

Seasonal Groundwater-Elevation Variations and Potentiometric Surfaces in the Tobacco Valley, near Eureka, Montana

AWRA 10/8/2025

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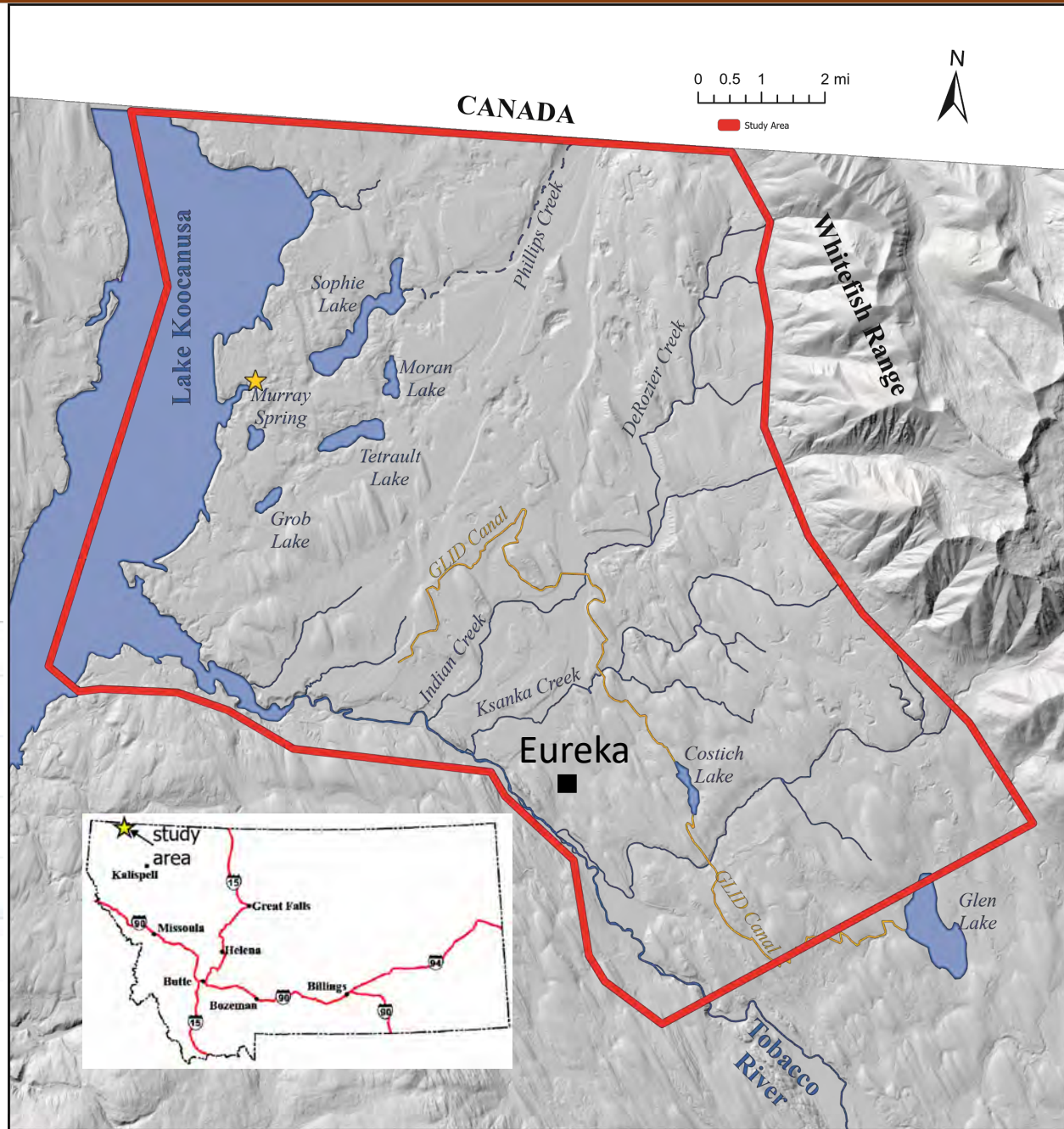
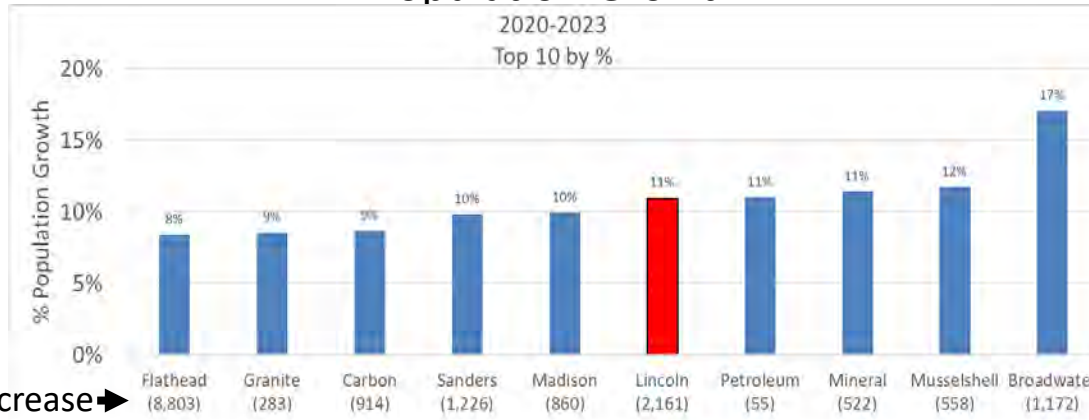
Introduction

- Tobacco Valley, Eureka MT
- Growing water demand and regulatory requirements drive the need to understand interactions between surface waters and the aquifer system.



Tobacco River

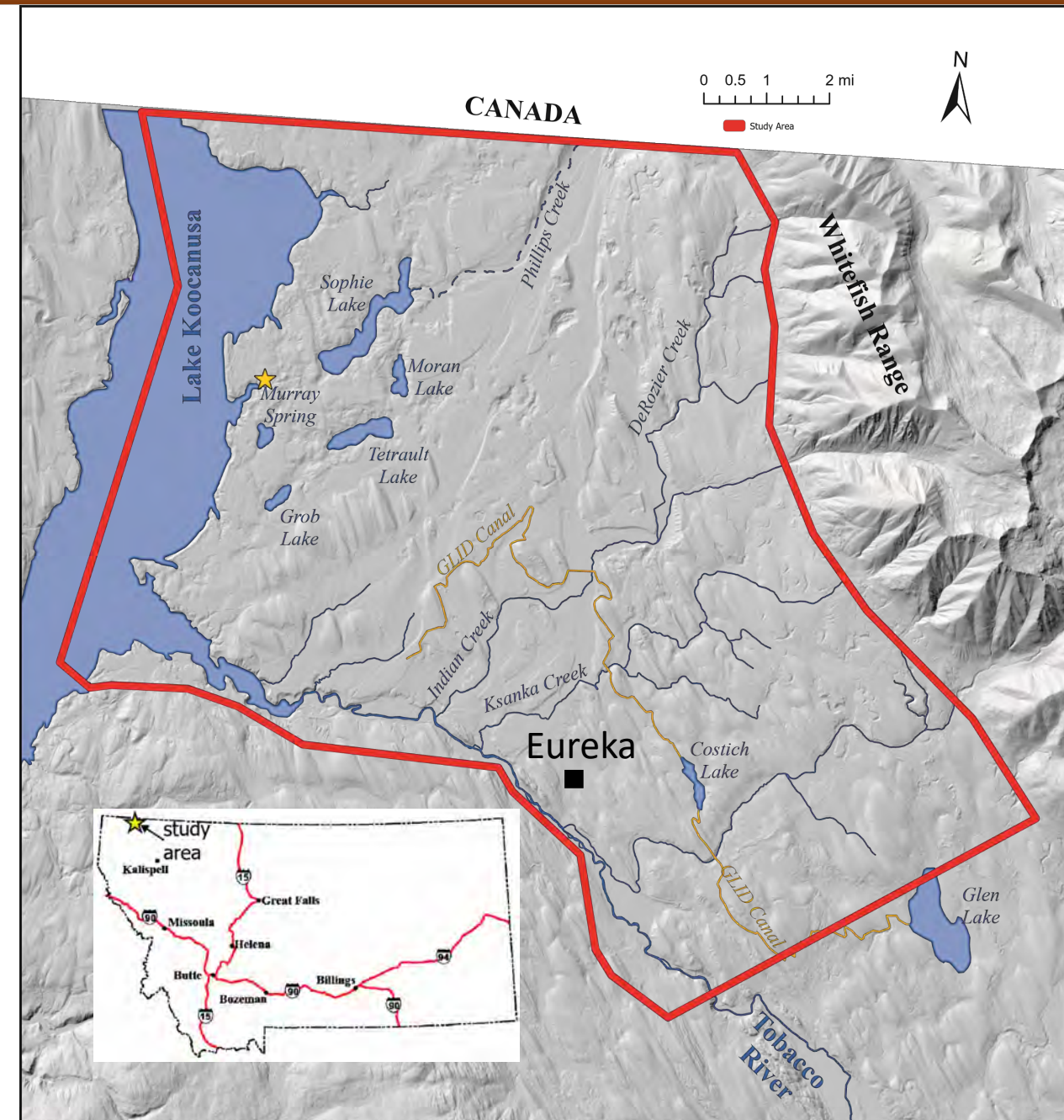
Population Growth



Provisional information not for distribution

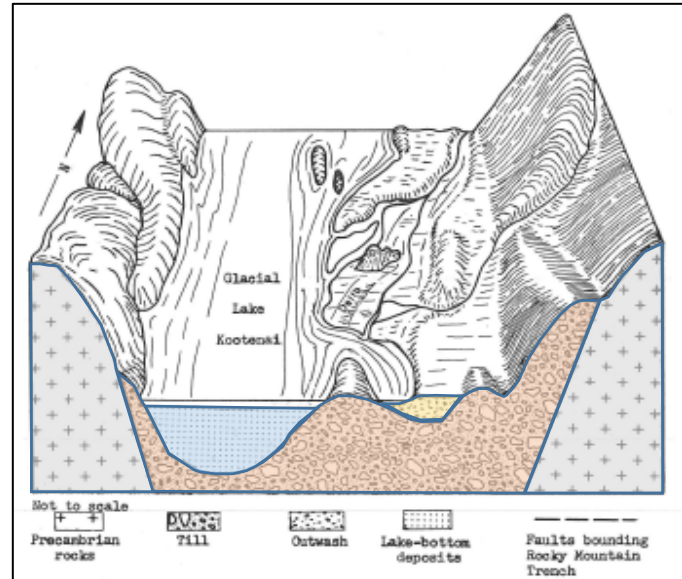
Groundwater Investigation

- Study by the Montana Bureau of Mines and Geology Ground Water Investigation Program (GWIP)
 - Fieldwork (WY 2023)
 - Groundwater and Surface-Water Monitoring
 - Drilling
 - Aquifer testing
 - Hydrological Report
 - Hydrogeologic Framework
 - Groundwater Budget
 - Groundwater Surface-Water Interactions
 - Seasonal Groundwater Elevations
 - Potentiometric Surface Maps
 - Groundwater Model

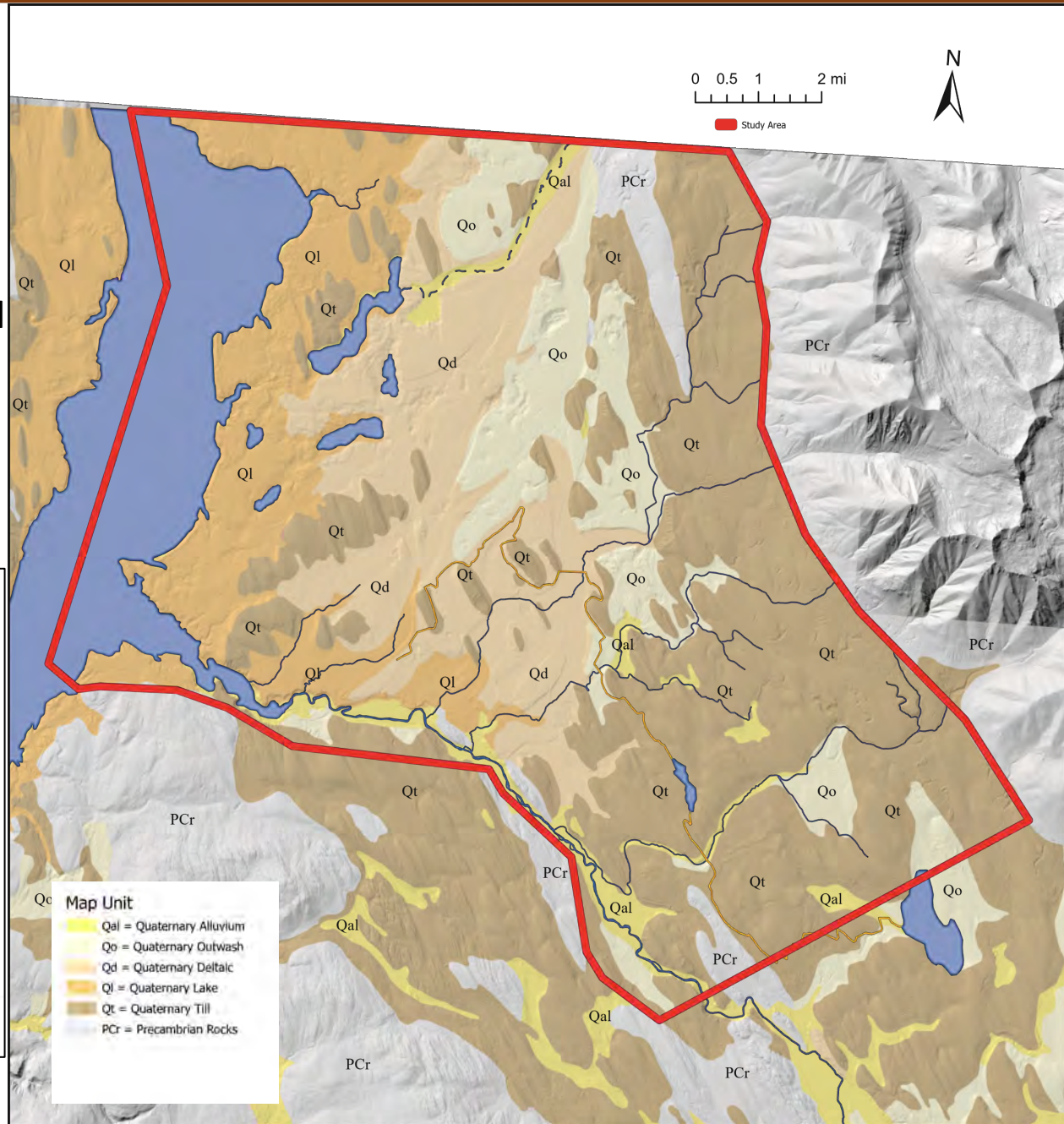


Background – Geologic Units

- Bedrock
- **Heterogeneous glacial sediments**
 - Basal till with sand and gravel lenses
 - Concurrent Deposition, with interfingering/ gradational contacts of:
 - Glacial outwash
 - Deltaic sediments
 - Lacustrine sediments
- Modern alluvium

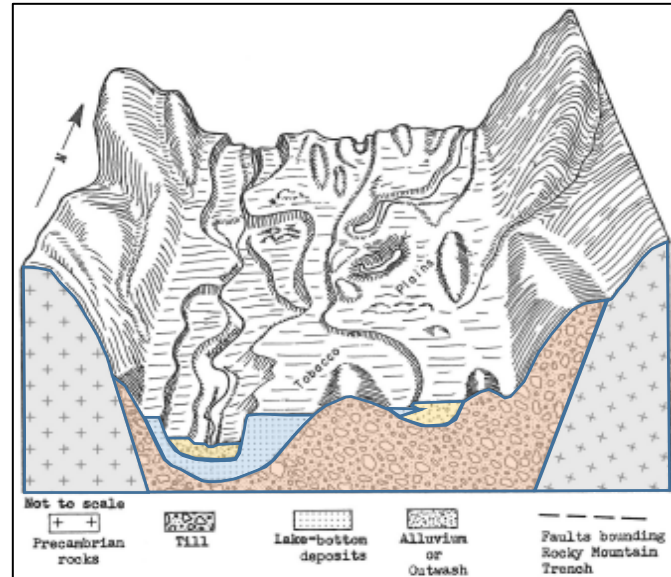


Coffin and others, 1971

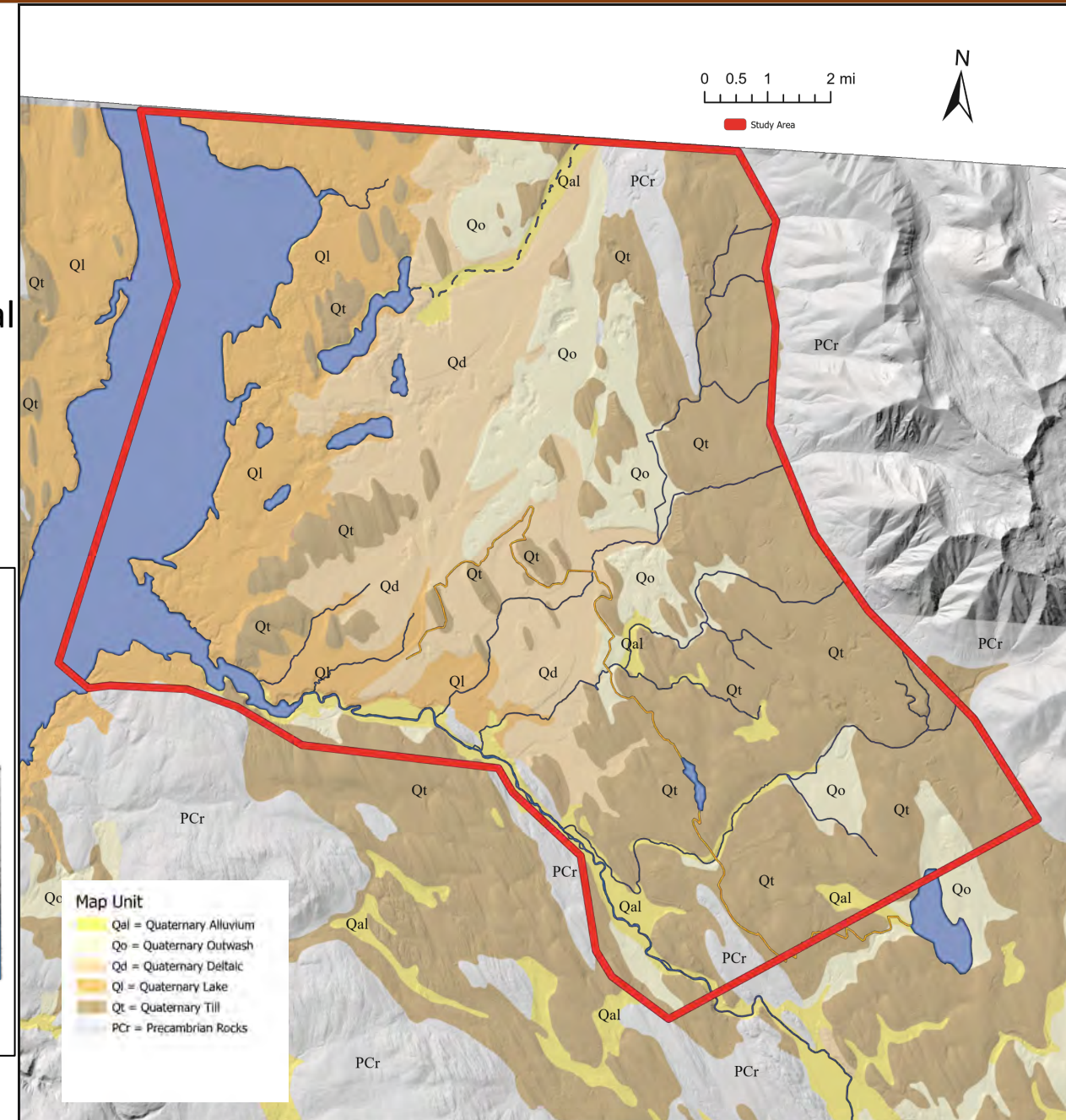


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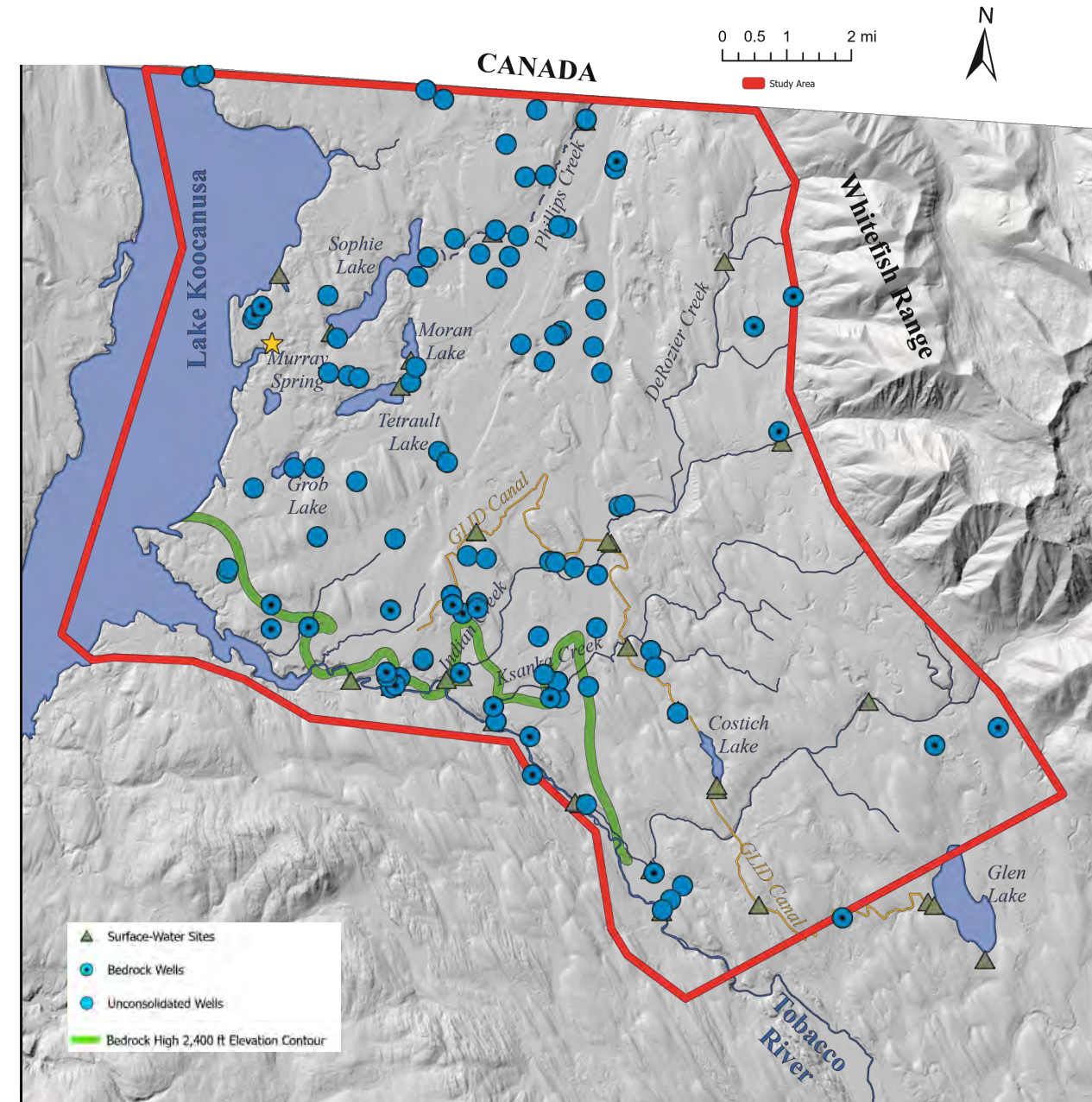


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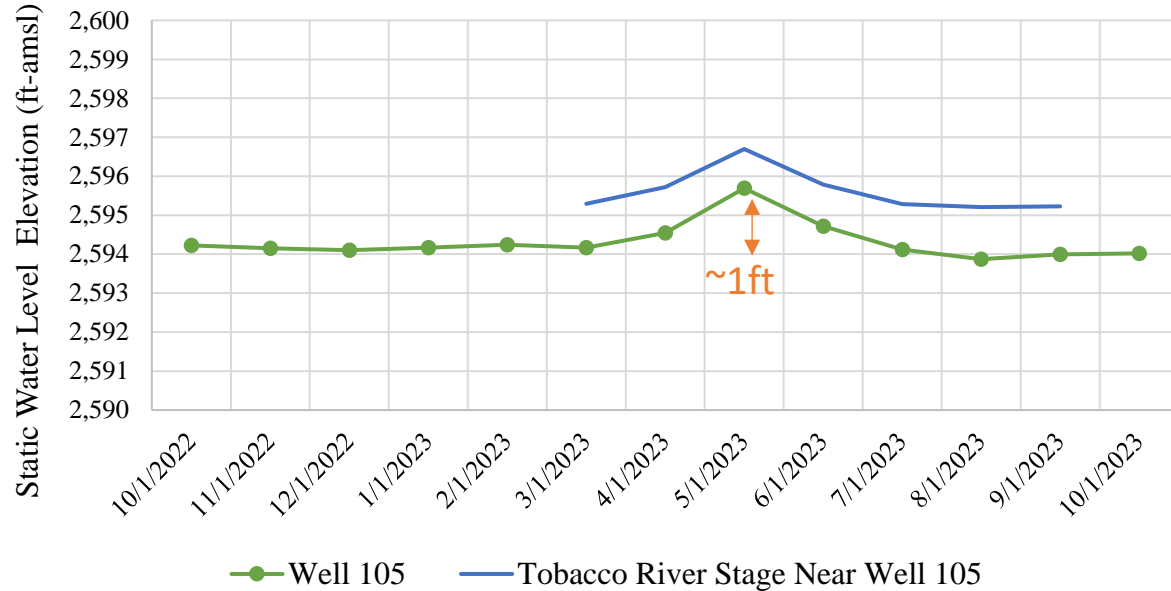
Hydrograph Signals

- Monitoring Network
 - 31 surface water sites
 - 105 wells
 - 29 completed in bedrock
 - 76 completed in unconsolidated deposits
 - Median total depth 220ft
- Monitoring well data was used to evaluate seasonal groundwater elevation patterns
 - We categorized these patterns into 6 hydrograph types or hydrograph signals
 - These signals illustrate aquifer responses to a stressor such as recharge and pumping
 - Results inform vertical/horizontal connectivity and provide insight for model calibration and management decisions

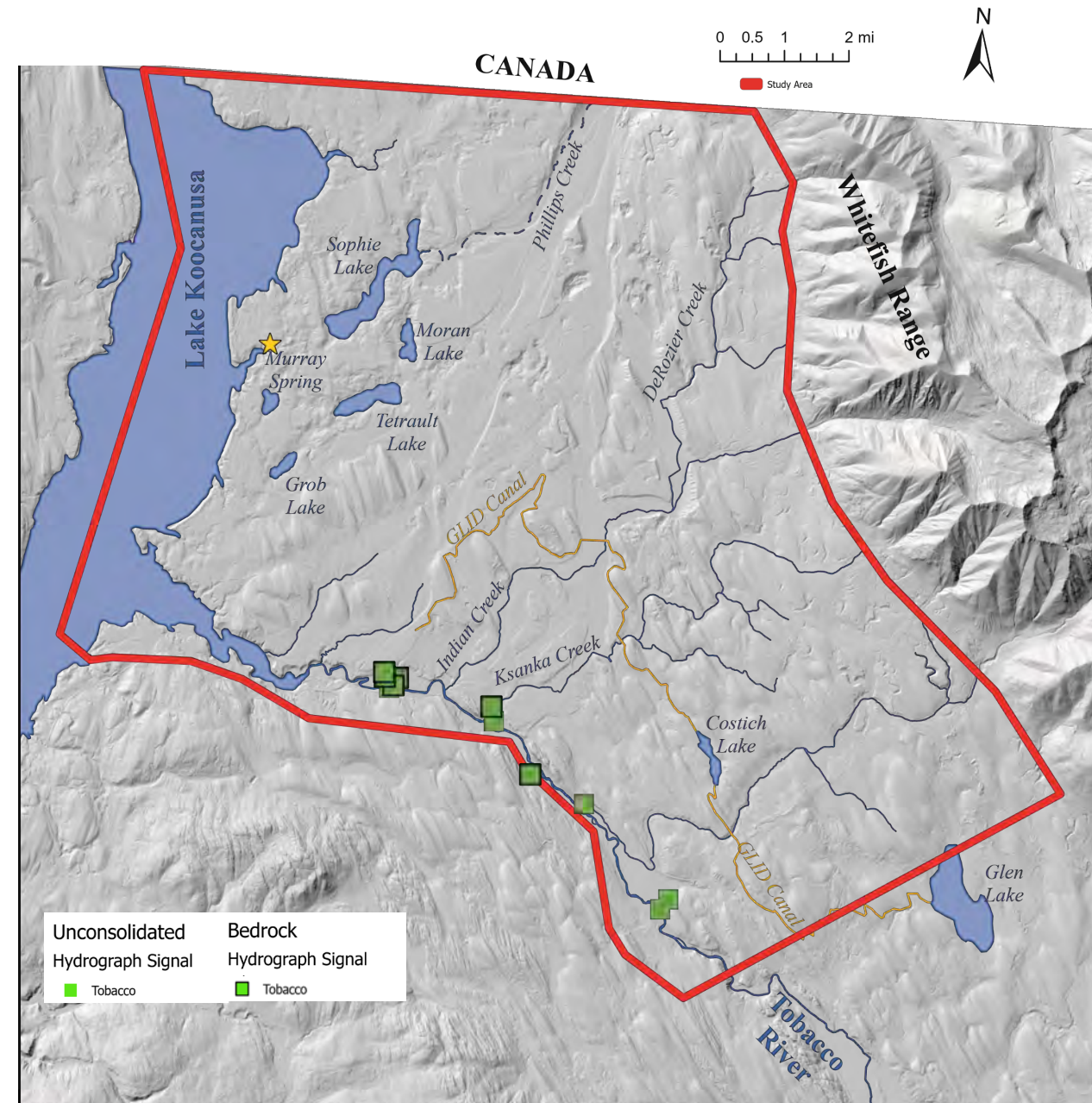


Hydrograph Signals – Tobacco River

Representative "Tobacco Signal" Hydrograph (well 105)

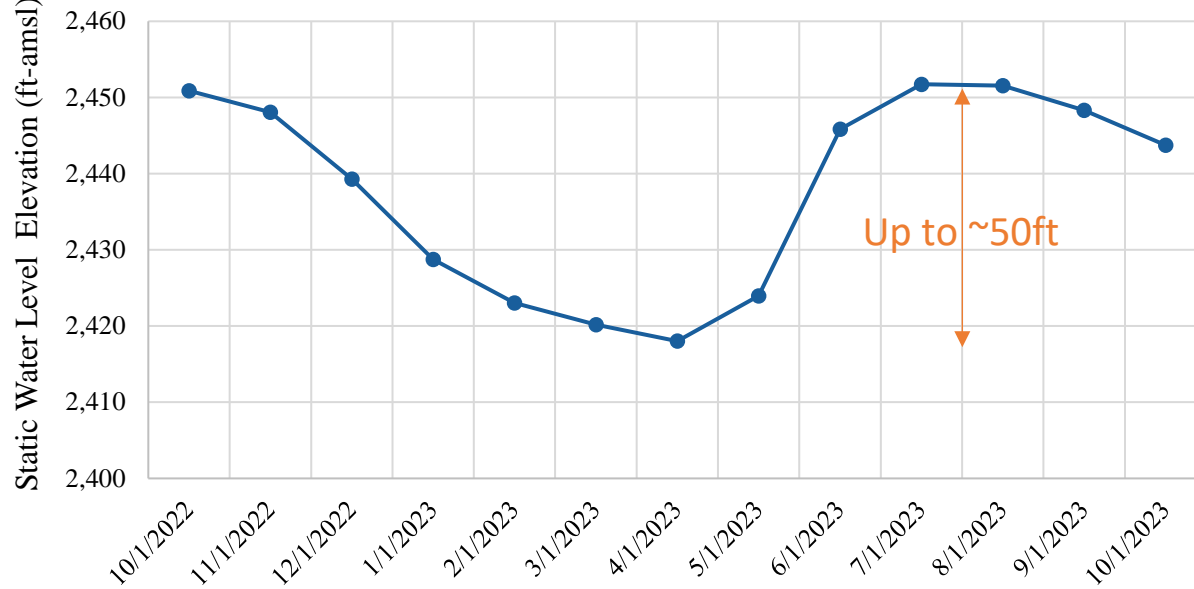


- Stressor: Tobacco River
- Discharge data collected at 5 sites along the Tobacco River shows it is strongly losing most months of the year.

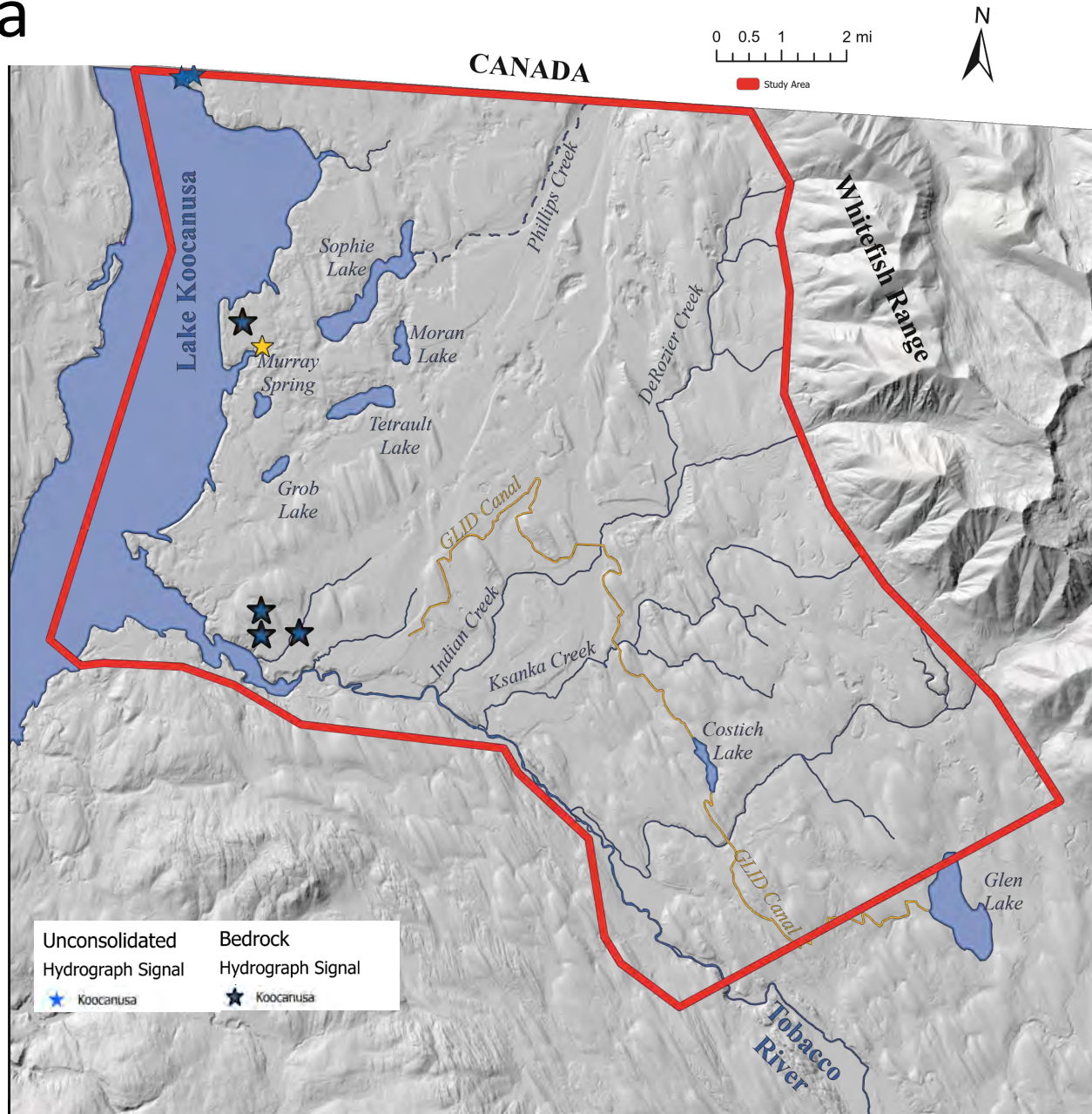


Hydrograph Signals – Lake Koocanusa

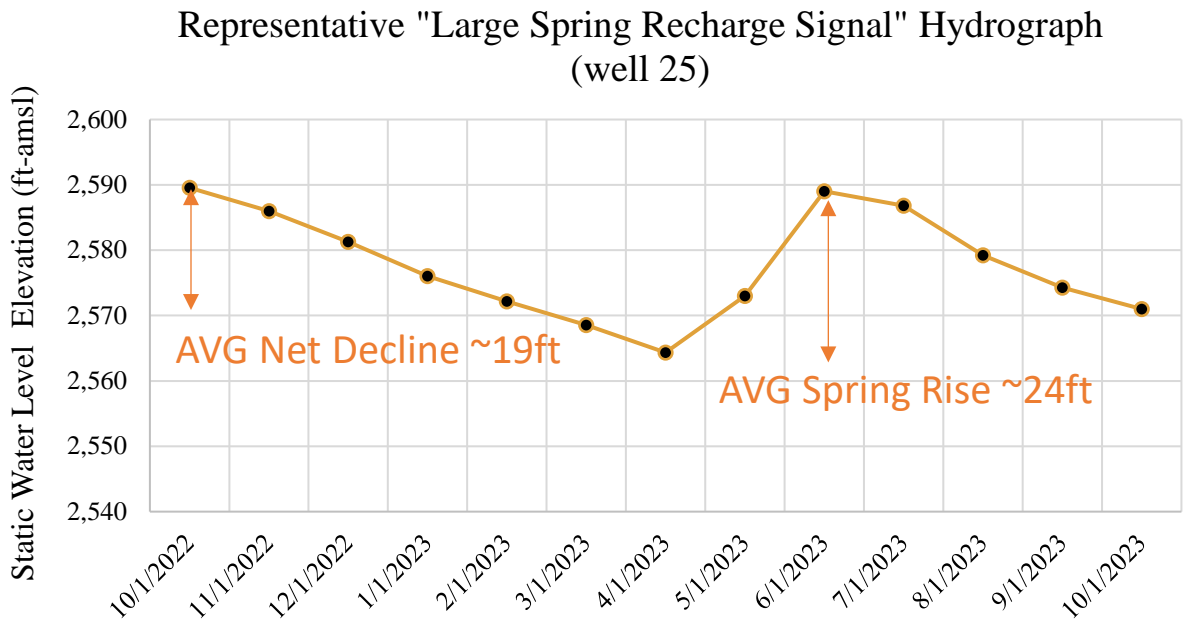
Representative "Lake Koocanusa Signal" Hydrograph (well 66)



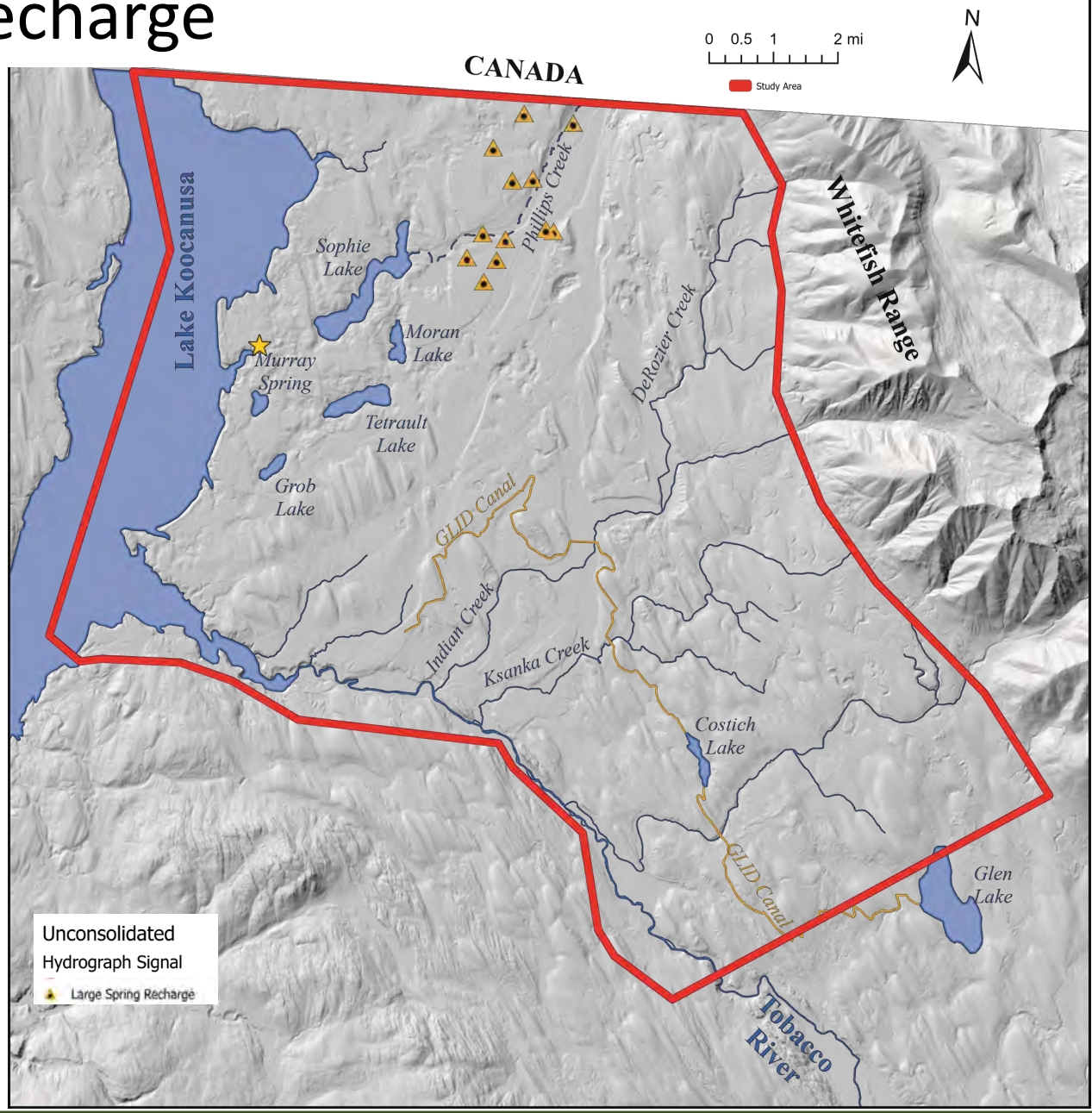
- Stressor: Lake Koocanusa
- Wells with large fluctuations (up to 50ft) mirroring reservoir operations



Hydrograph Signals – Large Spring Recharge

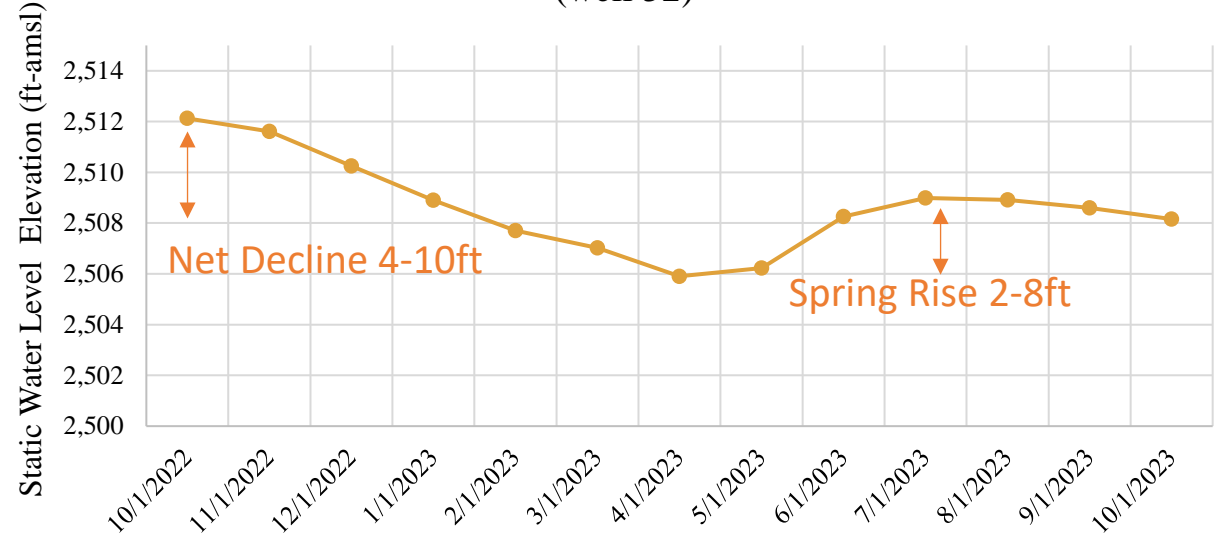


- Stressor: Phillips Creek and possibly groundwater underflow from Canada
- Clearest most defined signal

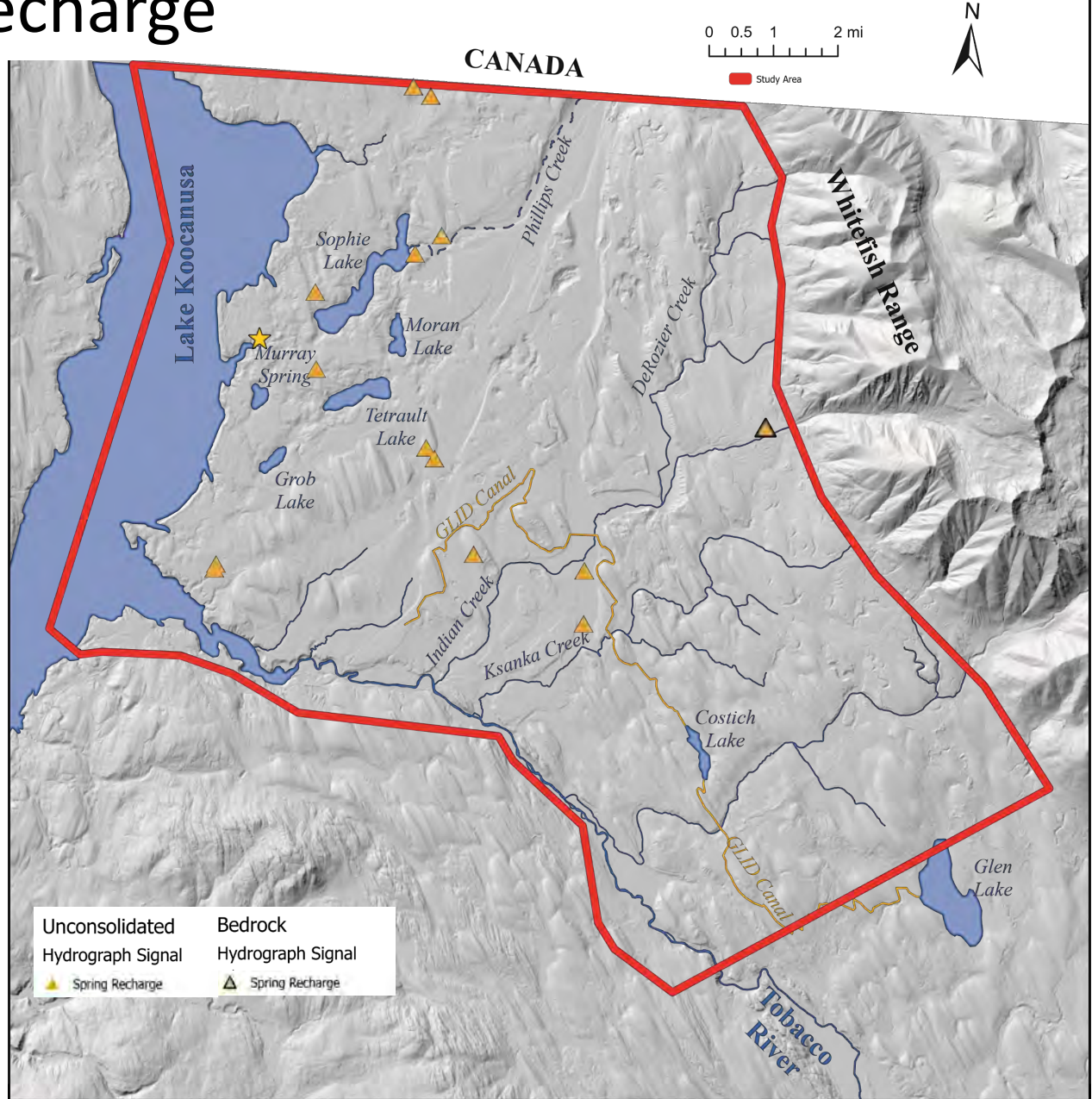


Hydrograph Signals – Small Spring Recharge

Representative "Small Spring Recharge Signal" Hydrograph (well 52)



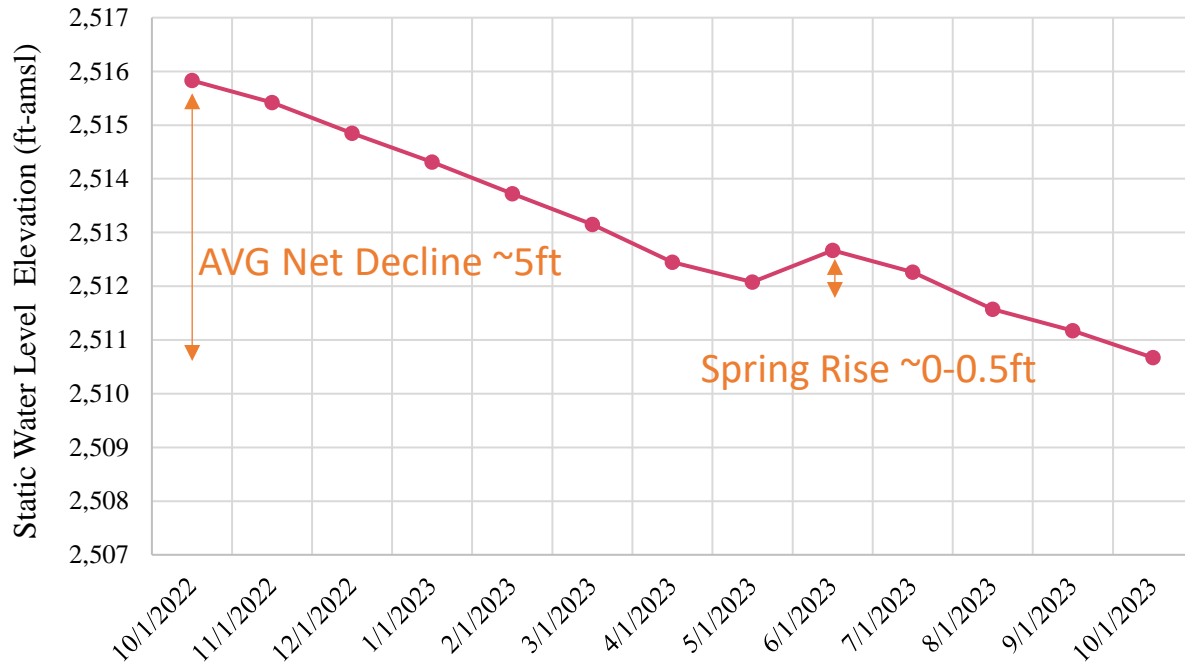
- **Stressor:**
 - attenuated versions of the large recharge signal
- Or
- areal recharge
- mountain block or mountain front recharge
- canal leakage
- irrigation recharge



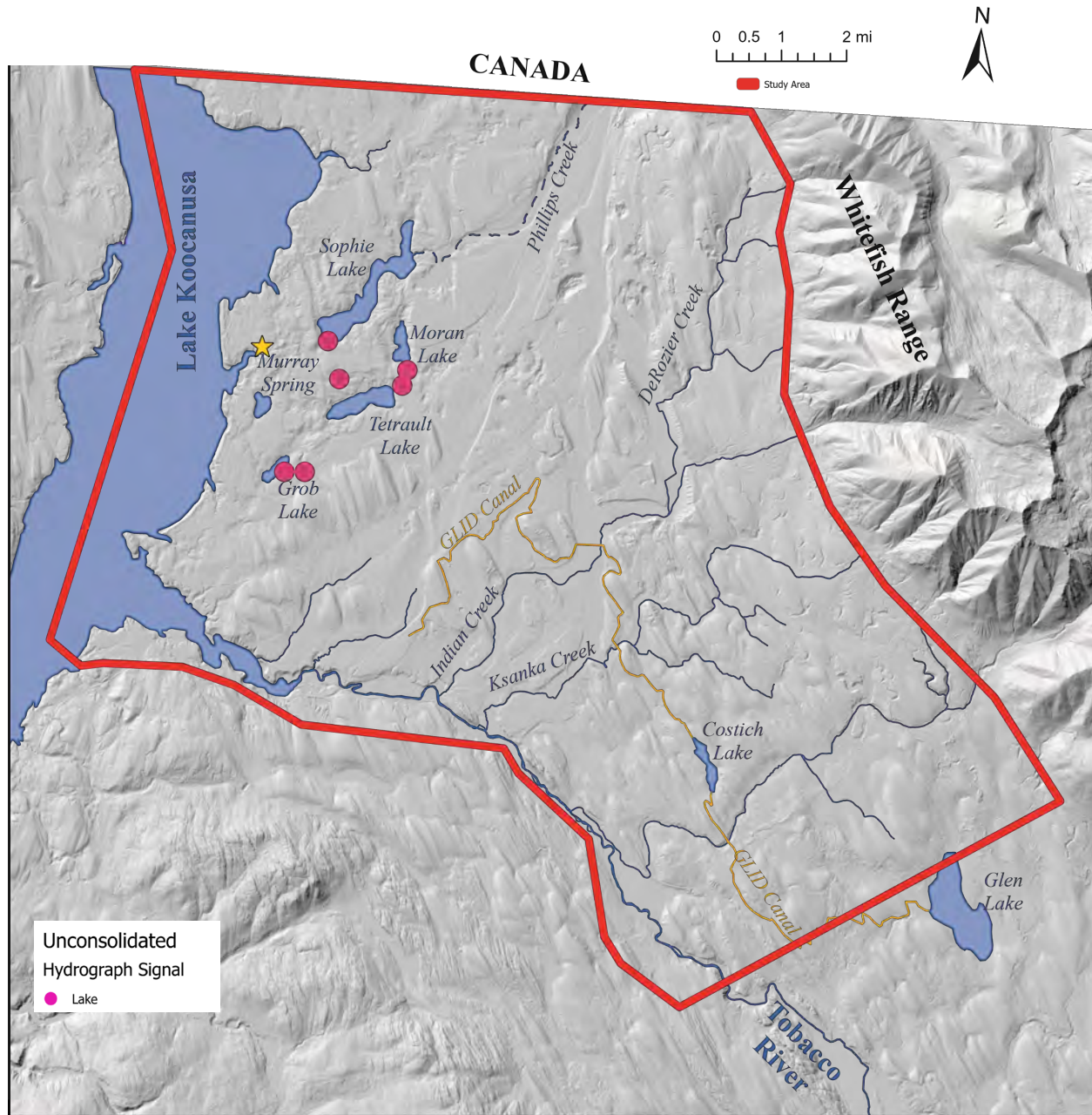
Provisional information not for distribution

Hydrograph Signals – Declining Lake

Representative "Declining Lake Signal" Hydrograph (well 33)

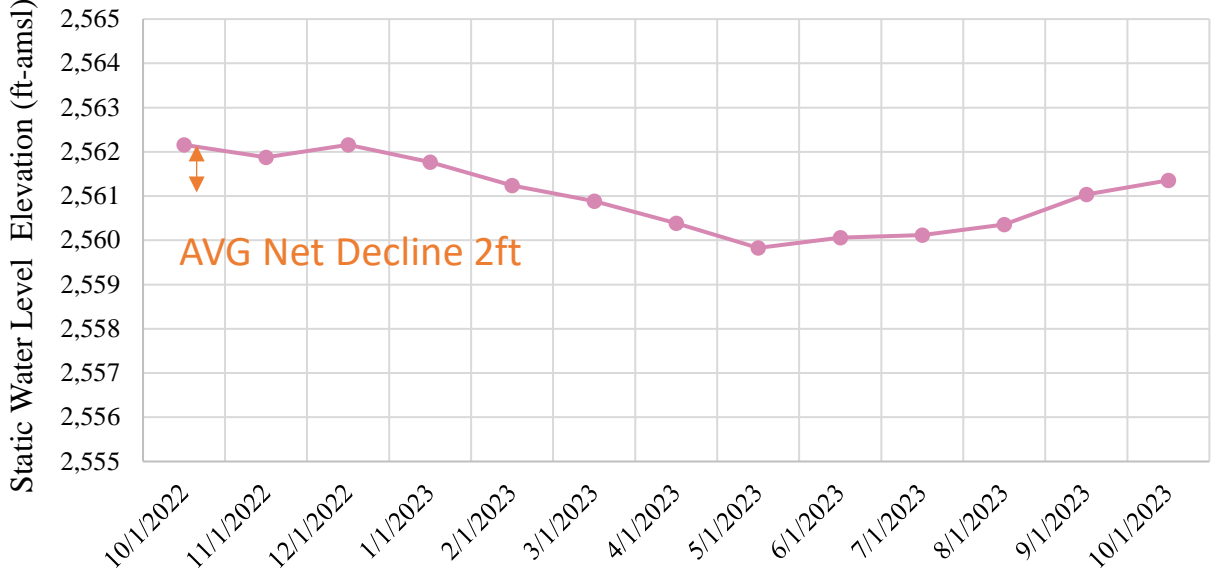


- Stressor: Sophie, Tetrault and Moran Lake
- Shallow wells (<100 ft depth) that mirror lake stages, which declined in WY2023

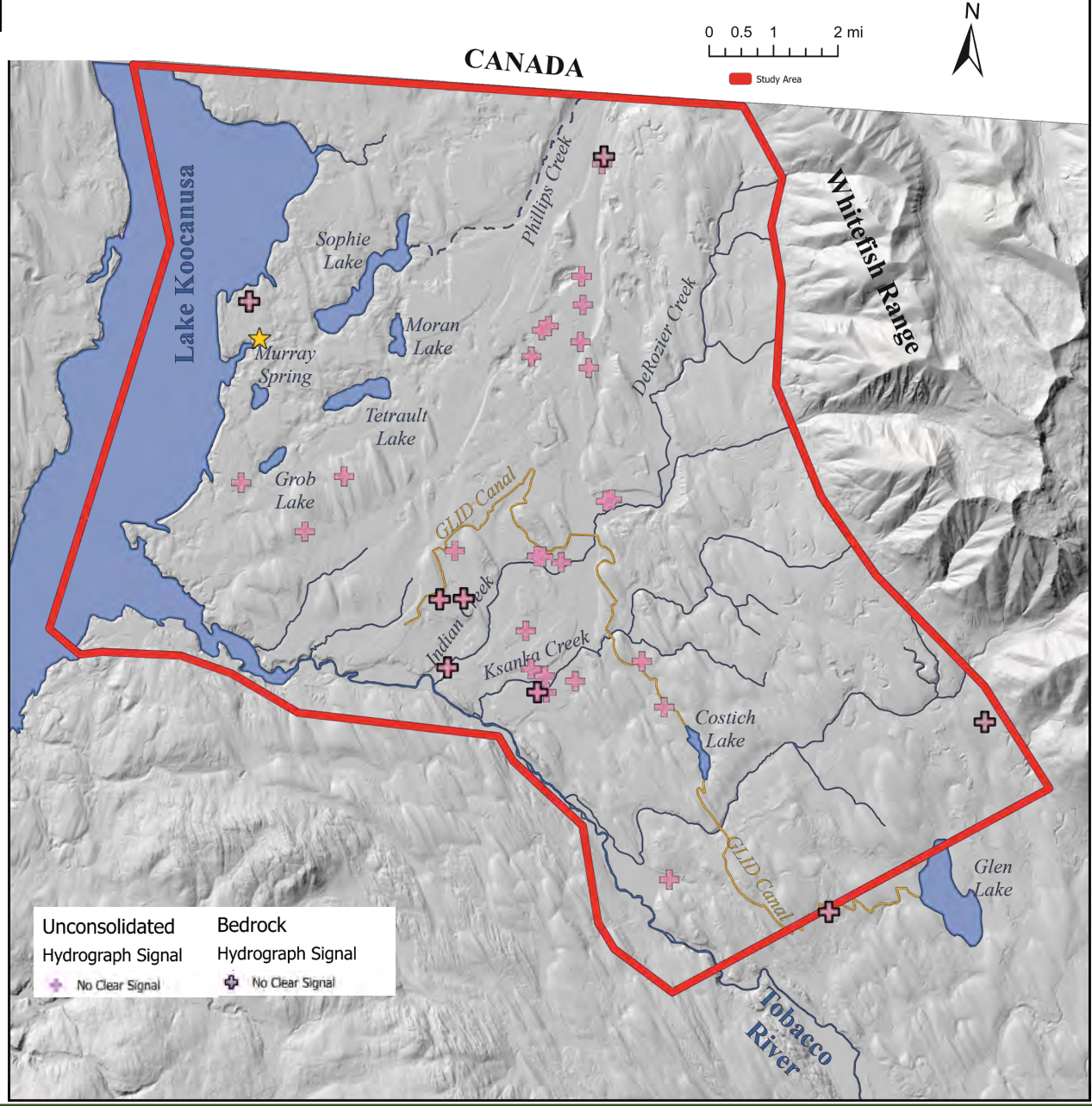


Hydrograph Signals – No Clear Signal

Representative "No Clear Signal" Hydrograph (well 76)



- Includes wells with flat hydrographs, mixed signal behavior, strong pumping influences, or otherwise atypical patterns



Hydrograph Signals – All Signals

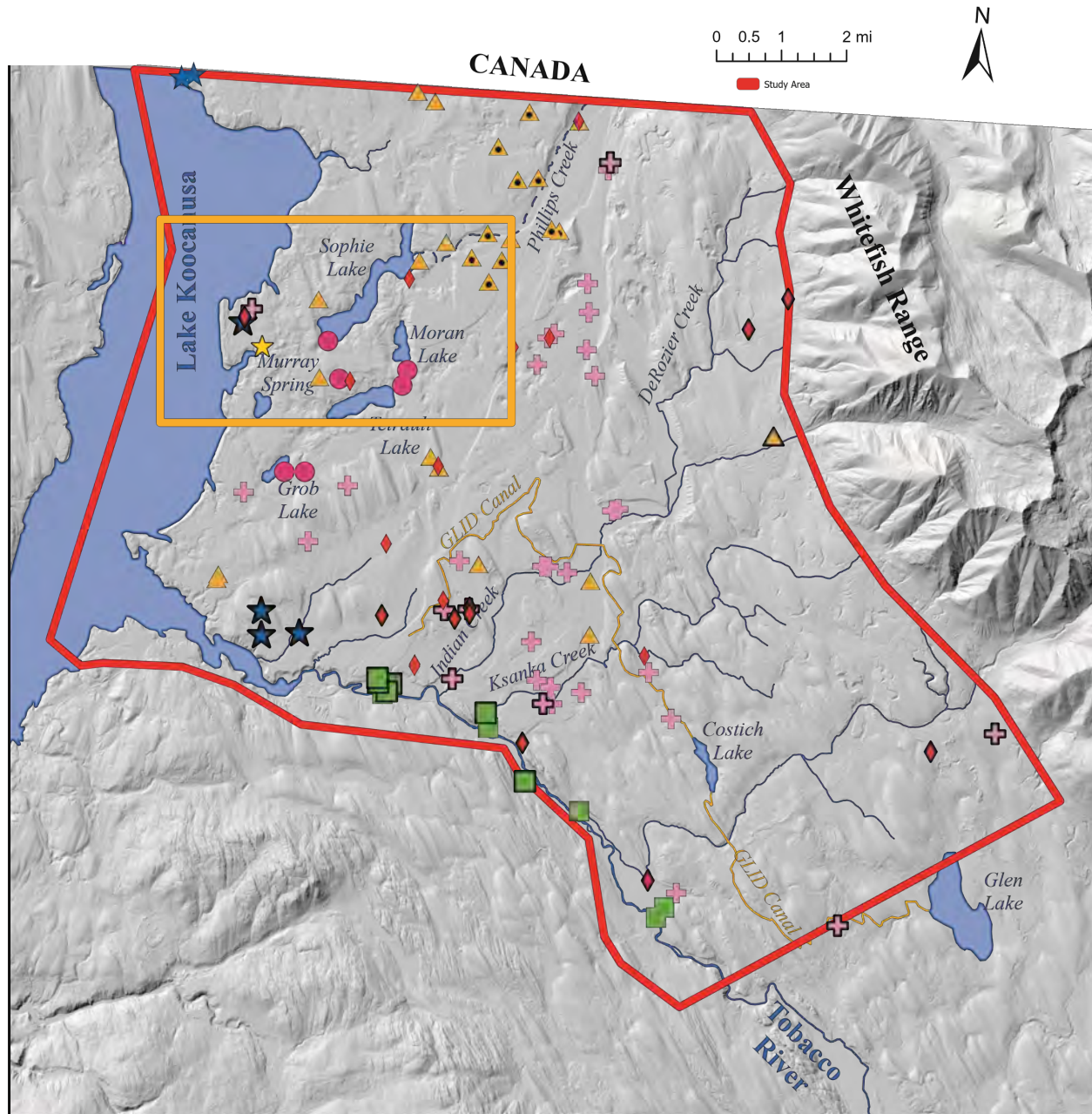
Unconsolidated Hydrograph Signal

- ◆ Insufficient Data
- + No Clear Signal
- ★ Kooconusa
- Lake
- ▲ Large Spring Recharge
- ▲ Spring Recharge
- Tobacco

Bedrock Hydrograph Signal

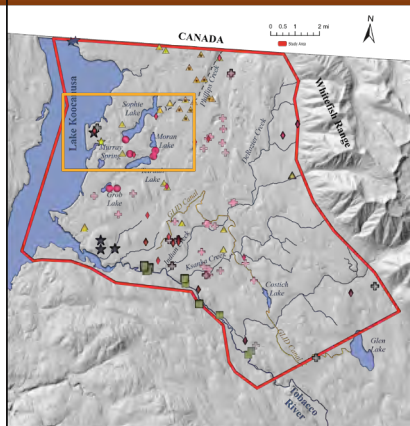
- ◆ Insufficient Data
- + No Clear Signal
- ★ Kooconusa
- Lake
- ▲ Large Spring Recharge
- ▲ Spring Recharge
- Tobacco

- Hydrograph signals are generally grouped by geographic region tied to major surface water bodies
- Some areas have mixed signals
- Do we see evidence of vertical disconnection in areas with mixed signal types?
 - Lake Area

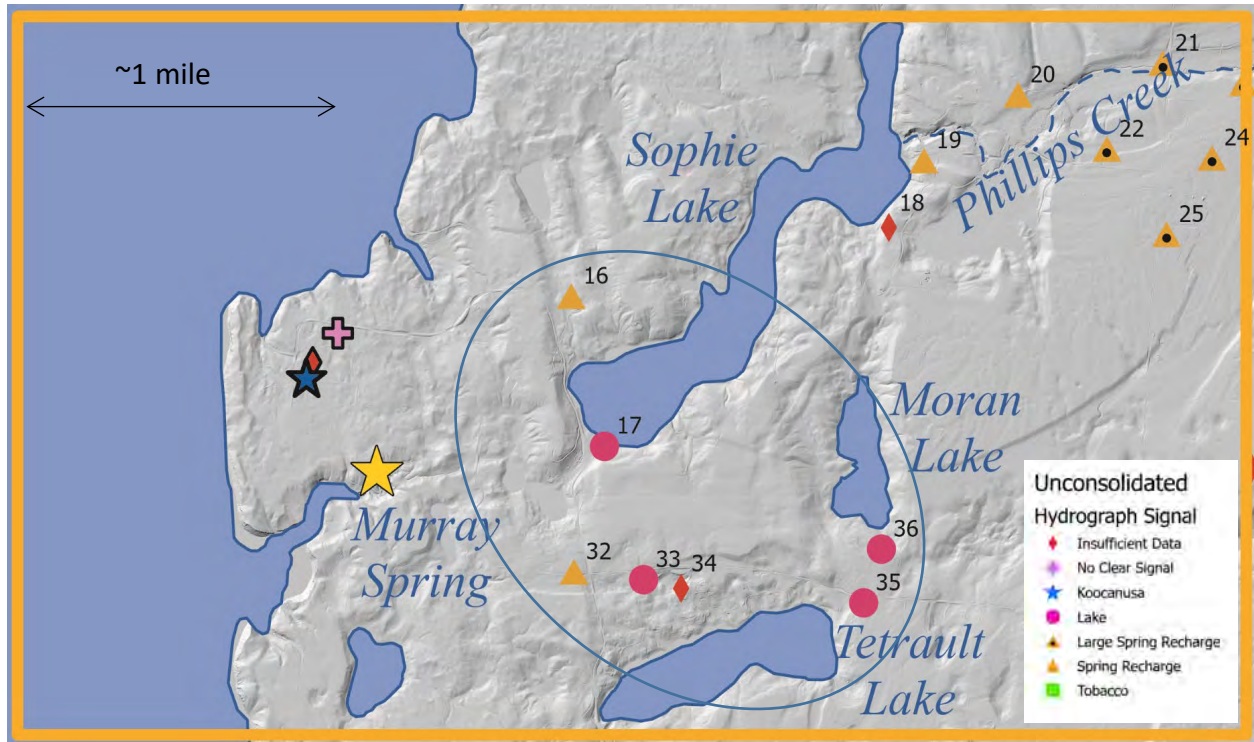
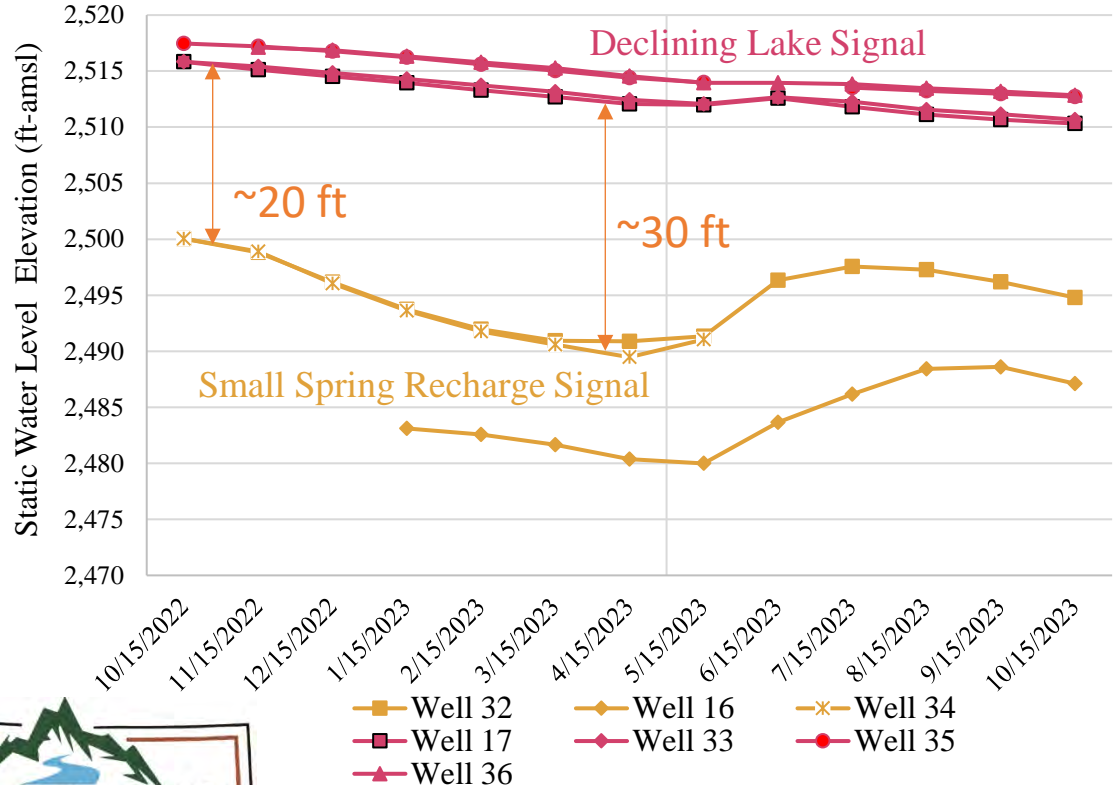


Evidence of Vertical Disconnection – Lake Area

- Shallow “Declining Lake Signal” wells are completed between 2,480 and 2,500 ft amsl (TD < 100 ft)
- Deeper more regional “Spring Recharge Signal” wells are completed between 2,200 and 2,300 ft amsl

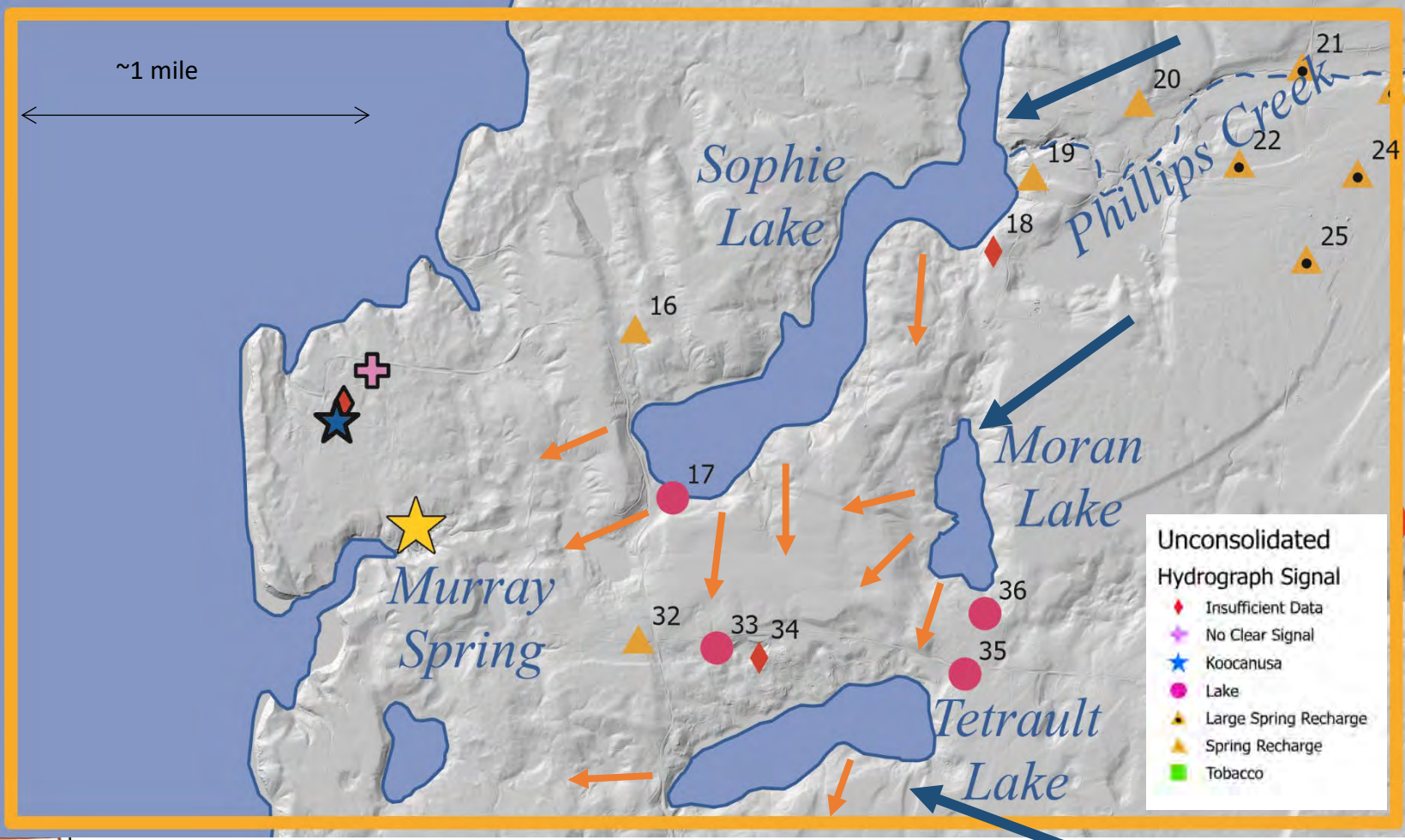
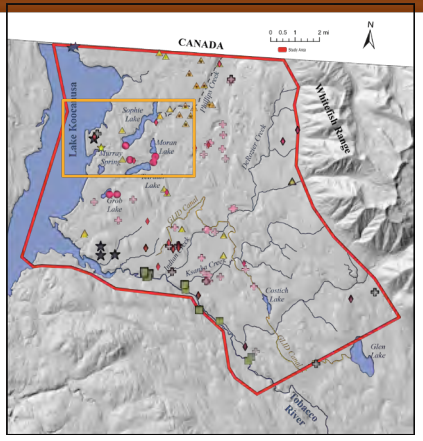


Declining Lake and Nearby Spring Recharge Well Cluster



Evidence of Vertical Disconnection – Lake Area

Regional GW Discharges to Lakes



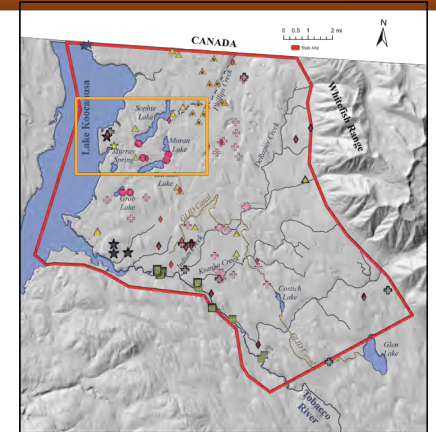
- Regional groundwater discharges to the lakes from the East
 - For Sophie Lake, this is overlain by surface water inflow from Phillips Creek
- Lakes infiltration recharges the shallow unconsolidated deposits

Lake Infiltration Recharges Shallow Aquifer

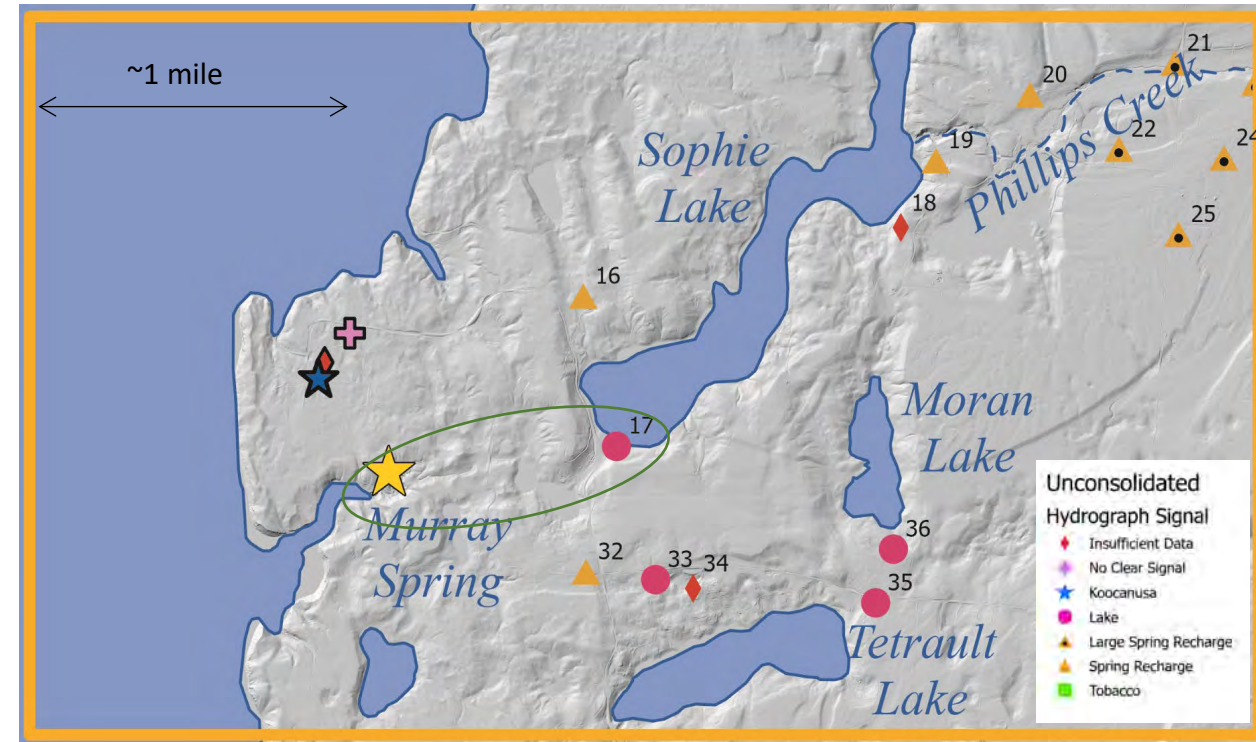
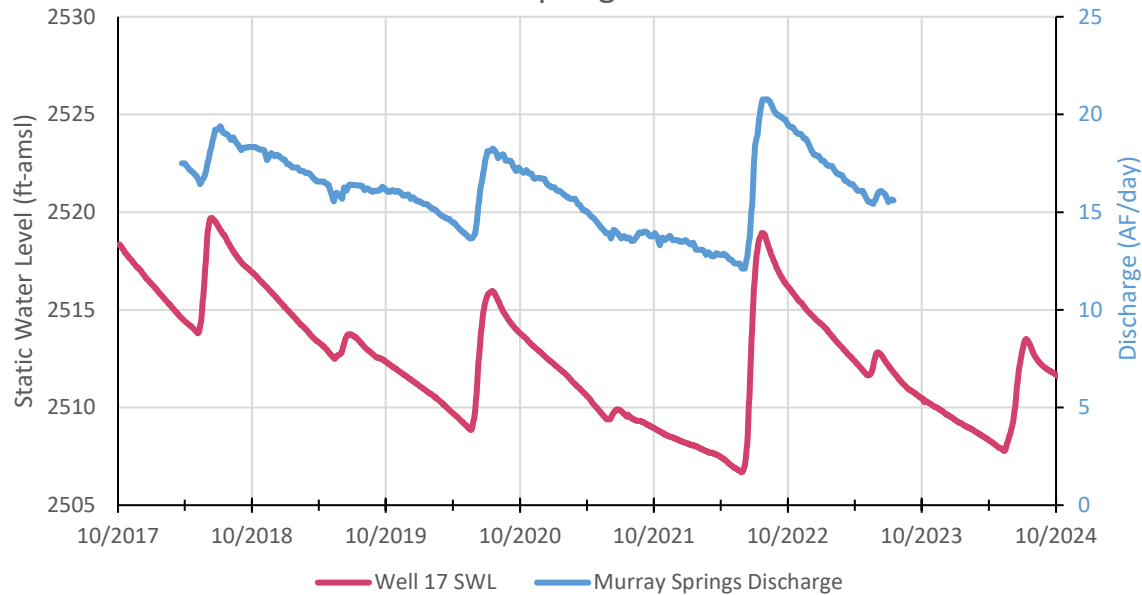


Evidence of Vertical Disconnection – Lake Area

- Discharge at Murray Springs closely track water levels in the shallow alluvium



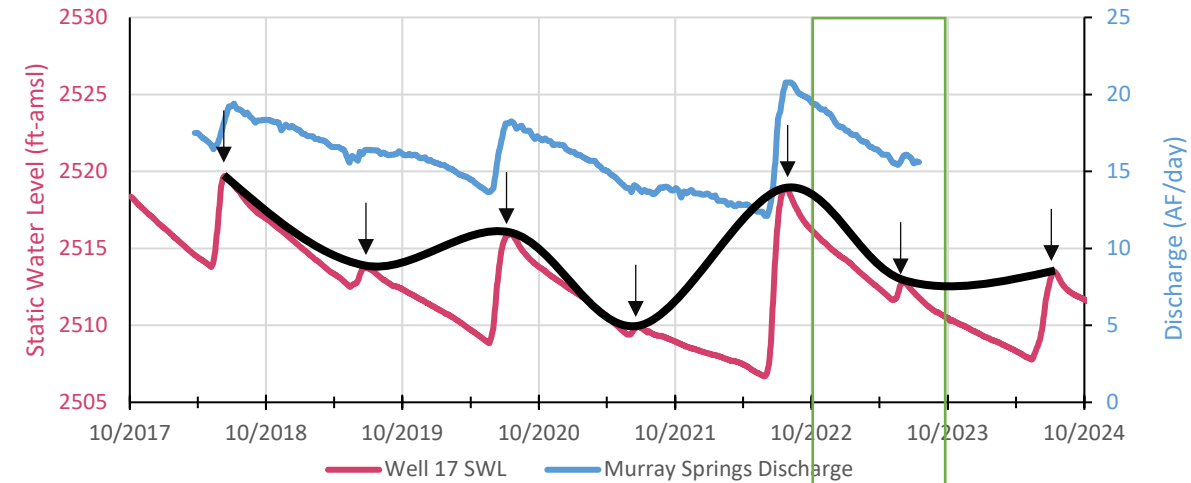
Static Water Level in Well 17 and Discharge in Murray Springs



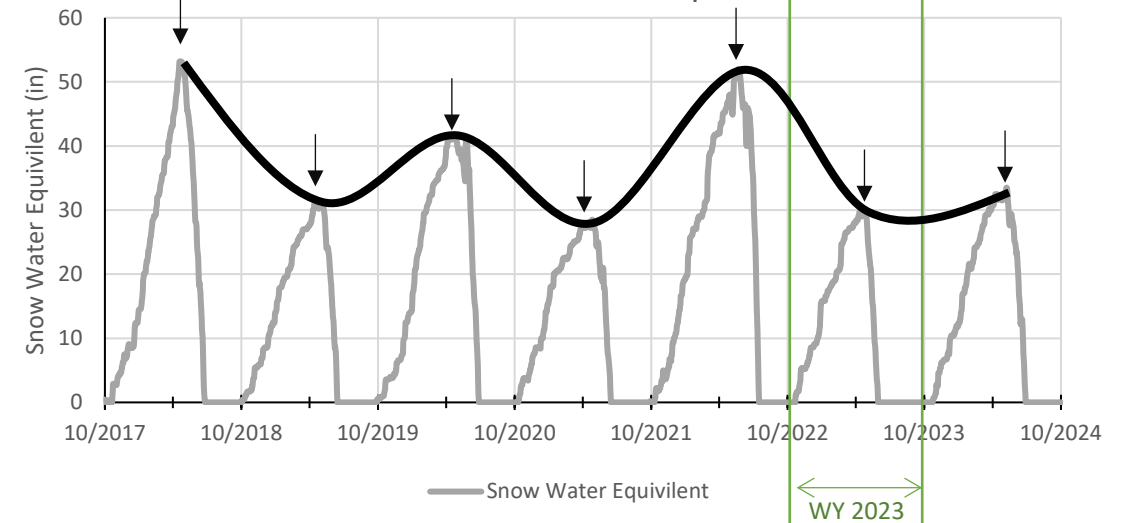
Long Term Water Levels and Snow Pack

- In WY 2023 we saw lower than average snow water equivalent at the Stahl Peak Snotel and water levels decreased
- Peak annual water levels correspond to peak snow water equivalent
- WY 2023 represents a loss of storage from a previous high storage

Static Water Level in Well 17 and Discharge in Murray Springs



Stahl Peak Snow Water Equivalent



Questions?

