Update on MBMG Groundwater Study Near Glen, MT

Influences on Water Supply and Temperature in the Big Hole River

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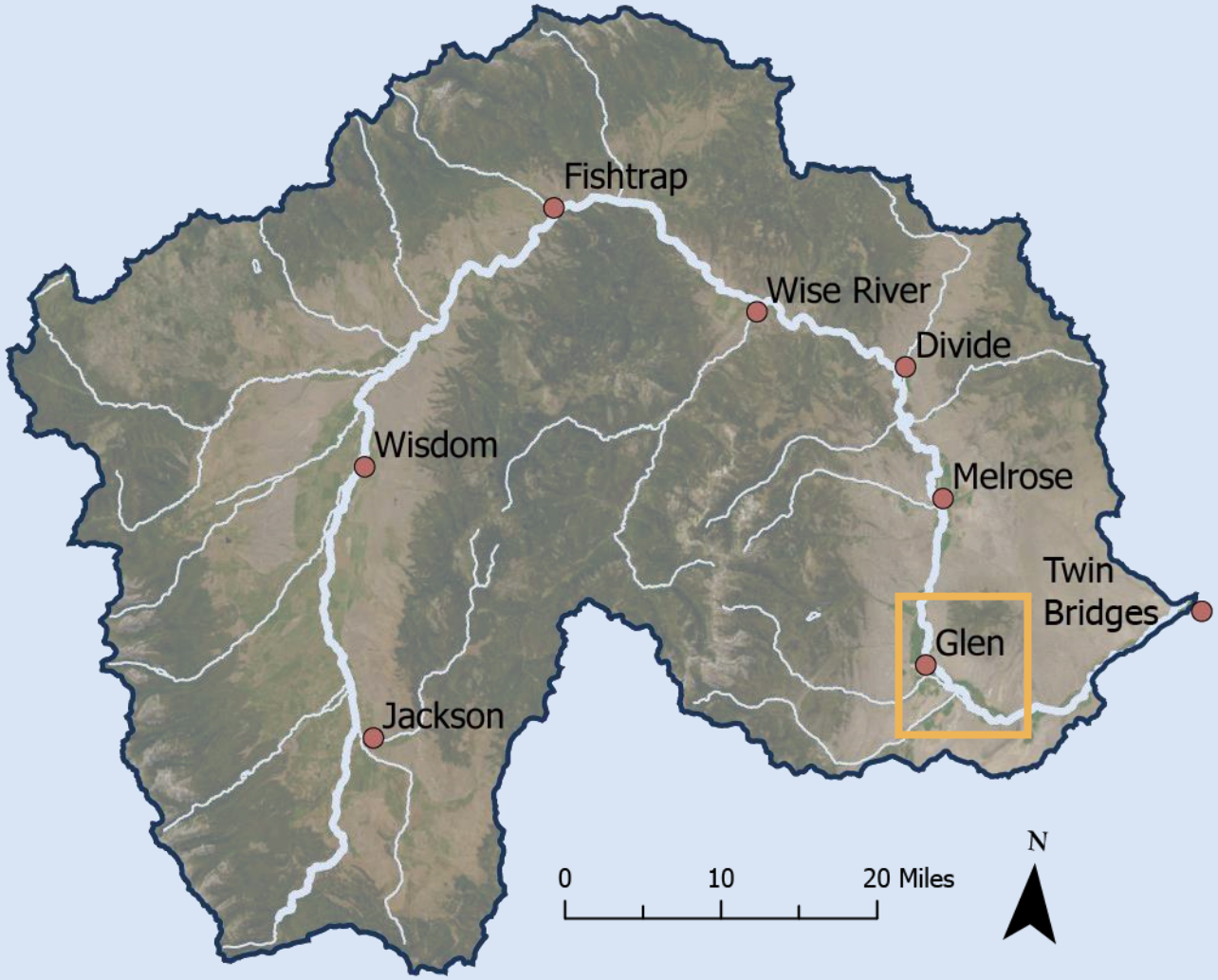
Ground Water Investigation Program

Jenna Dohman, Ann E.H. Hanson, Todd Myse, Mary Sutherland, and Tyler Storey

The Big Hole River



The Big Hole River

Blue-ribbon trout fishery

- Last naturally-producing population of fluvial Arctic Grayling in the lower 48

Pat Clayton, courtesy Center for Biological Diversity

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Agriculture

- Grass hay and alfalfa
- Cattle ranching

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Drinking water

- City of Butte

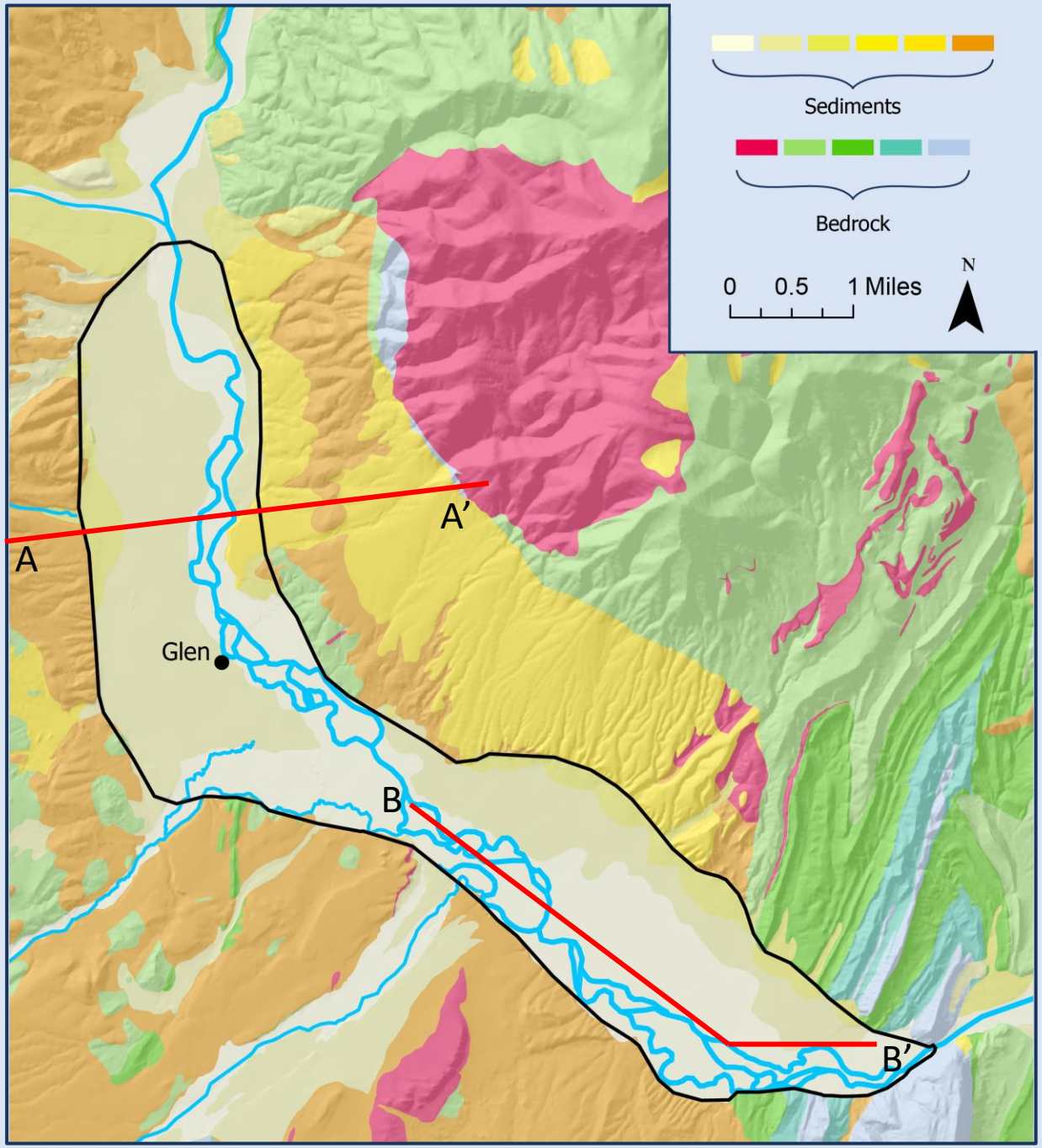
Project Motivation

PURPOSE: Determine the hydrogeologic influences that most affect water supply and temperature on the lower Big Hole River near Glen.

Stakeholders can use this information to better understand which land management practices most benefit the water resources in the area.

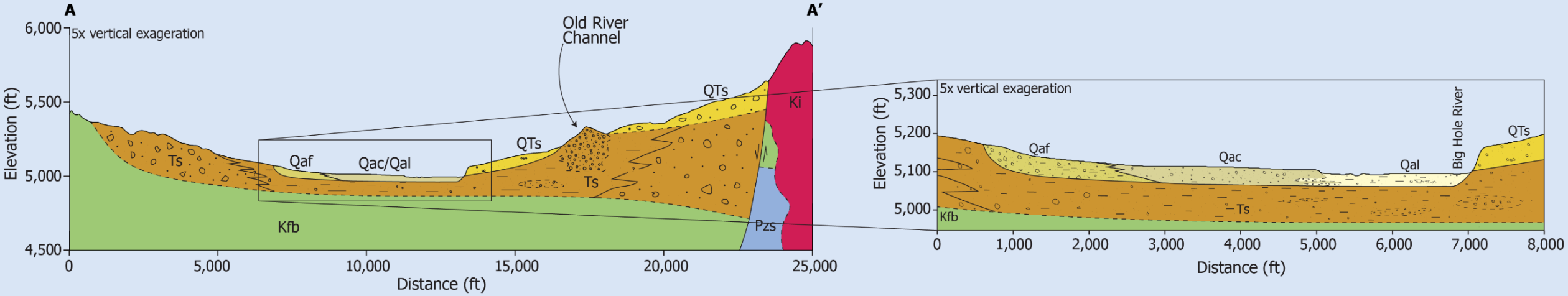
Water Supply

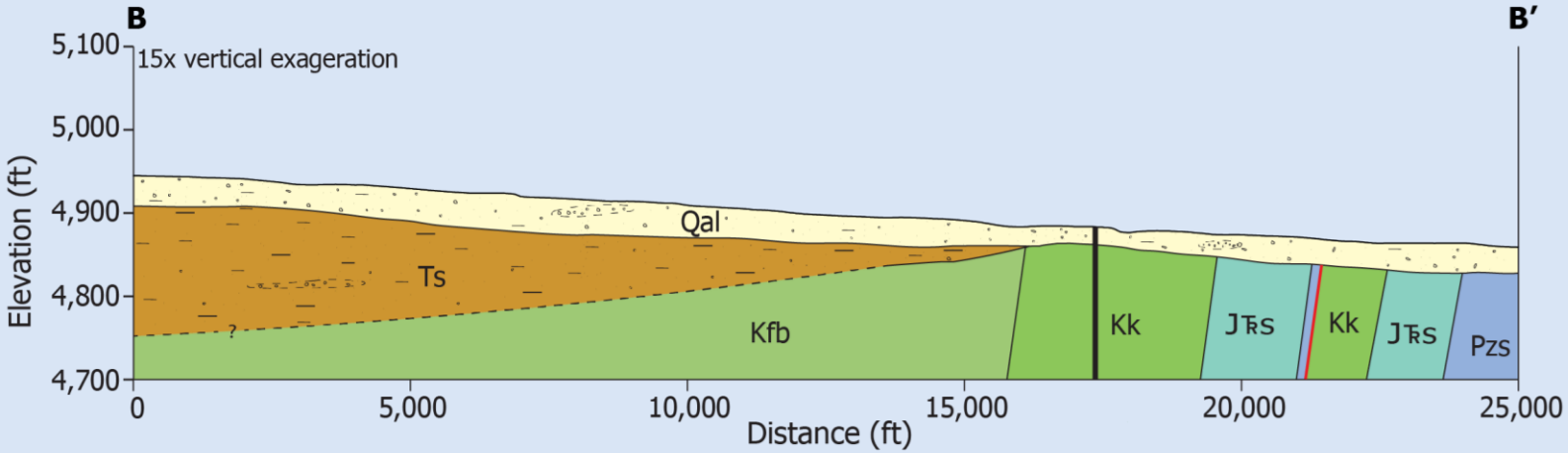
Study Area

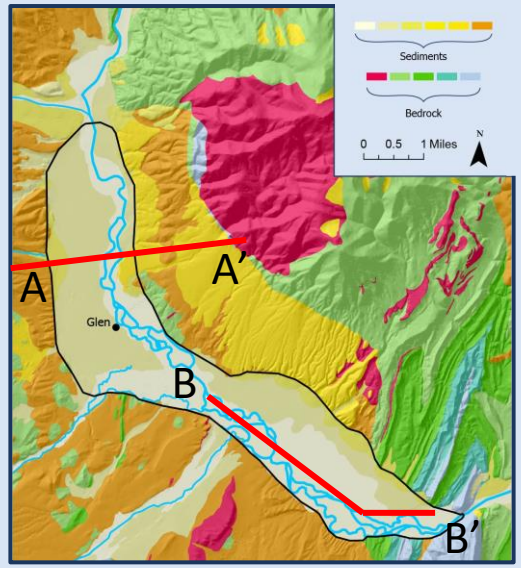


Simplified from Parker and others (in press), McDonald and others (2012) and Mosolf and McDonald (in press).

Lower Big Hole Geology







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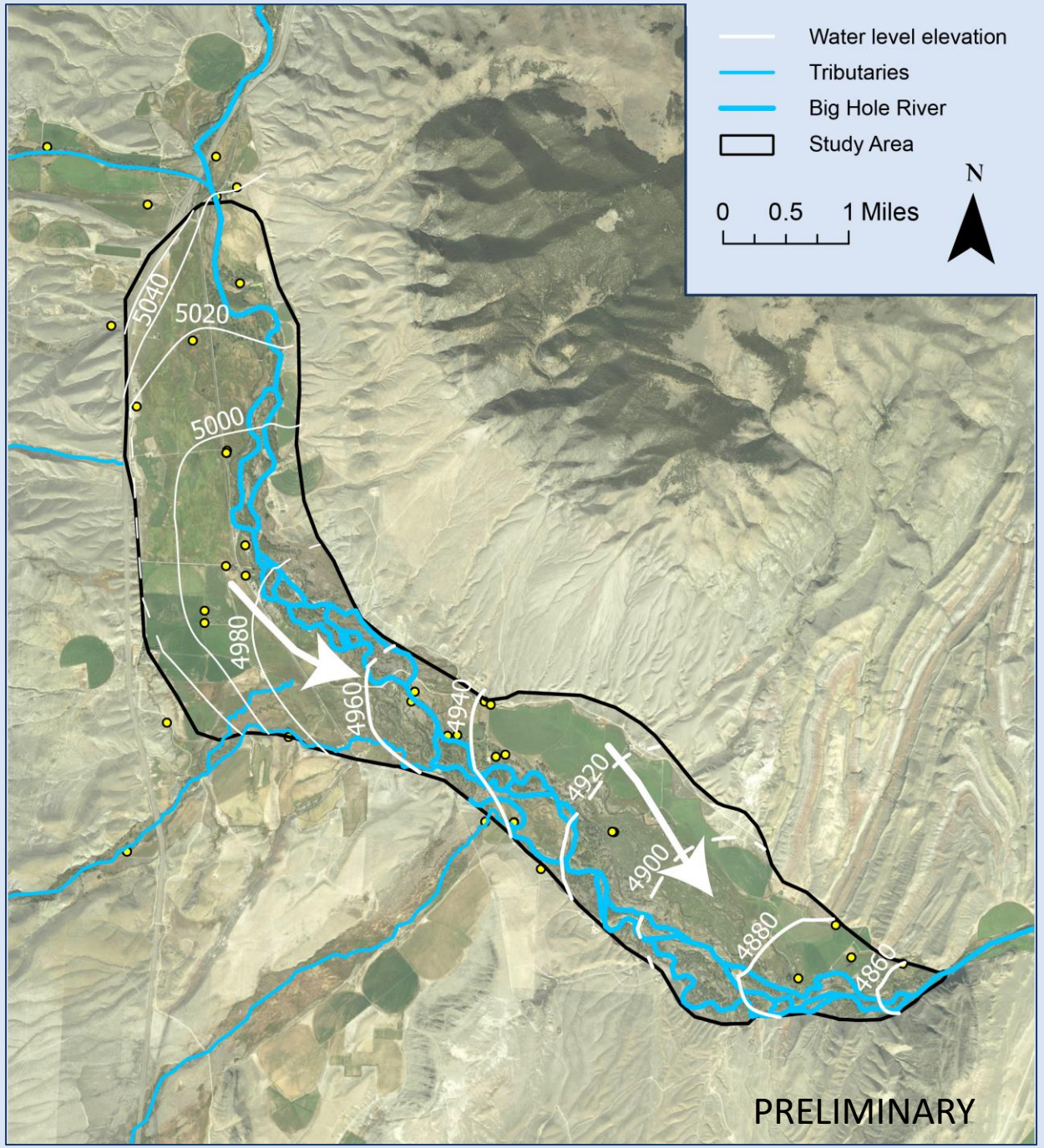
Preliminary Water Levels



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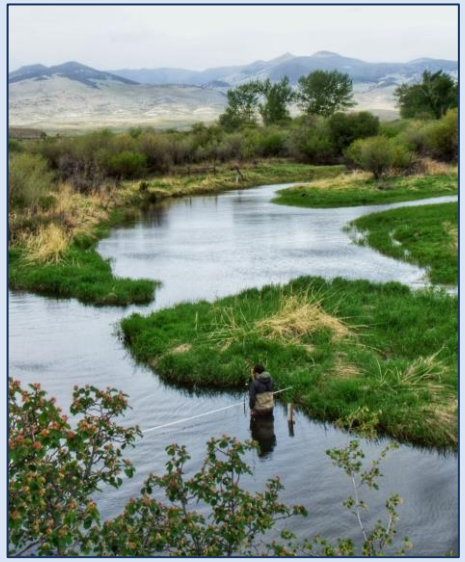
Monitoring Network

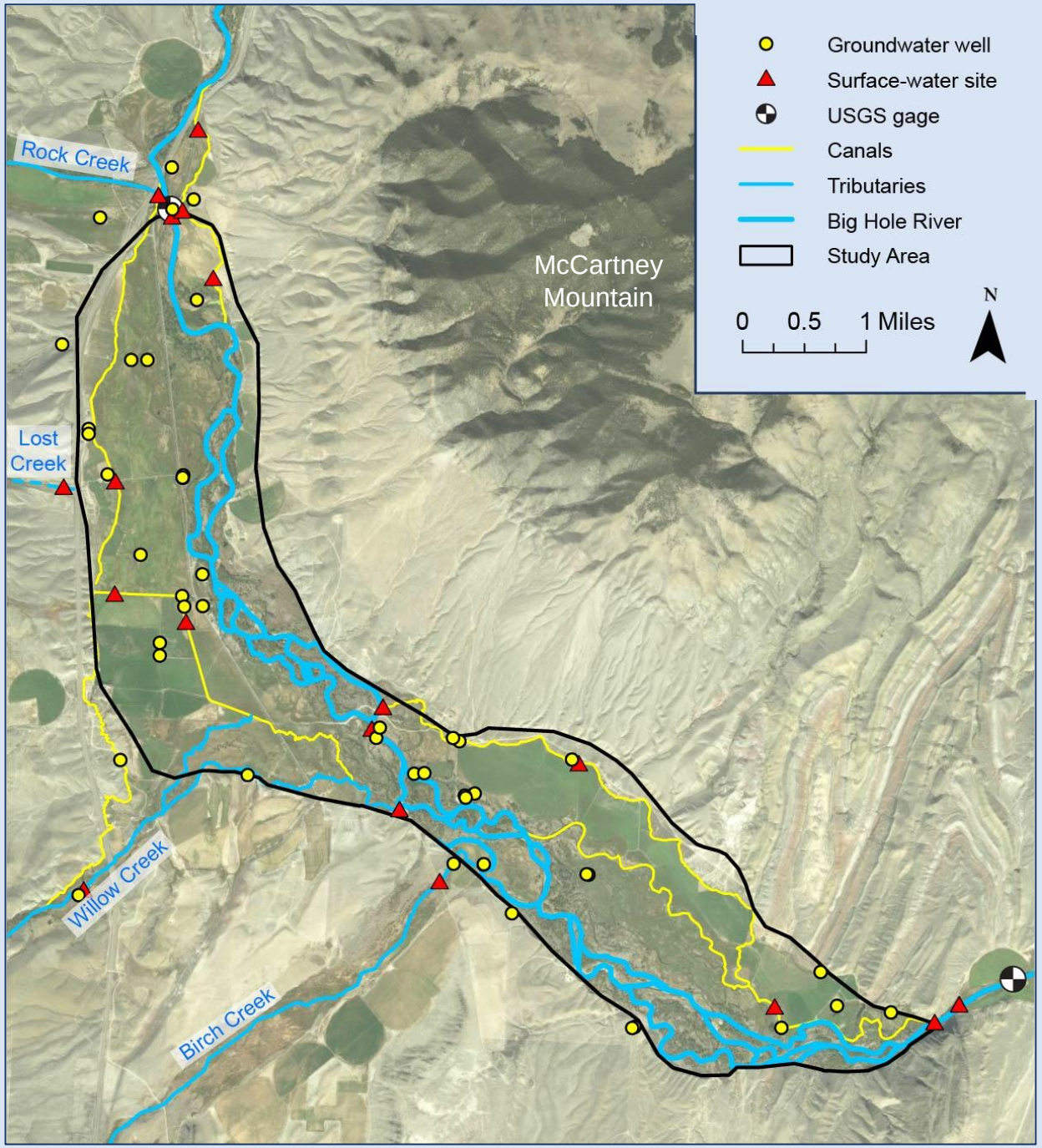
Surface-water monitoring

- Stage and discharge at 16 sites
  - Canal seepage
- Water chemistry at 11 sites

Groundwater monitoring

- Water levels at 47 wells
- Water chemistry at 16 wells





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Aquifer Tests

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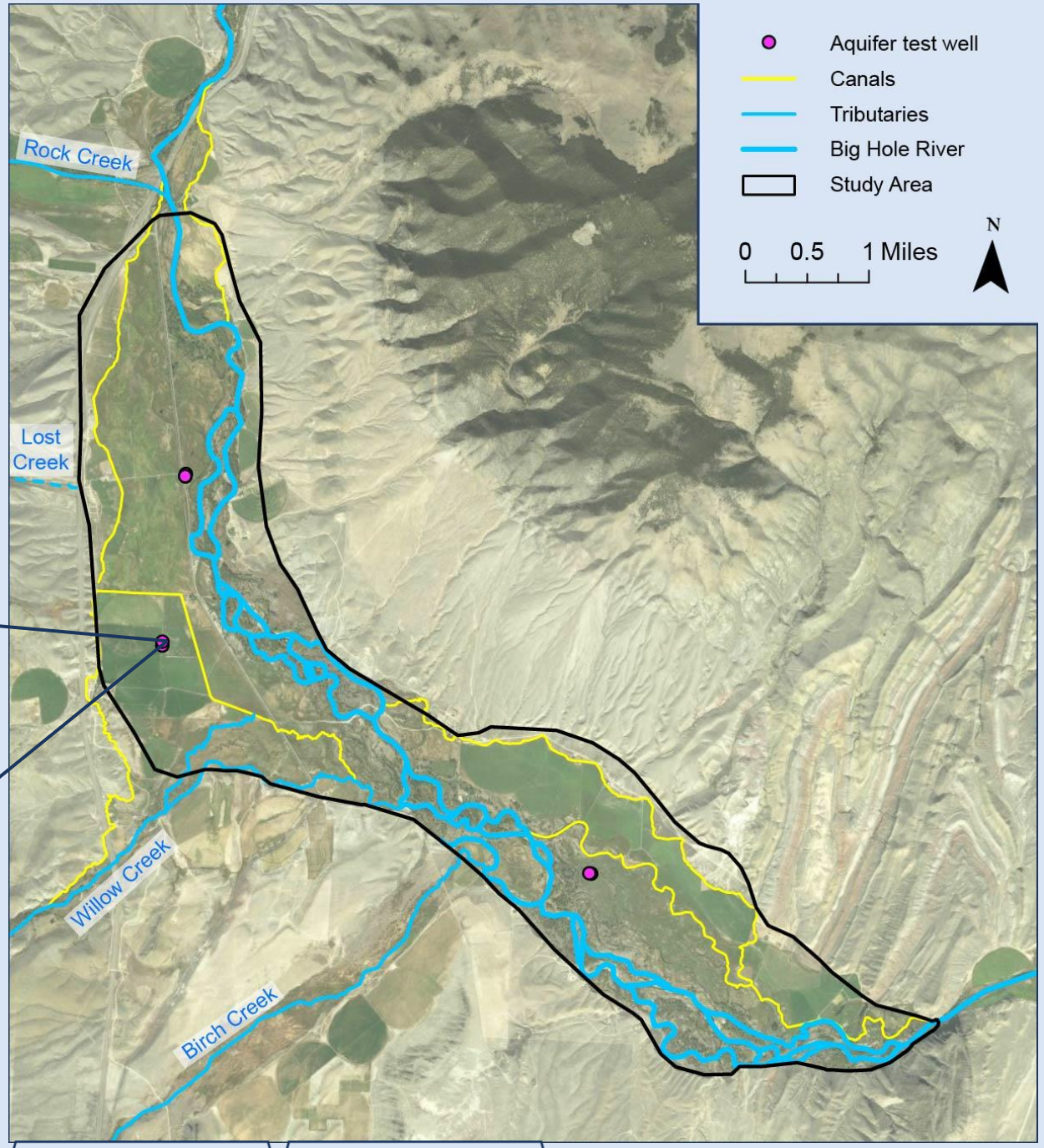
Aquifer Tests

- Clay layers were observed in northern part of the study area, causing disconnections between deep and shallow wells

Sands & gravels
0-40ft

Clay
40-100ft



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Aquifer Tests

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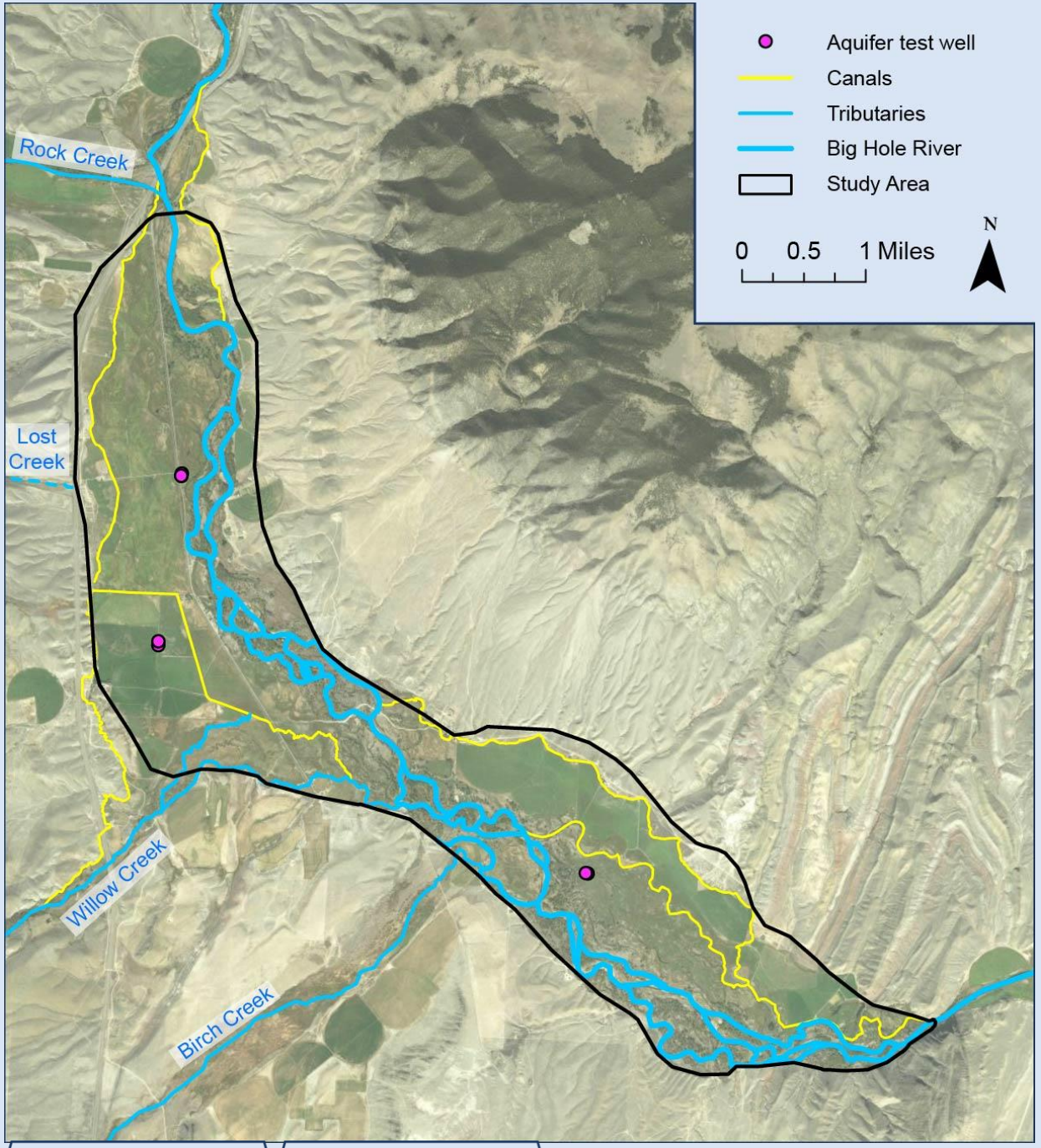
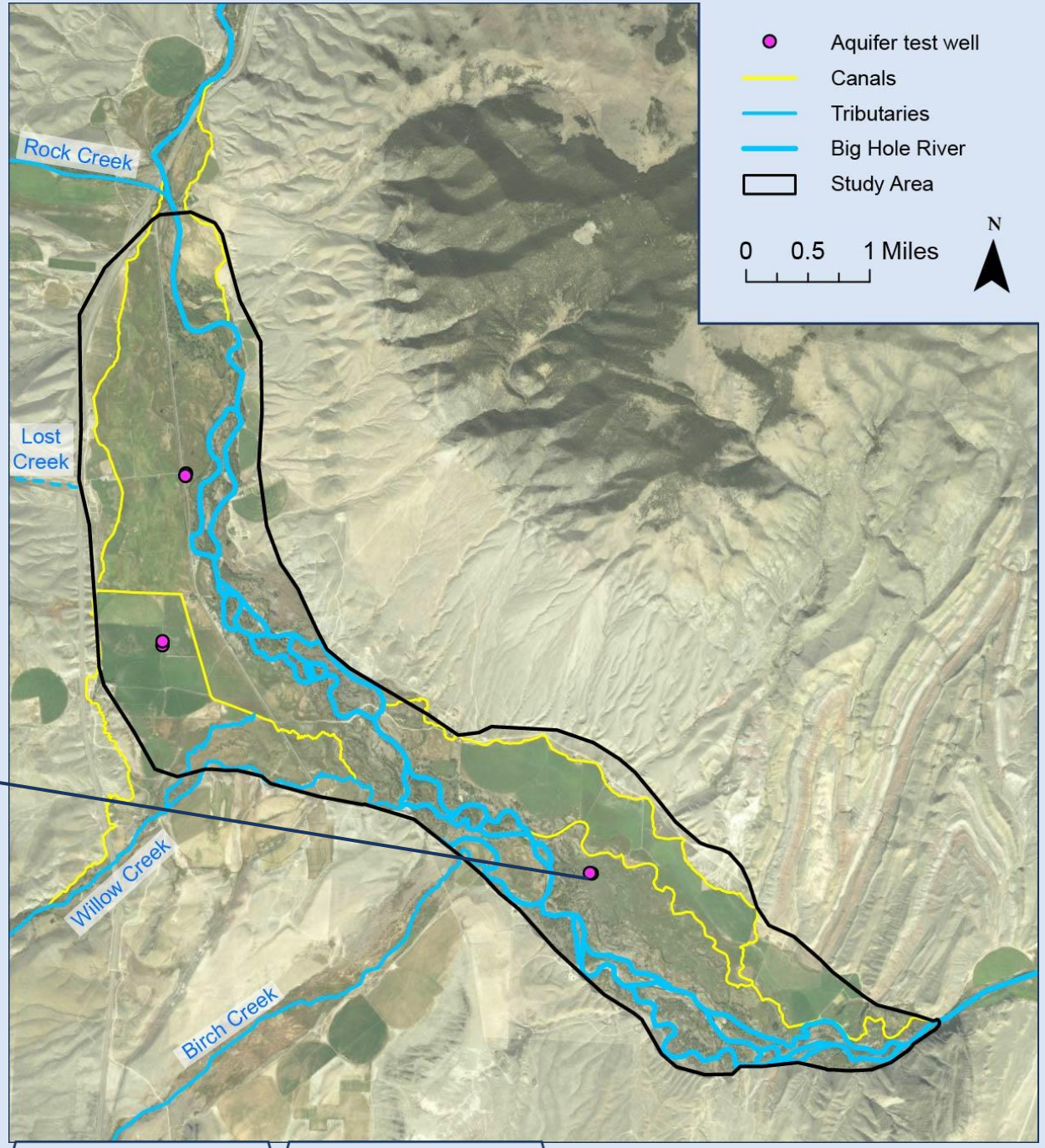
- All locations were highly transmissive



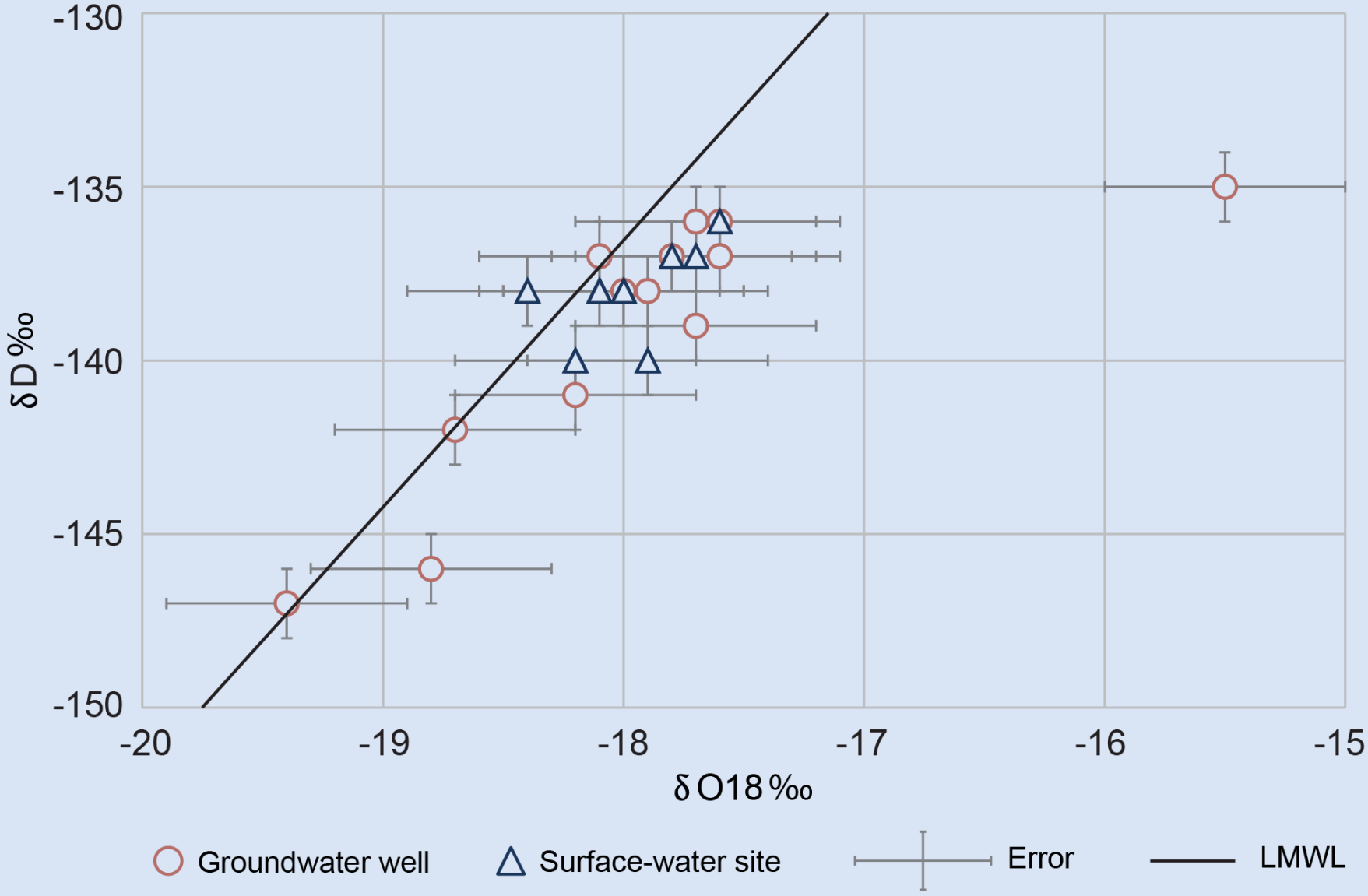
Aquifer Tests

- Clay layers were observed in northern part of the study area, causing disconnections between deep and shallow well
- All locations were highly transmissive
- In the southern part of the study area, good communication between deep and shallow wells was observed



Preliminary Findings: GW-SW Connection

River and shallow ground water are interconnected



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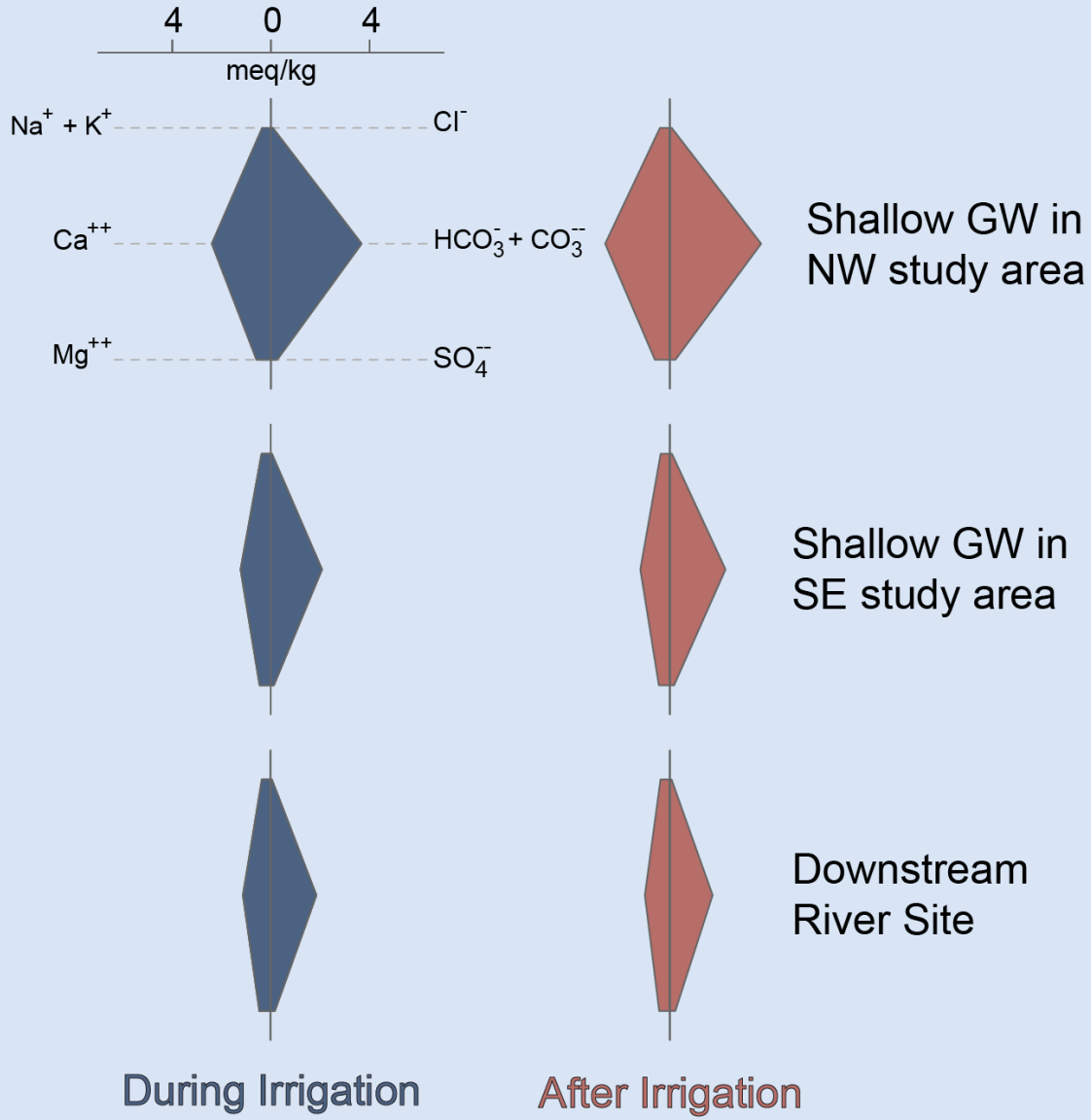

Preliminary Findings: Irrigation Impacts

Irrigation type influences the amount of groundwater recharge

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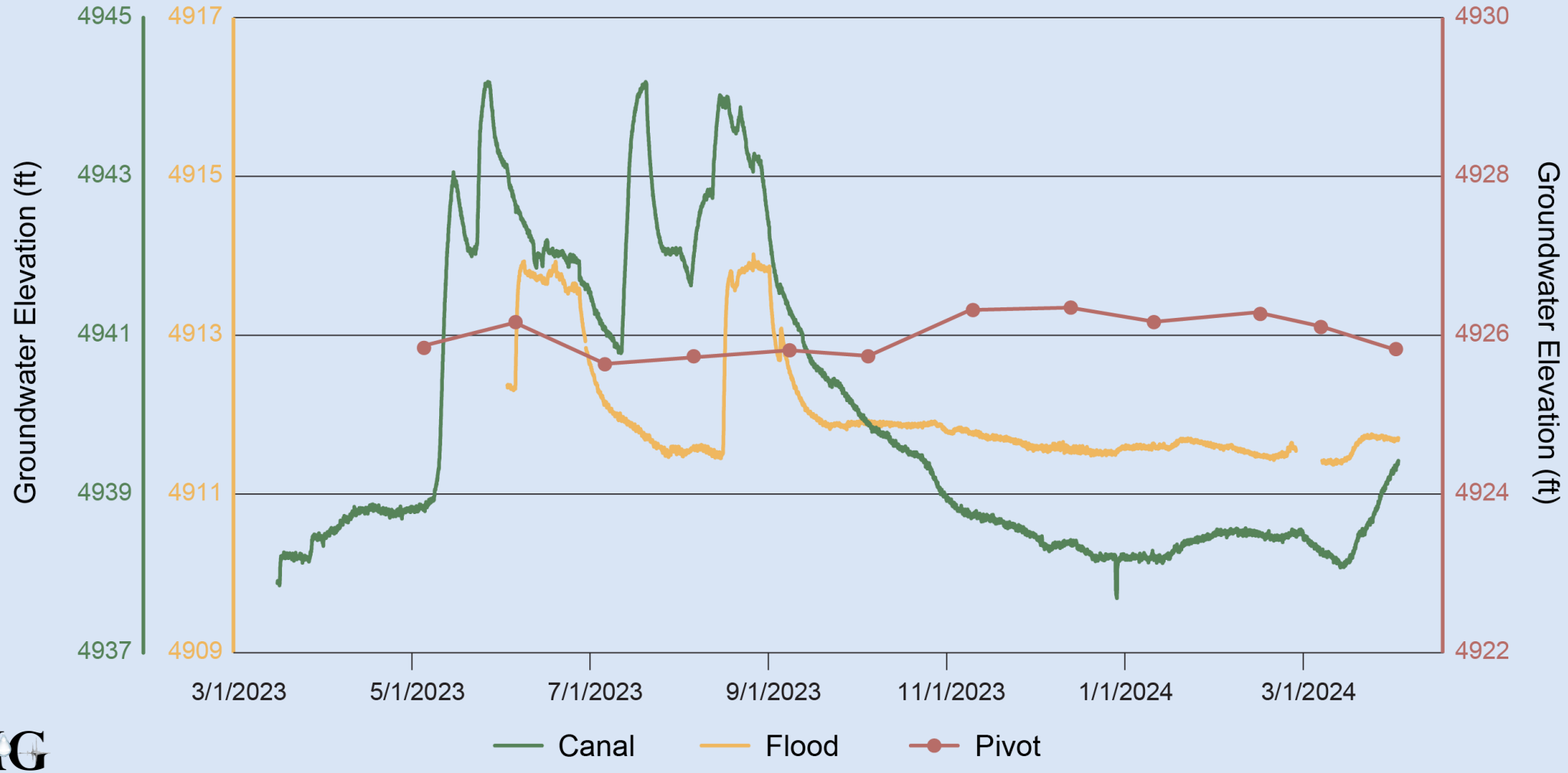

Preliminary Conclusions

1) Shallow subsurface is highly transmissive

2) River and shallow groundwater are strongly interconnected

3) More groundwater recharge results from flood irrigation and canal leakage than from pivot irrigation

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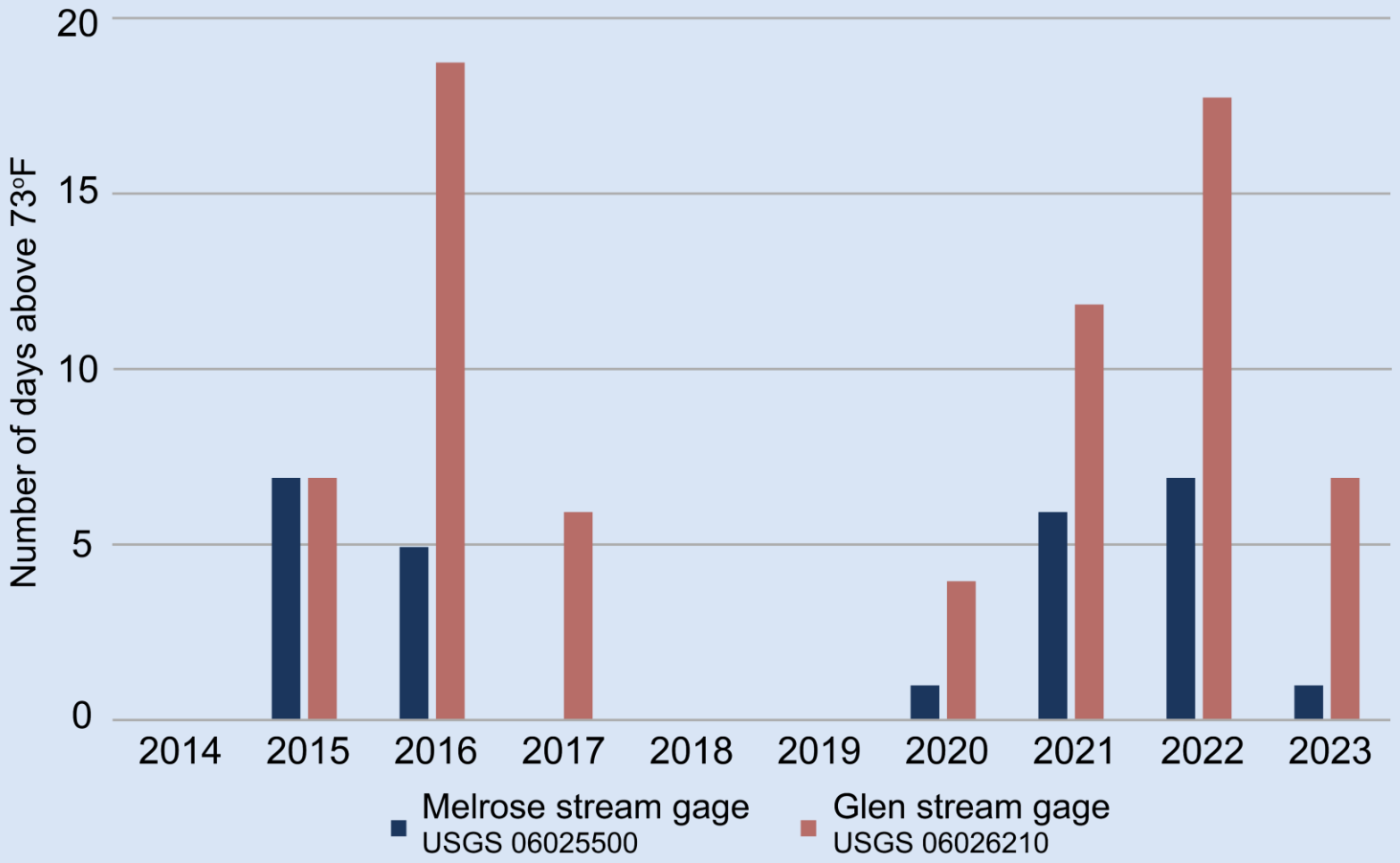
Future work:
- Continuing groundwater and surface-water monitoring
- Analyzing aquifer test data
- Developing a groundwater flow model to run predictive scenarios
- Developing a groundwater budget

Temperature

Elevated Temperatures in the Big Hole



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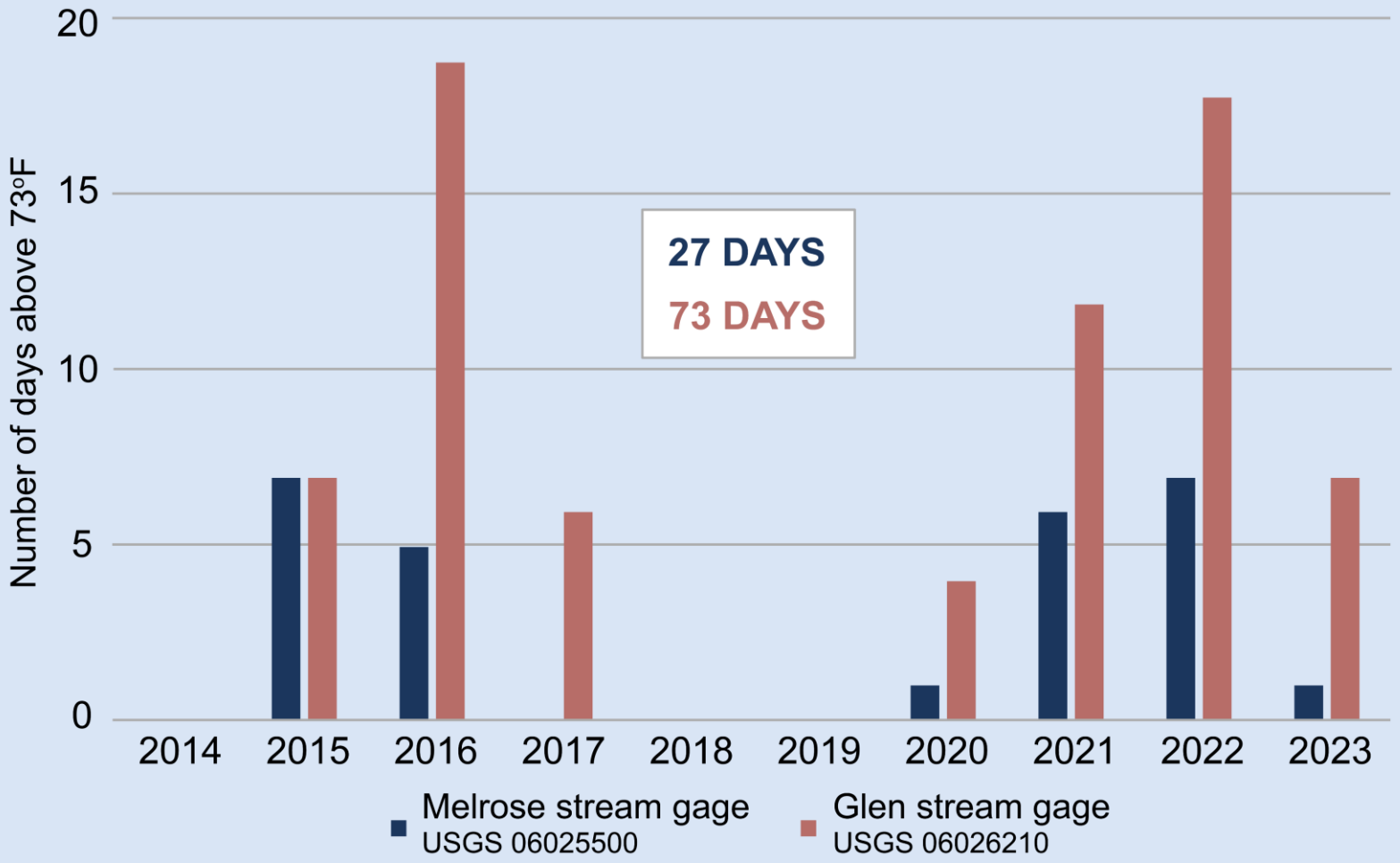
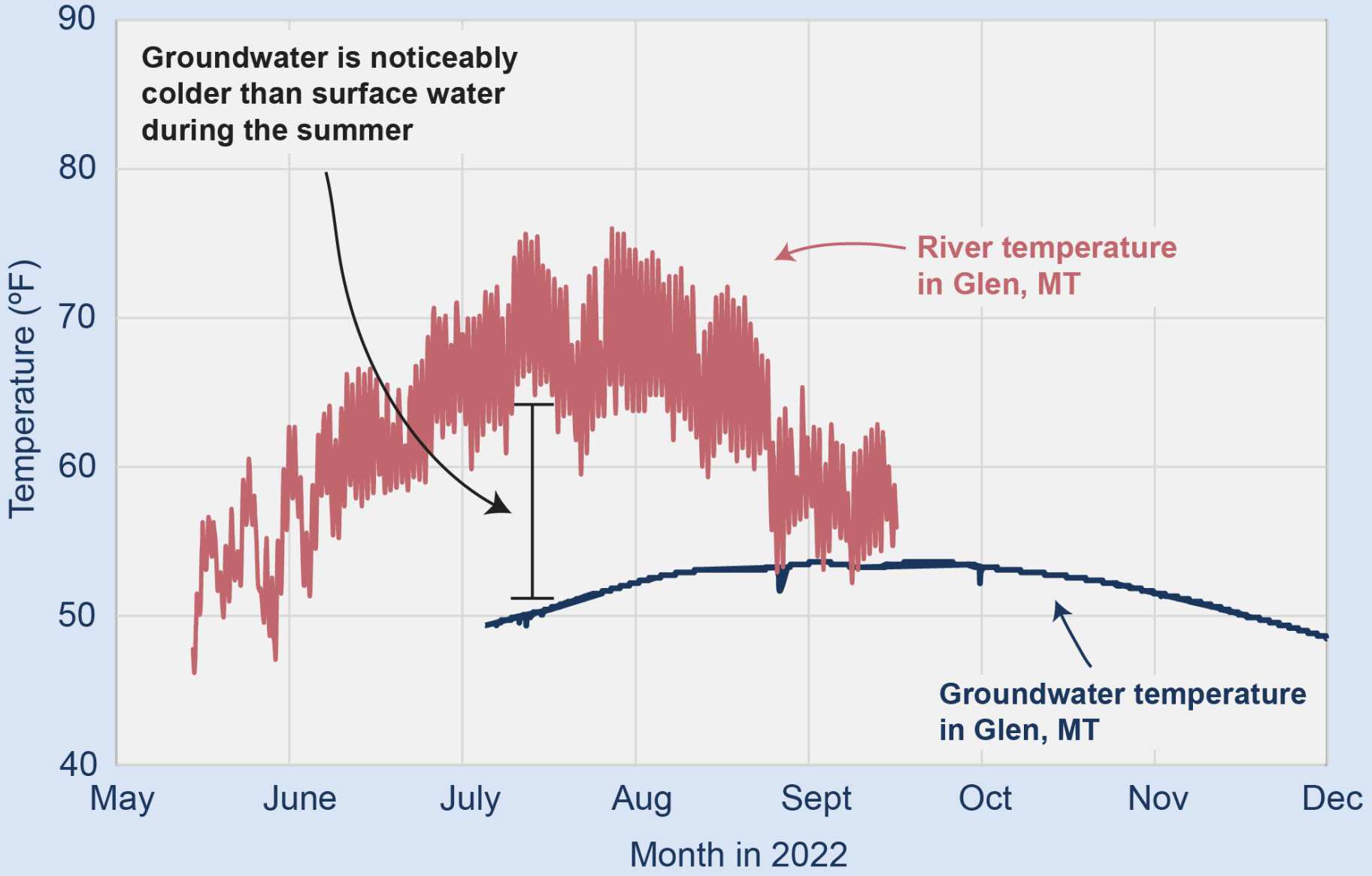


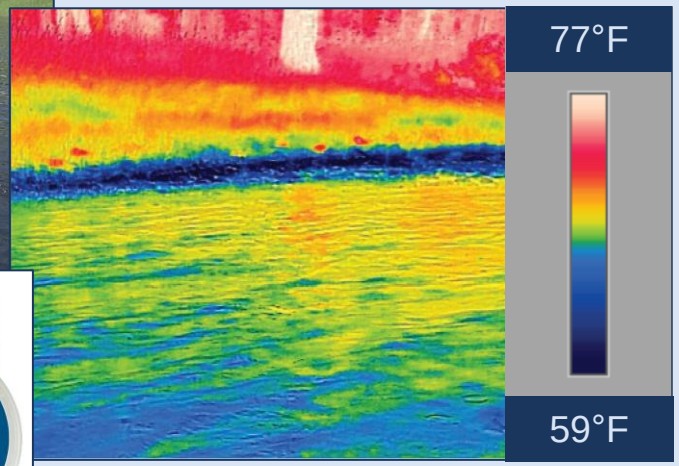
Why Groundwater Matters



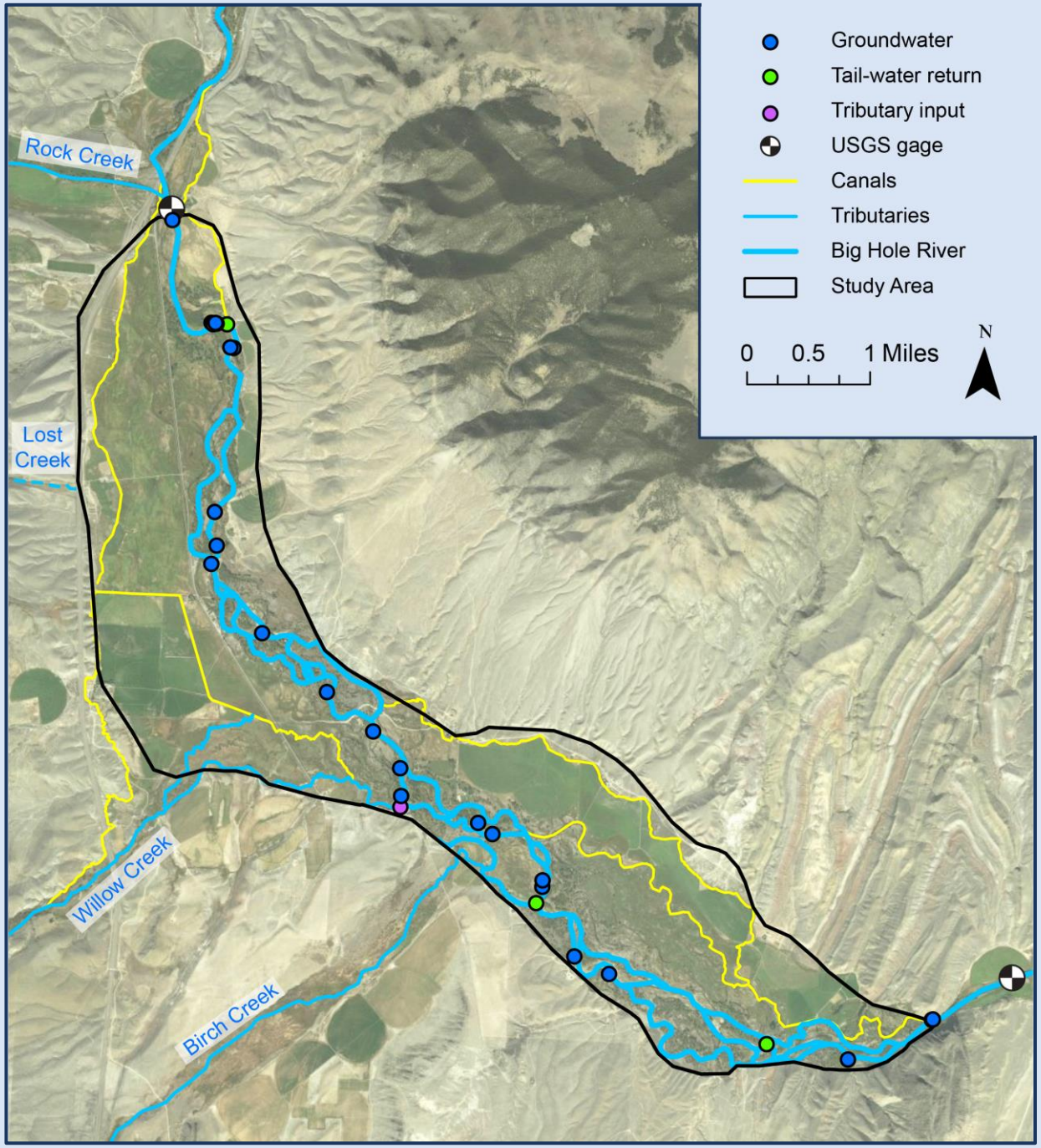
Temperature Study

Bi-monthly river floats during low-flow conditions to monitor groundwater inputs

- Handheld thermal infrared camera
- Temperature loggers



https://www.onsetcomp.com/products/data-loggers/mx2201



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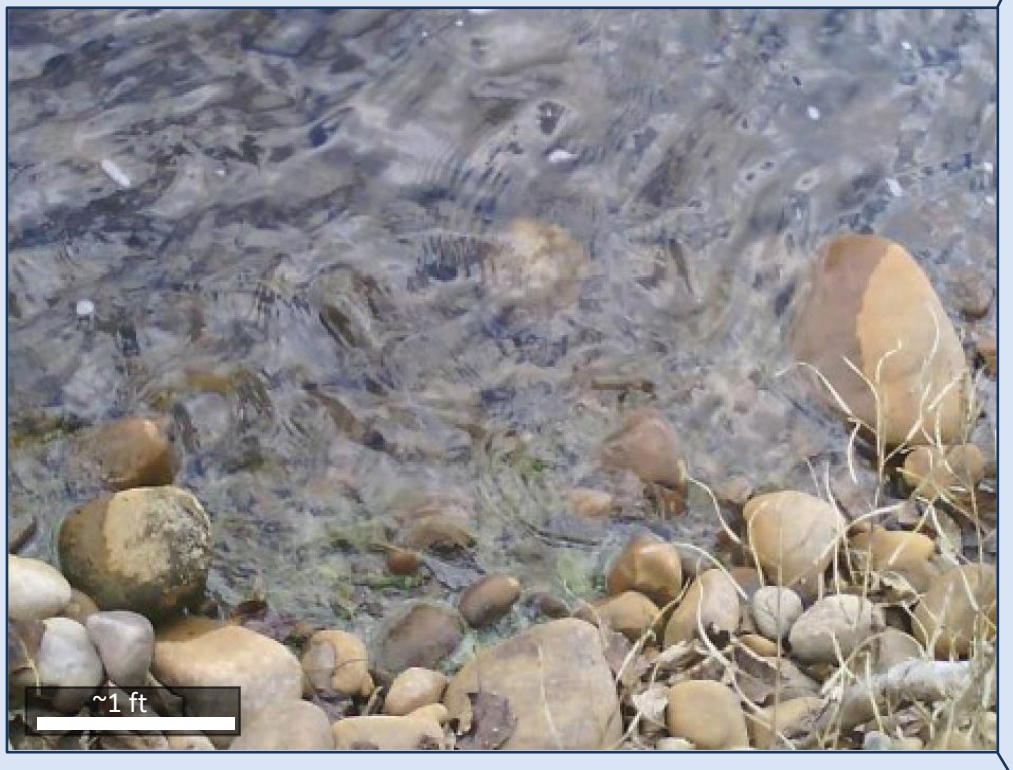
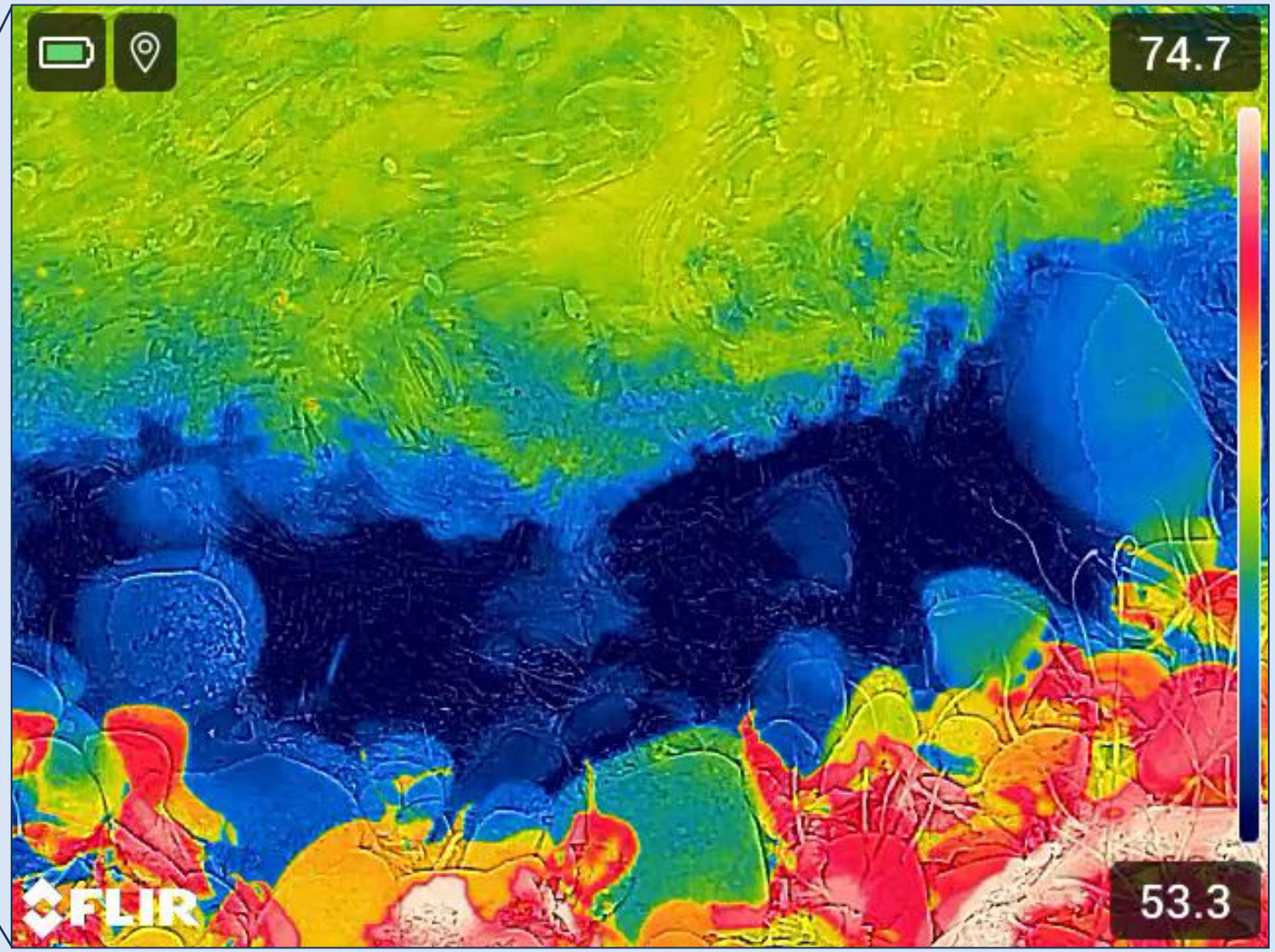
Thermal Visualization of Groundwater Discharge

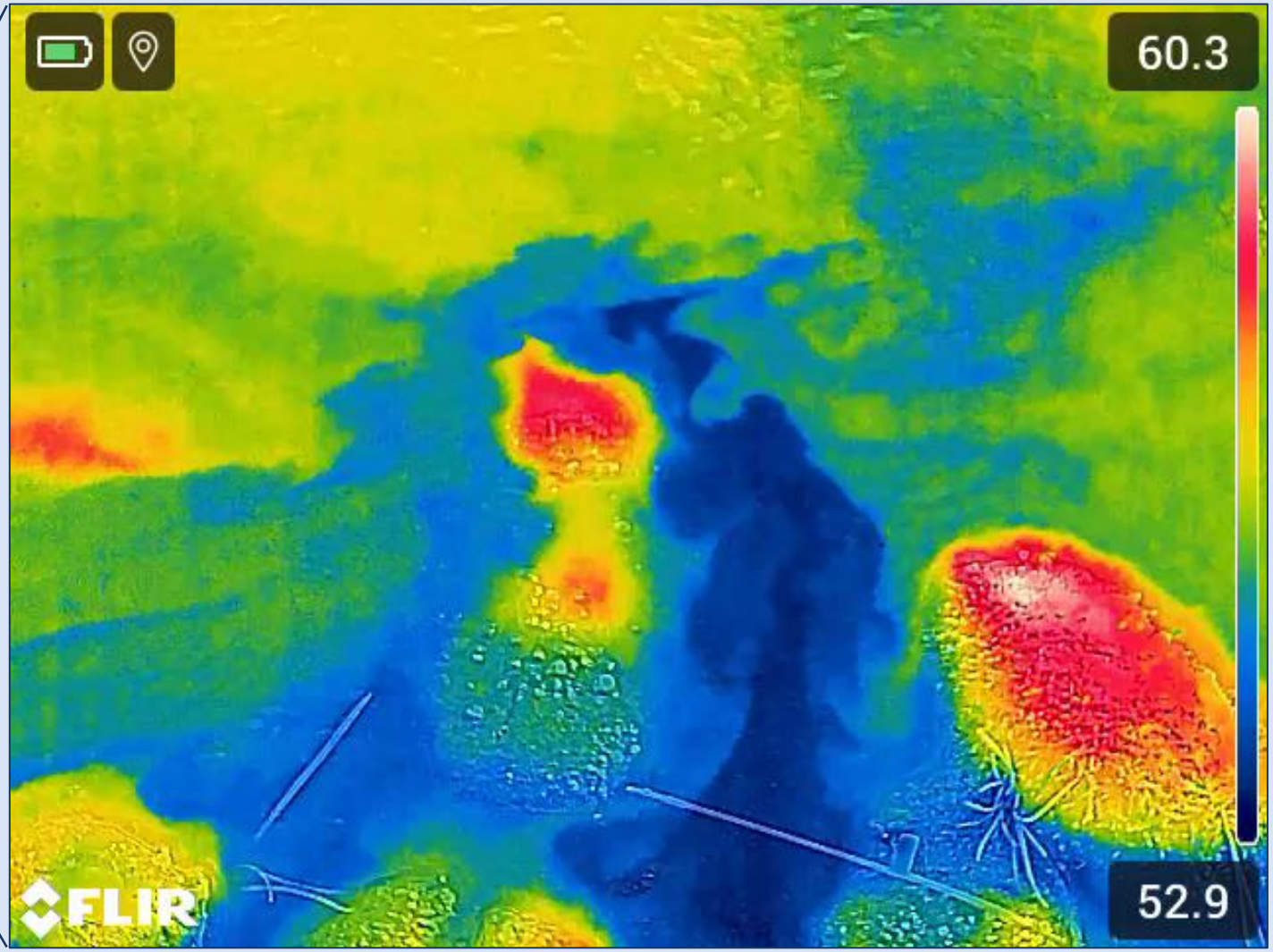
Diffuse Flow





Thermal Visualization of Groundwater Discharge

Discrete Flow



Visual Indicators of Groundwater Discharge

Iron precipitate

- Forms as iron in water becomes oxidized due to moving from low-oxygen to high-oxygen environment or iron-oxidizing bacteria

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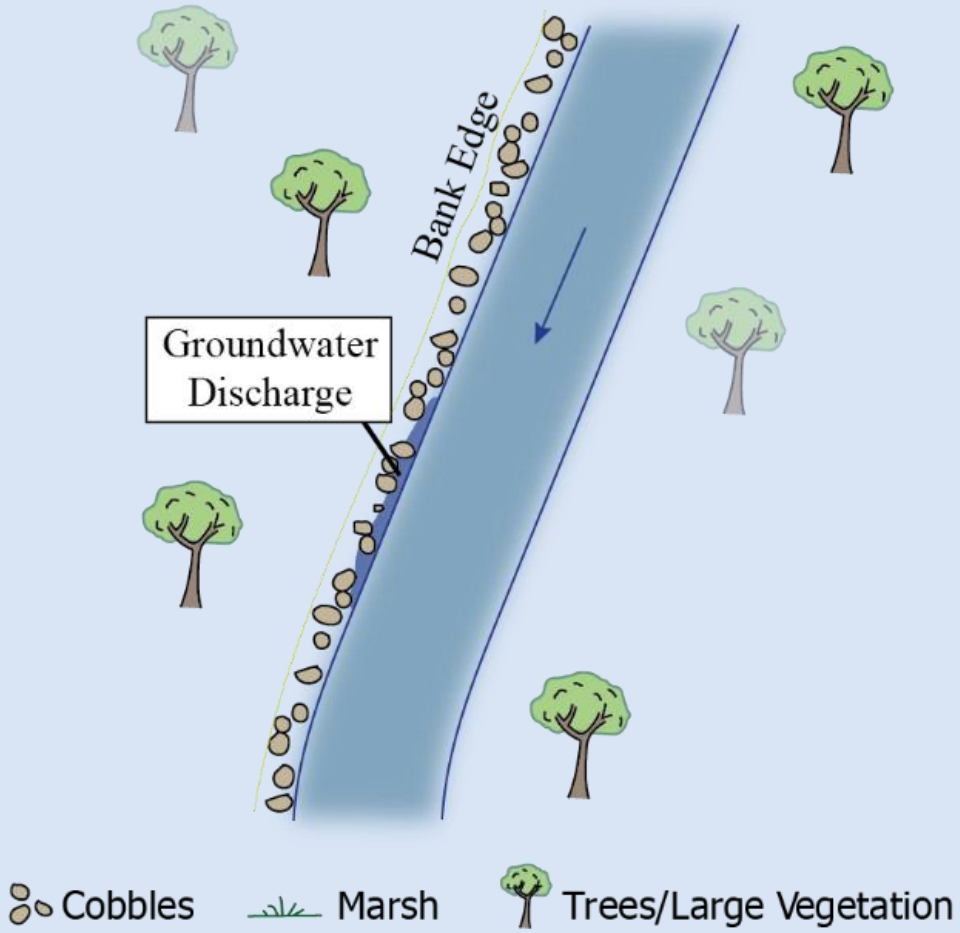
Biofilm

- Produced by iron-oxidizing bacteria

Preliminary Findings: Flowpath Matters



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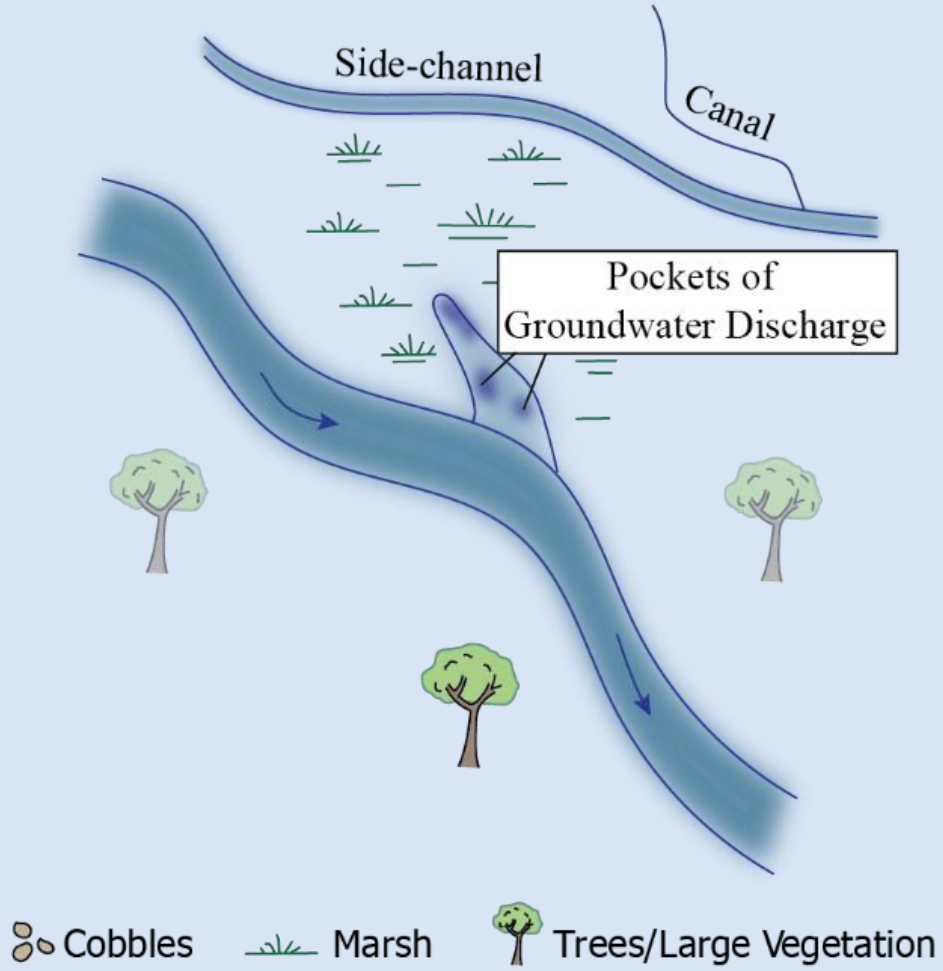

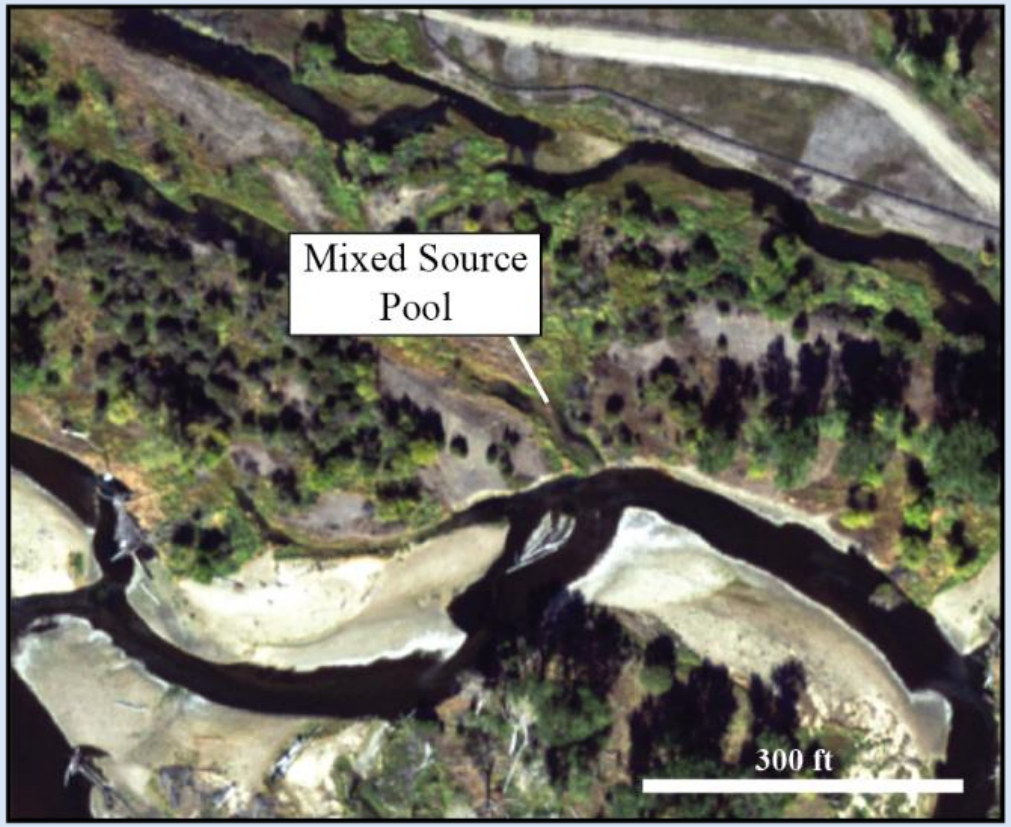

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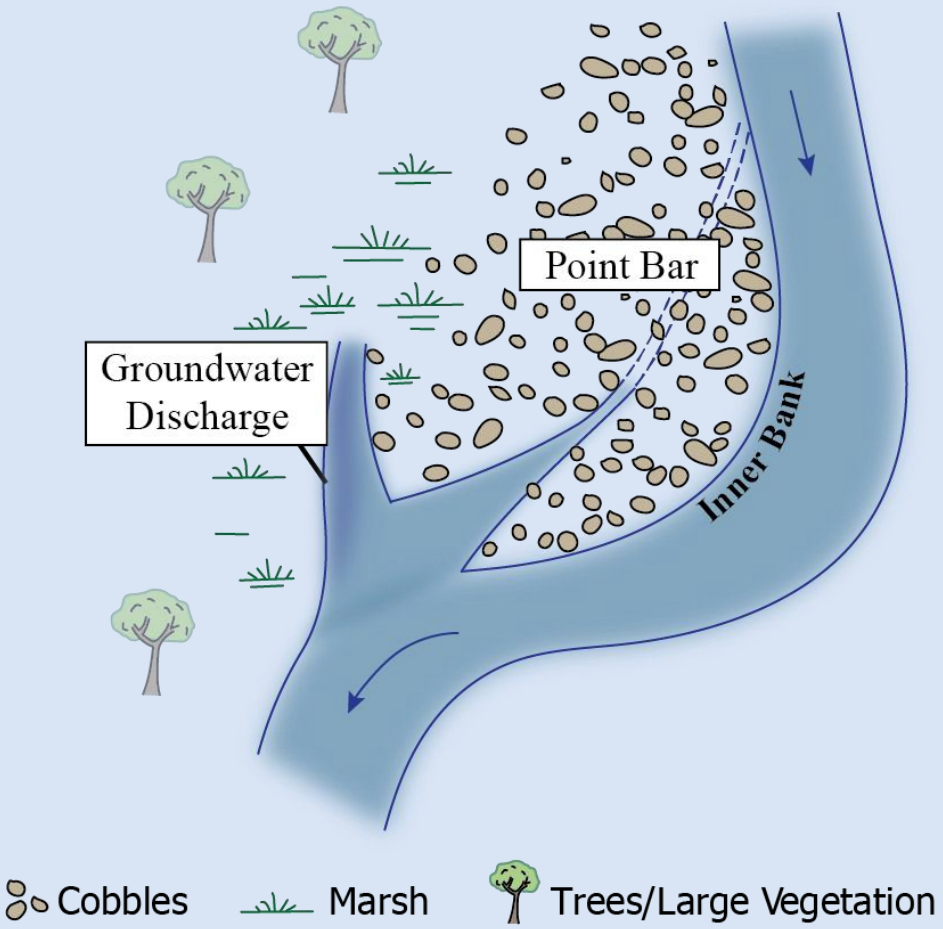

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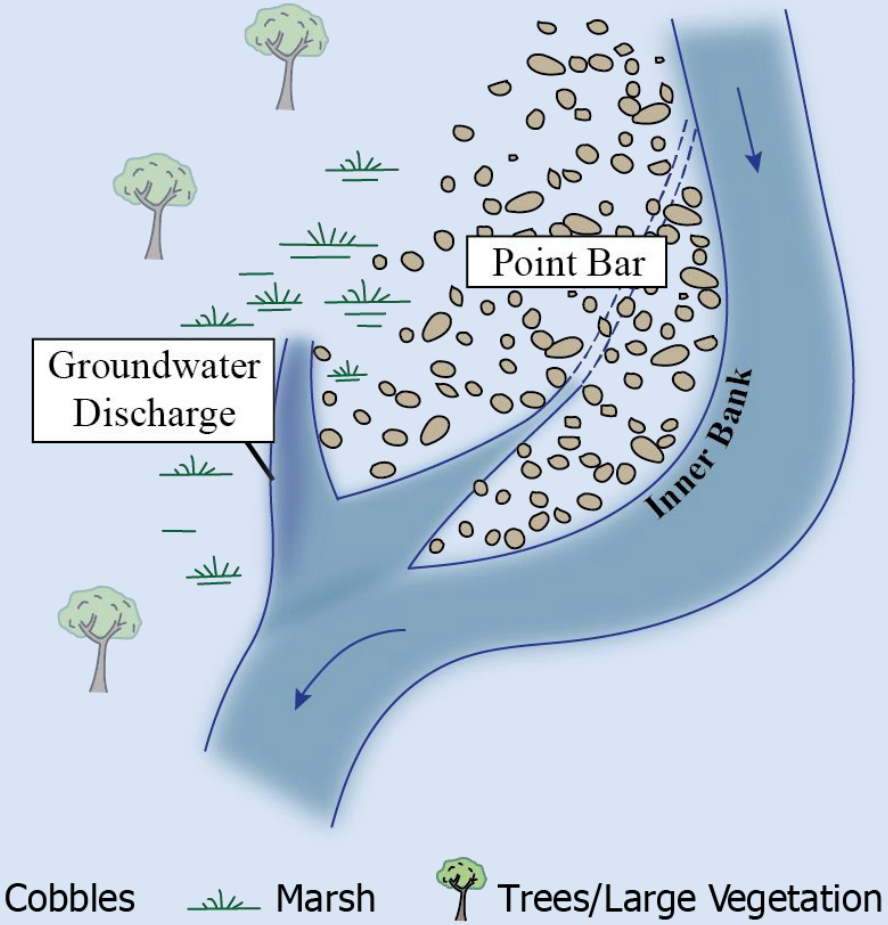

Flows are small compared to the river!

Preliminary Findings: Surface-Water Inputs

Tributary/Canal Returns

- The tributary was consistently colder than the river
- Only one surface-water site was warmer than the river
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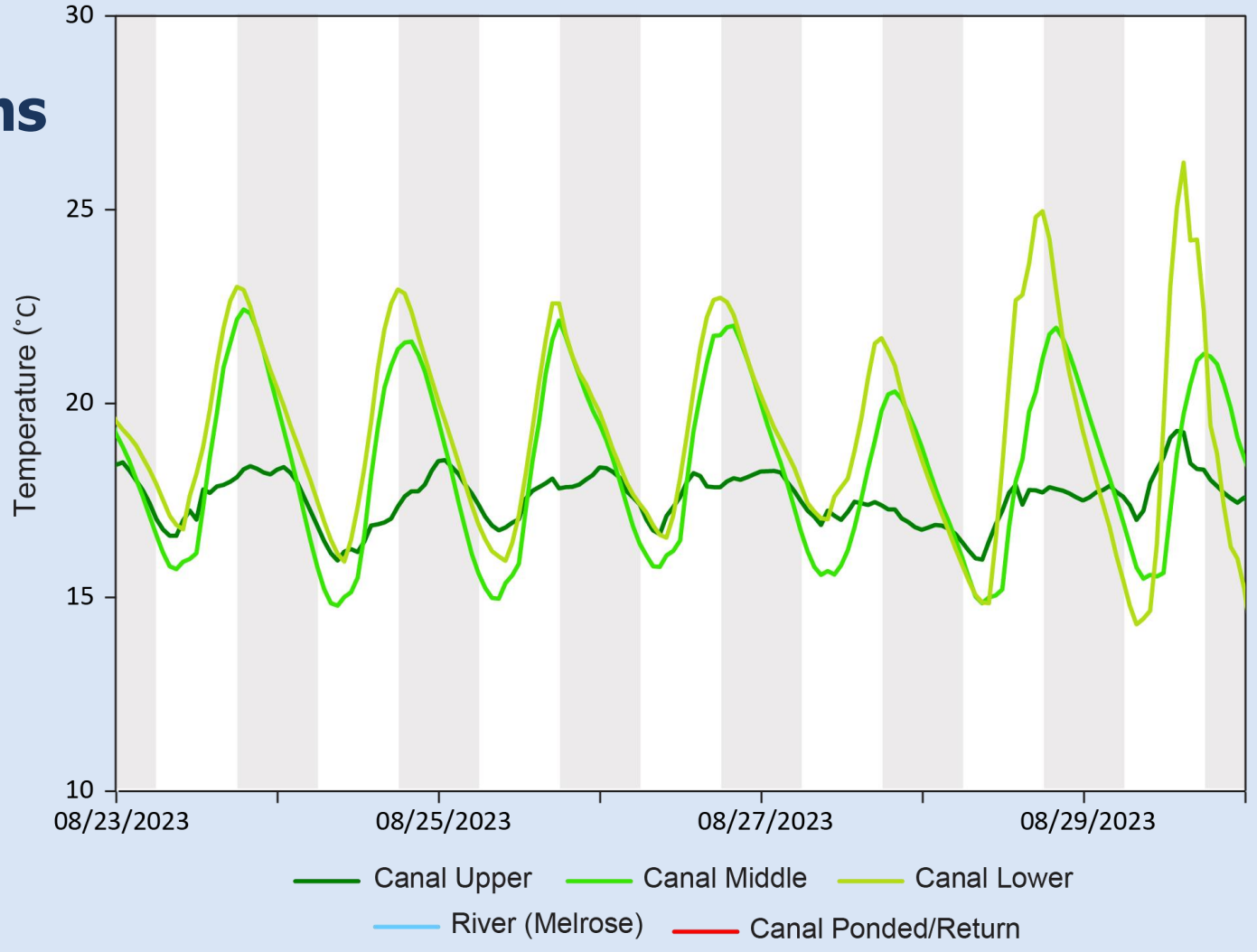

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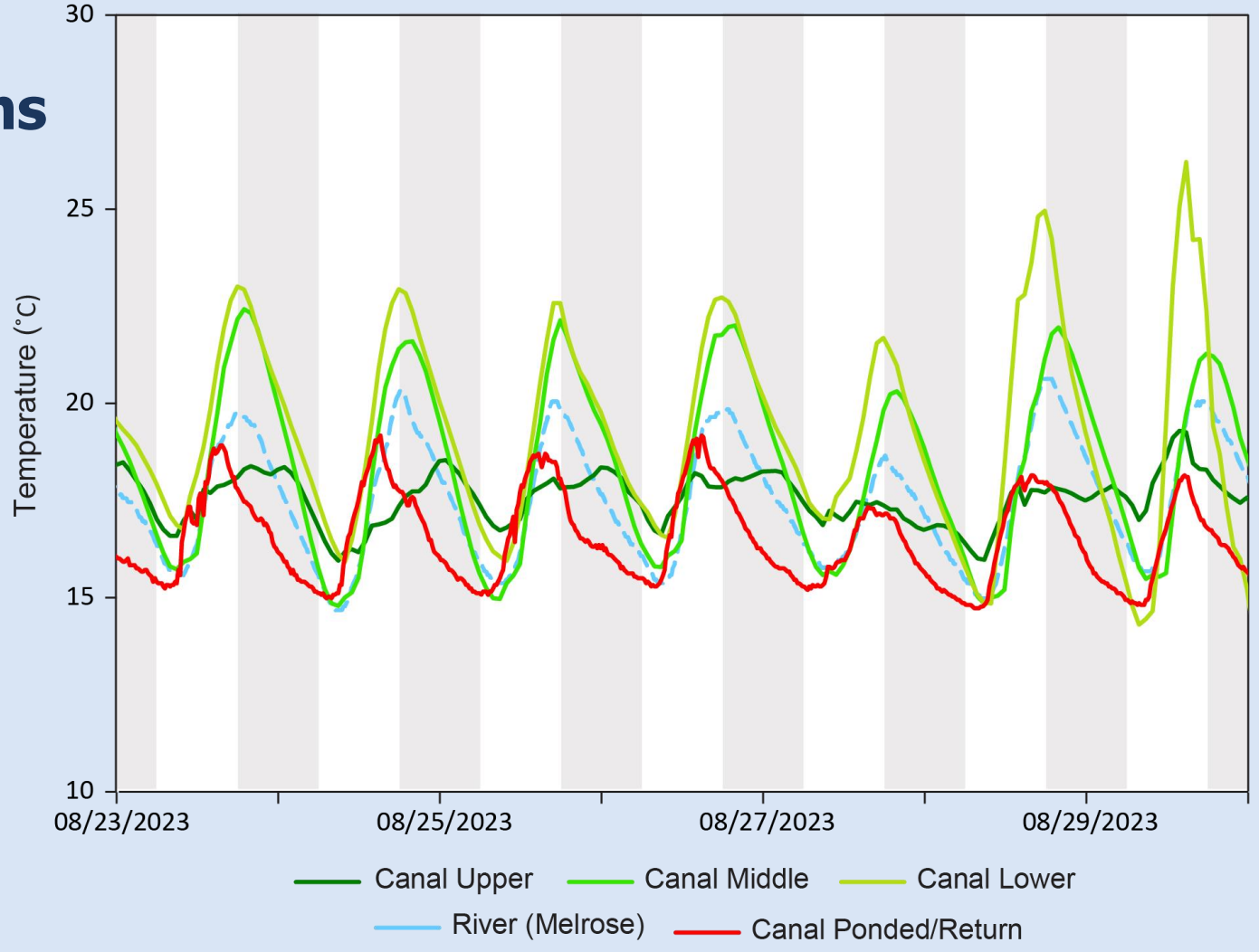

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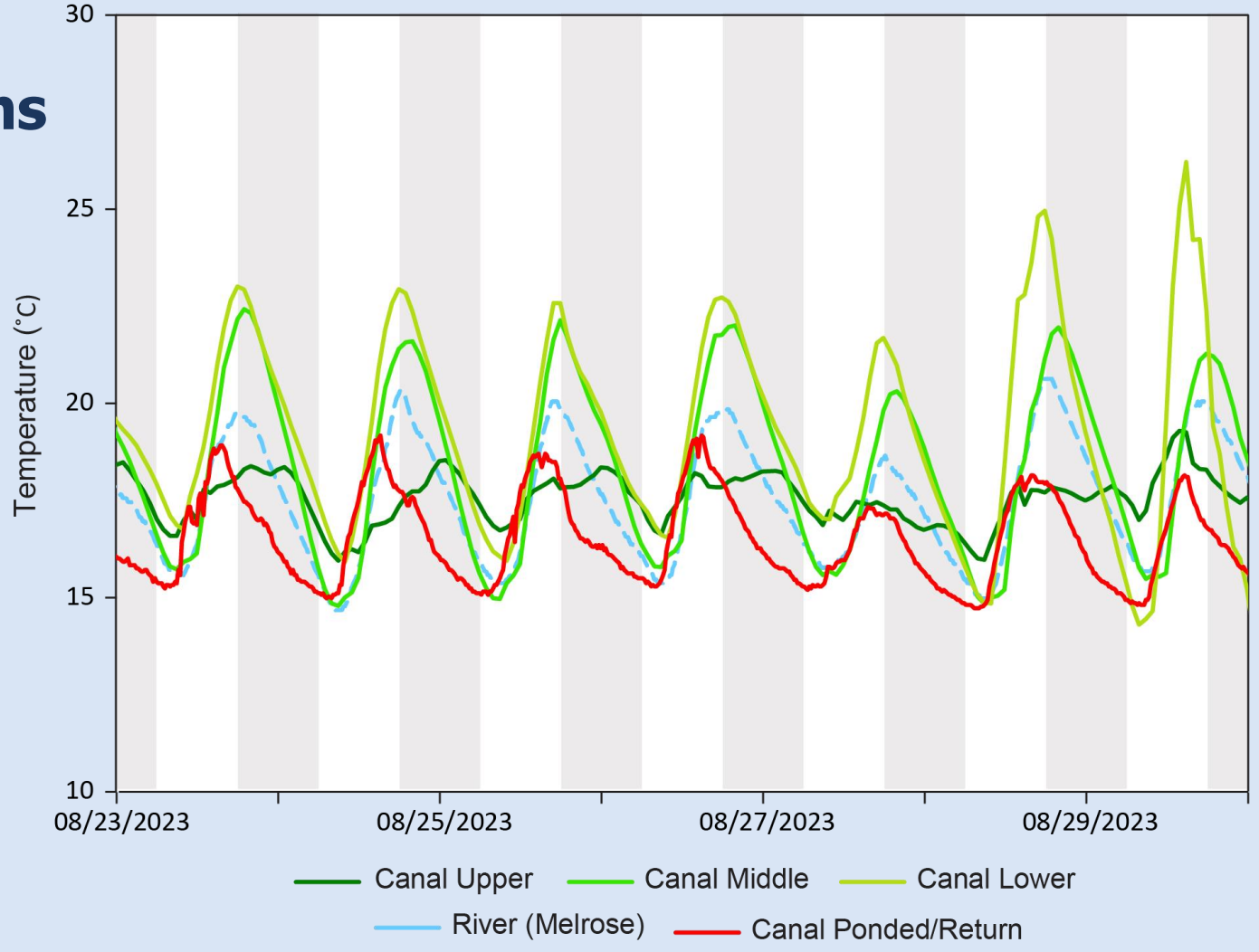

Preliminary Findings: Solar Radiation

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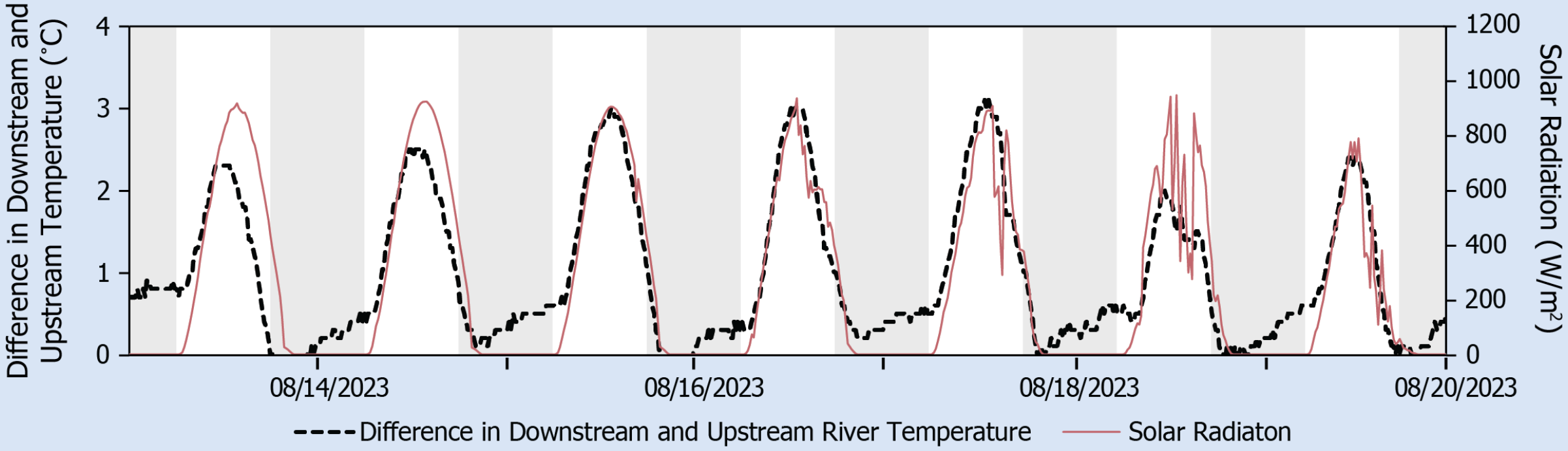

Preliminary Conclusions

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3) Solar radiation is warming the river

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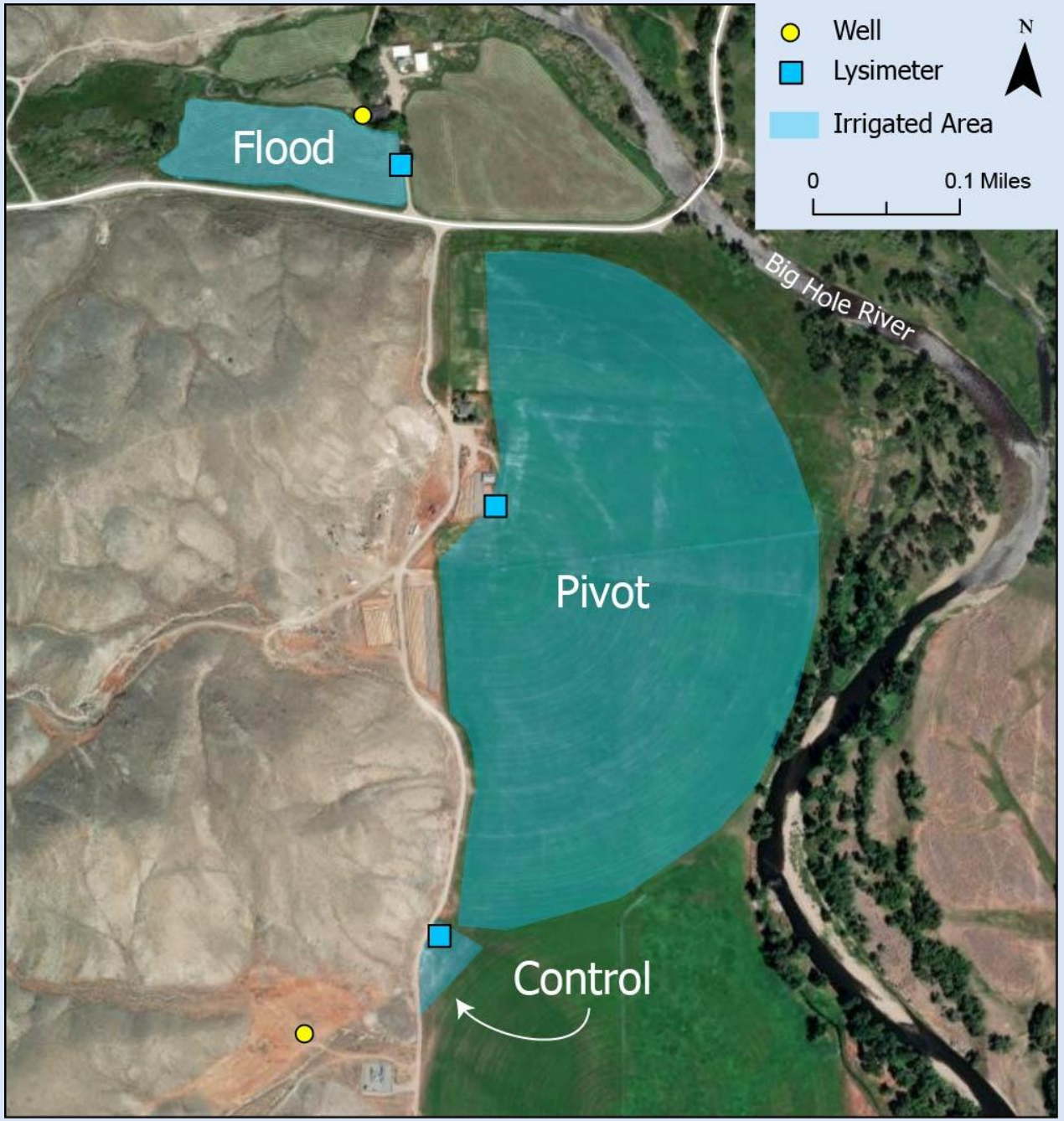
Future work:
- Continuing temperature surveys
- Measuring depth and surface area of the Big Hole River
- Quantifying surface-water inflows

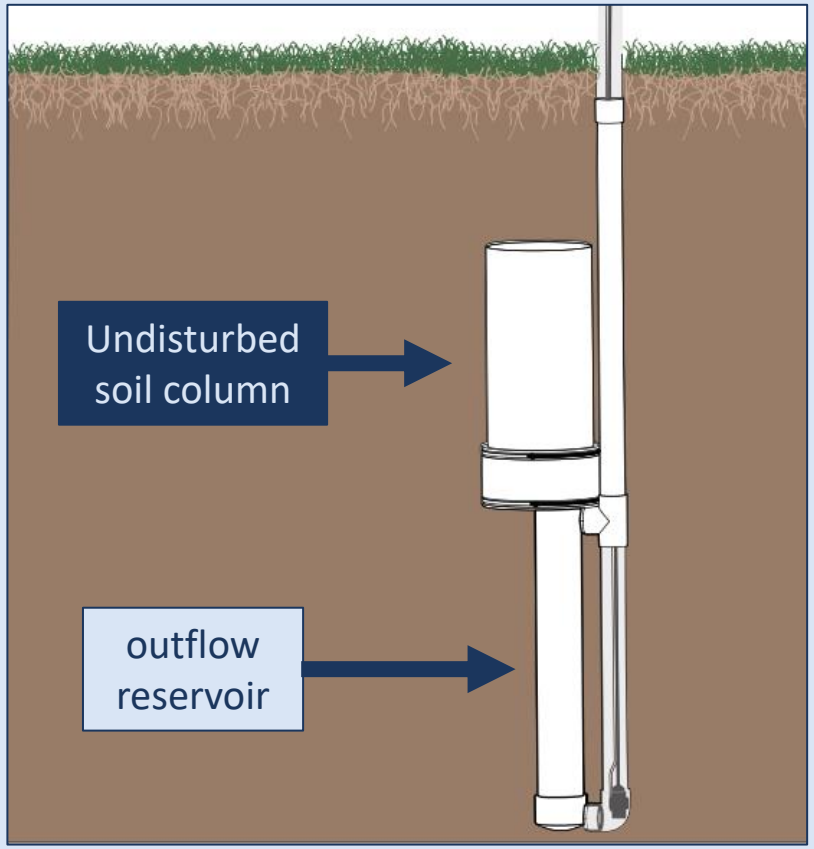
Irrigation Recharge

How much groundwater recharge results from flood irrigation vs. pivot irrigation?

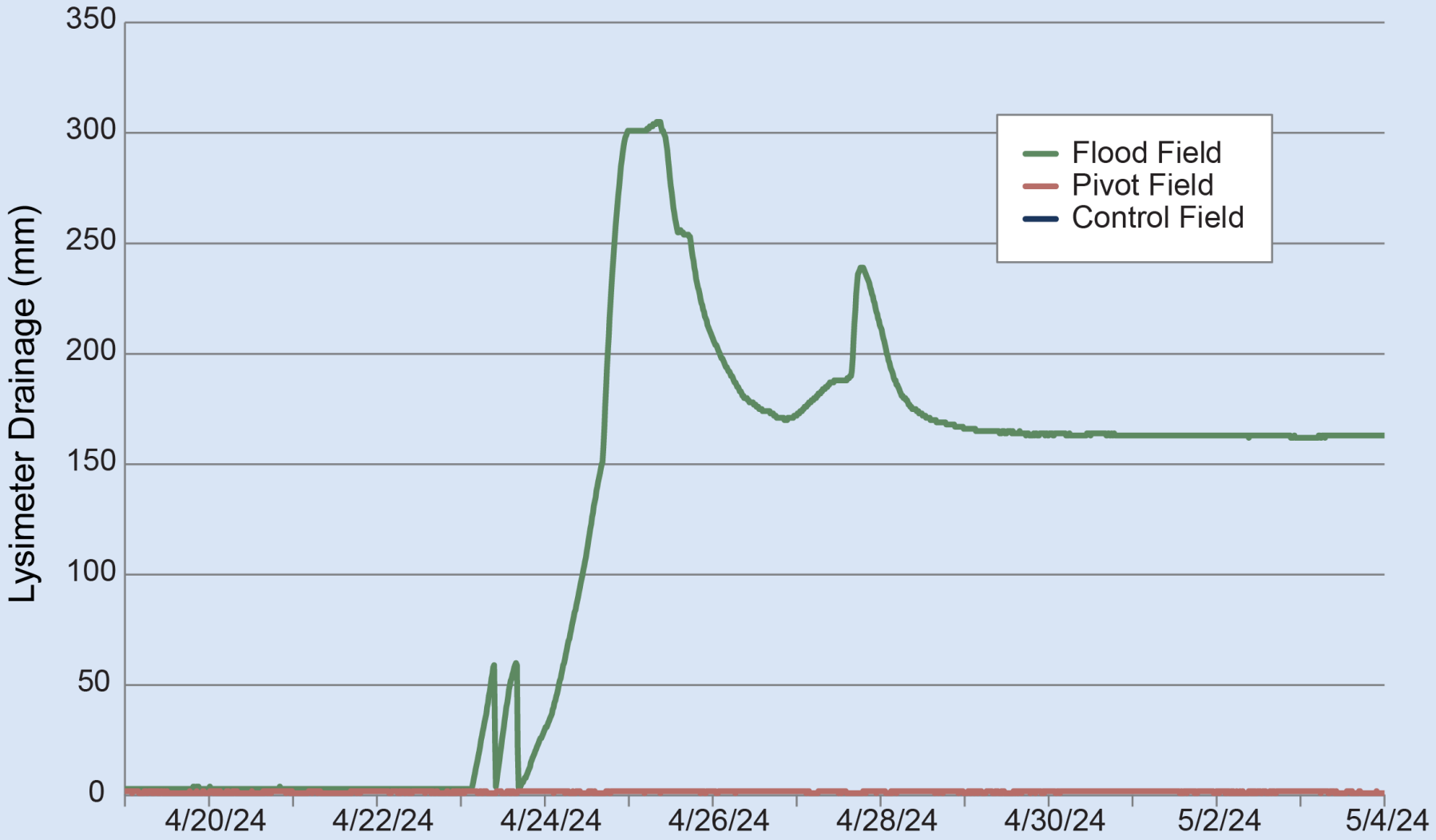


Irrigation Recharge

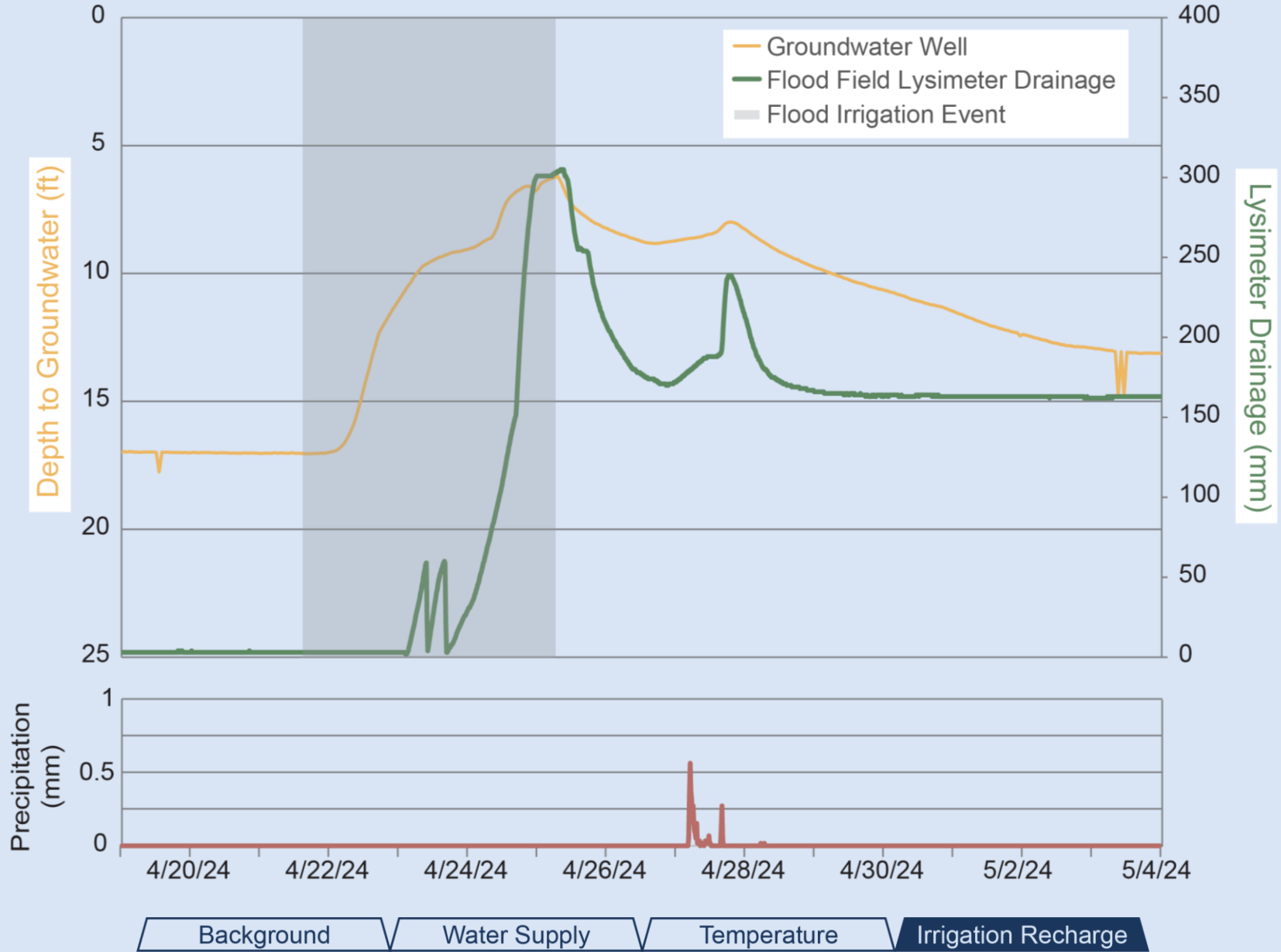
Lysimeter Installation



Recharge and Irrigation Type



Flood Irrigation



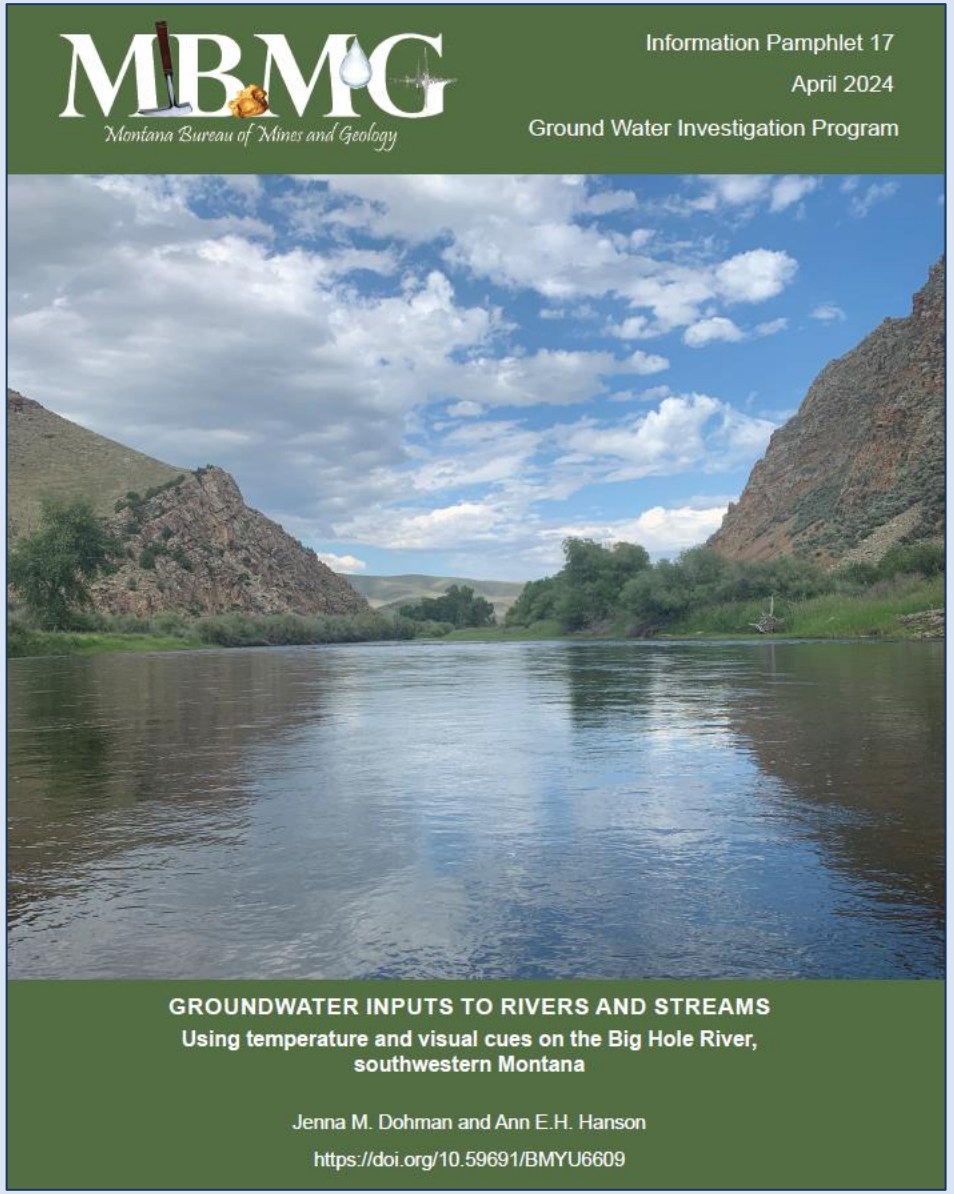
Questions?

Thanks to:
Landowners in Glen & Melrose
Big Hole Watershed Committee

Want to see more thermal videos?

Visit MBMG's YouTube for thermal videos of groundwater flowing into the Big Hole River:

https://tiny.cc/mbmgthermal



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