Enhanced Ground Water Monitoring in Big Sky, MT

Montana Bureau of Mines and Geology
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GLWQD

MBMG Montana Bureau of Mines and Geology

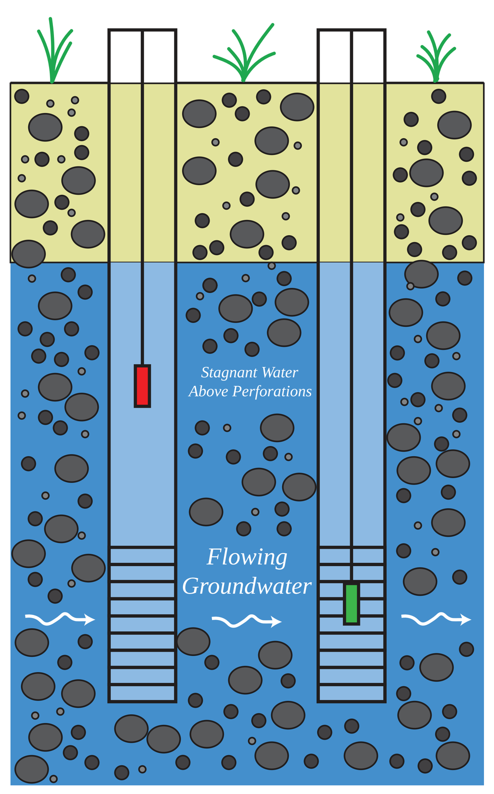
Hydrogeologic Setting

The Meadow Village aquifer (MVA) and the Upper Gallatin aquifer (UGA) are unconfined, alluvial aquifers that range from about 10-60 ft thick. The MVA supplies municipal water for Big Sky, Montana, with the public water supply wells completed in the deeper, productive zone north of the West Fork (AKA Middle Fork). The UGA supplies water to domestic and public water supply wells serving homes, businesses, and schools with wells completed in the deeper, productive zone west of the Gallatin River. Both aquifers are connected to surface water and are underlain by relatively impermeable Cretaceous shale. Nitrate values greater than 5 mg/L have been observed in periodic sampling of MVA and UGA wells. Potential anthropogenic sources of nitrate include land application of treated effluent, septic effluent from unsewered developments, fertilizer, stormwater, and seasonal runoff from horse corrals.

Methods

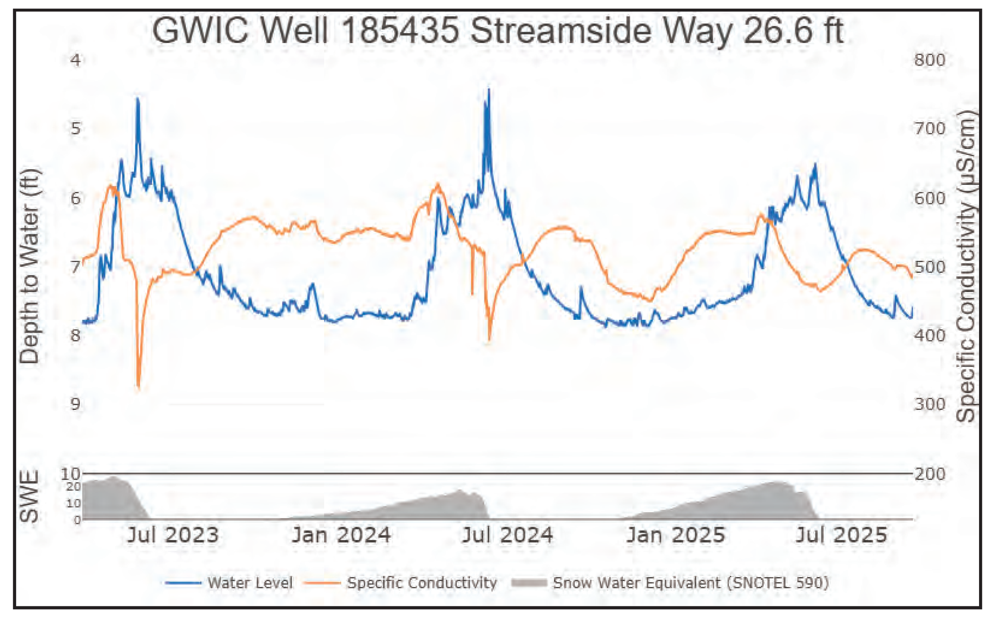
Nine wells previously instrumented for hourly water-level and temperature measurements were upgraded with dataloggers that record Specific Conductance (SC) in addition to water level and temperature; SC, reported in units of microSiemens per centimeter (µS/cm), provides an indirect measure of the total dissolved solids concentration.

The initial deployment of the loggers above the screened interval revealed that water quality in the wellbore could become stratified, and the results were not representative of the aquifer. Therefore, the loggers were installed within the screened interval to ensure that the measurements reflect the groundwater flowing through the aquifer.

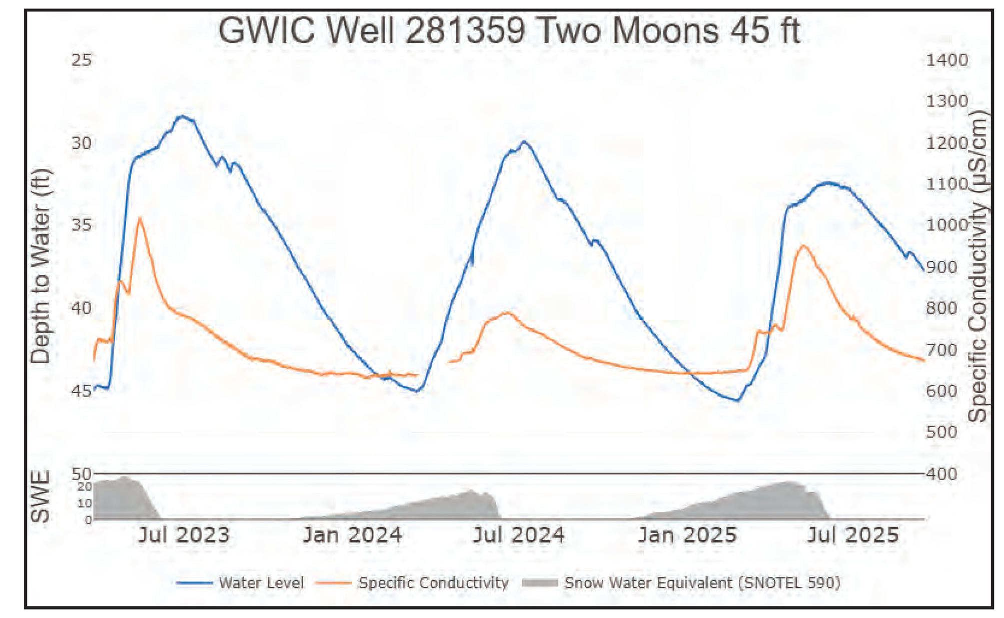


Irrigation discharge of treated wastewater.
Monitoring well in foreground

A



B



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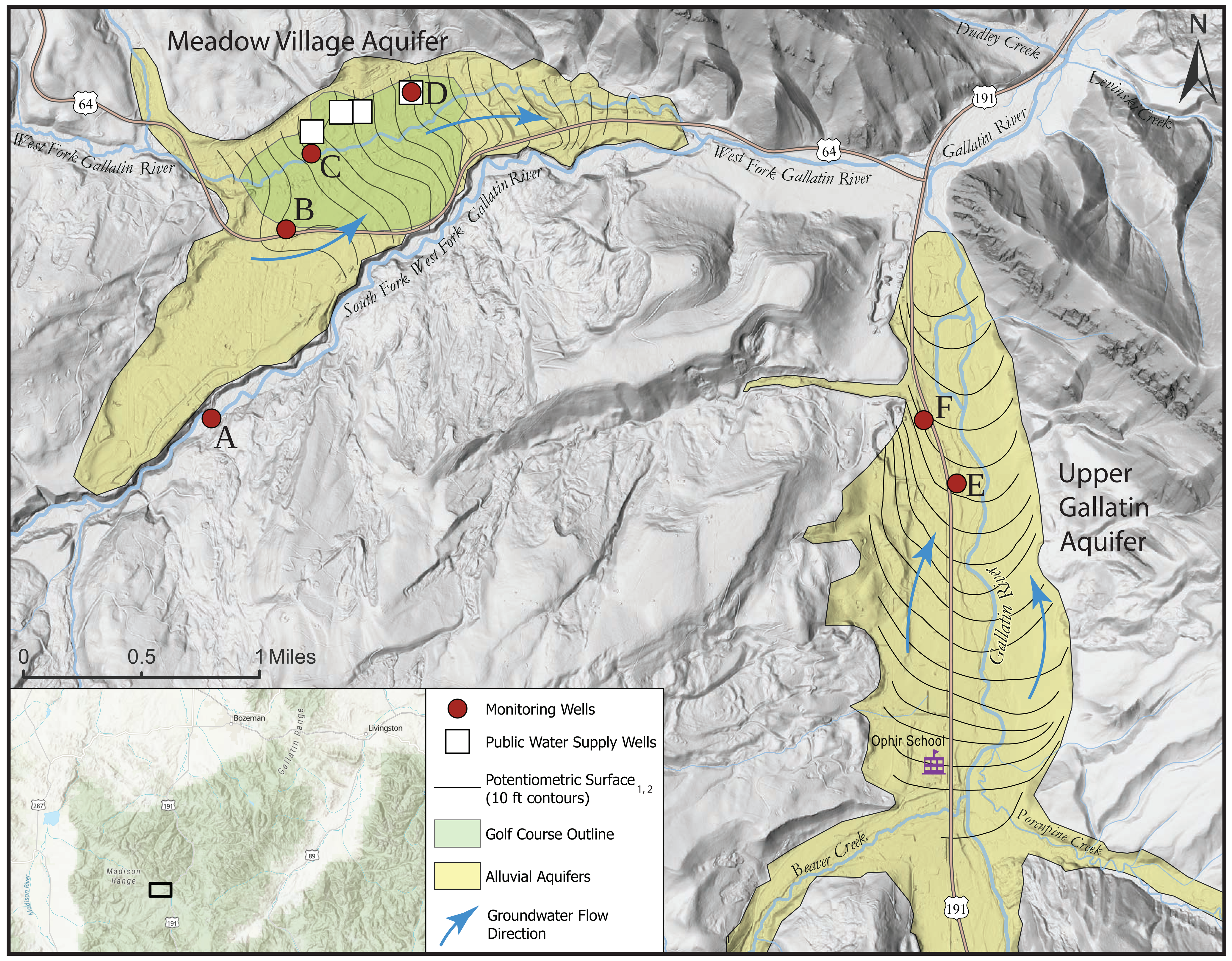

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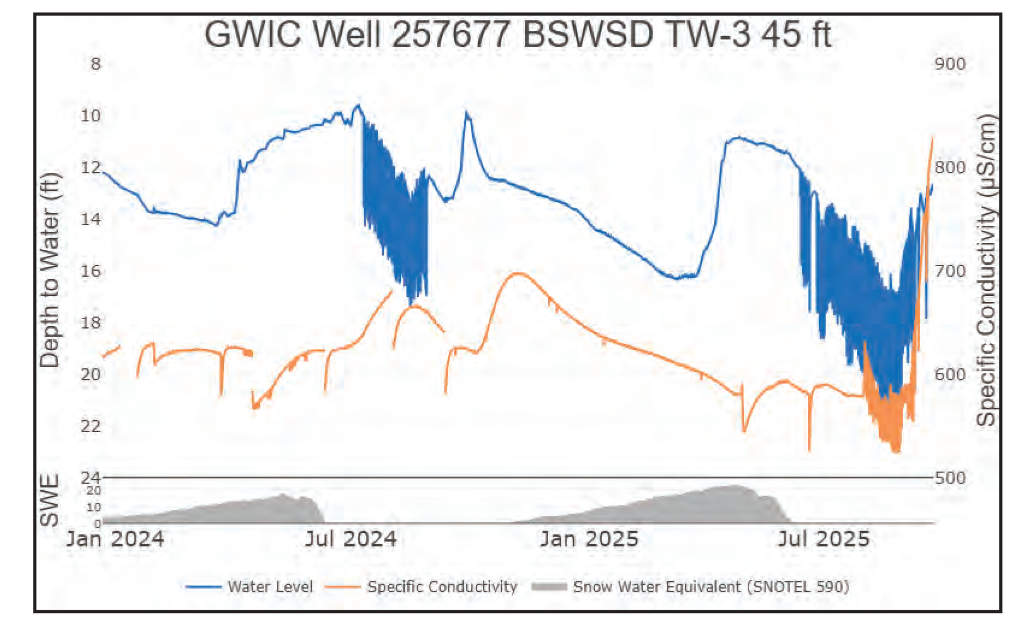
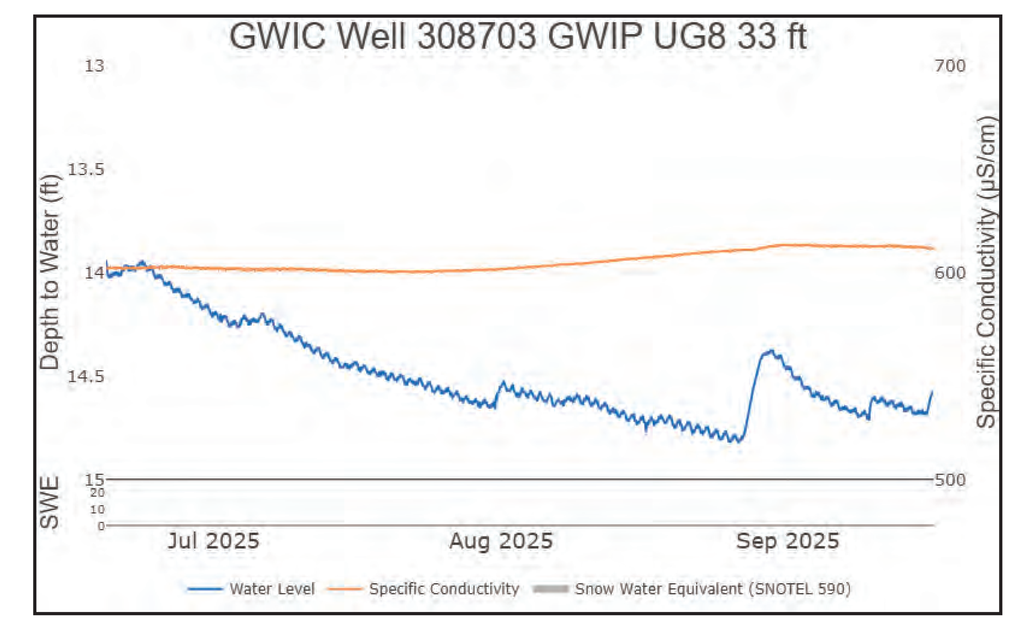


E



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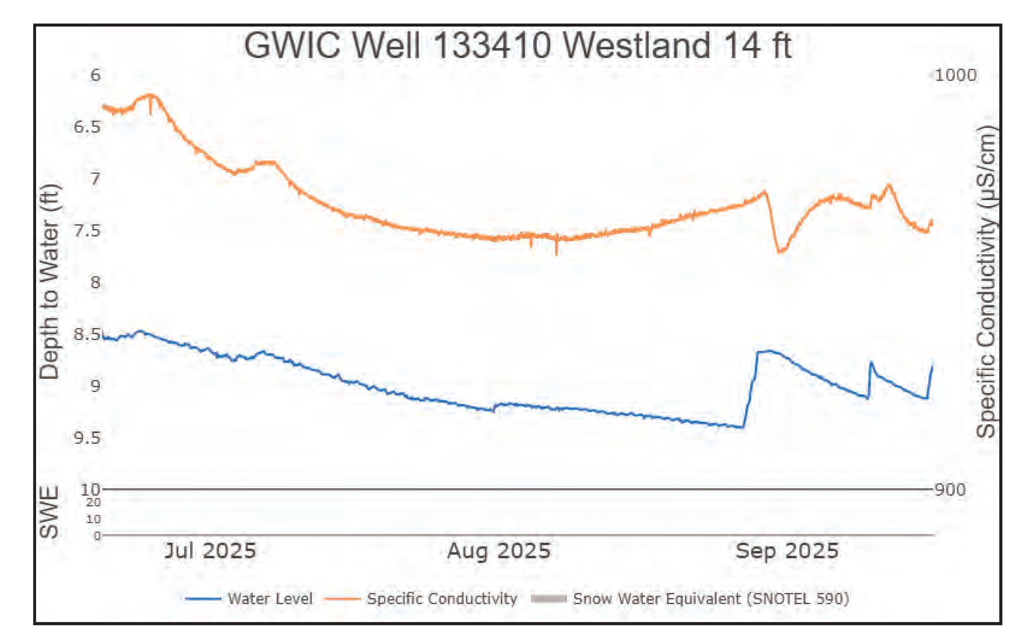
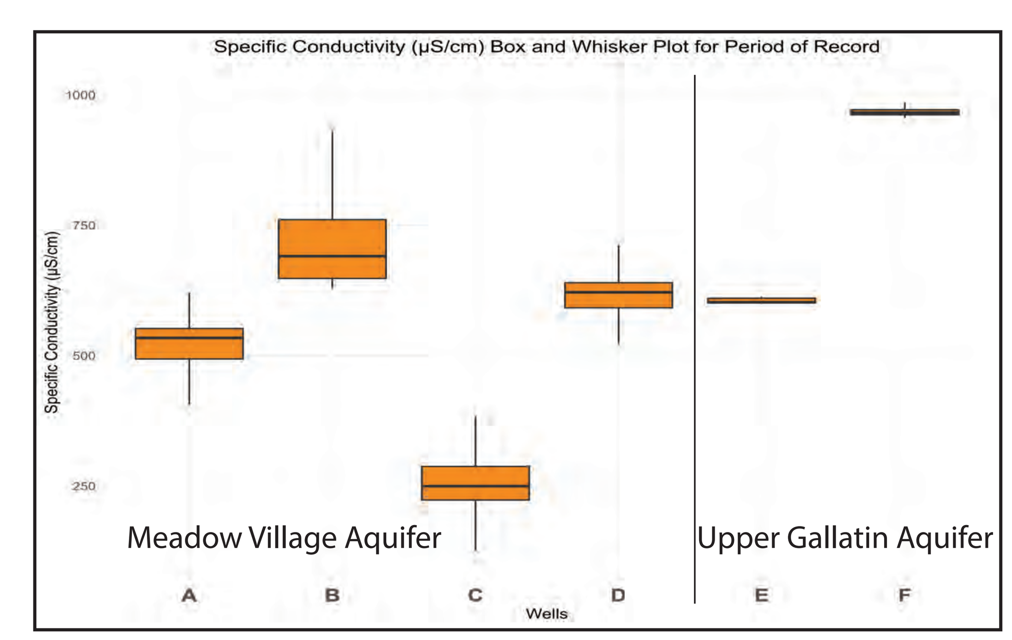


Discussion

The high-frequency SC measurements reveal significant seasonal variations in water quality and the timing and magnitude of the variations differ across the aquifers. Wells in the MVA south of the West Fork show an SC peak preceding peak water levels (A and B). Wells in the productive zone of the MVA (C and D) show a lagged response, with SC peaks after snowmelt and precipitation events. Well C, located near the West Fork and downgradient of an effluent irrigated pasture, shows a significant SC peak in July 2024. This pattern was not seen in the other wells or in July 2025.

Two wells in the UGA (E and F) were instrumented for SC in June of 2025 as recommended by MBMG open file report 772: 'Hydrogeologic Investigation of the Upper Gallatin River Corridor, Big Sky, Montana'. SC values in the shallower well E show significantly higher SC values that respond to snowmelt and precipitation events.



1. Rose, J., and Waren, K., 2022, Hydrogeology and groundwater availability at Big Sky, Montana: Montana Bureau of Mines and Geology Open-File Report 747, 90 p.
2. Meredith, E., Abdo, G., Myse, T., Breitmeyer, R., and Rose, J., 2025, Hydrogeologic investigation of the Upper Gallatin River Corridor, Big Sky, Montana: Montana Bureau of Mines and Geology Open-File Report 772, 47 p.