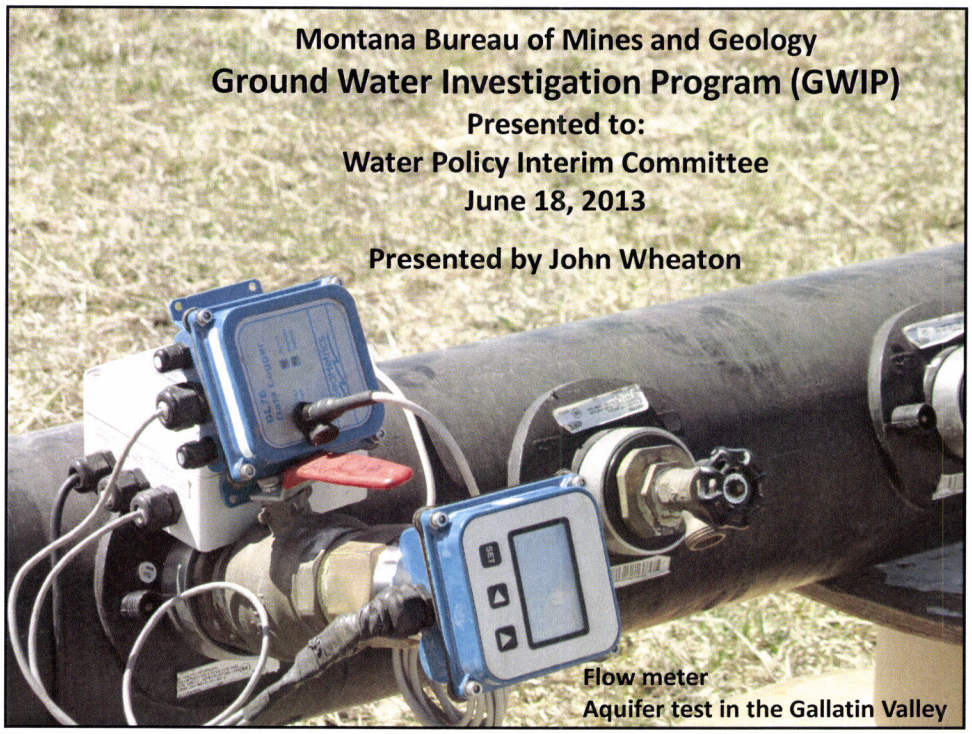


Ground Water Investigation Program (G W I P)

- Answer questions that are crucial for groundwater resource management
- Established research approach in a structured, objective program
- Provide information so aquifers can be intentionally managed, not just used
- State funded program initiated in 2009
- There are currently about 50 nominated projects

http://www.mbmg.mtech.edu/gwip/gwip.asp

Specific issues that need a consistent Statewide approach that GWIP is working to address

Stream depletion due to groundwater development

Impacts to aquifers: increasing demand and changing land use

Protection of senior water rights (groundwater and surface water)

Water quality impacts such as septic effluent

Cumulative effects of water development

Aquifer Storage and Recovery (ASR) in Montana

How Projects are Chosen:

Nominations are based on locally identified concerns

Ranked by the:

Ground Water Steering Committee

Voting: DNRC, DEQ, Dept of Ag, State Library

Non-voting: Representatives of other perspectives

Ranking Criteria:

Population growth, increasing number of wells, industrial pressure, land use conversion, complexity.

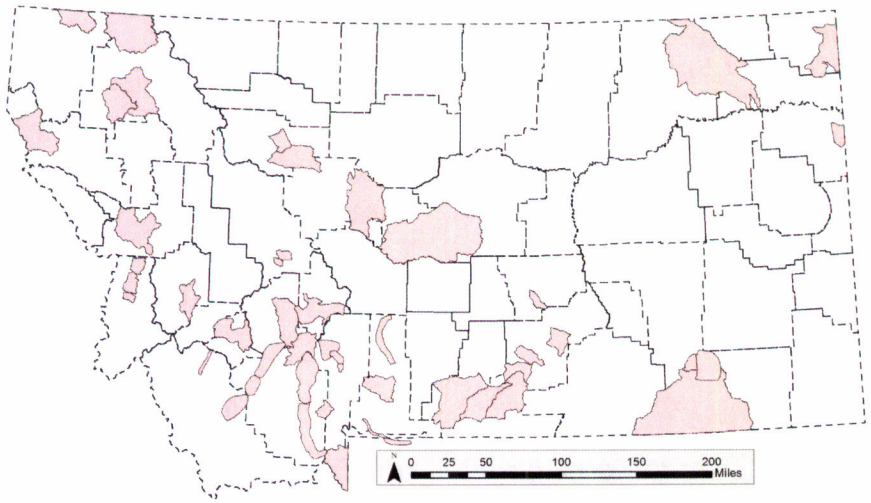
Approach: Build on geologic mapping, GWAP aquifer characterization, collect project-specific data and develop a groundwater flow model

Products:

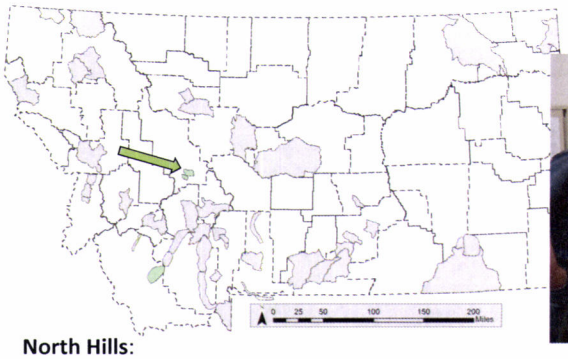
- Interpretive Report
- Modeling Report
- Technical Data Report (if appropriate)
- A comprehensive set of hydrogeologic data
  - Available through the MBMG
  - Ground-Water Information Center (GWIC)
  - Archived forever

Decision making information for resource optimization

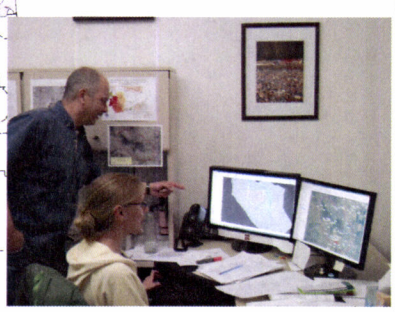
Nominated GWIP Projects



Completed GWIP Projects



Modeling files are now available on our home page.

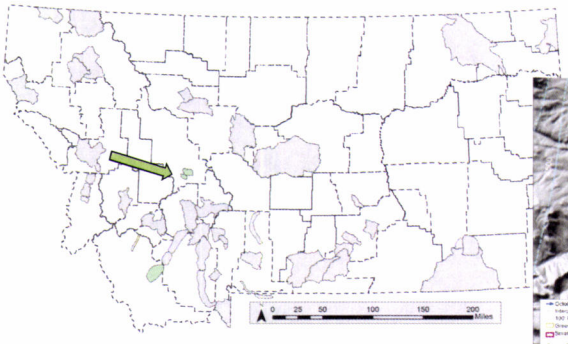


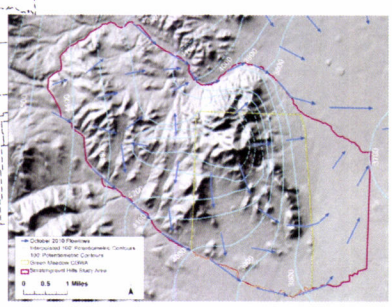
North Hills:

Issue: Dense rural residential developments rely on groundwater
Groundwater levels have been declining for nearly two decades

Results: The aquifer is being stressed
Groundwater modeling suggests existing uses are sustainable
New wells near denser subdivisions should be drilled with a minimum of 35 feet of drawdown available above the pump, in anticipation of future groundwater level declines

Completed GWIP Projects



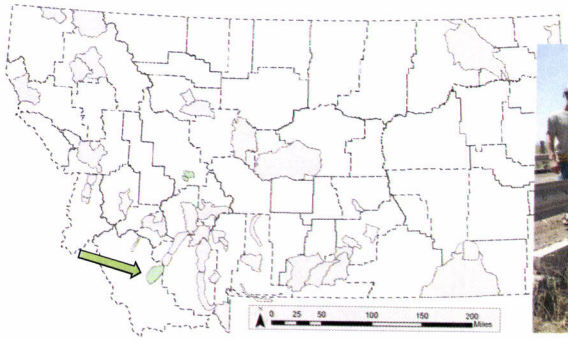


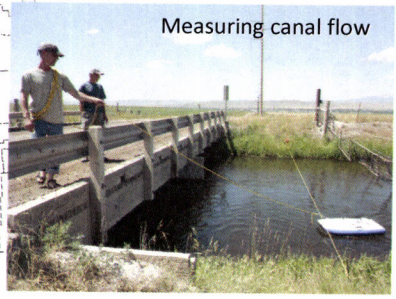
Scratchgravel:

Issue: Pressure on groundwater supplies from subdivision growth

Results: Area-wide drawdown does not appear to be occurring
Individual well pumping is causing some local drawdown trends

Completed GWIP Projects





Lower Beaverhead:

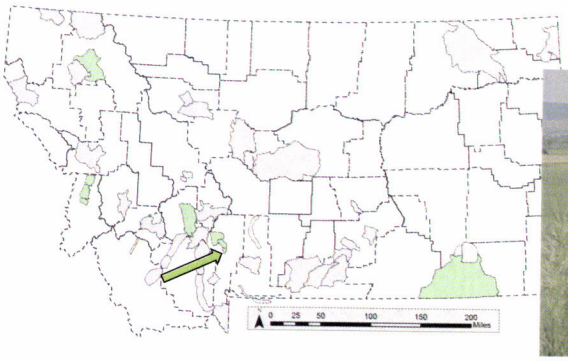
Issue: Determine the impact to drawdown and stream depletion from irrigation pumping

Results: Irrigation canals are significant sources of groundwater recharge (76,000 ac-ft in 2010)

Aquifer drawdown by irrigation wells is not apparent

Surface water is impacted by pumping, but at a rate that can be calculated but not measured

Underway GWIP Projects



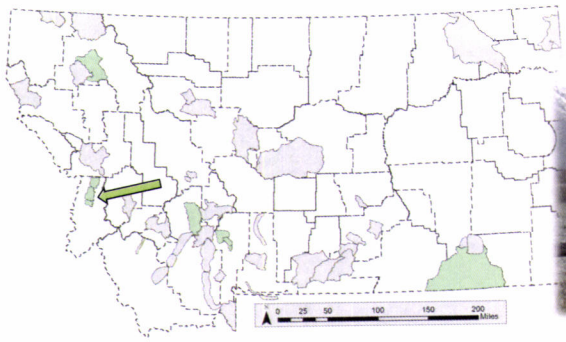
Four Corners:

Issue: How does changing land use from irrigated agricultural to high-density residential impact groundwater and surface water supplies in this area?

Results: Area-wide groundwater level trends show minor change with time

Groundwater flow has decreased

Underway GWIP Projects



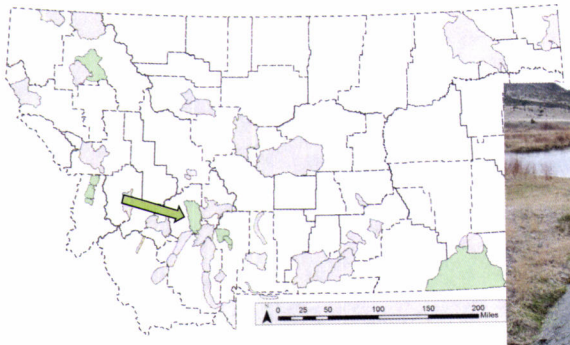
Stevensville:

Issue: Examine the feasibility of supplementing surface water irrigation supplies with groundwater.

Approach:

Find and use existing information
Collect groundwater and surface water elevations
Groundwater Flow Model

Underway GWIP Projects



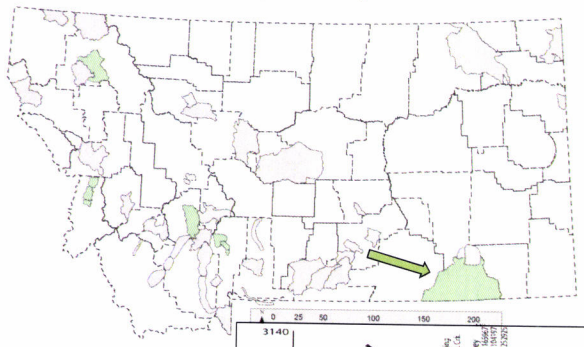
Boulder River:

Issue: Current and potential effects of housing developments on surface water flows
Potential to enhance late summer flows through managed recharge

Preliminary:

Managed recharge may enhance flows, but magnitude may be small

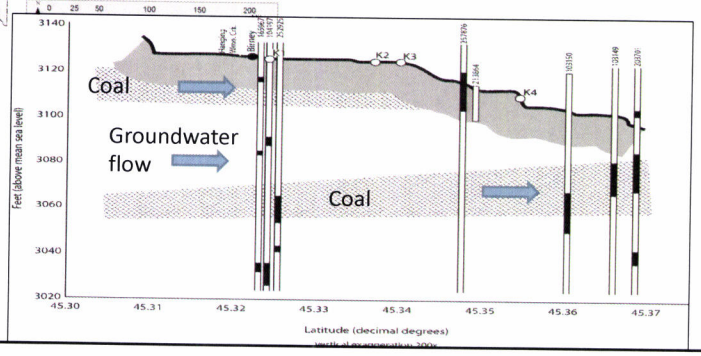
Underway GWIP Projects



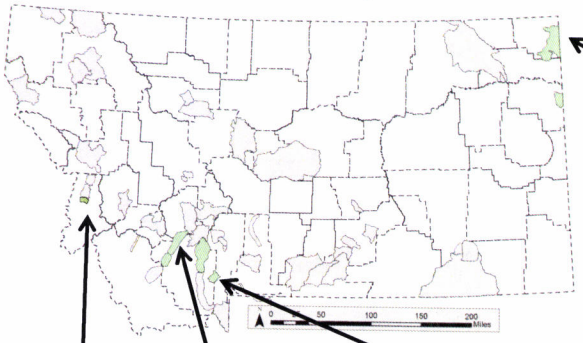
Coalbed Methane:

Issue: Groundwater withdrawal during coalbed methane production has the potential to reduce baseflow to streams

Can coal contribution to streams be directly measured?



Scheduled GWIP Projects

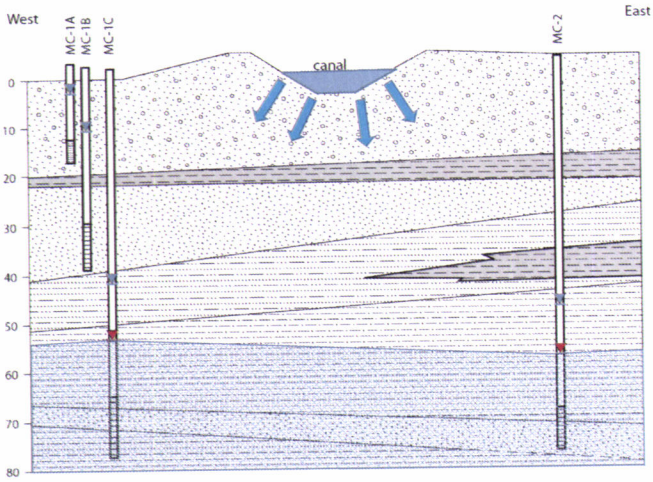


Clear Lake

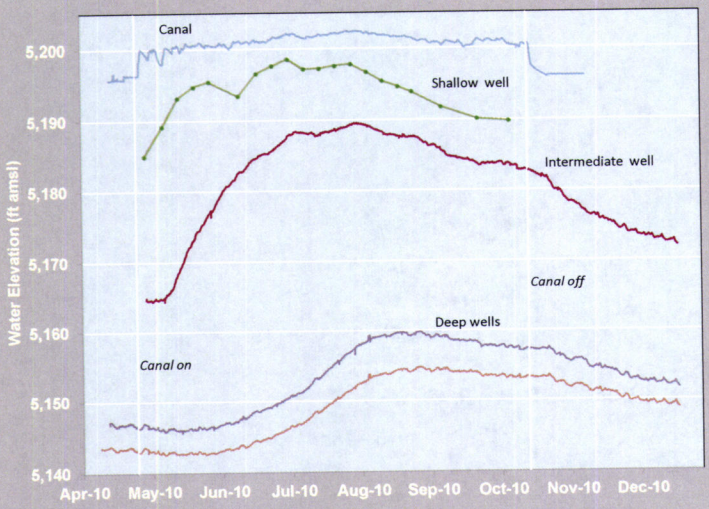
Big Sky

Hamilton

Upper Jefferson River



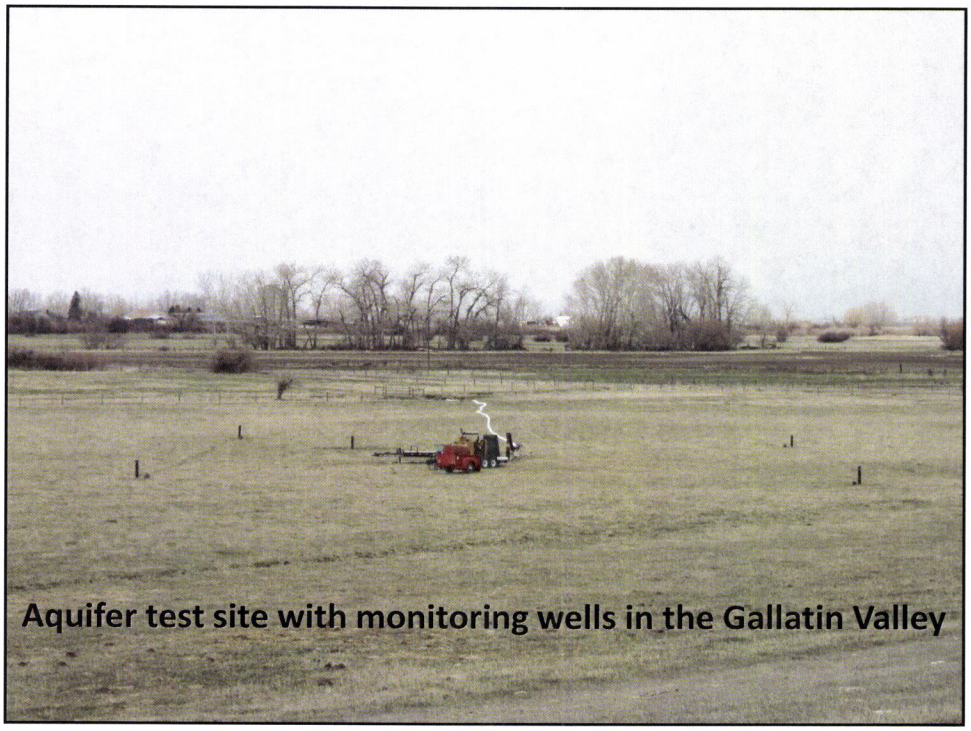
Canal leakage monitoring site, Beaverhead River valley



Groundwater response to canal leakage

Seepage Loses for several irrigation canals

• East Bench Canal	2.2 cfs/mile
• West Side Canal	1.2 cfs/mile
• Bozeman area ditches	1.1 cfs/mile
• Upper Big Hole	0.15-1.5 cfs/mile
• Helena Valley	0.6 cfs/mile
• Billings area	0.05-0.5 cfs/mile
• Stillwater-Rosebud Watershed	1.1-1.8 cfs/mile
• Greenfields Bench	0.45-4.7 cfs/mile



Aquifer test site with monitoring wells in the Gallatin Valley

Groundwater / surface-water interface
Beaverhead River

Groundwater / surface-water interface
Cold Spring, Boulder River