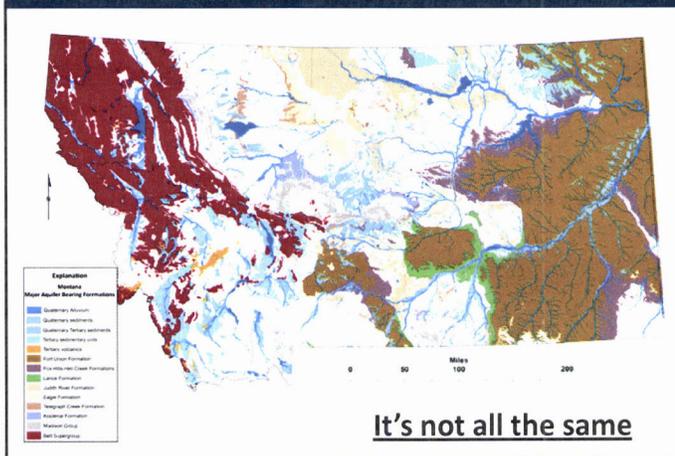


Ground Water Investigation Program (GWIP - MBMG)  
Program Status and Update

Presented to the Water Policy Interim Committee  
September 10, 2012

Presented by:  
John Wheaton

Preparation by:  
GWIP staff



Topics for today:

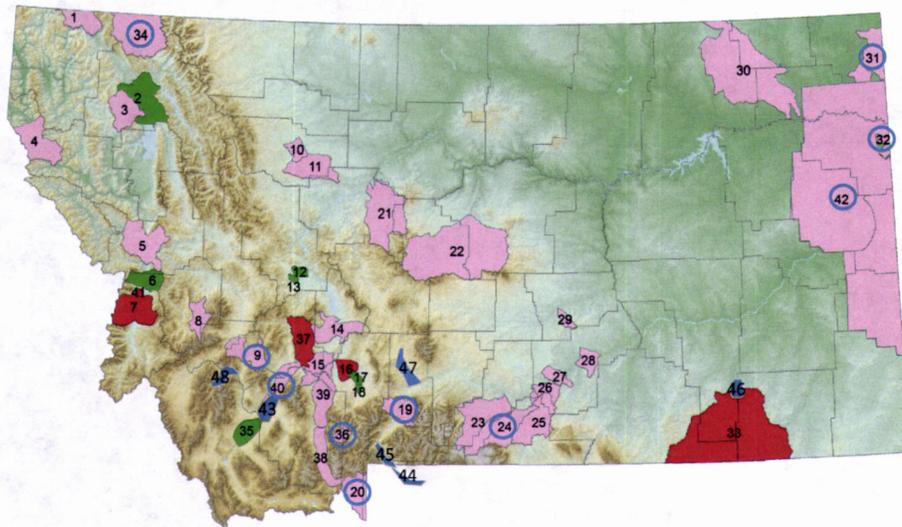
Status of GWIP projects  
John Wheaton

Gallatin Valley (4 Corners) model and project results  
Mary Sutherland

Review of lessons learned from GWIP  
Kirk Waren

Ranking meeting of Ground Water Steering Committee September 26.

New nominations are in blue.



New nominations or re-nominated projects  
 Issues and concerns nominated and being considered:

- 9 Summit Valley
  - Upper Clark Fork stream depletion
  - Land release
  - Development – industrial and domestic
- 19 Small tributaries that feed Paradise Valley (Pine Creek)
  - Development stresses
  - How these catchments support the main valley
  - And now a major fire
- 31 Clear Lake Aquifer
  - Water management
  - Ancestral Missouri River valley
  - Wetlands, irrigation use
- 32 Lower Yellowstone River Buried Channel Aquifer
  - Resource quantification and management
  - Irrigation and water supplies – Sidney area
- 34 North Fork Flathead River
  - Sensitive international river system

Issues and concerns nominated and being considered:

- 45 Yellowstone River north of YNP
  - Groundwater/surface-water interaction
  - Hydrothermal feature recharge
- 44 Soda Butte Creek – YNP
  - Increasing development in a seasonally high use area
- 20 West Yellowstone
  - Nitrate and water supply stress from expanded growth
- 36 Big Sky
  - Potential water resources to meet increasing demand
  - Water management of the resources
- 40 Upper Jefferson River to Whitehall
  - Irrigation stress on streamflow
- 42 Fox Hills aquifer
  - Stress due to oil and gas development
  - Water management in conjunction with multiple uses
- 43 Beaverhead River – Point of Rocks to Twin Bridges
  - Increased groundwater demand for irrigation
  - Increased instream flow rights
  - Water management with multiple uses

Issues and concerns nominated and being considered:

- 46 Otter Creek
  - Coal development
  - Large grazing district dependent on wells and springs
  - Now major fire impacts
  - Finding common ground on management approaches thru science
- 47 Shields River Valley
  - Potential oil and gas development
  - Increased groundwater demands
- 48 Wise River
  - Watershed health and functionality through better management
  - Function of irrigation for groundwater recharge and stream flow

**Issues nominated for the 2012 ranking process:**

Stream Depletion from groundwater stress

Land use changes and reduced irrigation in various settings

Irrigation

Development in mountainous terrain

Industrial use

Impacts of major wildfires on aquifers, springs and groundwater dependent ecosystems

Better science for water management

Sensitive international groundwater and surface water system

Hydrothermal feature protection

Nitrate and water quality impacts

Coal, Oil and Gas development

GWIP project data and results are being put to use:

Some of those uses are known to us.

Helena Subdivision

Planning has changed as a result of GWIP project

Canal Seepage data

Irrigators

DEQ

Bureau of Reclamation

Stream Depletion information

DEQ

Consultant

Landowners:

Receive copy of data collected on their land

Have contacted us due to concerns which were directly answered  
on water quality and quantity in several instances.

Aquifer tests and hydrograph data

Consultants

Exempt well report (Metesh)

***Energy and Groundwater in Montana***

Co-Sponsored by

Montana Watershed Coordination Council  
Ground Water Working Group

Montana Bureau of Mines and  
Geology

Natural Resource Building, Room 122  
Montana Tech campus  
Butte - July 31, 2012

10:30 am	<b>Registration</b>
11:00 am	<b>Introduction and Welcome</b>
11:15 am -12:15 pm	<b>Unconventional Oil and Gas</b> moderated by Ginette Abdo Bakken and other tight plays in Montana <i>Jay Gundersen, Montana Bureau of Mines and Geology</i> Engineering and fracking wells in tight plays <i>John Evans, Montana Tech, Department of Petroleum Engineering</i>
12:15 to 1:00 pm	<b>Lunch, Natural Resource Building Lobby</b>
1:00 to 2:00 pm	<b>Coal development</b> moderated by John Wheaton Coal-related development in Montana and overview of the groundwater regulations <i>Angela McDannel, MDEQ, Coal and Uranium Program</i> Groundwater monitoring program for coal mines and coalbed methane <i>Elizabeth Meredith, Montana Bureau of Mines and Geology</i>
2:00 to 2:15	<b>Break</b>
2:15 to 3:30 pm	<b>Geothermal Energy in Montana</b> moderated by James Rose Types of development and potential around the state <i>John Metesh, Montana Bureau of Mines and Geology</i> Associated groundwater issues, permit requirements and implemented examples <i>Kath Montgomery, MDEQ, Renewable Energy and Air Quality</i> Mining Butte's Geothermal Resources <i>Edmond Deal, Montana Bureau of Mines and Geology</i>
4:00 pm	<b>Underground Mine Tour</b> The underground mine tour is adjacent to a heat-pump project under construction which will harness geothermal energy beneath the Montana Tech campus. <i>James Rose, Rob McCulloch, John Metesh, Montana Bureau of Mines and Geology</i>

Groundwater theme workshop

Communicating results

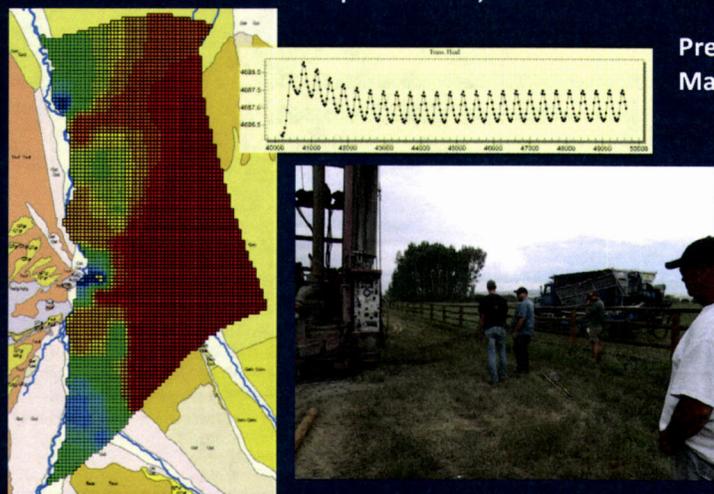
Addressing issues

70 attendees

Plan to continue this forum

**Gallatin Valley  
Four Corners Investigation Area**

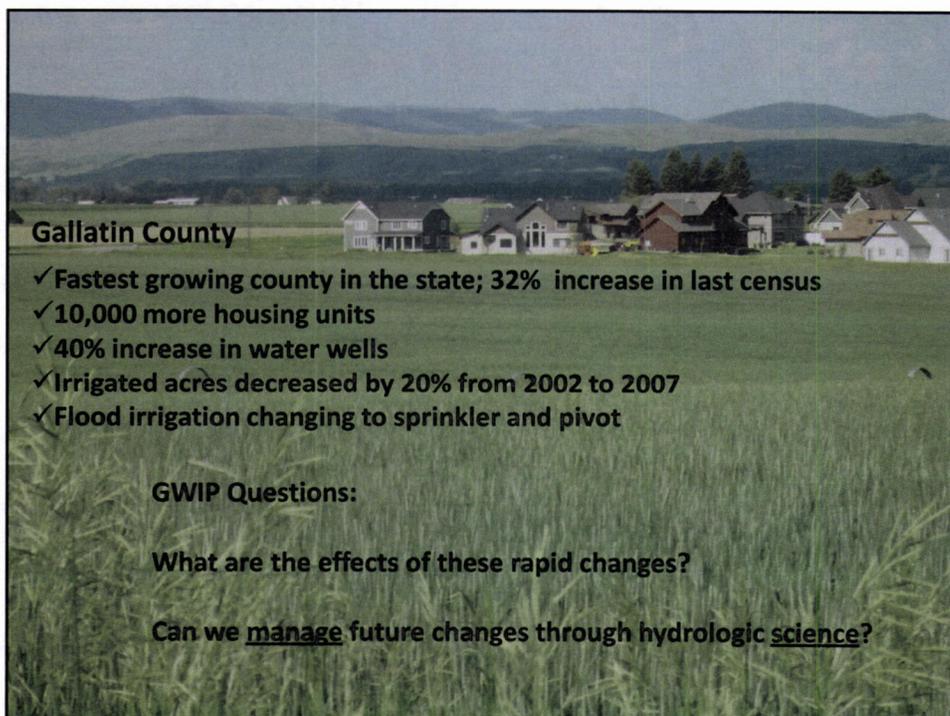
**Presented to the Water Policy Interim Committee  
September 10, 2012**



**Presented by:  
Mary Sutherland**

**Team Leader:  
Tom Michalek**

**Ground Water  
Investigation  
Program**



**Gallatin County**

- ✓ Fastest growing county in the state; 32% increase in last census
- ✓ 10,000 more housing units
- ✓ 40% increase in water wells
- ✓ Irrigated acres decreased by 20% from 2002 to 2007
- ✓ Flood irrigation changing to sprinkler and pivot

**GWIP Questions:**

What are the effects of these rapid changes?

Can we manage future changes through hydrologic science?

## Four Corners Ground Water Investigation Project

### Objectives / *Results*

- Determine the extent of alteration to the groundwater system in the Four Corners Area over the last 60 years.

*Small water elevation changes, large flux decrease*

- Correlate groundwater changes to land use conversion.

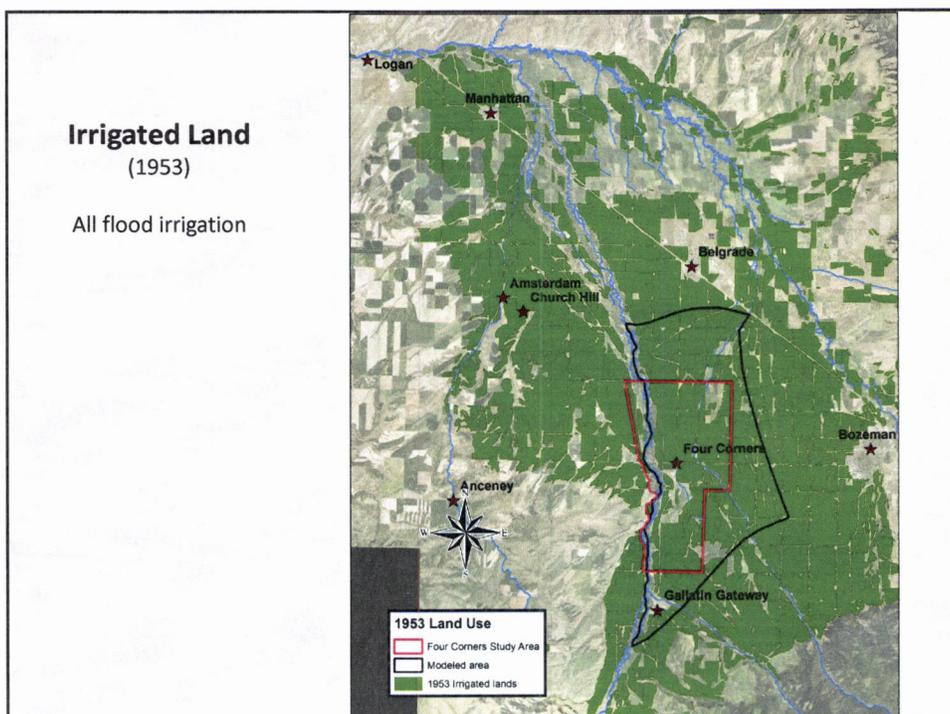
*Reduction of irrigated acres has decreased recharge  
Subdivision use has a minimal effect*

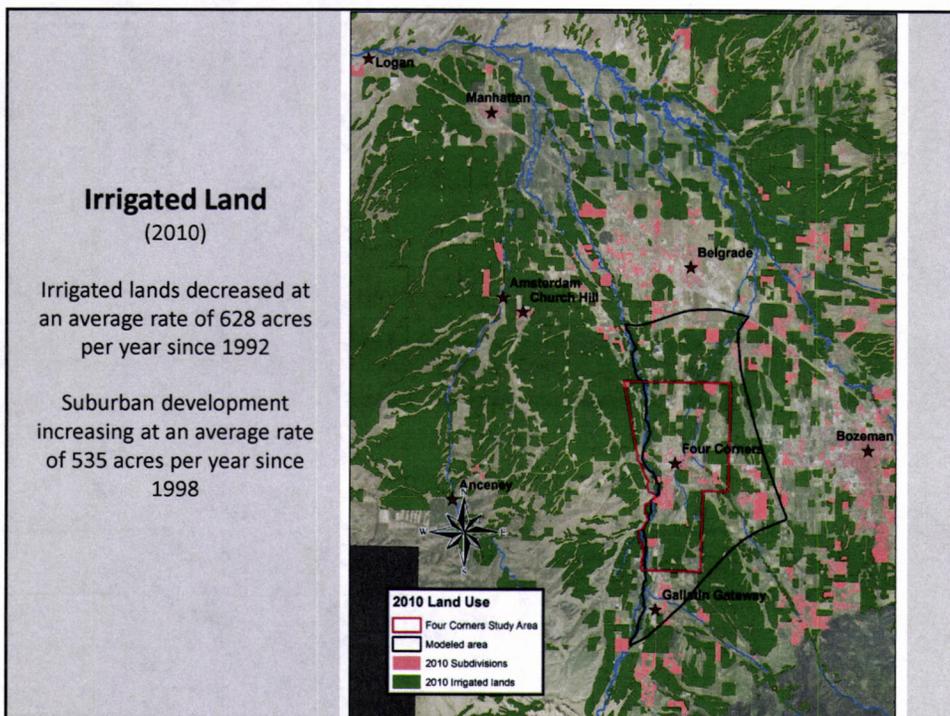
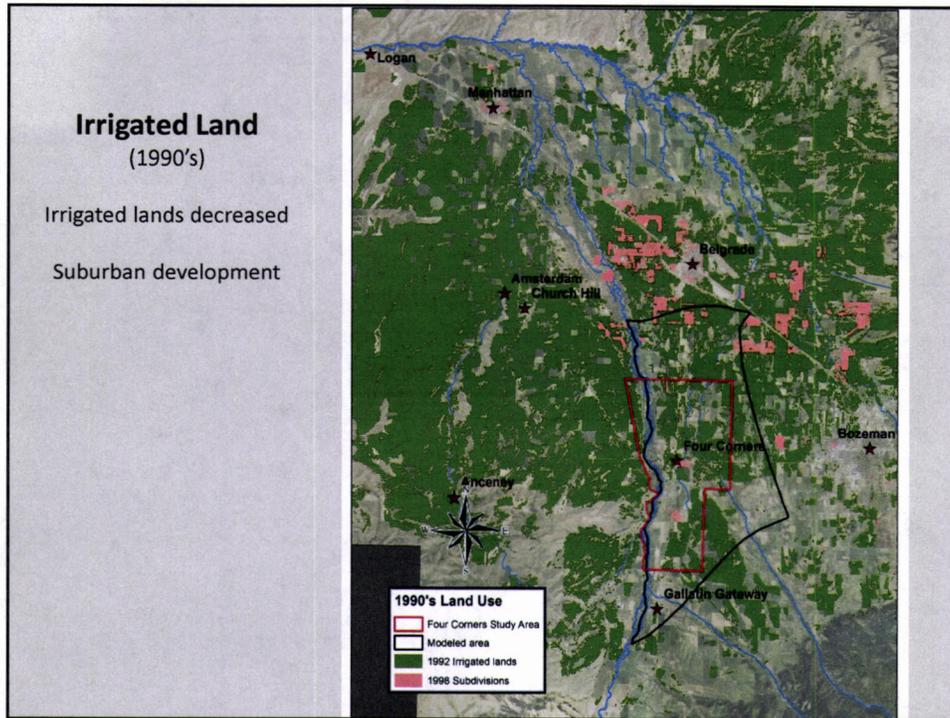
- Document the effects of irrigation and canal leakage on groundwater recharge.

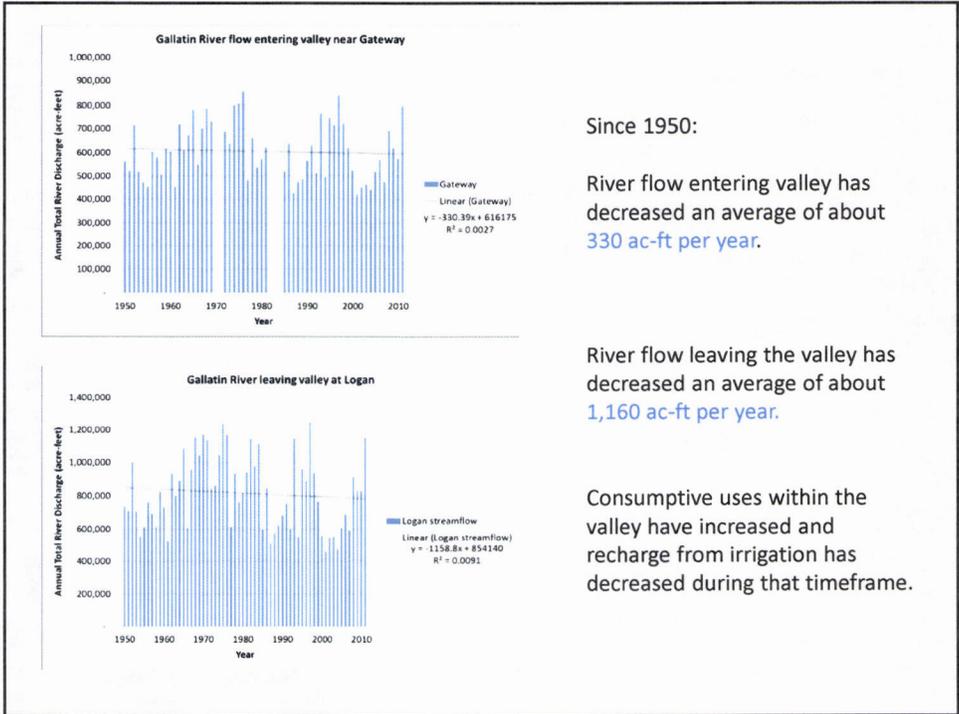
*Typical canal leakage is 1.1 cfs per mile*

- Evaluate likely effects of future changes and development.

*At past growth rates, future development will lower the water table about 2.5 feet*



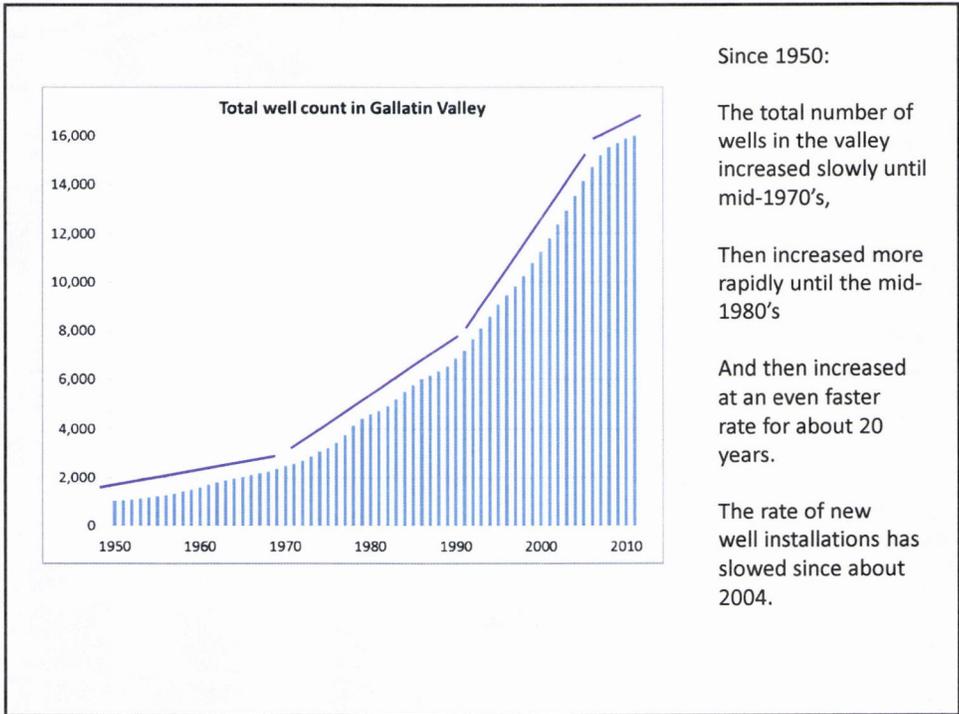




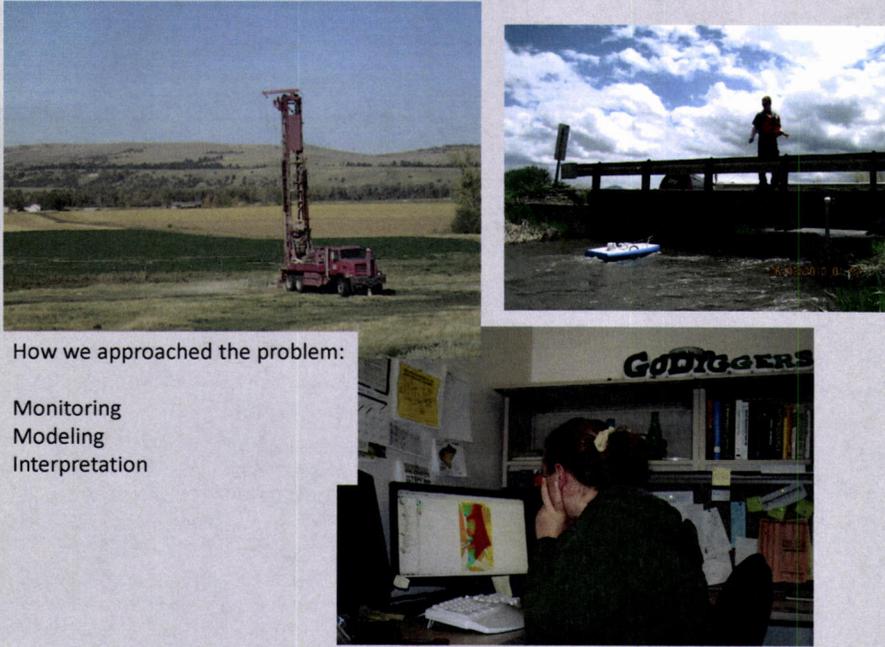
Since 1950:  
 River flow entering valley has decreased an average of about **330 ac-ft per year**.

River flow leaving the valley has decreased an average of about **1,160 ac-ft per year**.

Consumptive uses within the valley have increased and recharge from irrigation has decreased during that timeframe.

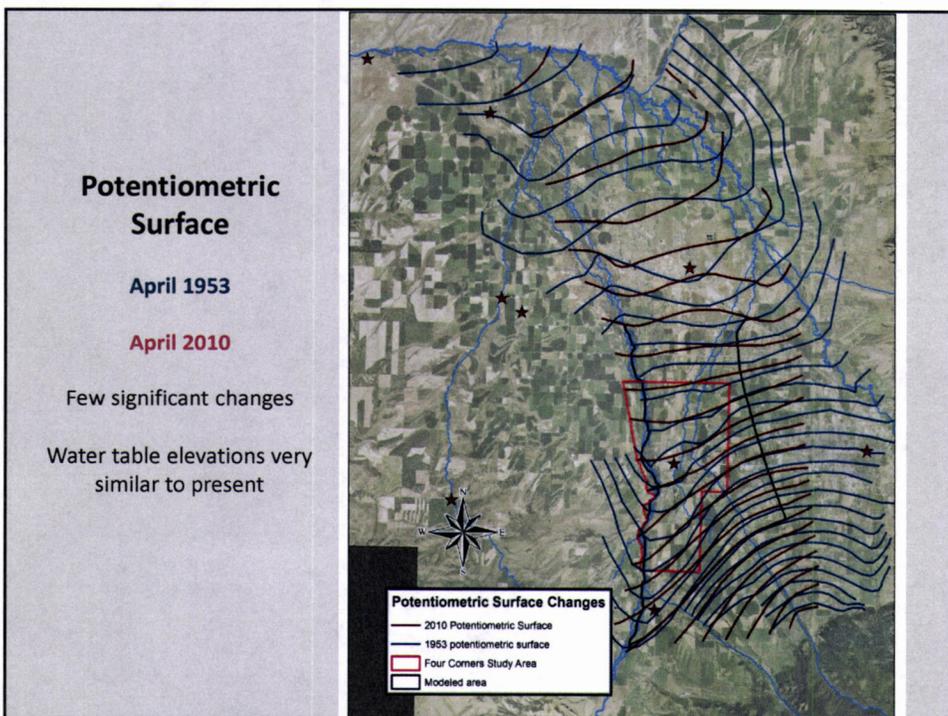


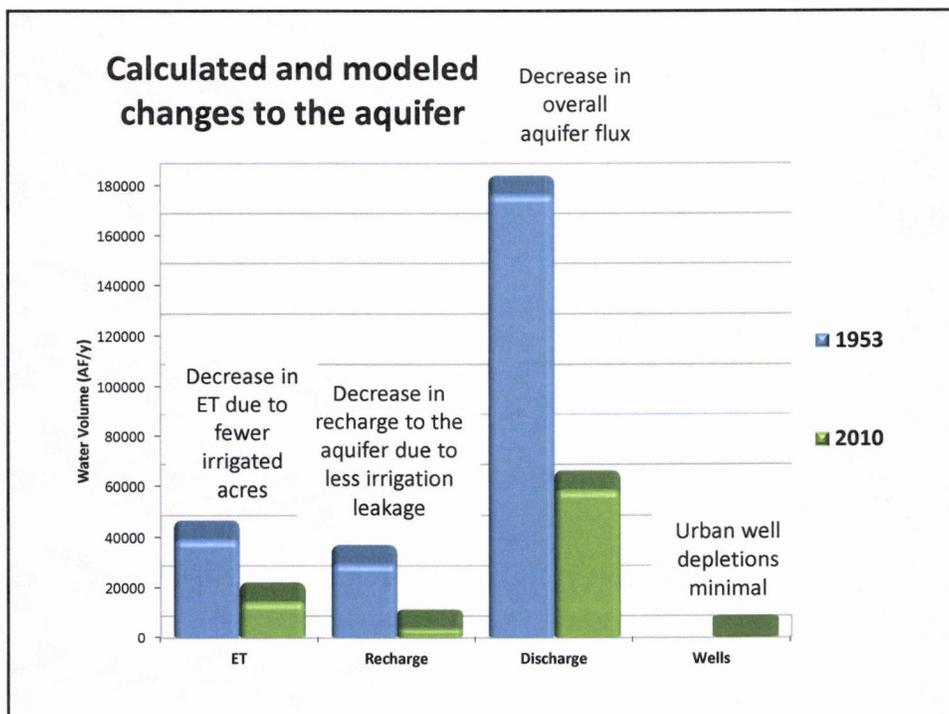
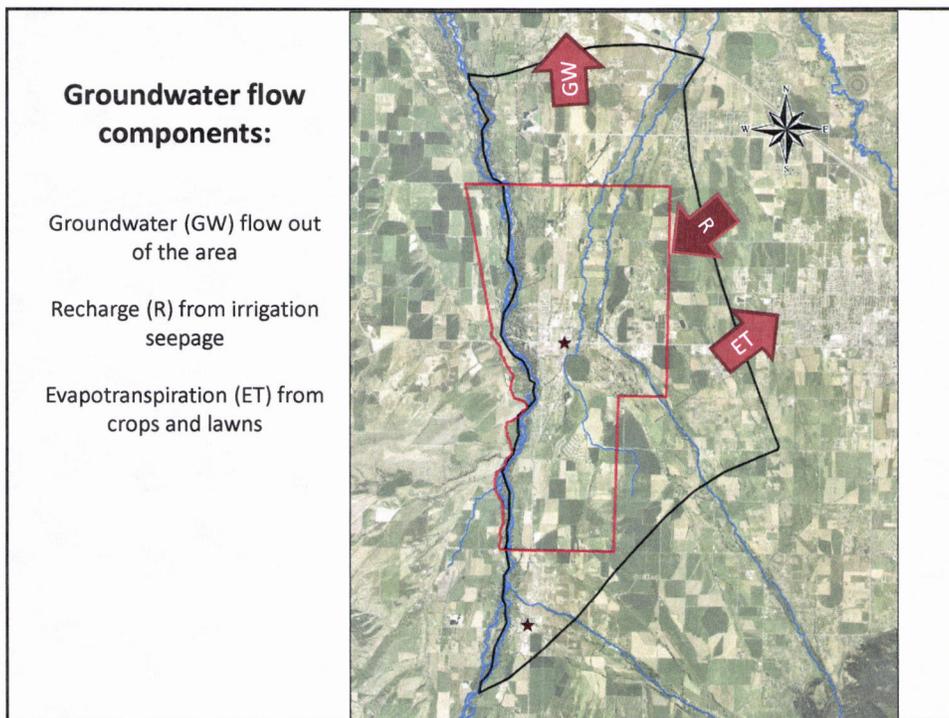
Since 1950:  
 The total number of wells in the valley increased slowly until mid-1970's,  
 Then increased more rapidly until the mid-1980's  
 And then increased at an even faster rate for about 20 years.  
 The rate of new well installations has slowed since about 2004.

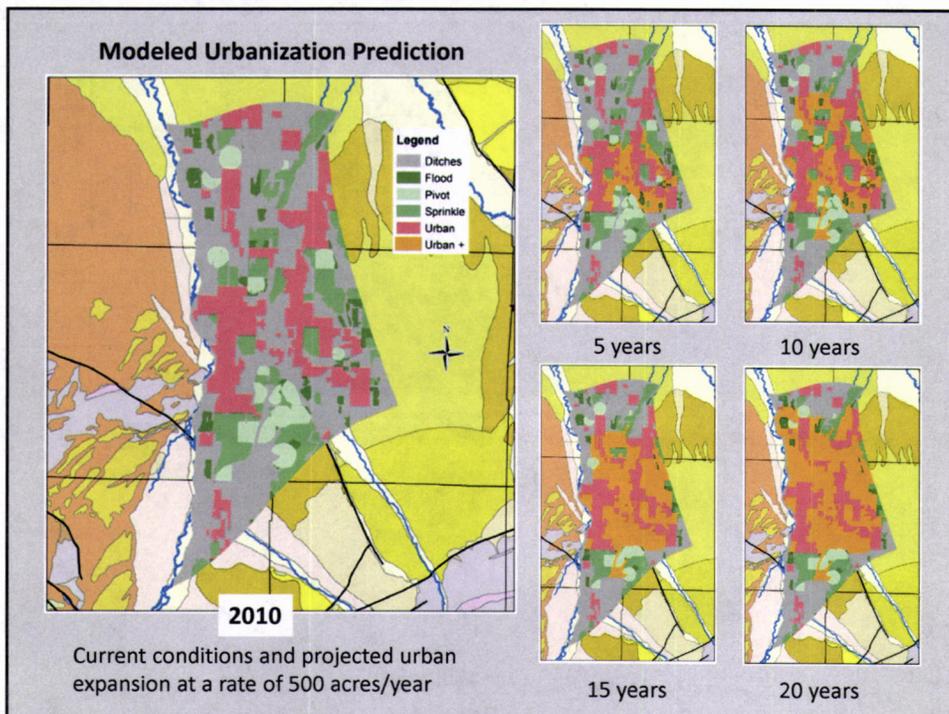
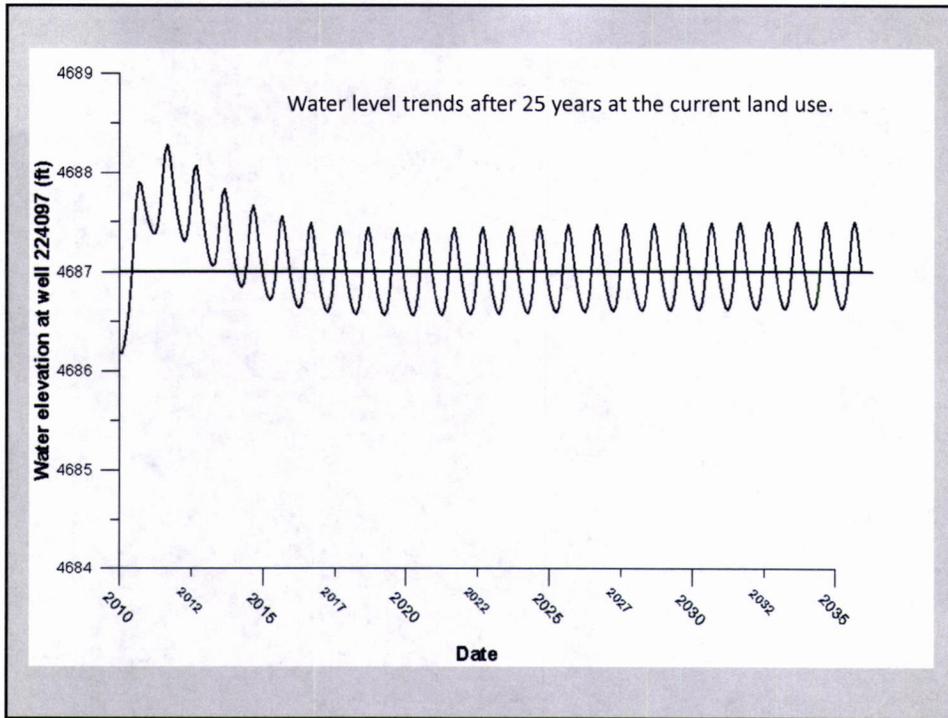


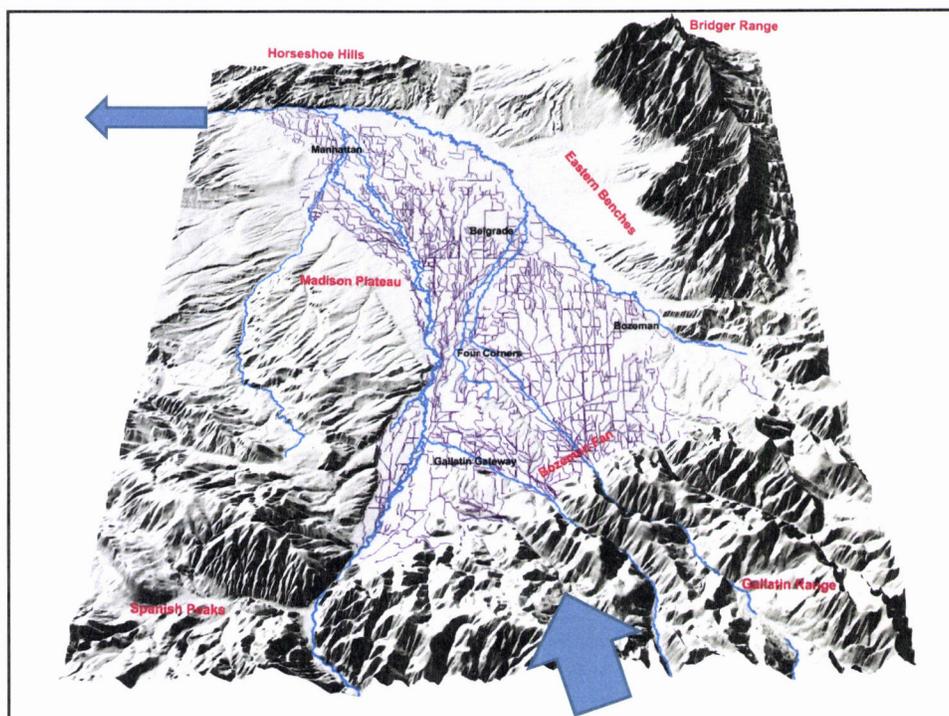
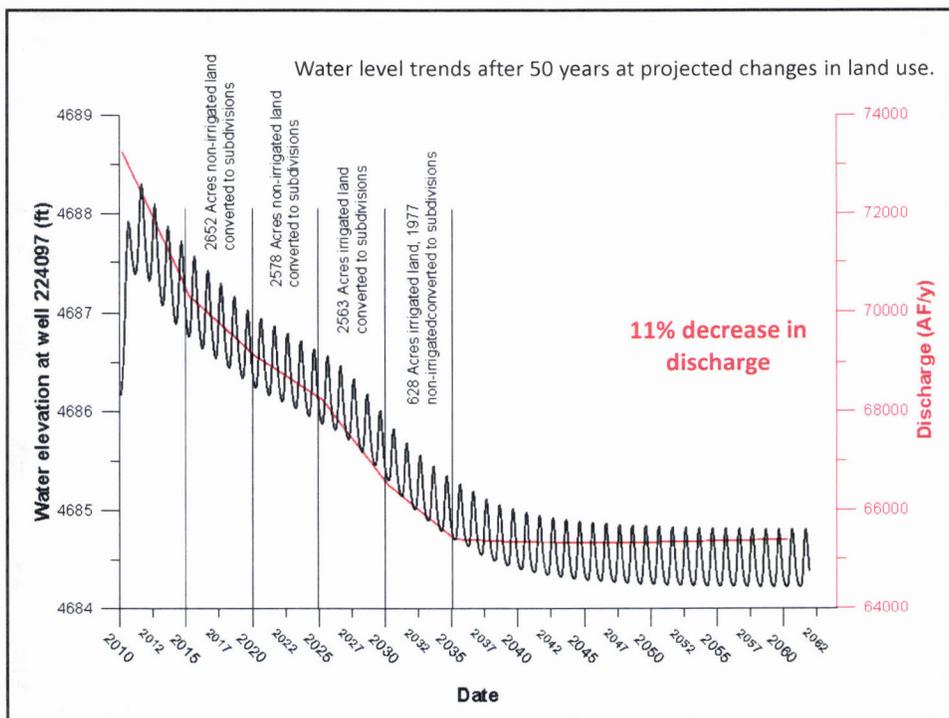
How we approached the problem:

- Monitoring
- Modeling
- Interpretation





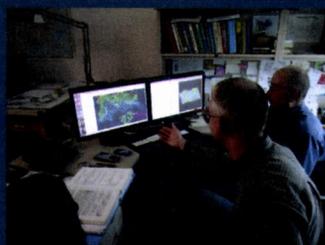




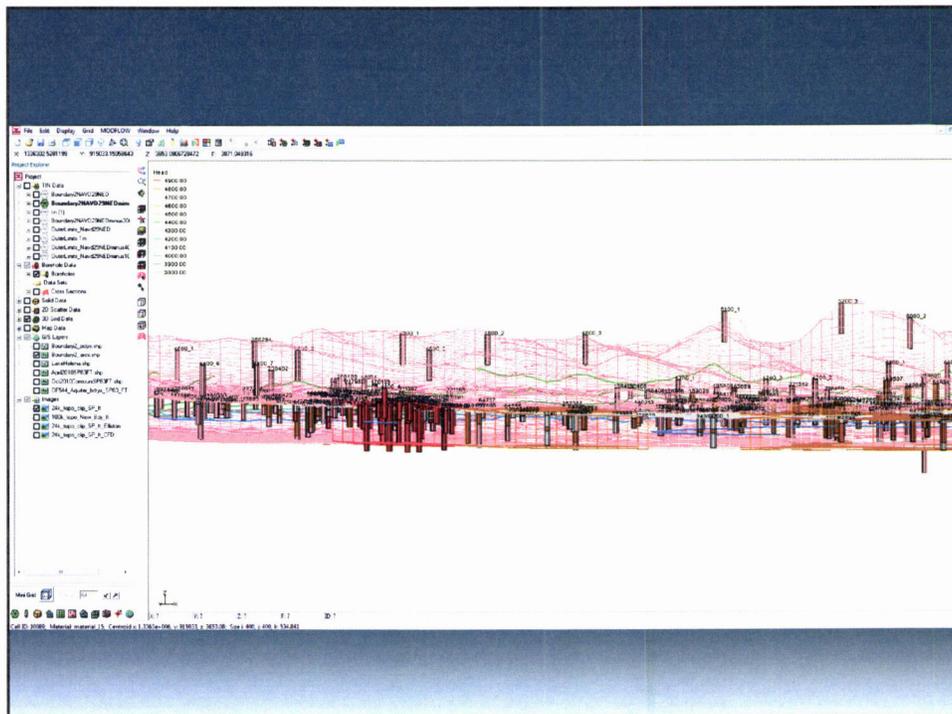
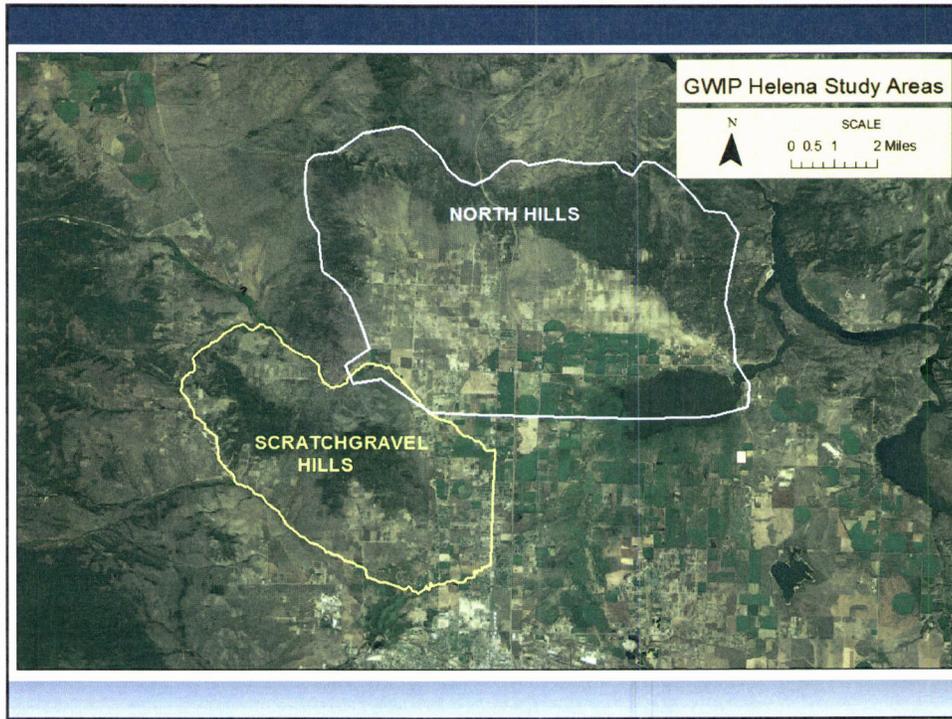
### Conclusions:

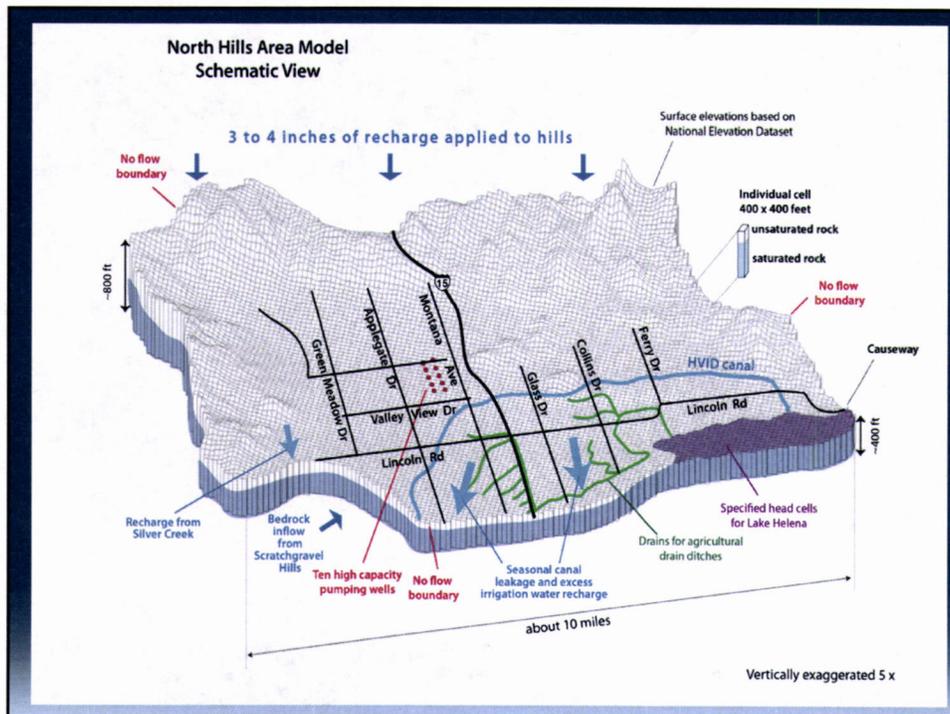
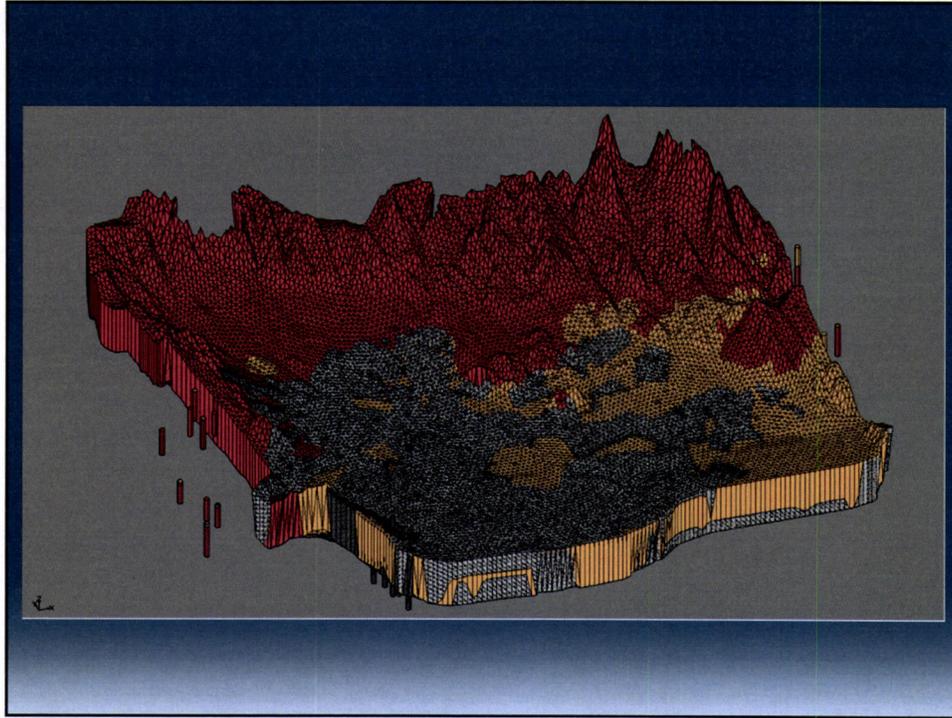
- *Use and recovery due to "bathtub effect"*
- *Water levels artificially elevated from irrigation*
- *Land use changes have decreased flow volume*
- *Water level decrease of approximately 1 foot predicted from current land use changes*
  - *Projected future land use changes could decrease the water level approximately 2.5 feet*
- *Groundwater flux is considerably more sensitive to land use changes than water levels*
- *The effect of reducing irrigated acres is significantly greater than increasing suburban acreage*

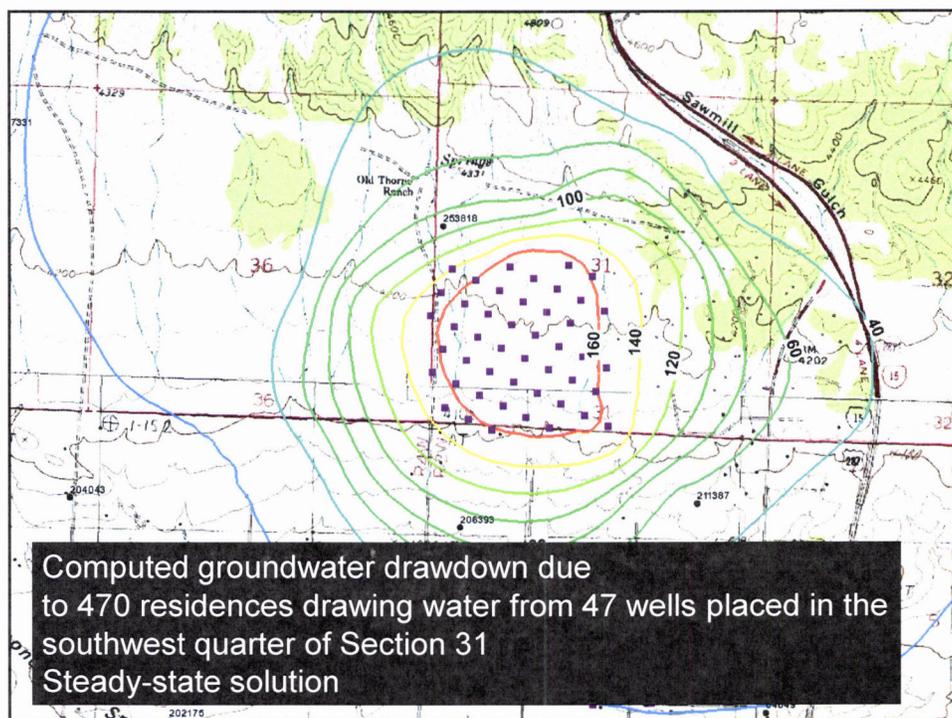
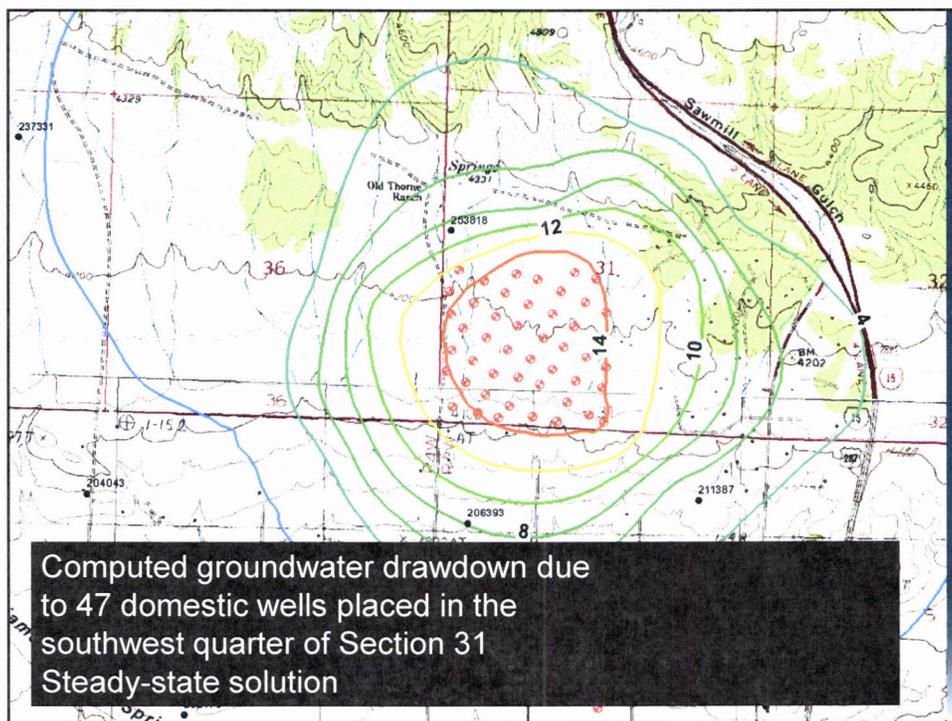
### Ground Water Investigation Program

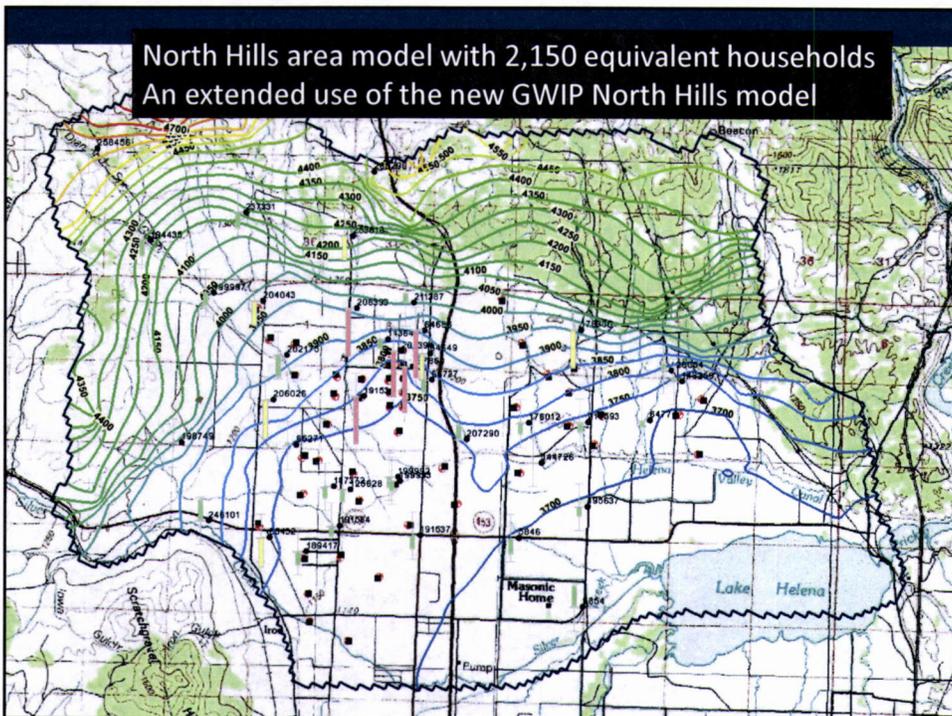
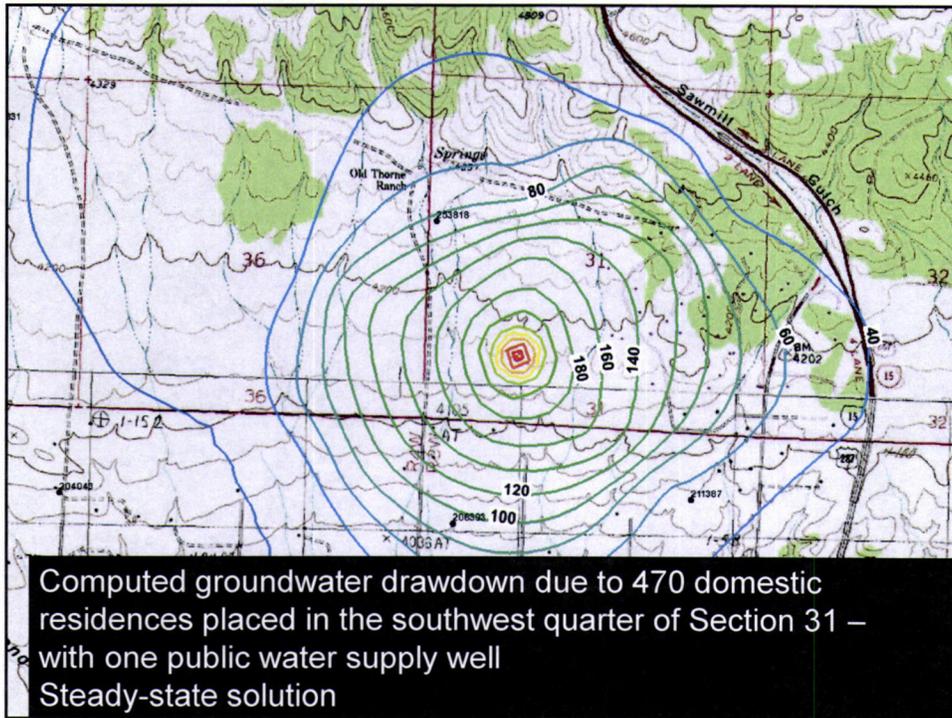


Highlights of project products, Sept. 2012  
presented by Kirk Waren

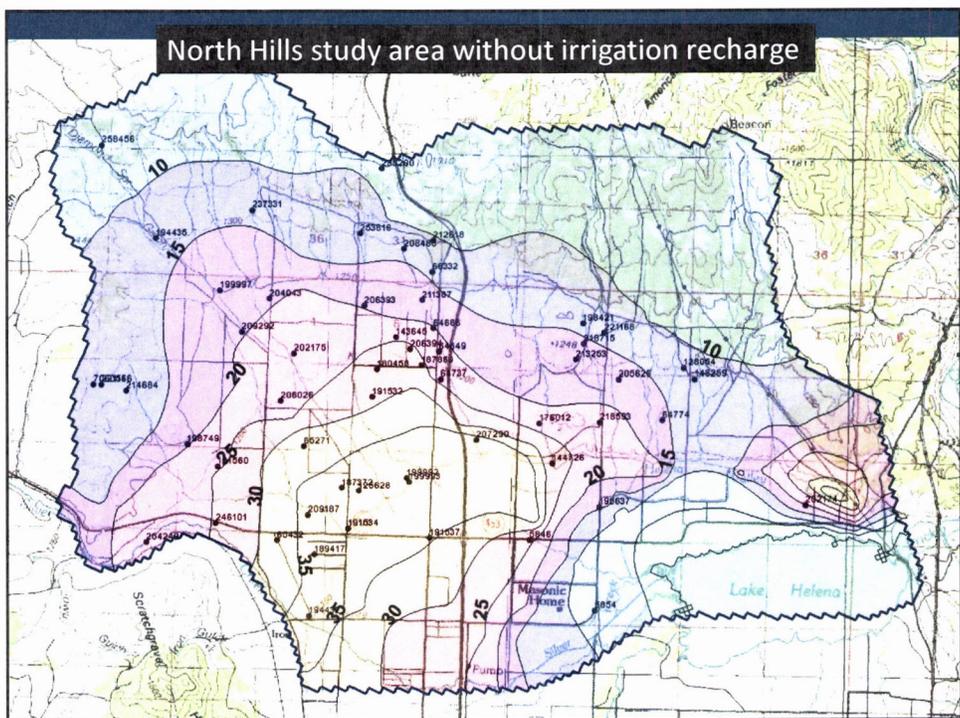
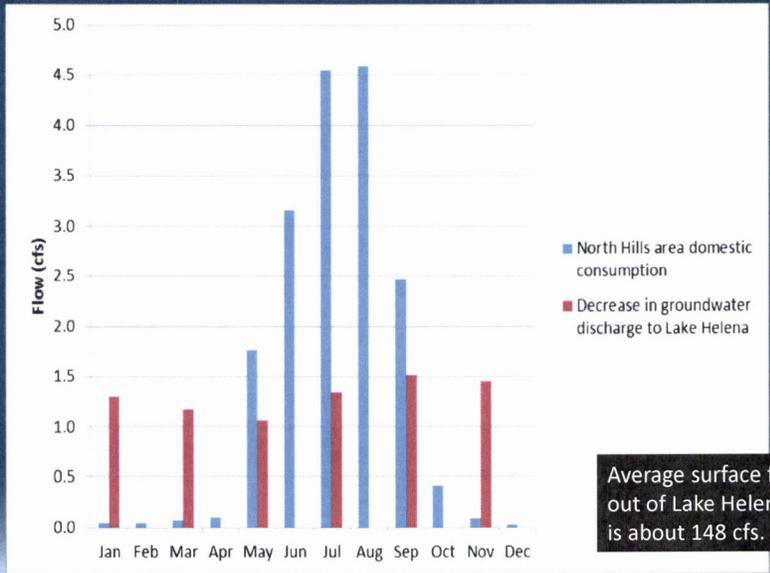






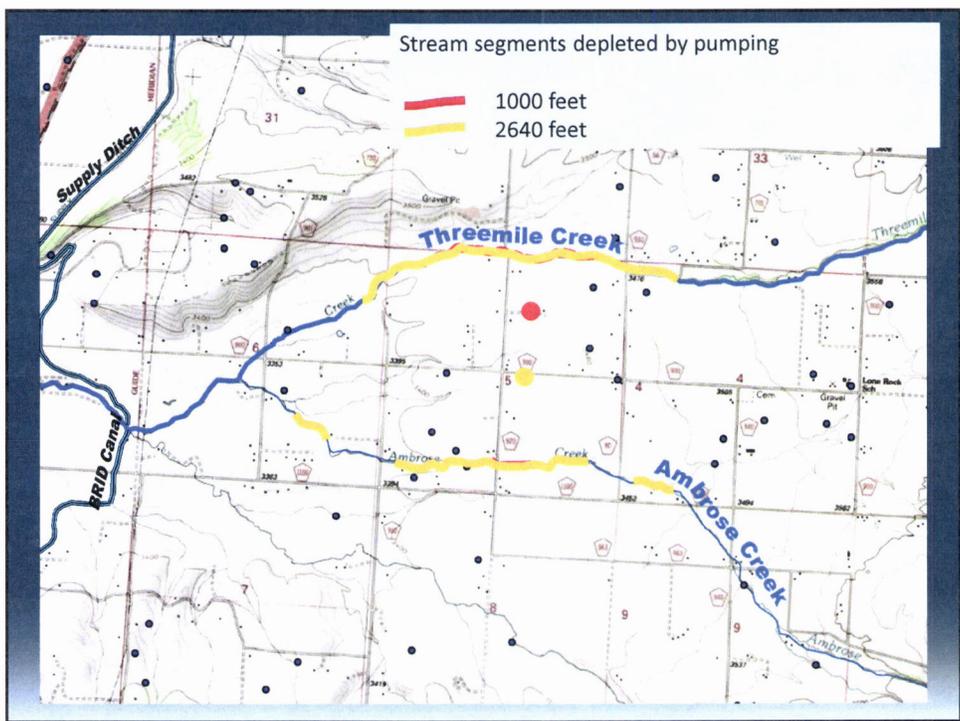
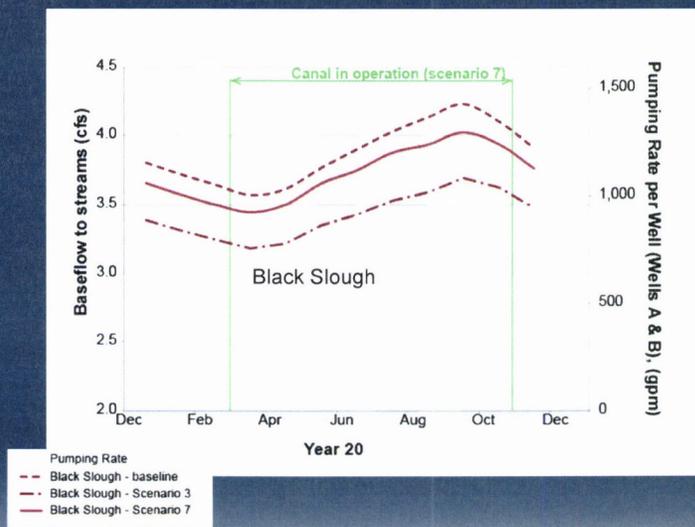


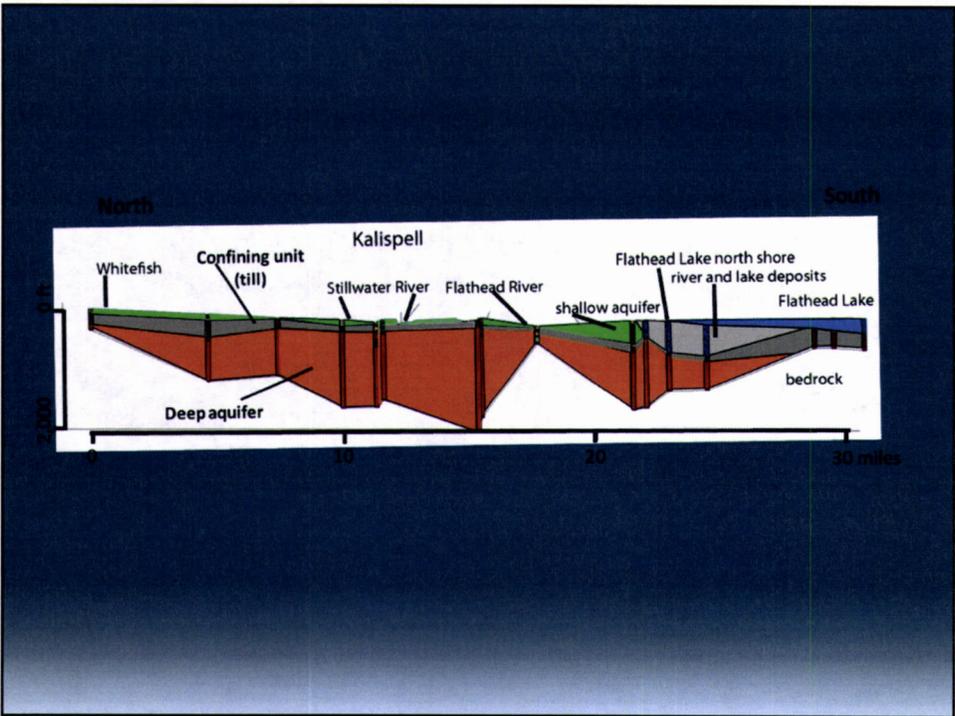
North Hills: 2,150 houses,  
Cumulative: 1,048 acre-ft per year

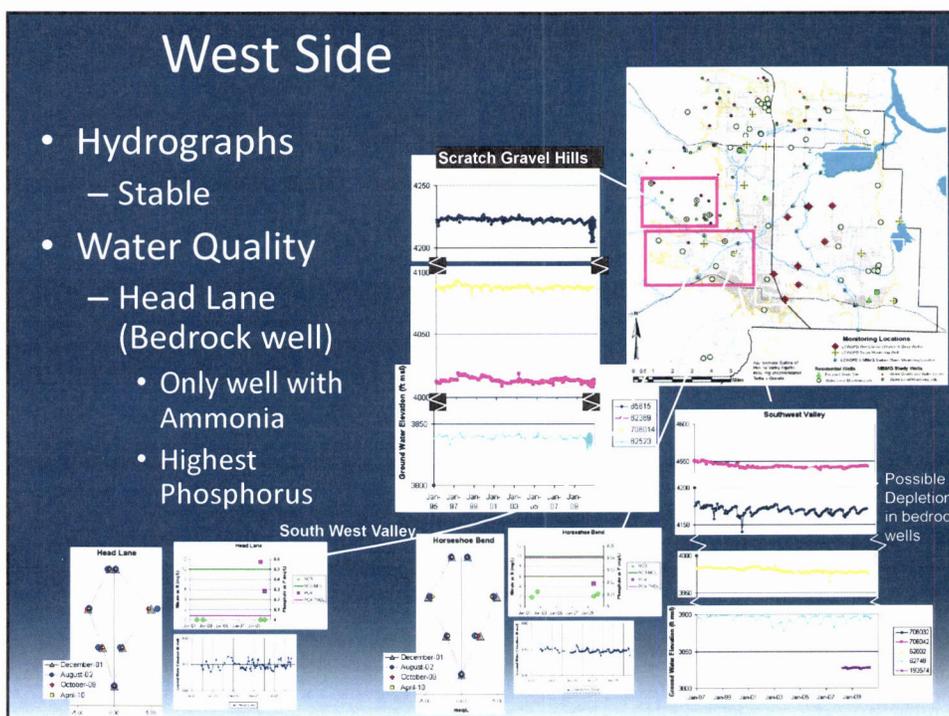
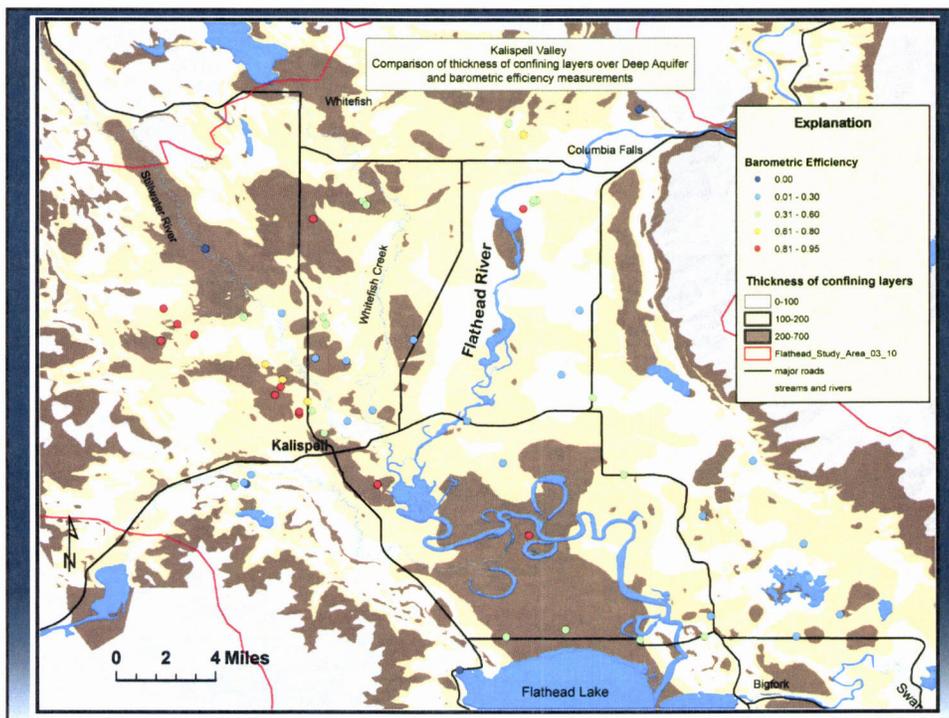


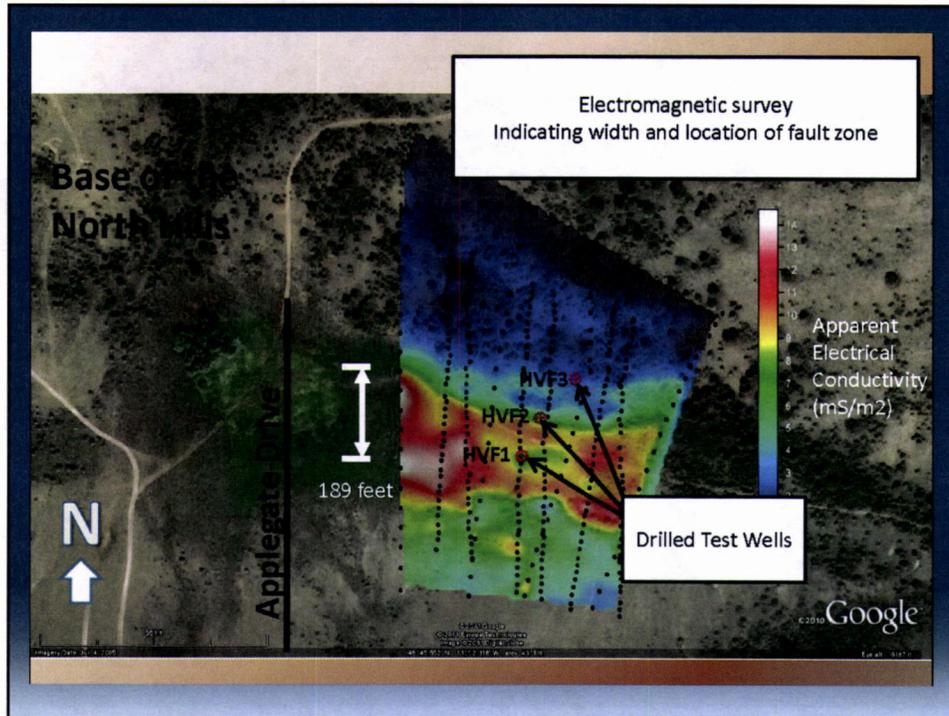


### Mitigating with additional canal seepage









## GWIP Solutions

- Problem-focused investigations
- Specific findings and recommendations for each problem
- Groundwater models for water resource management

## GWIP Products

- Interpretive Reports
- Groundwater Models and Reports
- Technical Reports
  
- Groundwater level data
- Surface water flow measurements
- Groundwater and surface water quality data