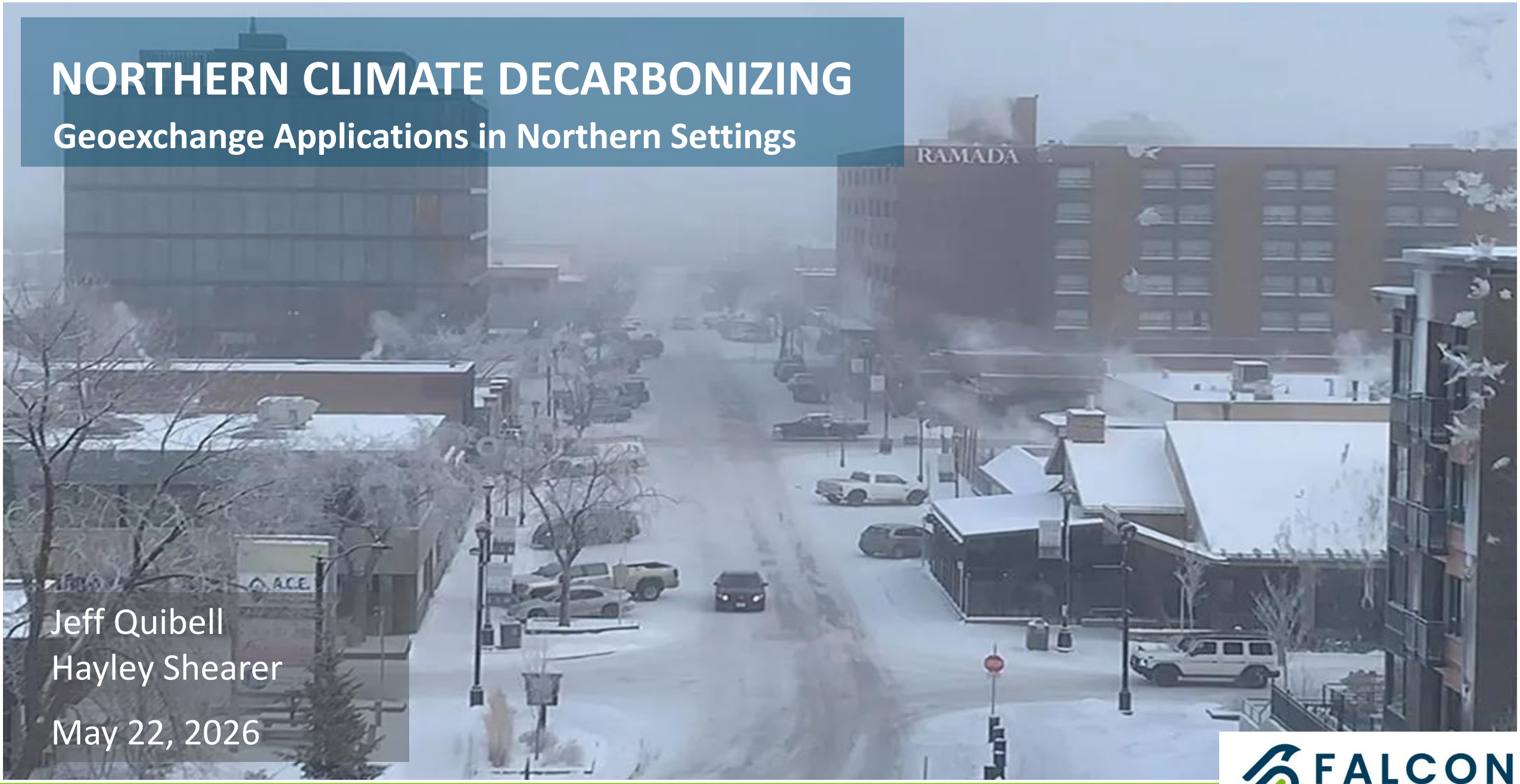
NORTHERN CLIMATE DECARBONIZING

Geoexchange Applications in Northern Settings



Jeff Quibell
Hayley Shearer

May 22, 2026

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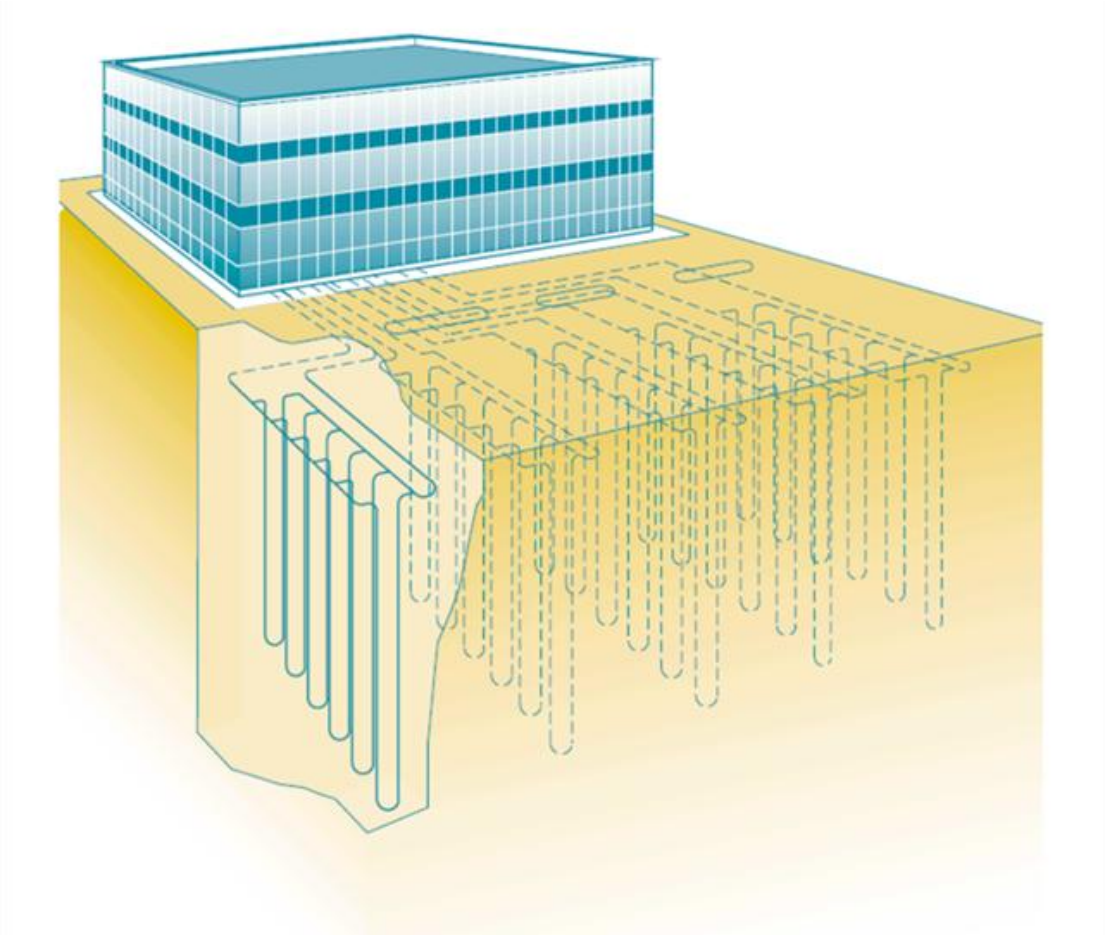
Objectives Today

1. Climate zones – BC distribution
2. Challenges to decarbonize in northern climates
3. Geoexchange heat pumps…..***Ultimate Cold Climate Heat Pumps***
4. Design adaptations for harsh climates
5. Misperceptions
6. Obstacles and pathways to overcome

Geoexchange Fundamentals

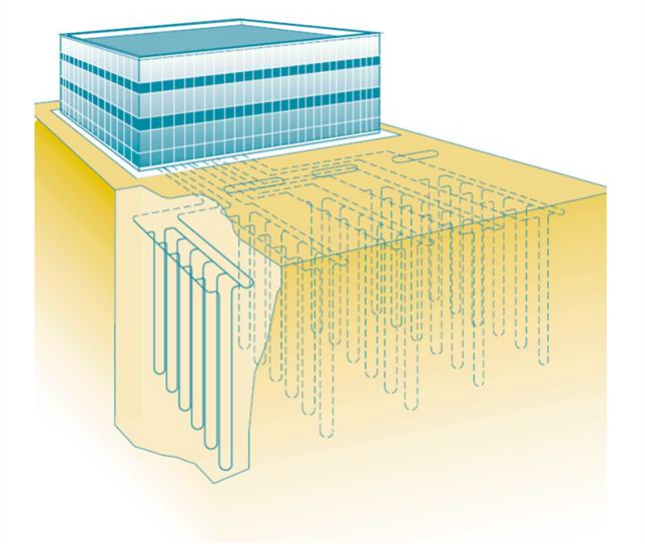


Source: Natural Resources Canada

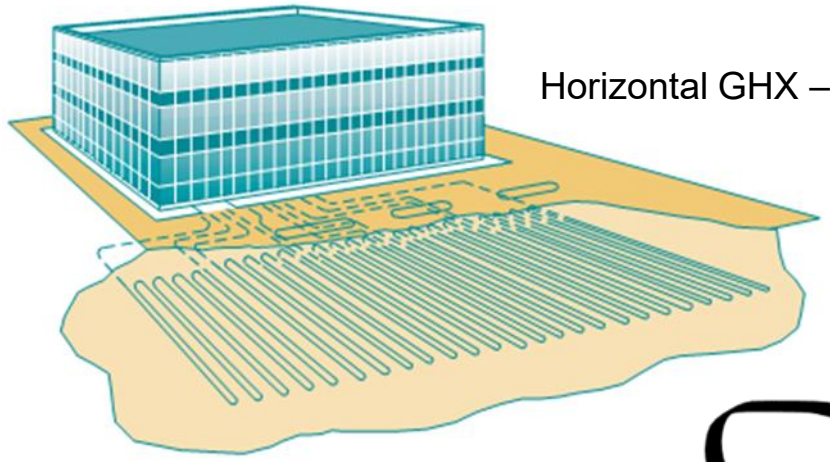
Terms

- Geoexchange
- Geothermal
- Ground Source Heat Pump (GSHP)
- Earth Energy Systems

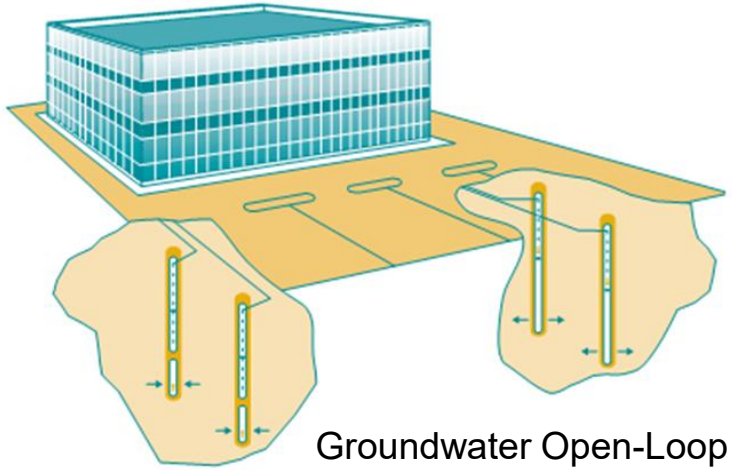
Common Forms of Geoexchange GHX



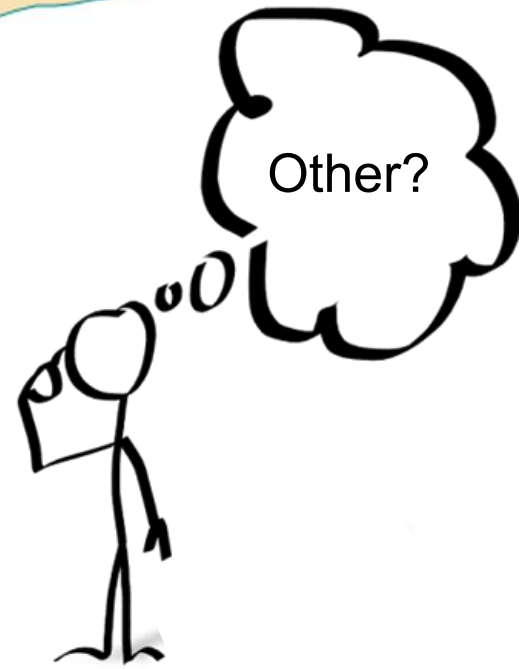
Vertical Borehole GHX – Most Common



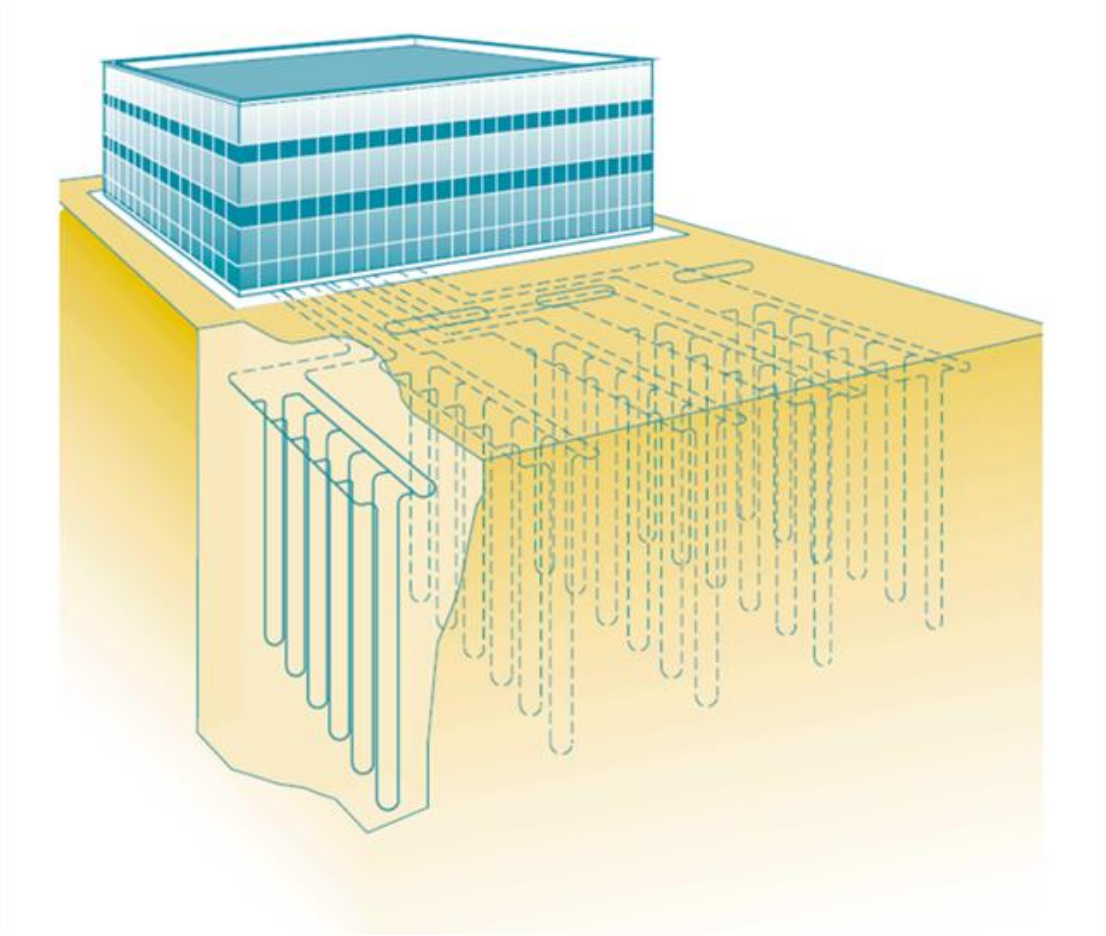
Horizontal GHX – Less Common



Groundwater Open-Loop GHX – Site-Specific



Geoexchange Fundamentals

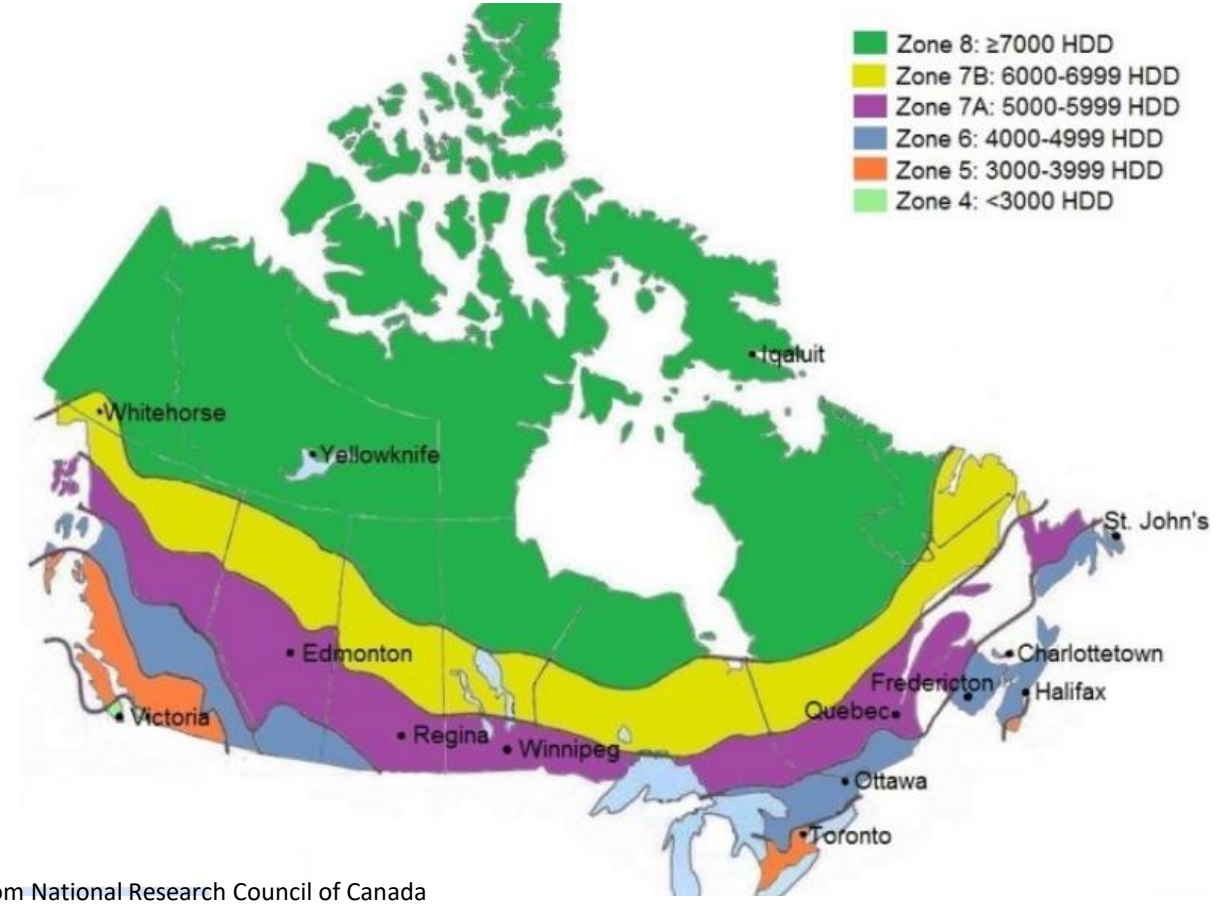


Source: Natural Resources Canada

Attractive Features

- Avoided noise, improved architectural aesthetics
- Season-to-season energy store
- District-scale energy leveraging benefits
- Very efficient – including extreme conditions
- ***Ultimate Cold Climate Heat Pump***

Big Nation… *Lots of Harsh Climate*



Adapted from National Research Council of Canada

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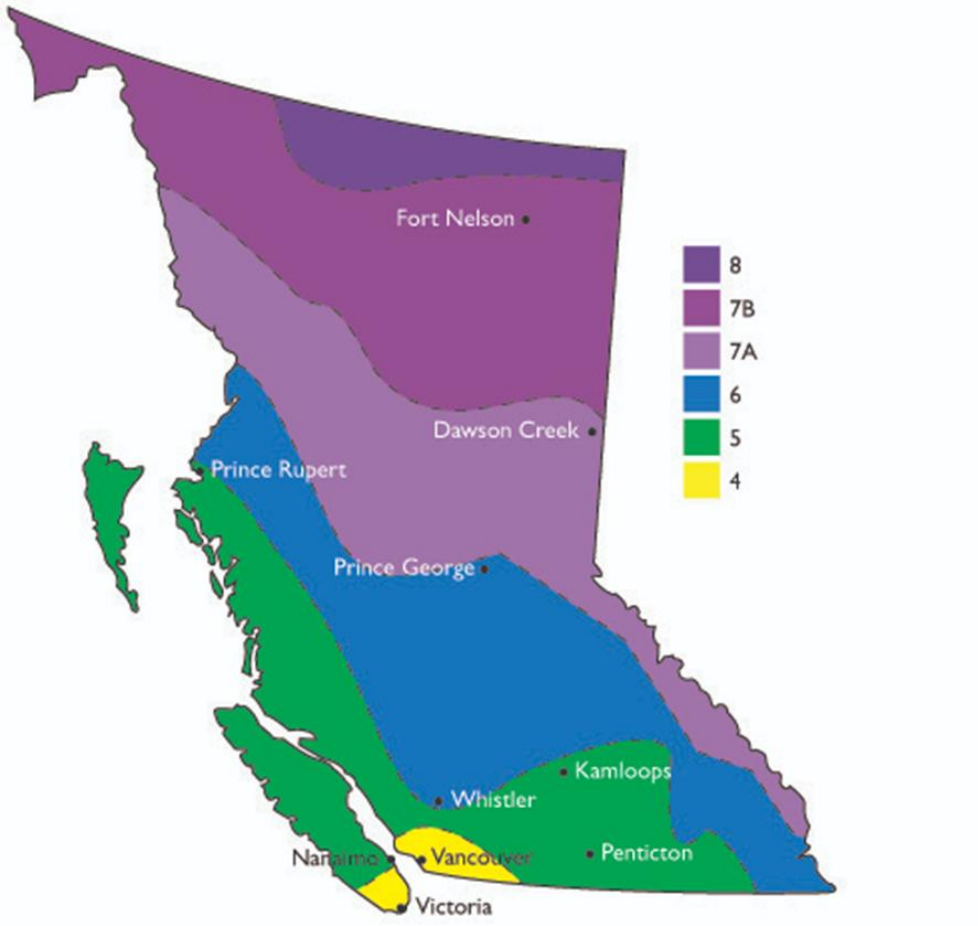
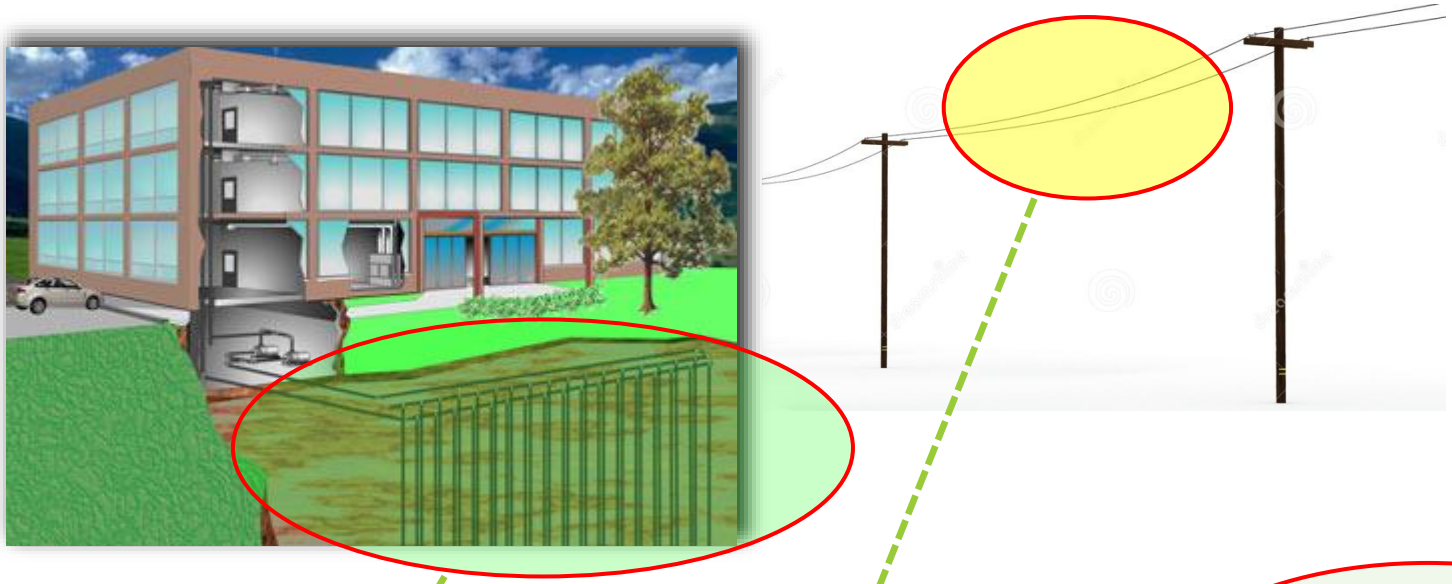
Big Province… *Lots of Harsh Climate*



Adapted from National Research Council of Canada

Leveraging Ratio - Coefficient of Performance (COP)



3 units
Renewable heat
absorbed from ground

+

1 unit
electricity
from utility

=

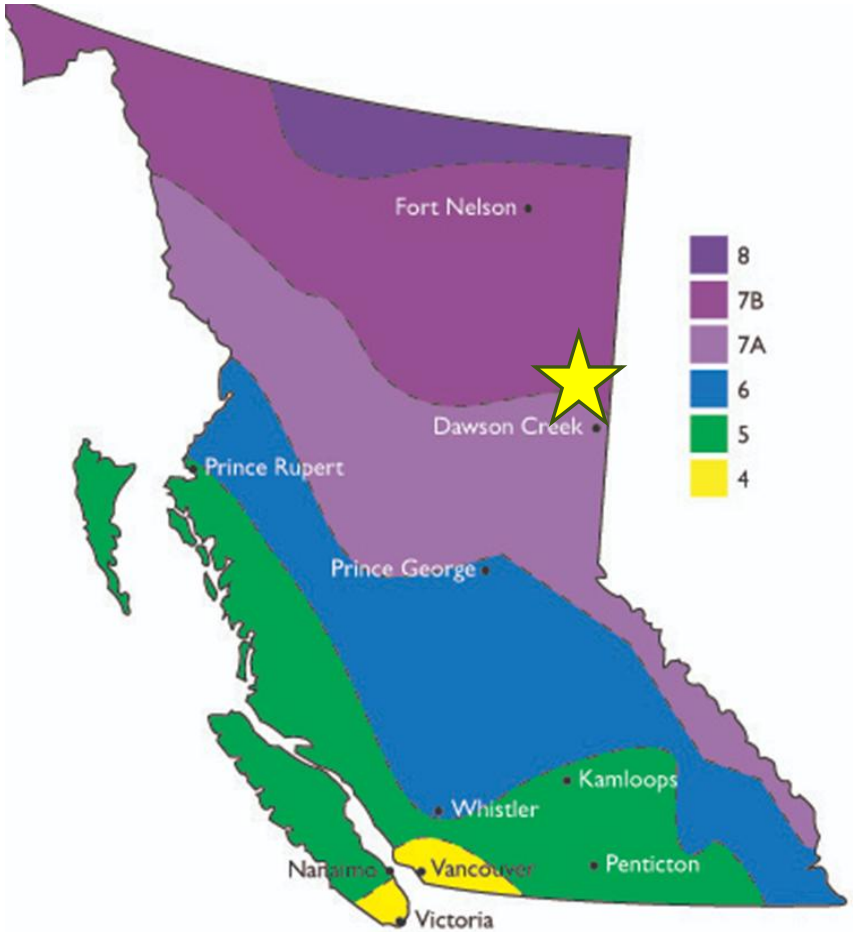
4 units
Heat Delivered to
Building

$$\text{Coefficient of Performance} = \frac{\text{Heat Delivered (4.0 units)}}{\text{Electricity Used (1.0 unit)}} = 4.0$$

Retrofit GeoX Upgrade - Northern BC

Ecole Frank Ross Elementary, Dawson Creek, BC

- 5,100 m^2
- 210 kW Geoexchange Heat Pump System
- 1950s era original wing, 1960s era addition



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Ecole Frank Ross Elementary, Dawson Creek, BC

Utility Data	Actual GeoX 2022	Pre-Retrofit Comparison
Natural Gas	11 kWh/m^2	215 kWh/m^2
Electricity	79 kWh/m^2	44 kWh/m^2
Combined Gas + Elec	90 kWh/m^2	259 kWh/m^2
GHG Emissions (CO_2e)	14.2 tonnes/yr	198.5 tonnes/yr
Energy Savings	$18,300/yr	-
Avoided GHG Emissions	184 tonnes/yr	-

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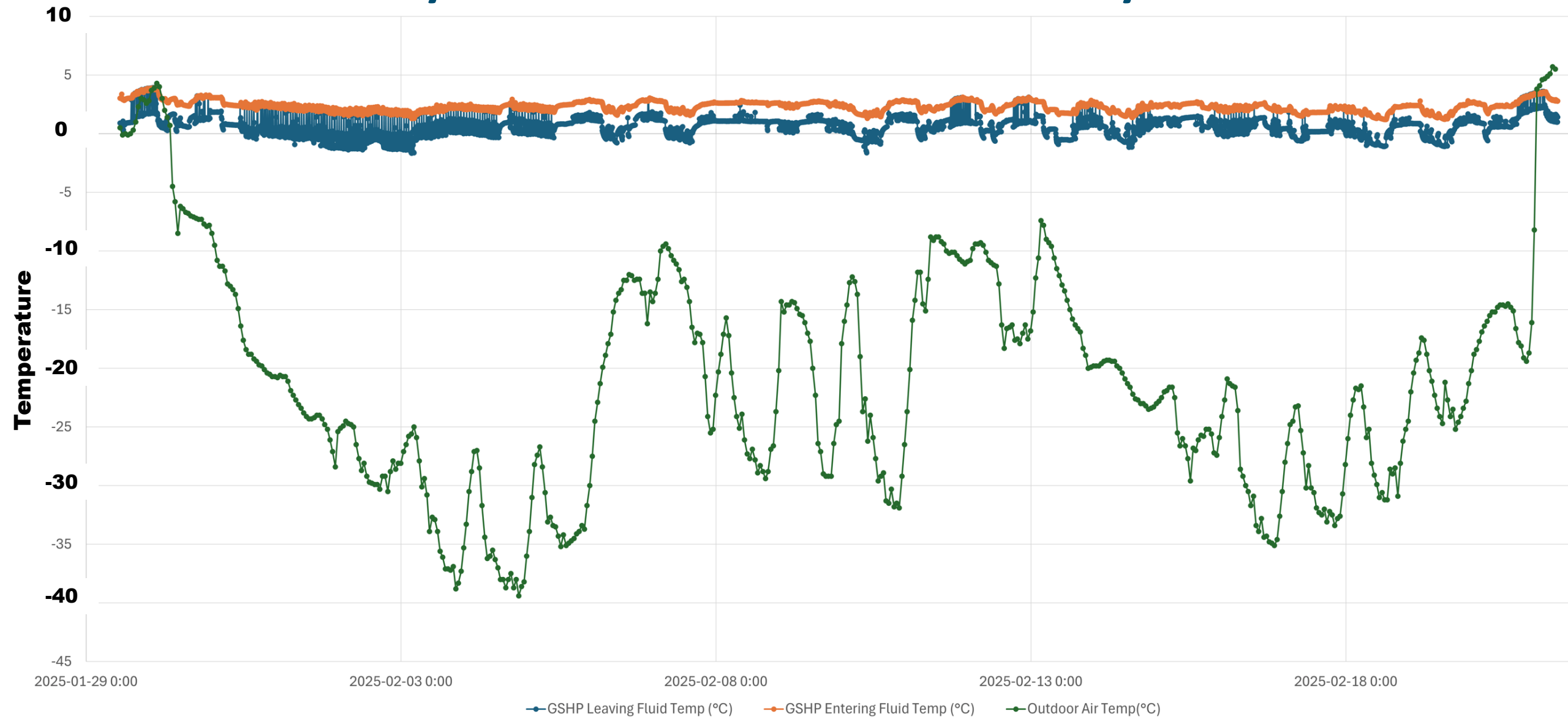
Ecole Frank Ross – School District 59 – Dawson Creek BC
20-day Cold Weather Period - February 2025

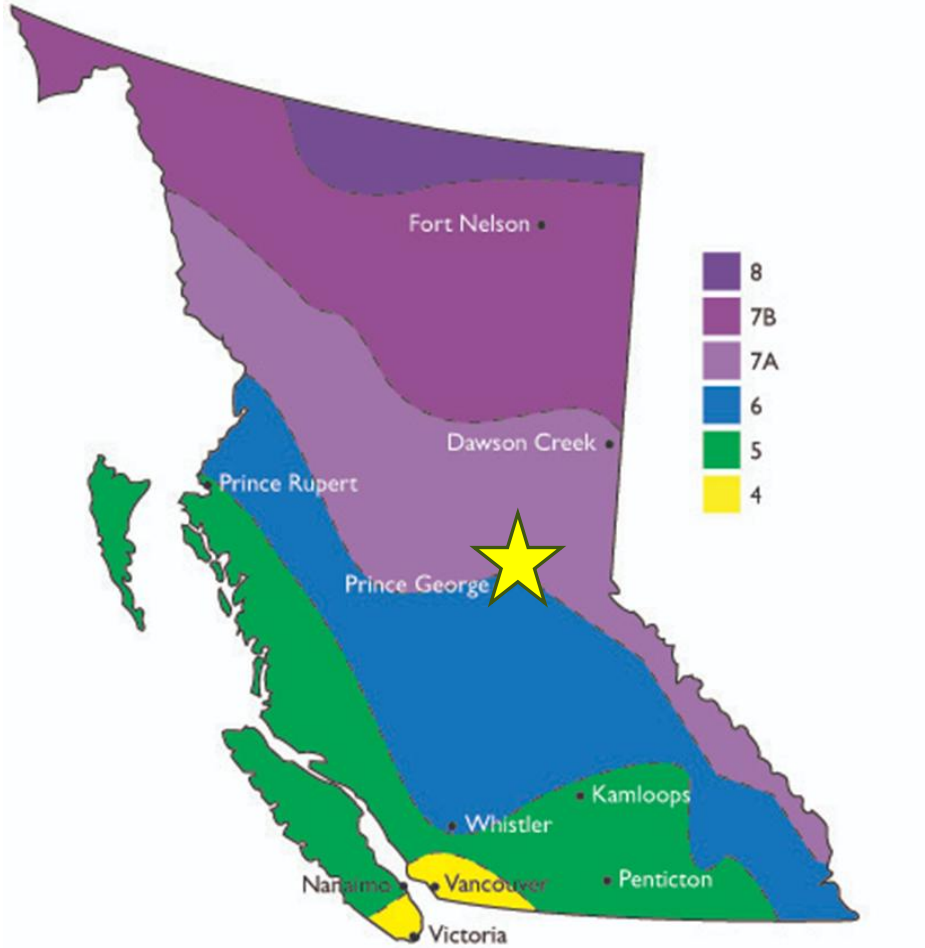


New Build School - Northern BC

Shas Ti Kelly Road Secondary School, Prince George, BC

- 9,595 m^2
- 280 kW Geoexchange Heat Pump System

Source: HMCA Architecture, SD57



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Shas Ti Kelly Road Secondary School, Prince George, BC

Utility Data	Actual GeoX 2021	Conventional Comparable
Natural Gas	7 kWh/m^2	110 kWh/m^2
Electricity	68 kWh/m^2	110 kWh/m^2
Combined Gas + Elec	75 kWh/m^2	220 kWh/m^2
GHG Emissions (CO_2e)	19.7 tonnes/yr	201 tonnes/yr
Energy Savings	$83,600/yr	-
Avoided GHG Emissions	181 tonnes/yr	-

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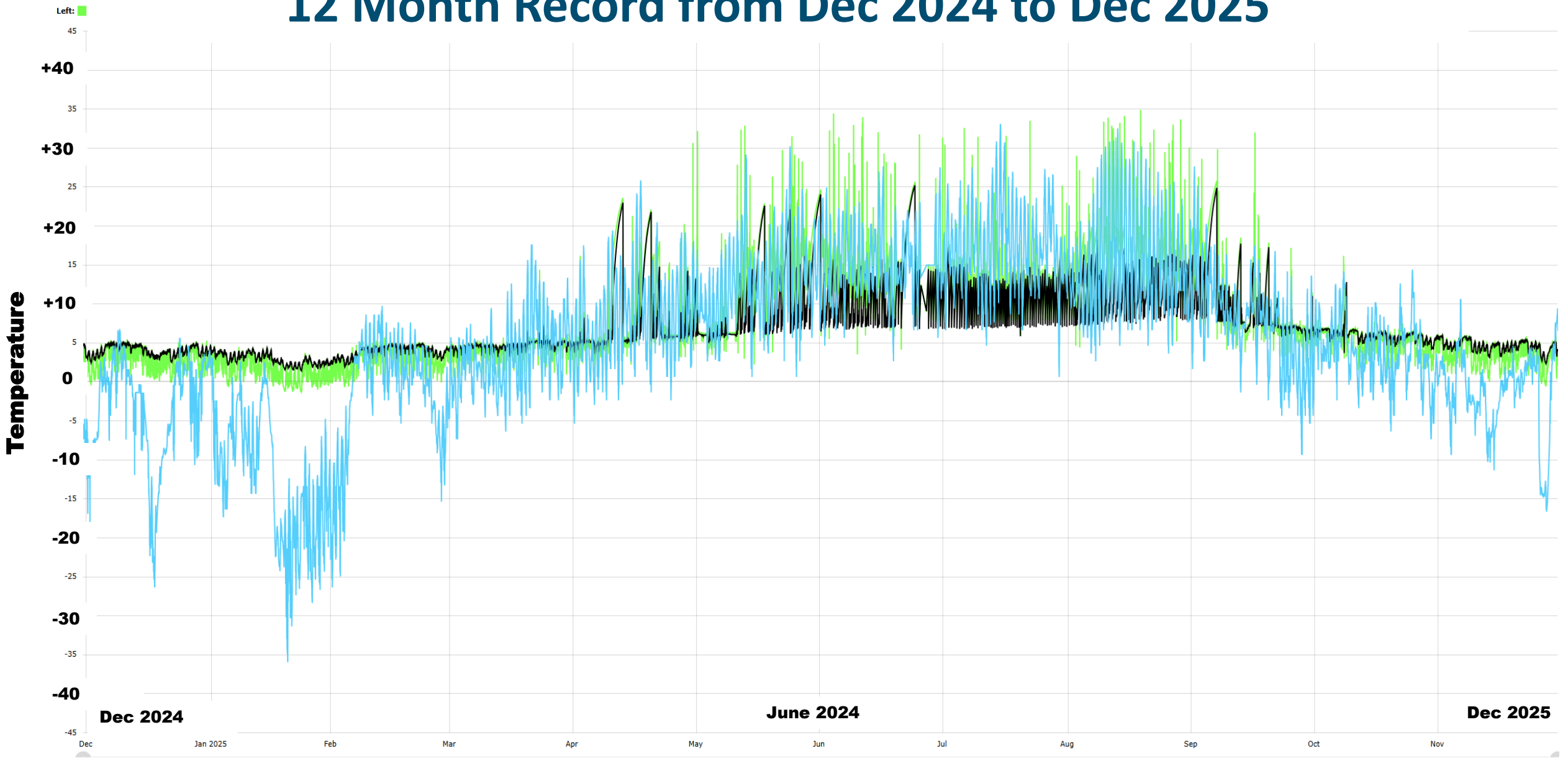
Shas Ti Kelly Road SS – School District 57 – Prince George, BC
12 Month Record from Dec 2024 to Dec 2025



Preview of Site Tour Conversation Topics
Shas Ti Kelly Road School

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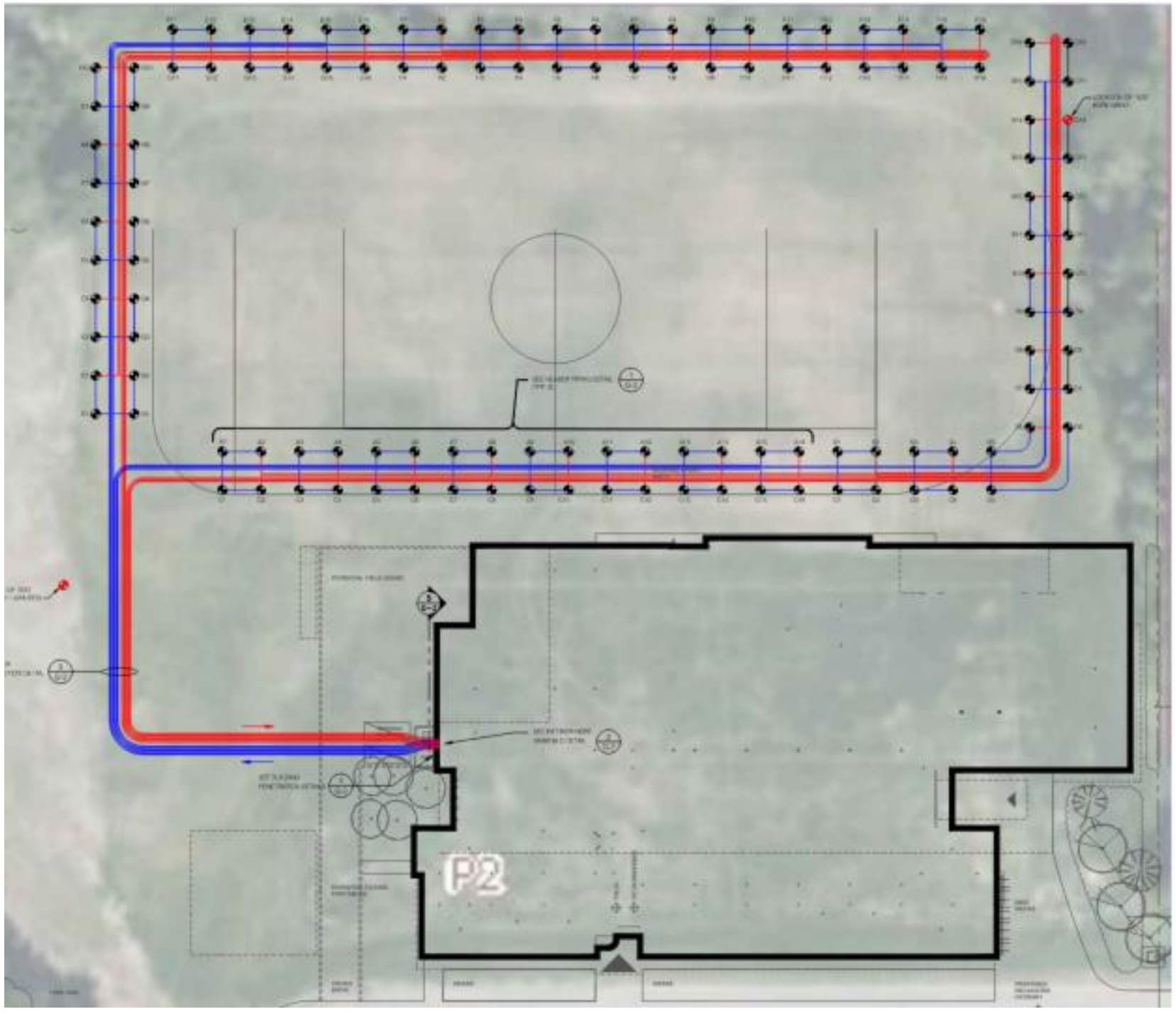
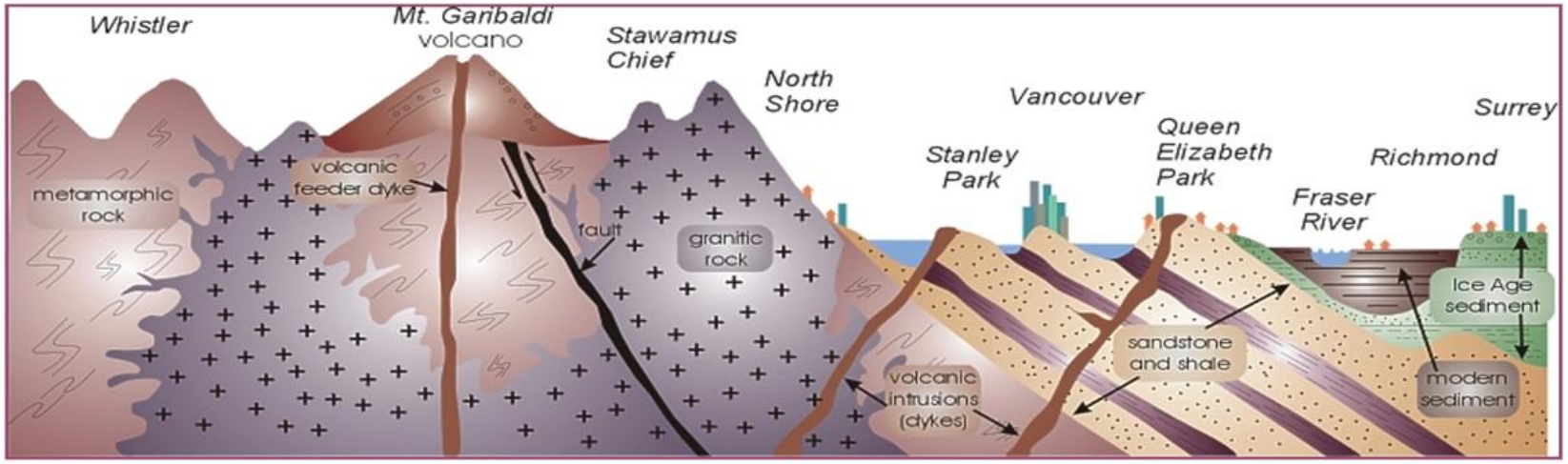
Cold Climate Design Considerations

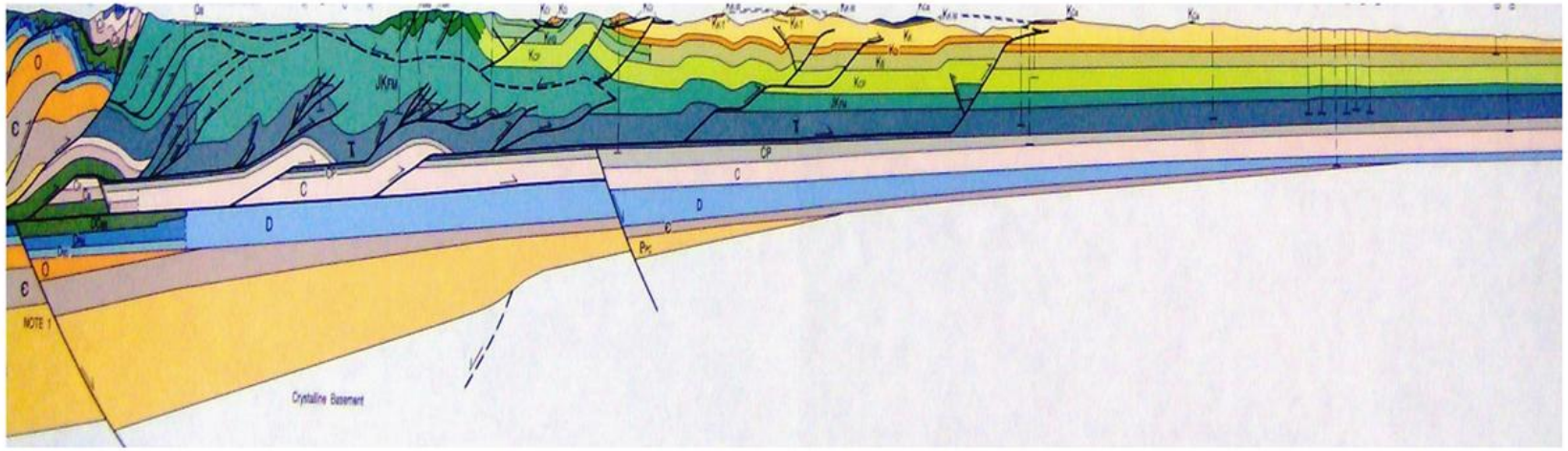
Shas Ti Kelly Road Secondary School
Prince George, BC

- Another example of elongated borehole layout for improved performance



BC Geology Settings – Adapt Designs to Suit Settings



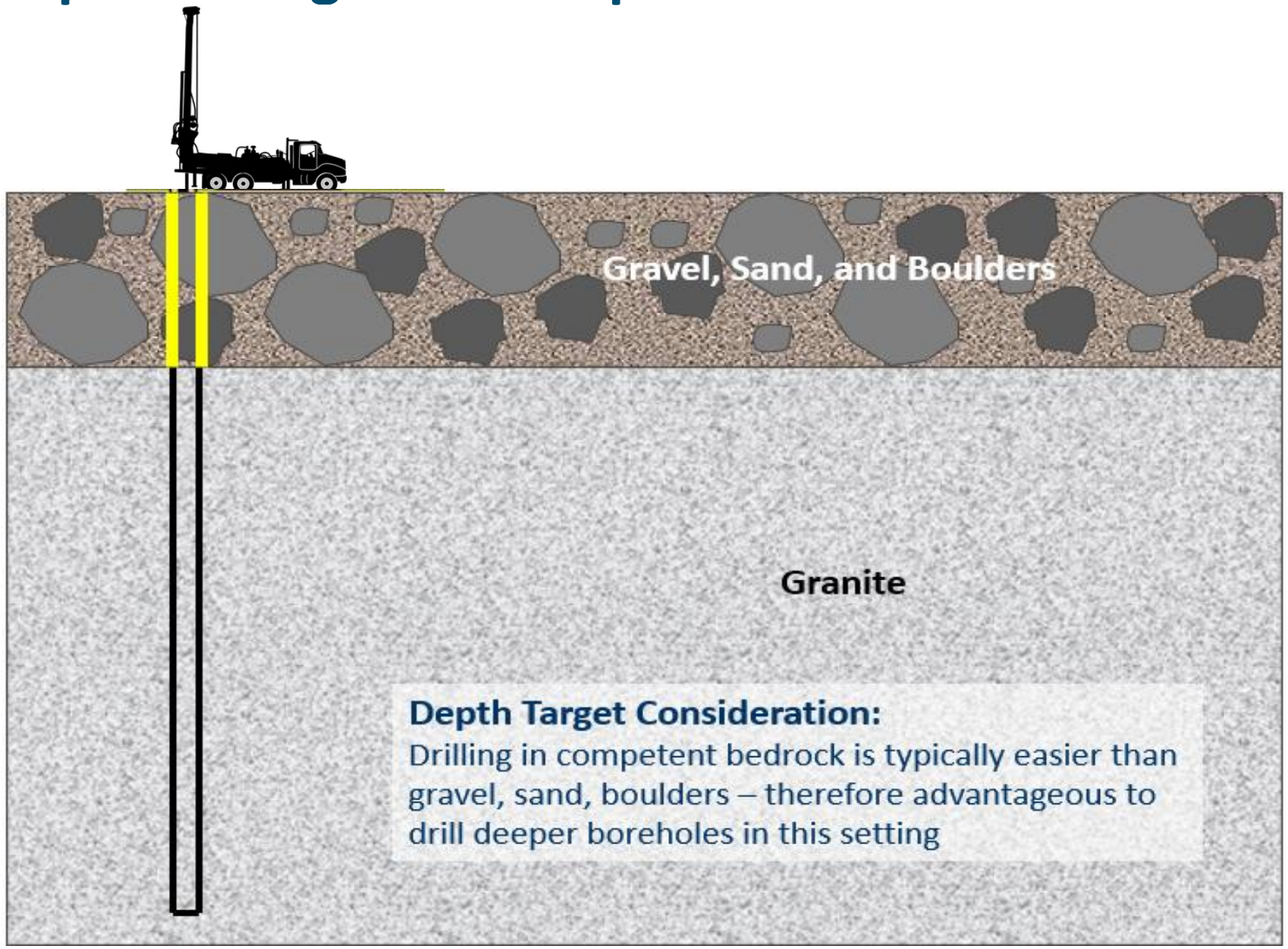


Rocky Mountain Front Ranges | Foothills | Prairies

Constructability Adapted Designs – Example 1

- Informed
- Practical
- Cost-effective

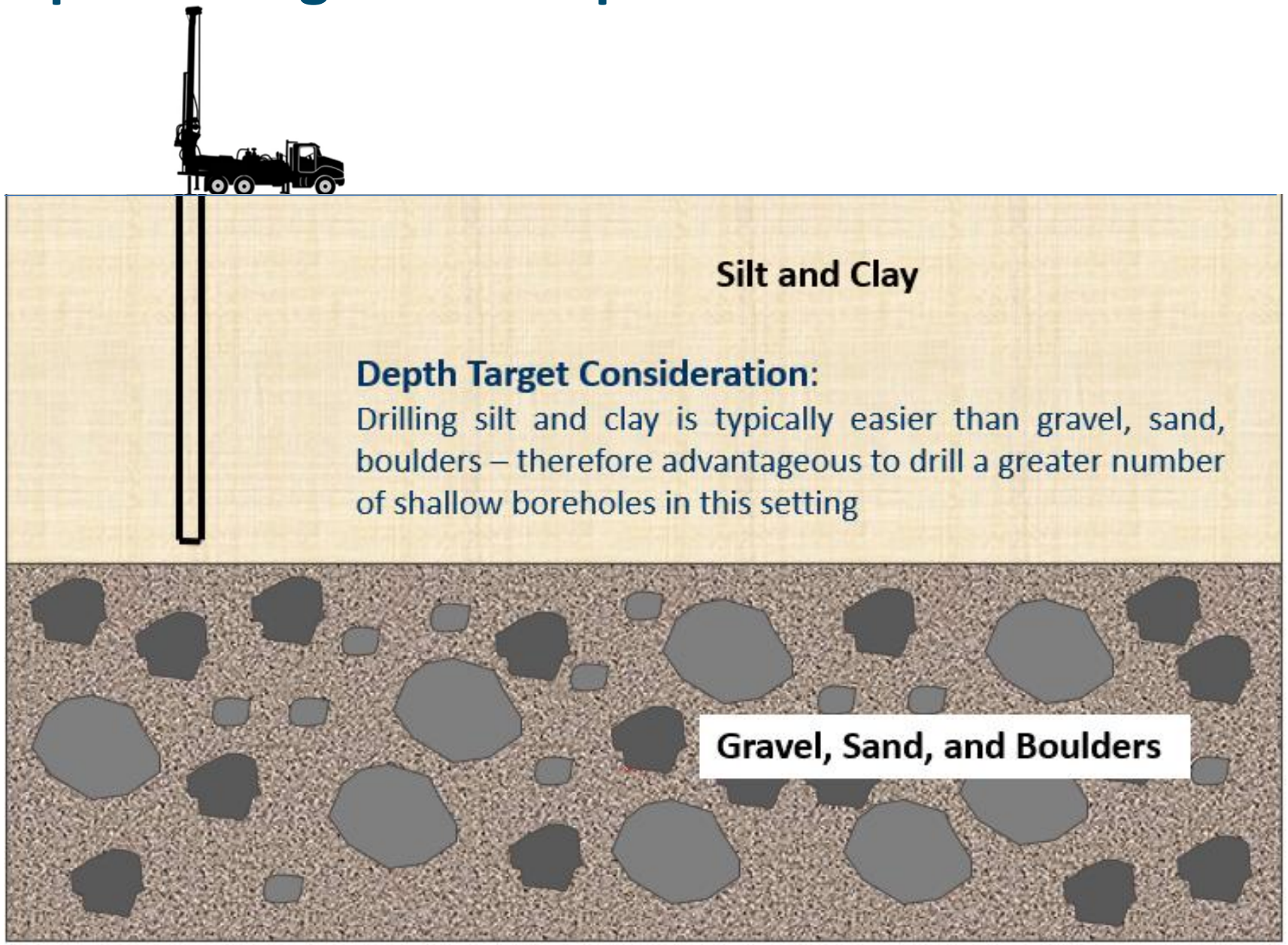
In this scenario fewer number of deeper boreholes is favoured



Constructability Adapted Designs – Example 2

- Informed
- Practical
- Cost-effective

In this scenario greater number of shallower boreholes is favoured



Recap

- Geoexchange is suited in many settings for different reasons
- Exceptional cold climate performance leads to attractive suitability in northern regions – ***Ultimate Cold Climate Heat Pump***
- Demonstrated high-performance outcomes
- High-performance conditional on appropriately adapted designs

Take-aways:

1. Geoexchange warrants routine consideration in northern settings
2. Geoexchange has unique potential to significantly decarbonise heating in northern climates

Thank You!

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