Lysimetry of Deep Drainage Below Irrigated Fields

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Project Motivations

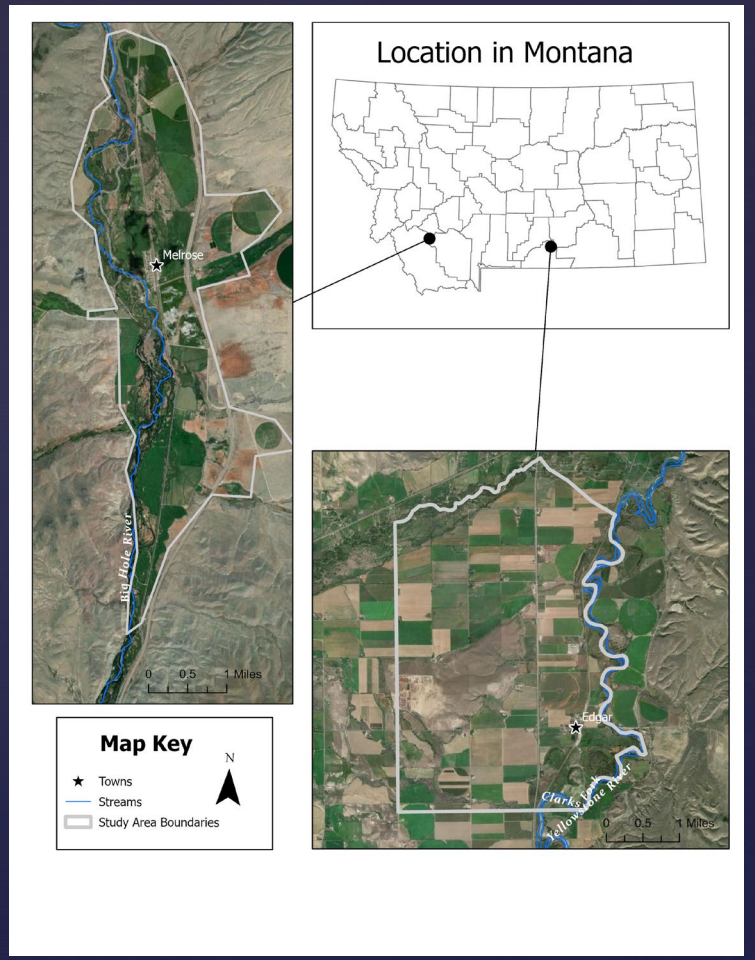
- Increasing proportion of irrigation is applied by sprinkler, primarily pivots in some Montana Communities
- Many pivot irrigated fields have historically been flood irrigated
- Groundwater recharge from irrigation application can be a critical piece of groundwater budgets in some areas
- Few direct measurements of irrigation recharge

Objective and Scope

- Objective – Measure irrigation recharge sourced from flood and pivot irrigation
  - Project proposed to the Ground Water Investigation Program (GWIP) at MBMG in 2021 by Carbon County, MT
- Project is conducted at the “field-scale” meaning individual irrigated fields
- Focus is on direct measurement of irrigation recharge

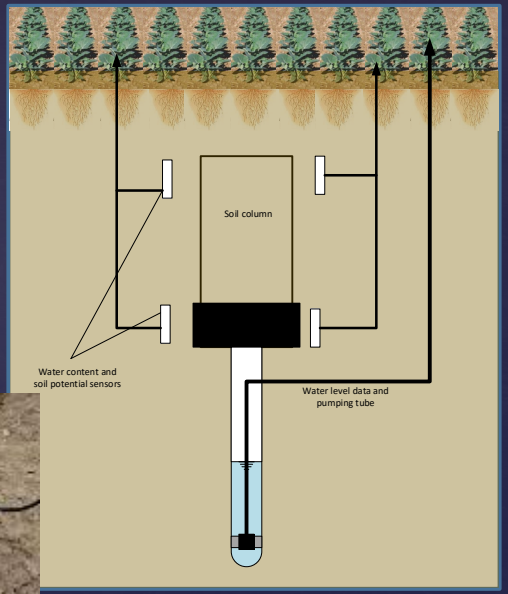
Approach

- Installation of lysimeters at two agricultural properties – one in Edgar, MT and one in Melrose, MT
- At each property, three installations
  - One control (no irrigation)
  - One under flood irrigation
  - One under pivot irrigation
- Considerations:
  - Access
  - Properties with necessary operations



Instrumentation

- METER Drain Gauge G3 drainage lysimeters
  - Automated operation and data collection
  - Relatively low maintenance demands
  - Plug and play functionality
- METER water content and matric potential sensors
- Zentra dataloggers (same data collection system as Montana Mesonet uses)



Installation

- Access pits were excavated using a small excavator
- A flat bench was excavated for pressing in the lysimeter body (control volume)
- The lysimeter body was pressed into the soil to obtain as undisturbed specimen as possible
- The filled lysimeter body was weighed, and attached to the drainage reservoir

Installation (continued)

- Installation site undermined beneath field so that vertical flow path was relatively undisturbed
- Lysimeter placed and moisture content and suction sensors installed
- Data loggers and surface infrastructure installed

Data Collection

- Instruments immediately began data collection in Fall/Winter period of 2022-2023
- First irrigation occurred in Melrose in late April 2023
- First irrigation in Edgar – June 2023

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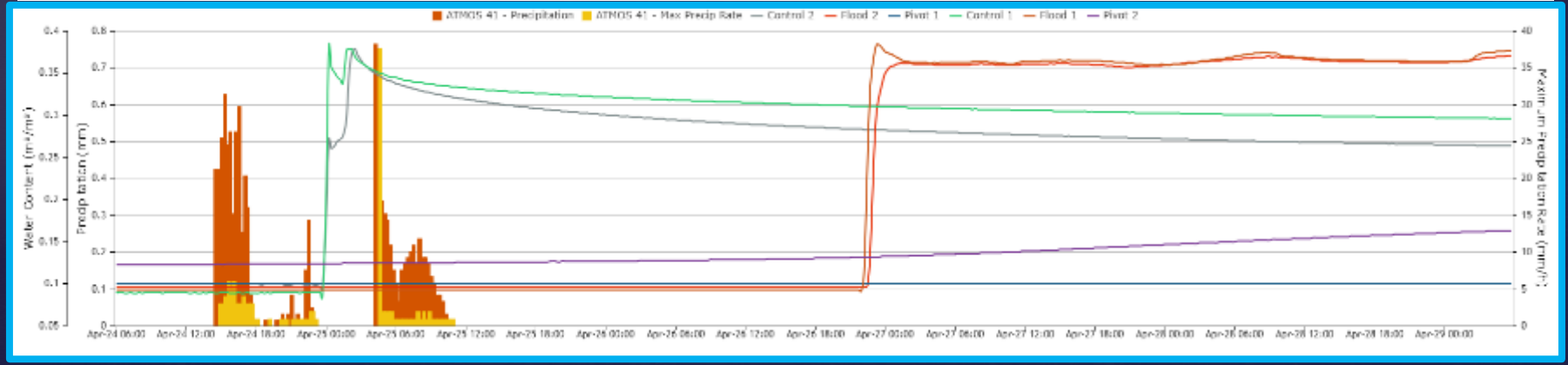
Initial Data

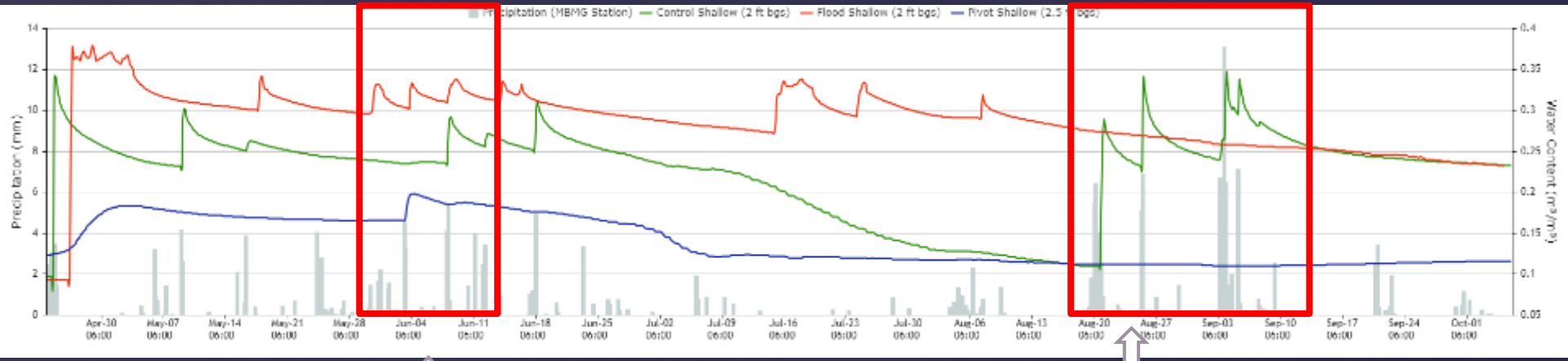


Initial Data – Flood Irrigation (Melrose)

Irrigation cycles

118 cm | 12 cm | 36 cm | 12 cm | 18 cm | 12 cm

First Look Data (preliminary)



Note pivot irrigated field responds to precipitation here

Does not respond here

Initial Conclusions

- First irrigation season showed much higher infiltration through flood irrigated fields – no surprises
- Temperature data shows the thermal behavior of soils upon initial irrigation
- Pivot irrigated fields (and controls) showed no percolation but showed different behavior that can be explained by vegetation growth and water availability

Next Steps and Lessons Learned

- Next Steps:
  - Run measurements for at least one more growing season to allow crop rotation in Edgar and additional data sets for both locations
  - Better constrain application rates on flood fields next season (application rates are measured on pivot fields)
  - Publish data
- Lessons learned
  - Installation was tricky in some sites due to soil conditions
  - Flood irrigated fields resulted in lots of percolation which lead to battery exhaustion on auto-pumps
  - Identify you cell service early