An Overview of the Upper Jefferson Groundwater Investigation

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Ground Water Investigations Program (GWIP)

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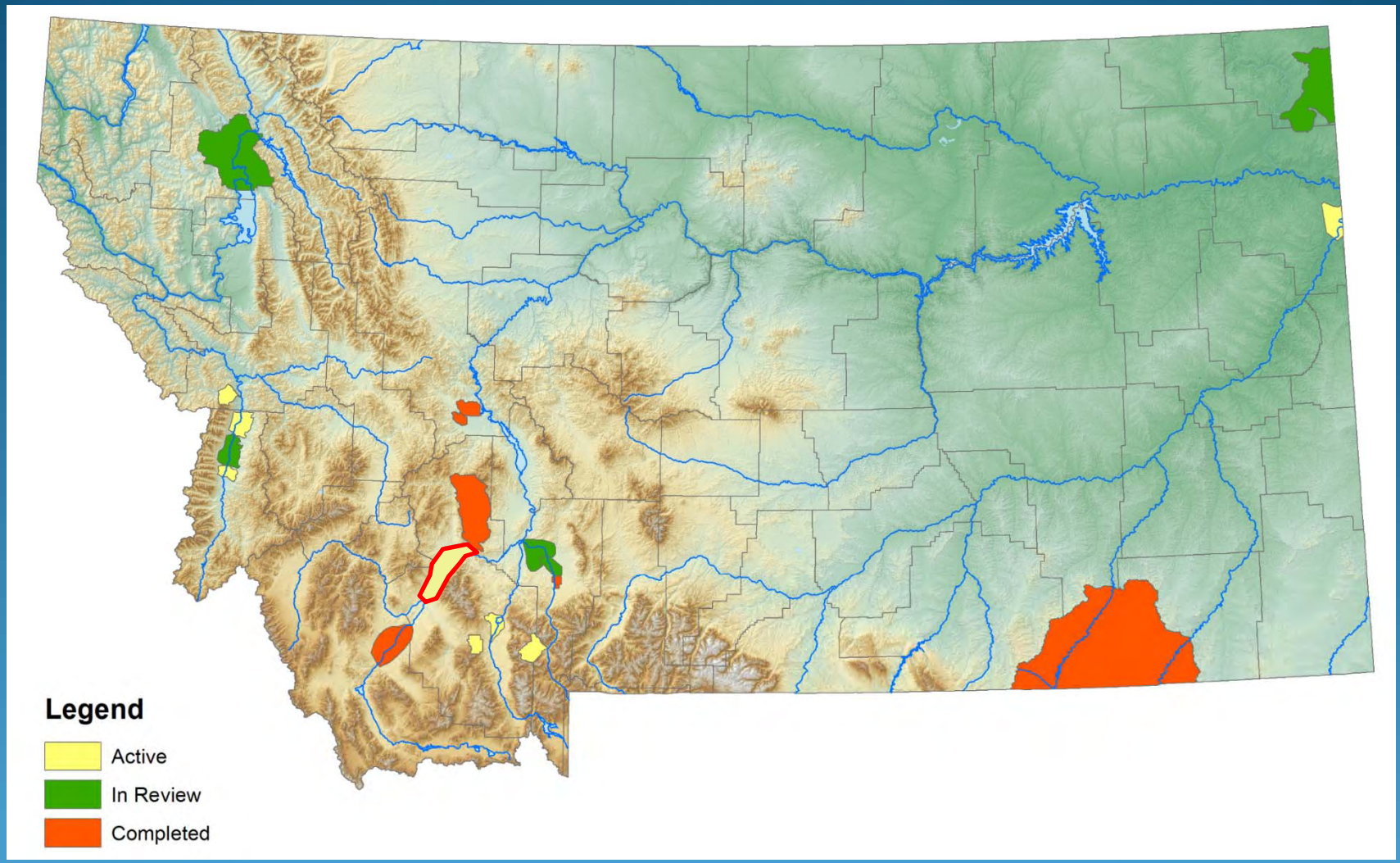
Ground Water Investigation Program

Specific groundwater questions that are ranked as the most urgent within the State



- Housing development
- Expansion of Agriculture
- Industrial and Commercial Growth

Acknowledgements

Supporters:
Jefferson County
Madison County
Golden Sunlight Mine

Landowners:
Dean Hunt
John Kountz
Lazy TP Ranch
Gary Nelson
Mark Hoyt
many others

MTech Students:
Nicole Decker, Mike Shirley, and Corey Swisher

MBMG Help:
Ali Gebril, Julie Butler, Camela Carstarphen, Jeremy Crowley, Tom Michalek, James Rose, Dean Snyder, Mary Sutherland, and Mark Wolfram

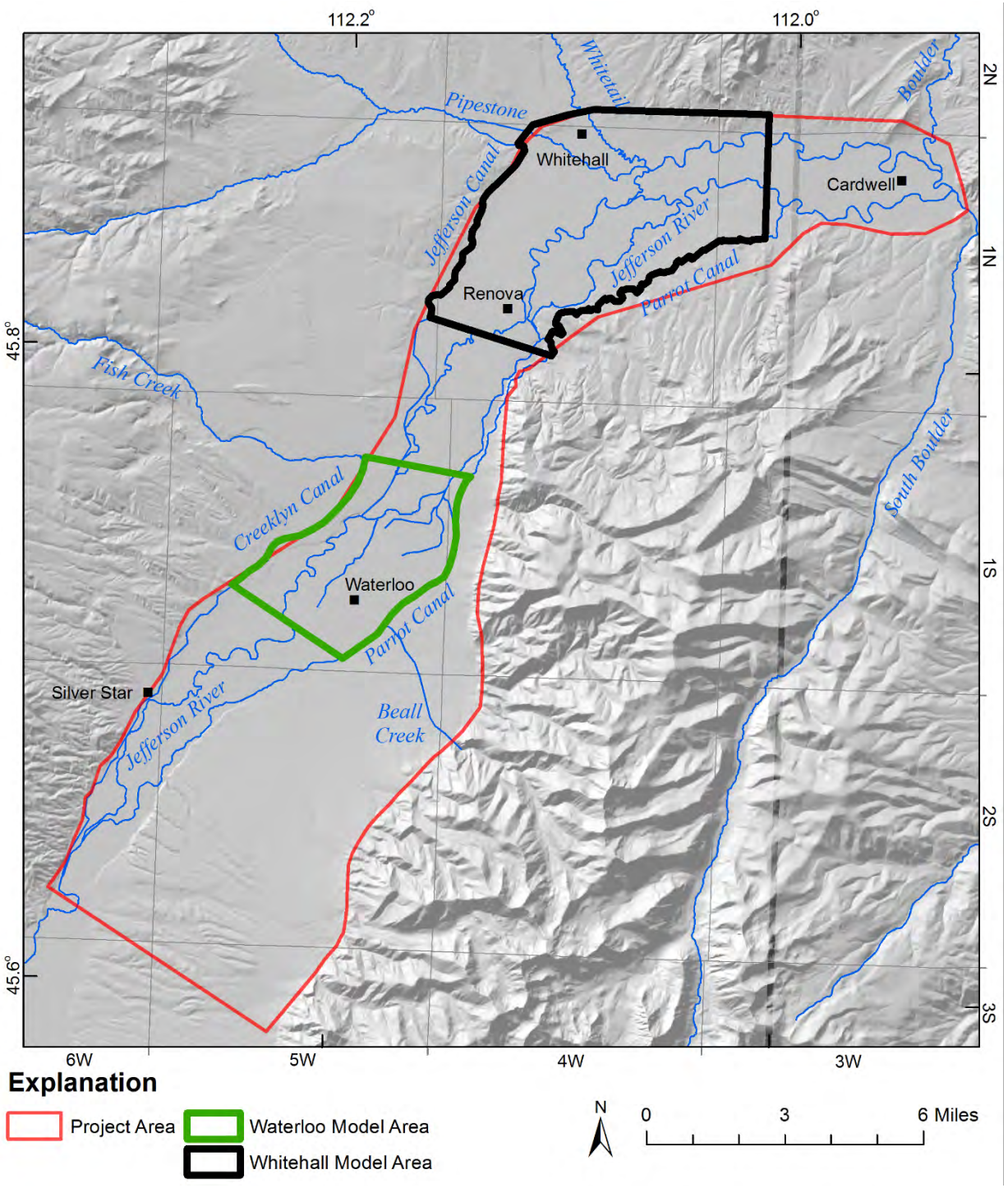
Upper Jefferson Groundwater Investigation

Effects to surface water flows from land use changes in the Waterloo Area

- Lining Canals
- Conversion from flood to pivot irrigation.

Effects to surface water flows from housing developments in the Whitehall Area

- Groundwater Pumping
- Change in land use



Study Approach

Monitoring
- Groundwater
- Surface Water

Understand Stream Gains and Losses

Geologic Model

Aquifer Tests

Groundwater Budgets

Develop and Calibrate Numerical Models
- Network of Related Equations

Use Models to make Predictions

Groundwater Monitoring

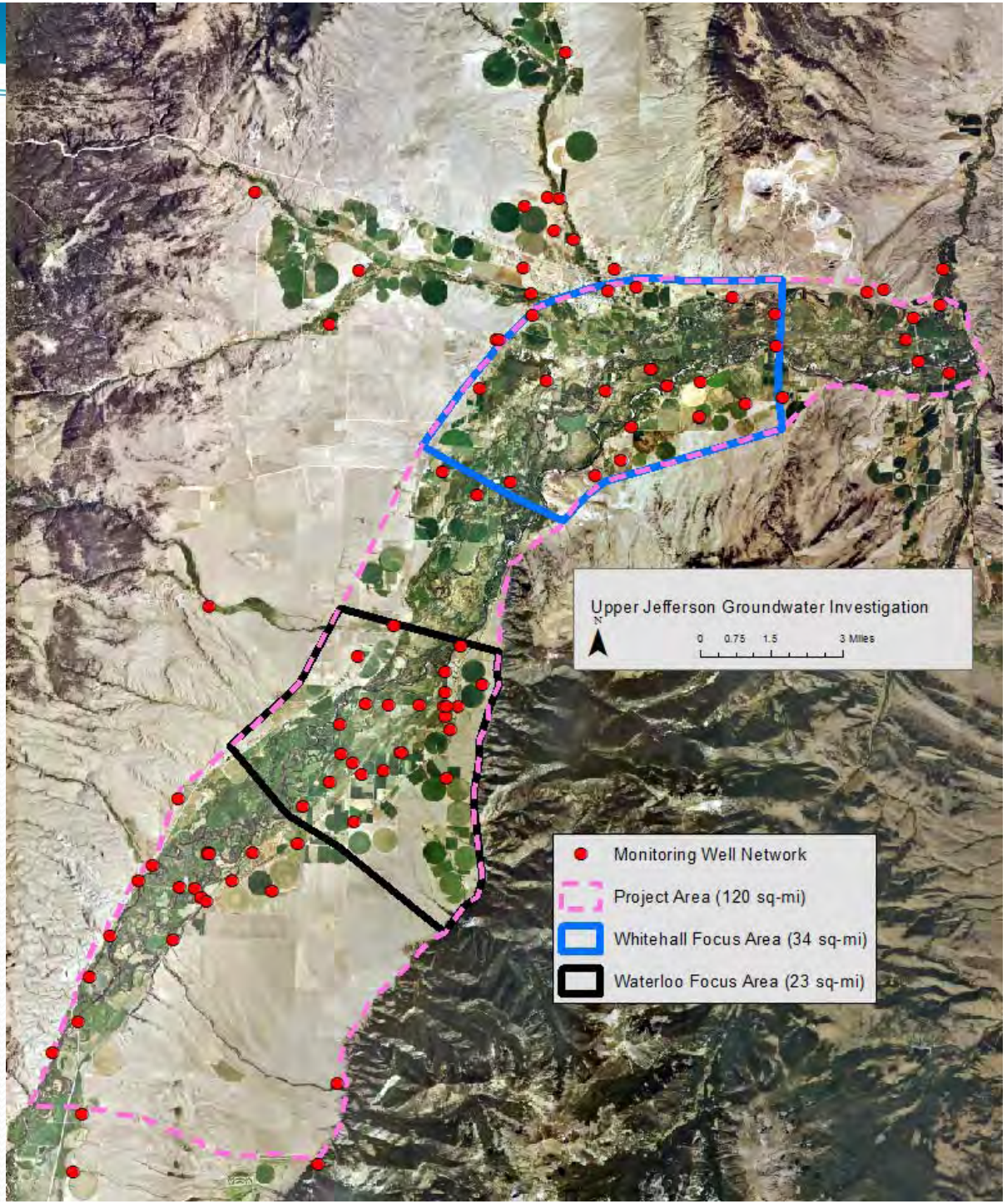
Drilling

Monitoring Wells

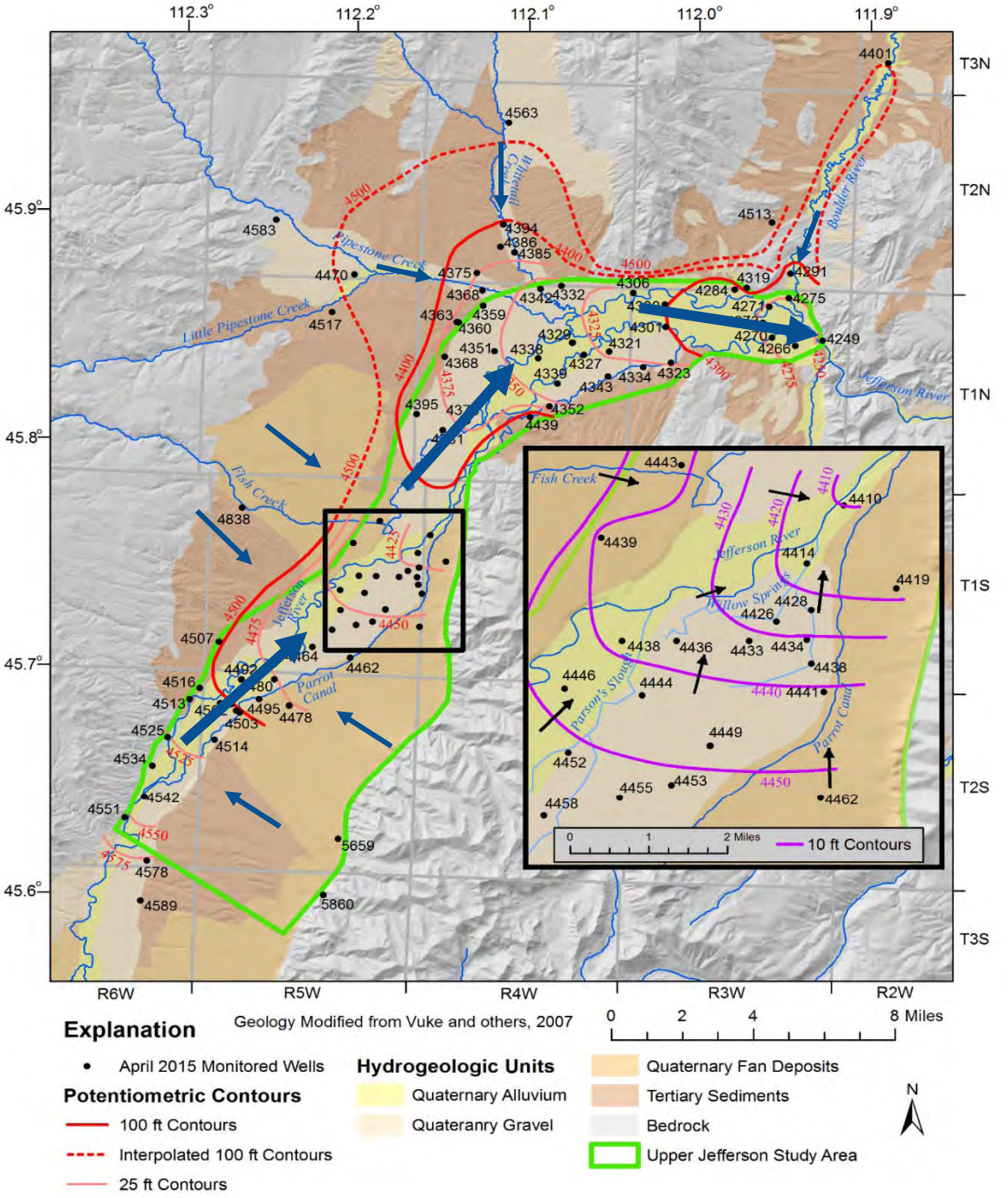
Aquifer Test Sites

Groundwater Monitoring Network

- 103 wells
- Monthly
- July 2013 to May 2015

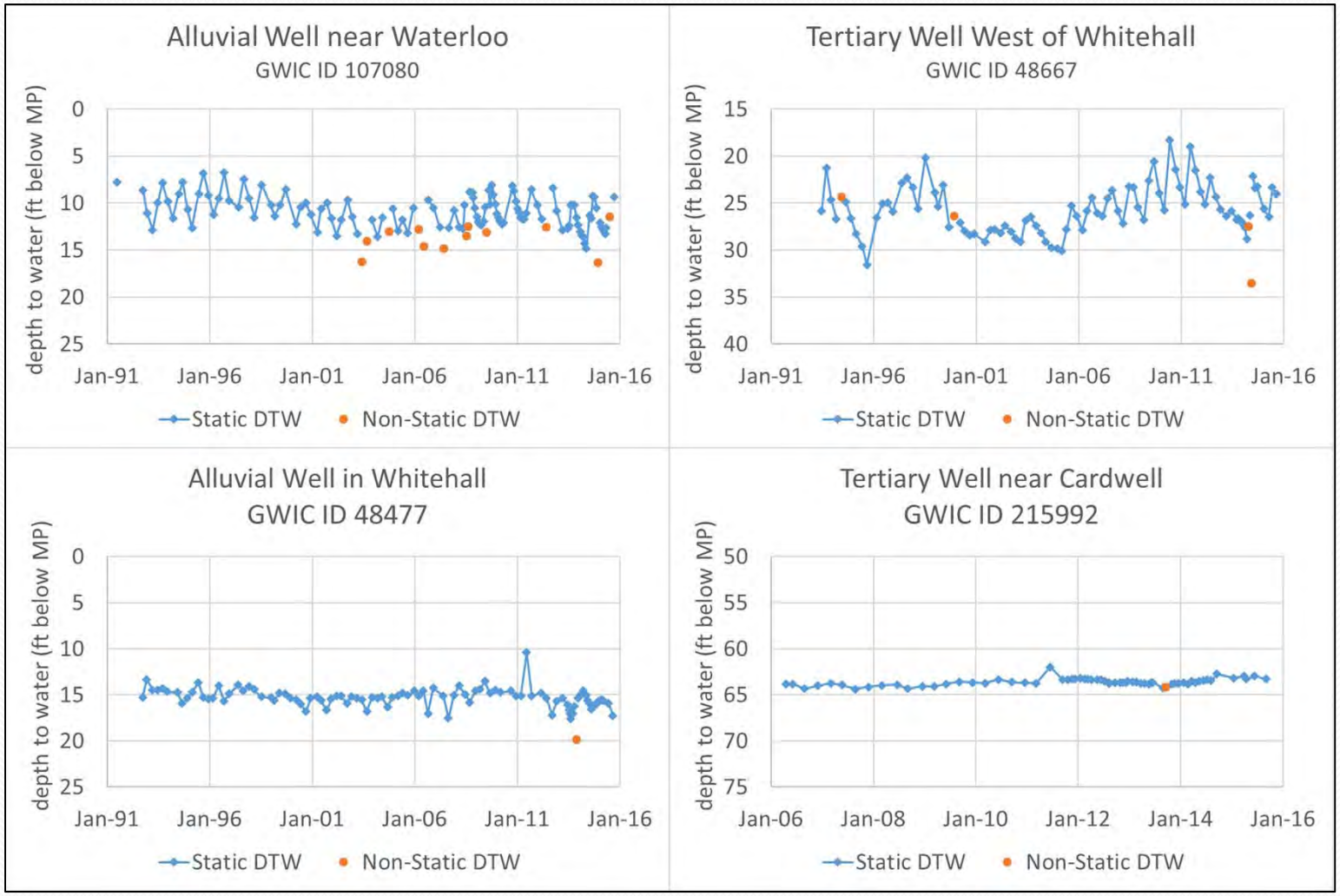


Potentiometric Surface

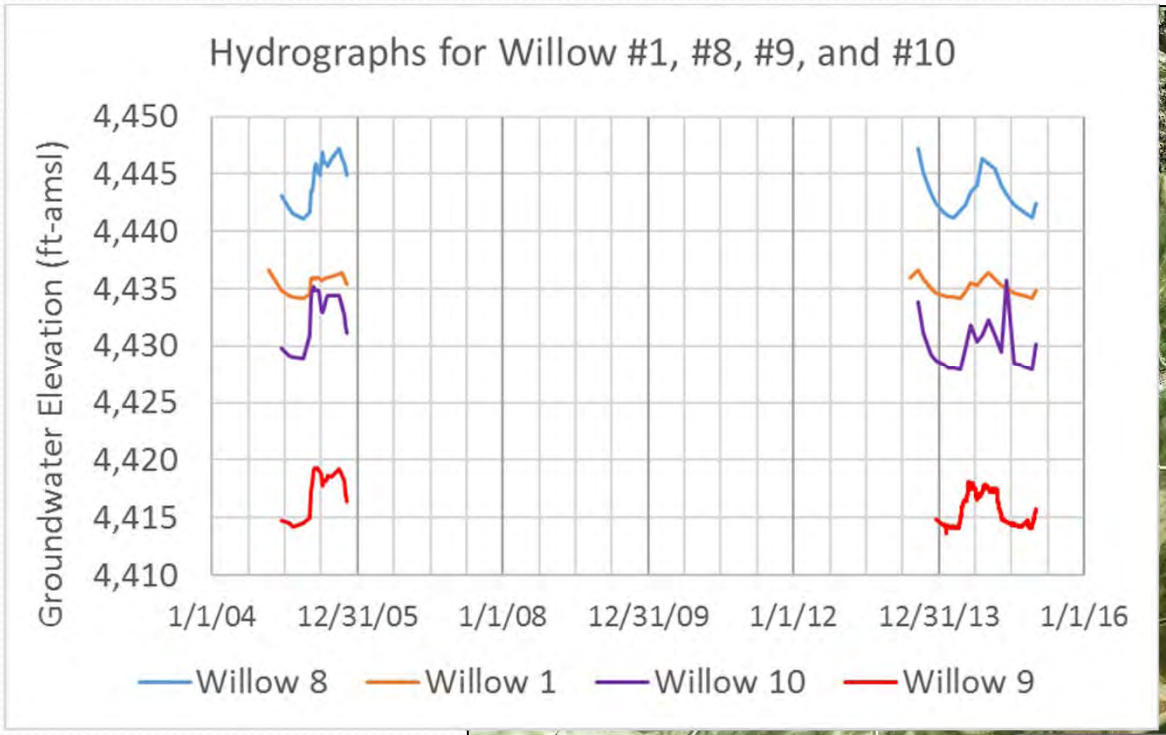


Preliminary

Long-Term Hydrographs (MBMG's GWAAMON Network)



Selected sites near Willow Springs



2005 data from WET

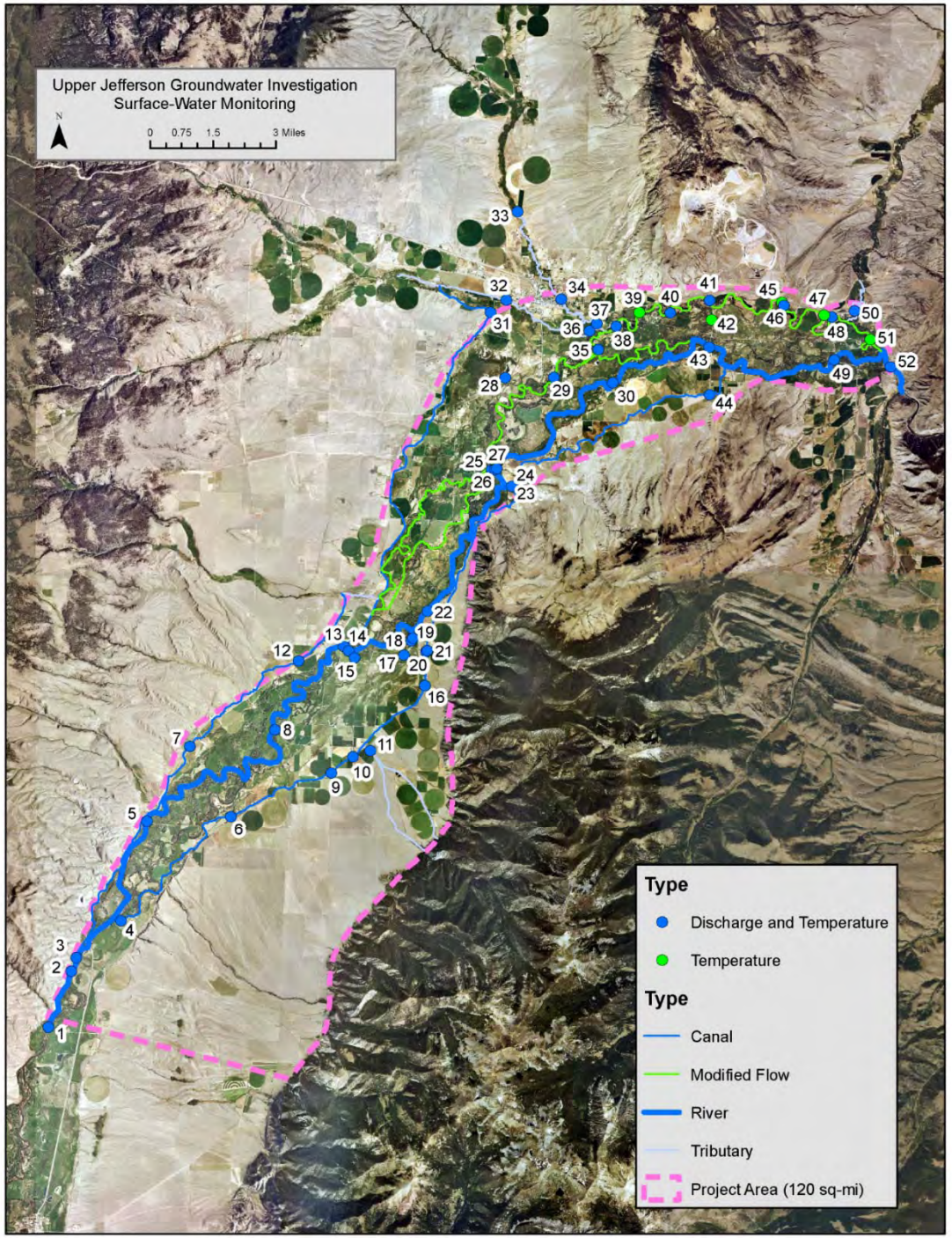
Flow is toward the river

No noticeable change from 2005 to 2014

Surface-Water Monitoring

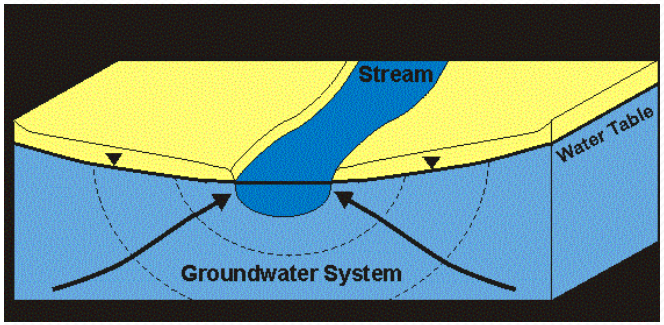
Surface-Water Monitoring Network

- 52 sites
  - MBMG 39
  - Confluence 11
  - USGS 2

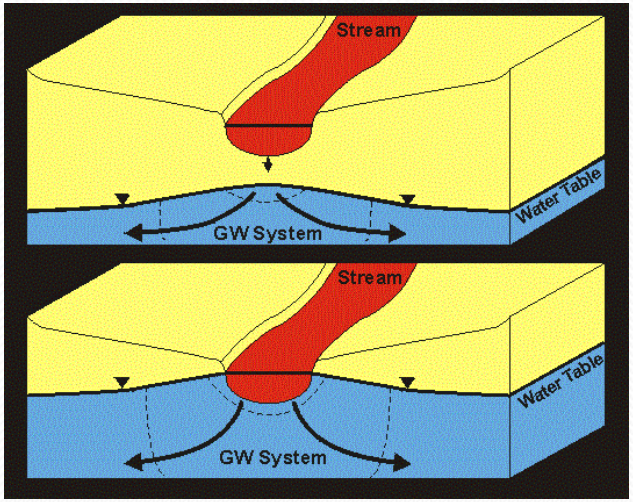


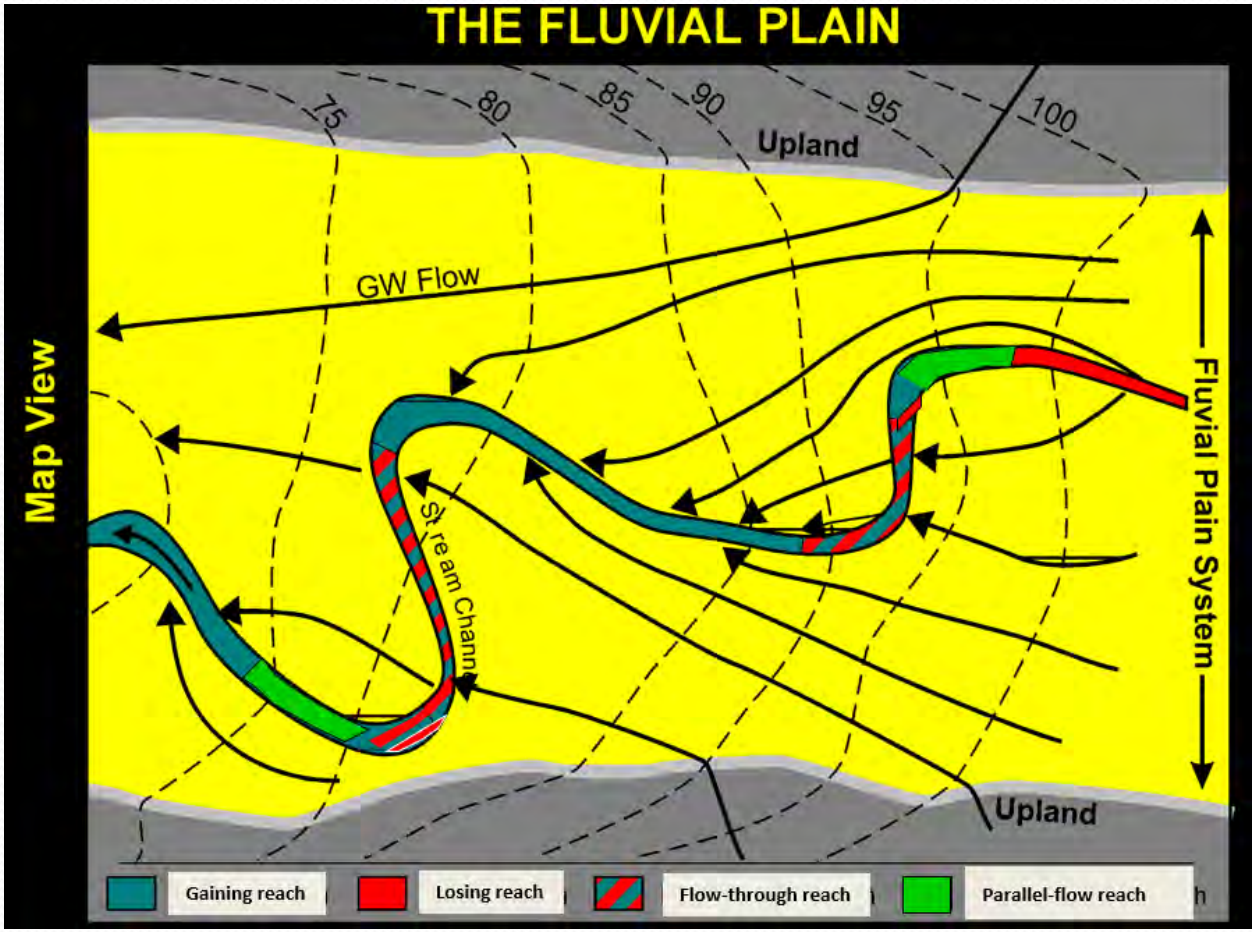
Surface-Water/Groundwater Interactions

Gaining Stream



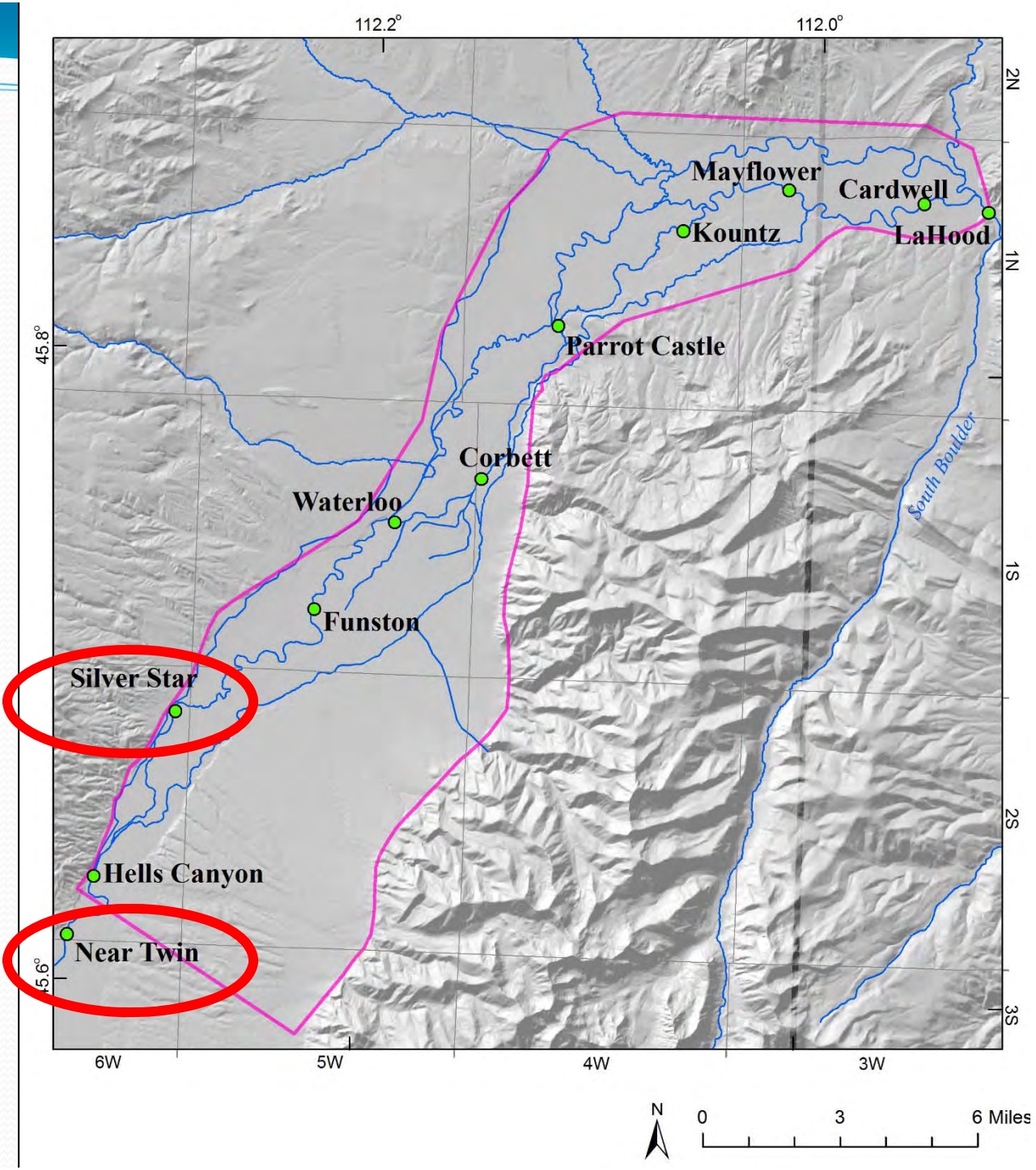
Losing Stream



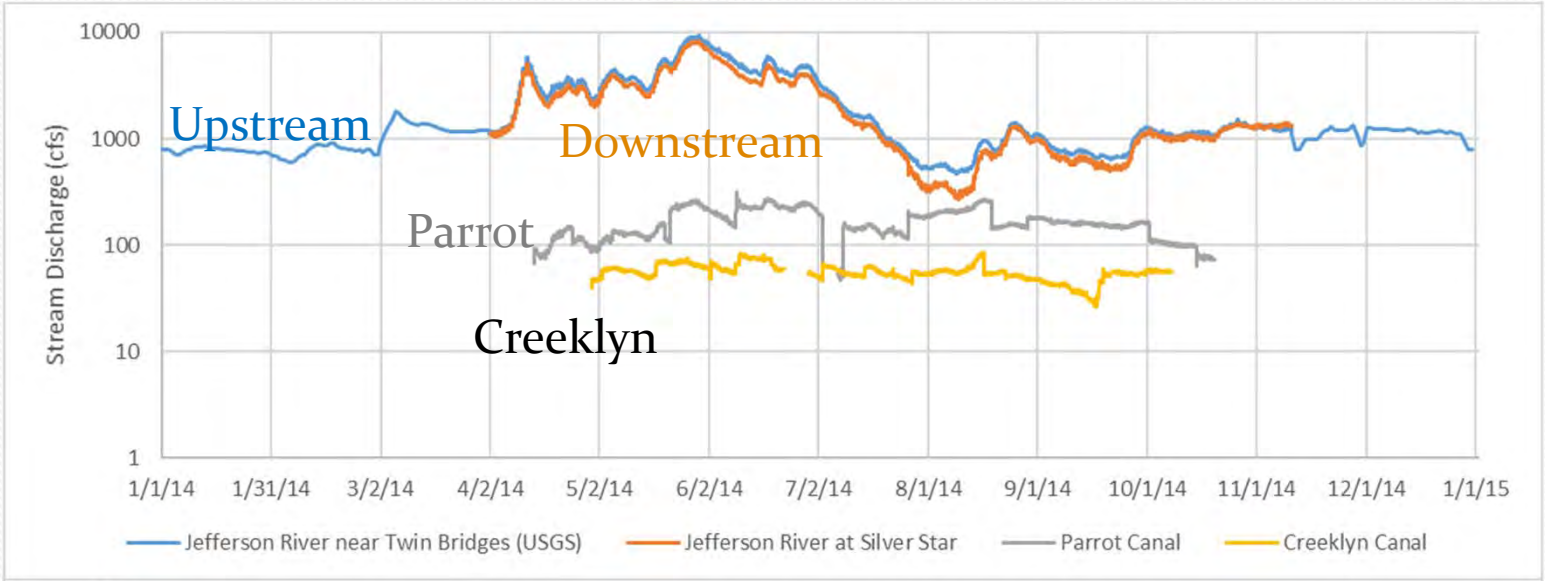


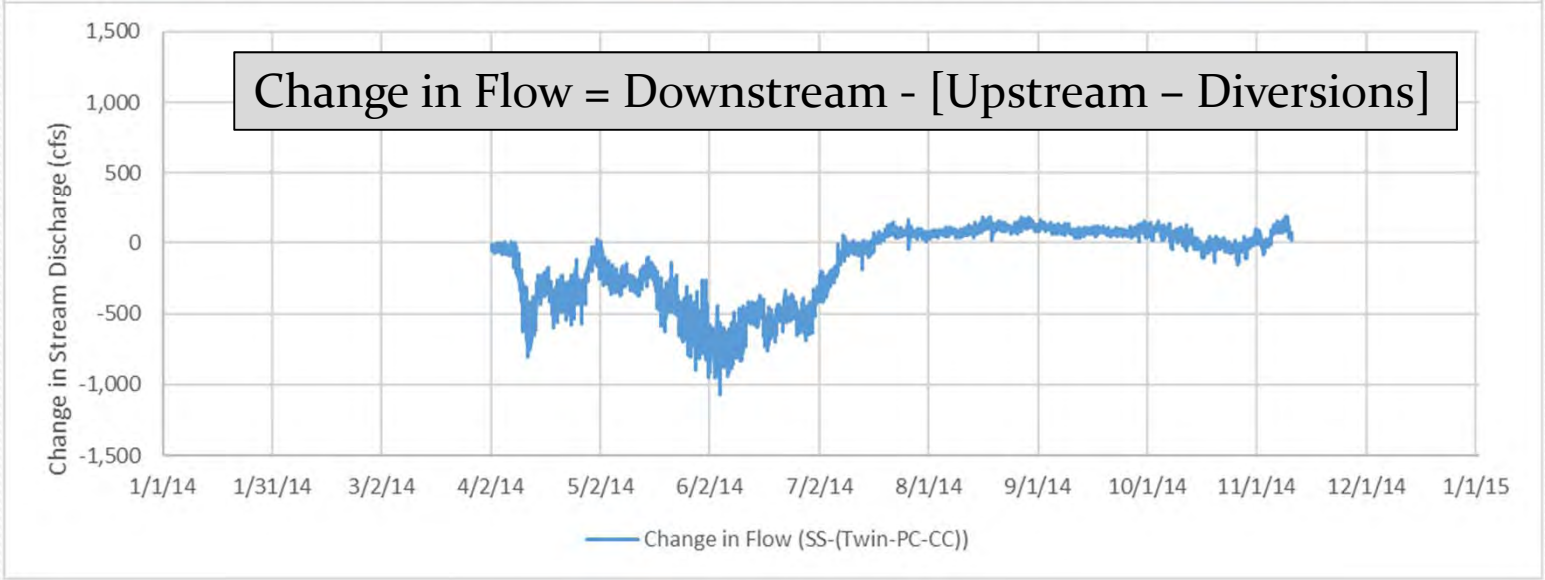
Figures from W. Woessner

Jefferson River Sites



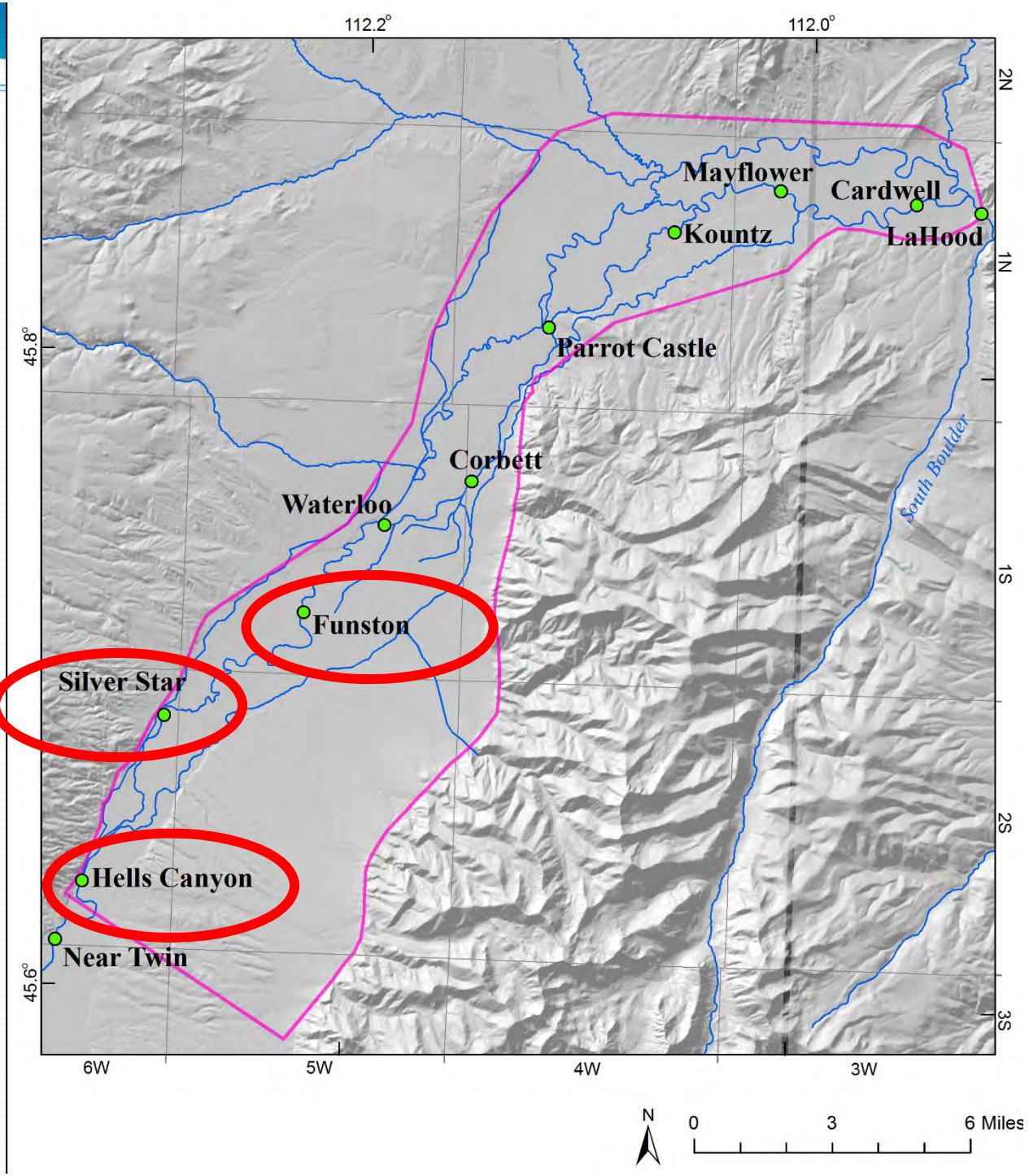
Discharge Comparison



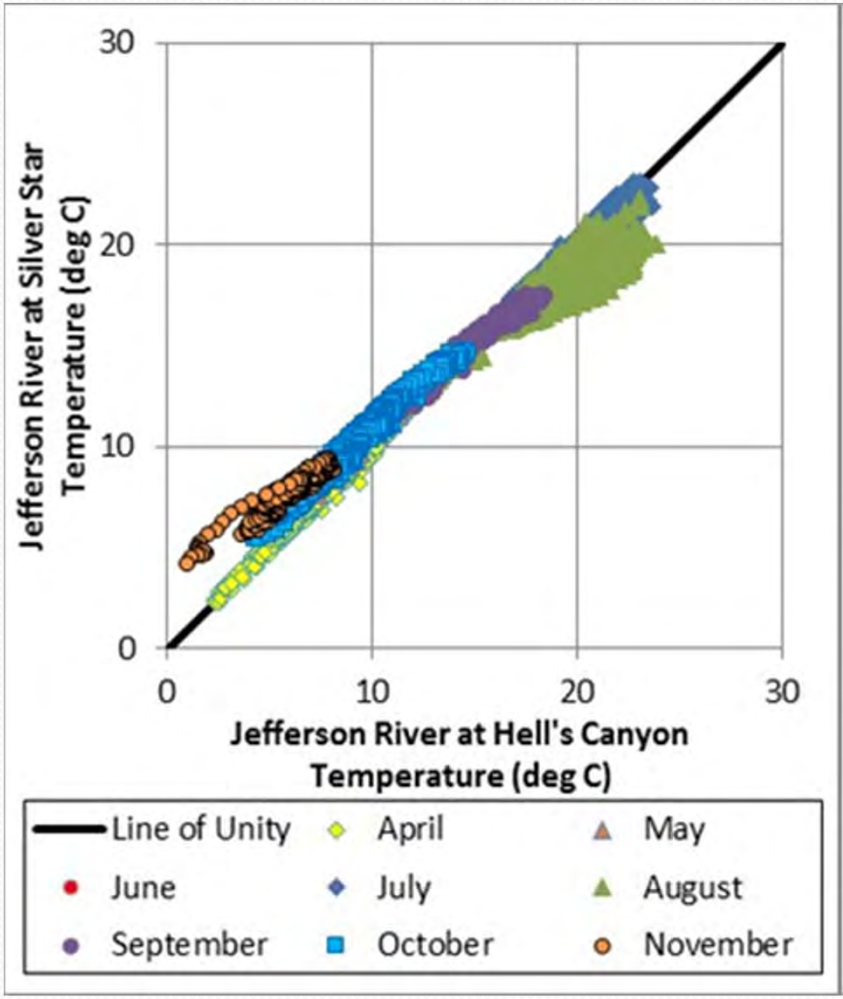


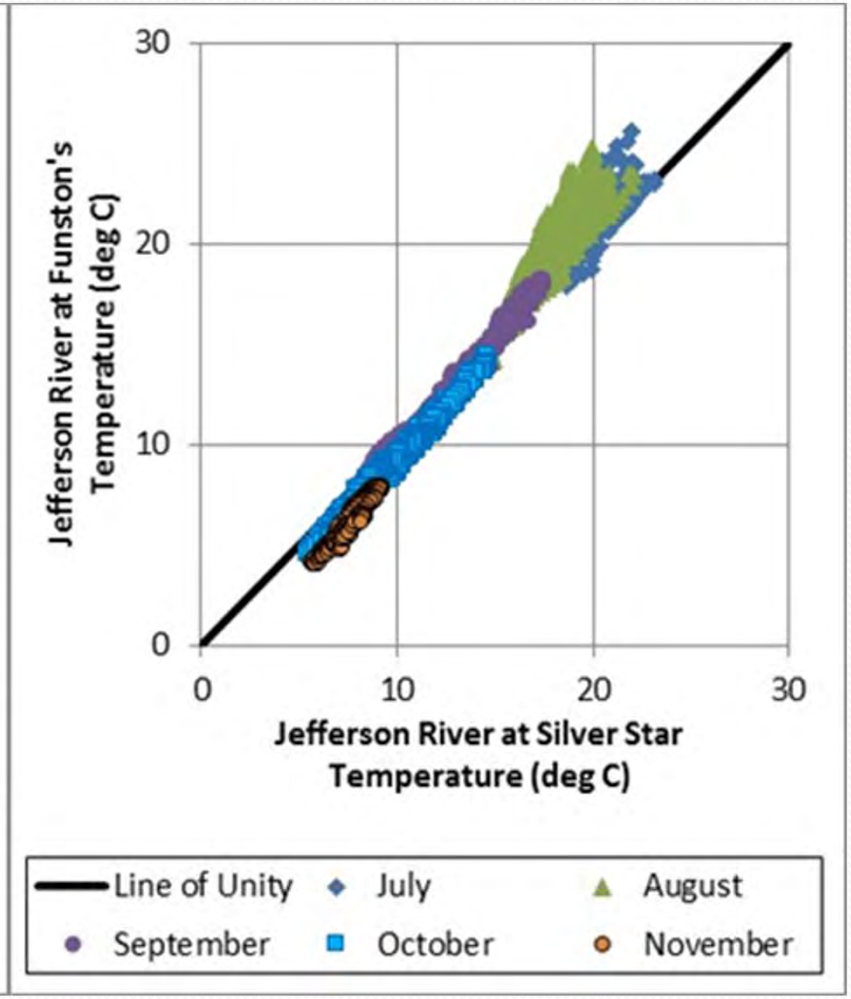
Preliminary

Jefferson River Sites



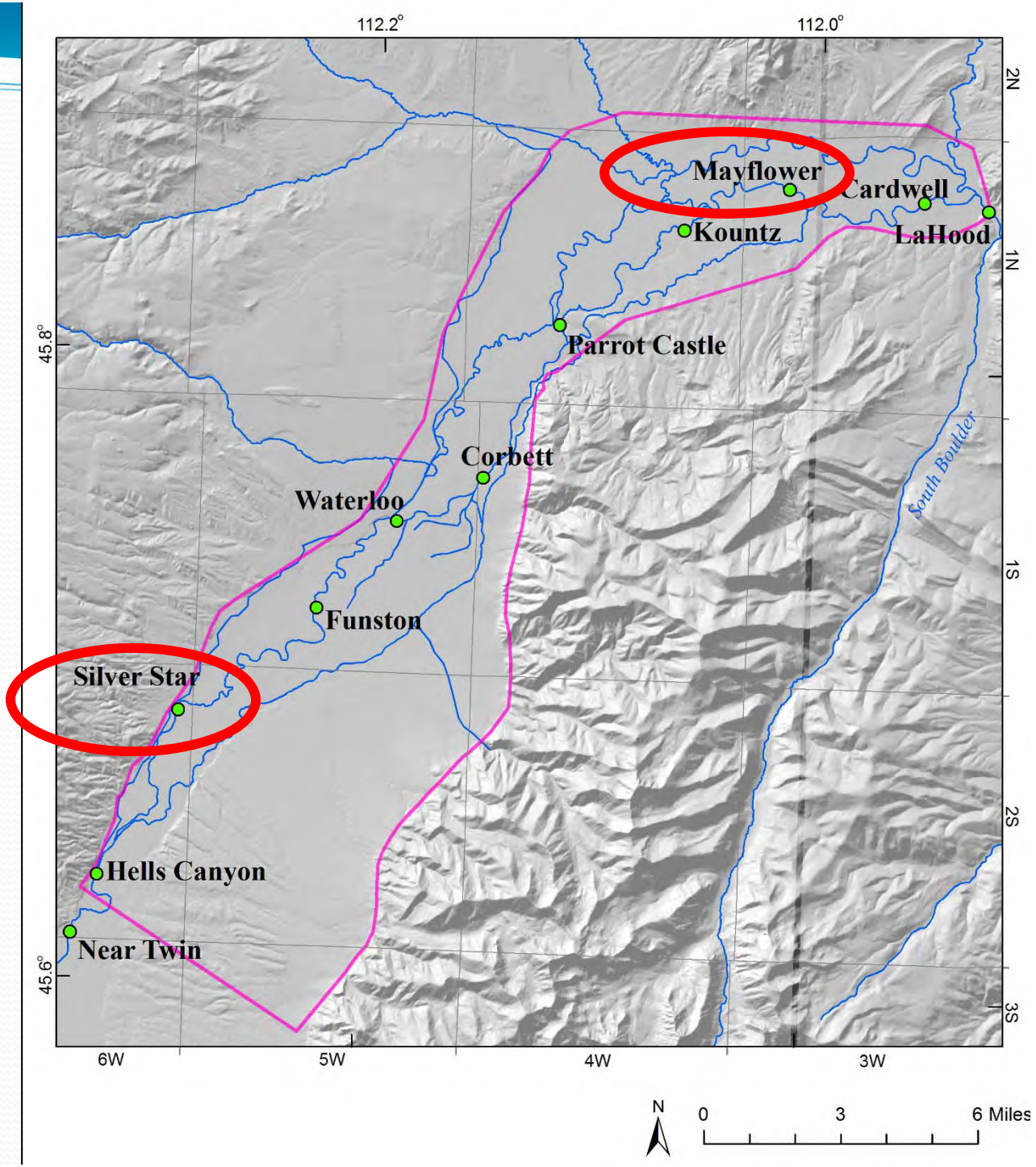
Stream Temperature



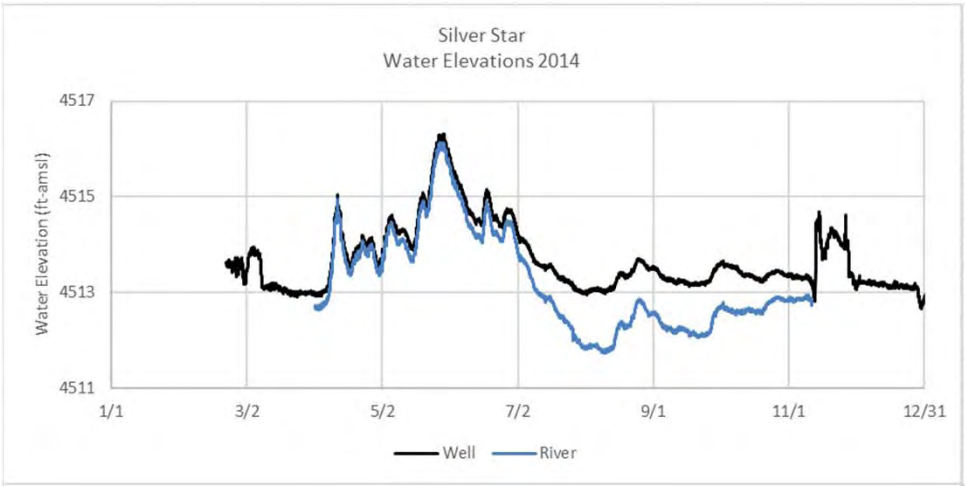


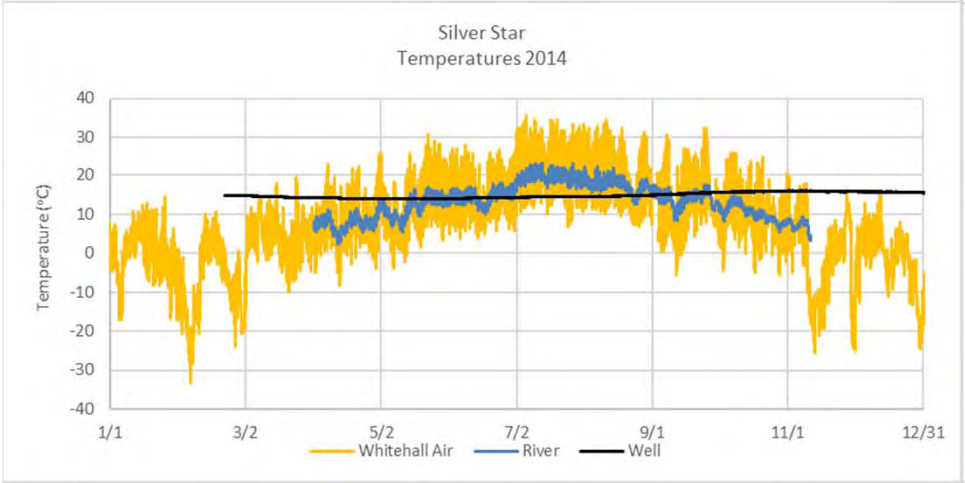
Preliminary

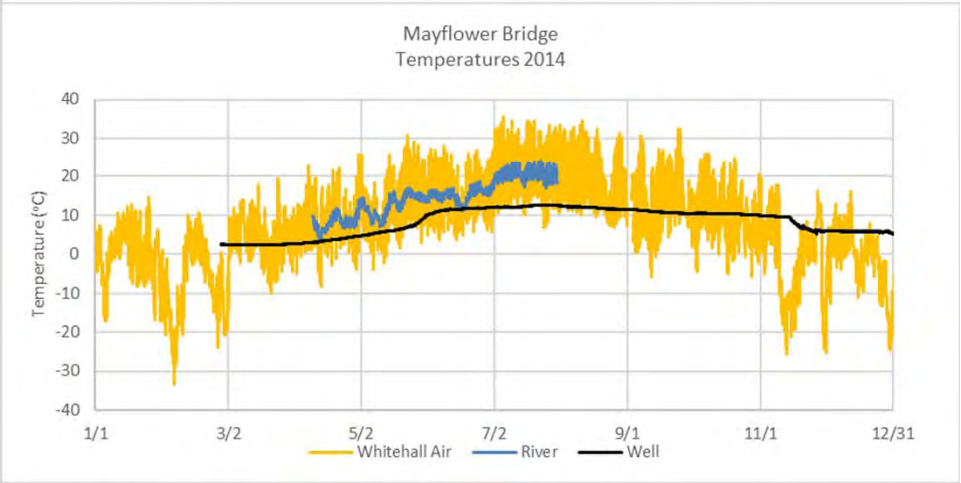
Jefferson River Sites



Stream and Groundwater Elevations and Temperatures







Preliminary

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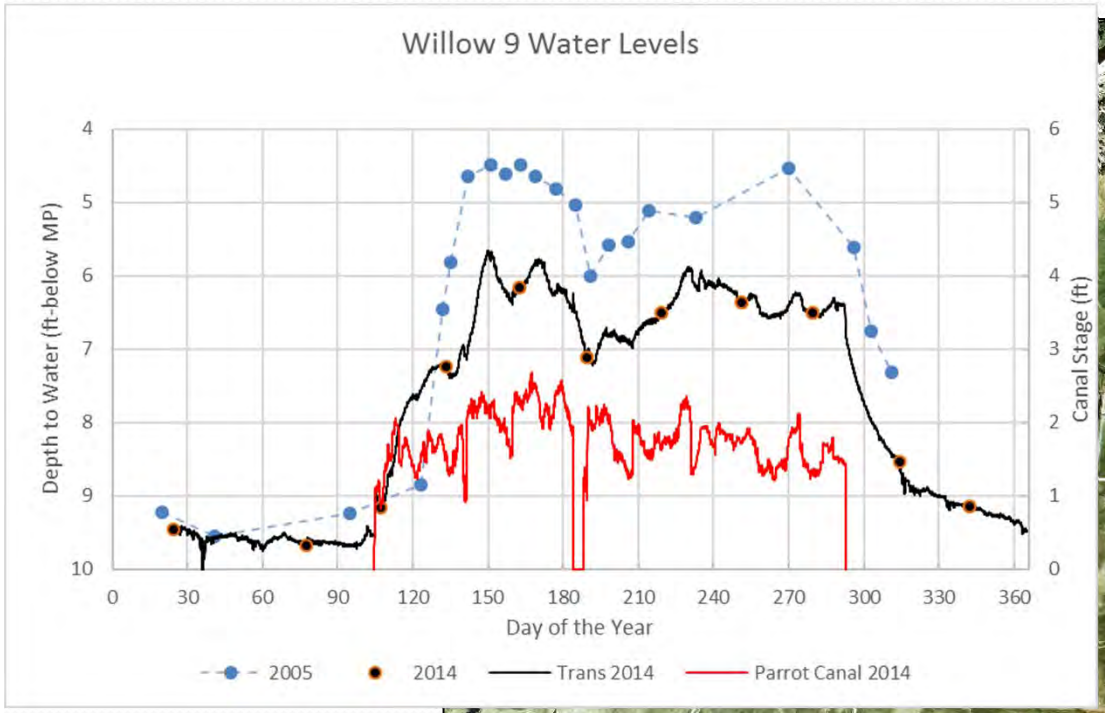
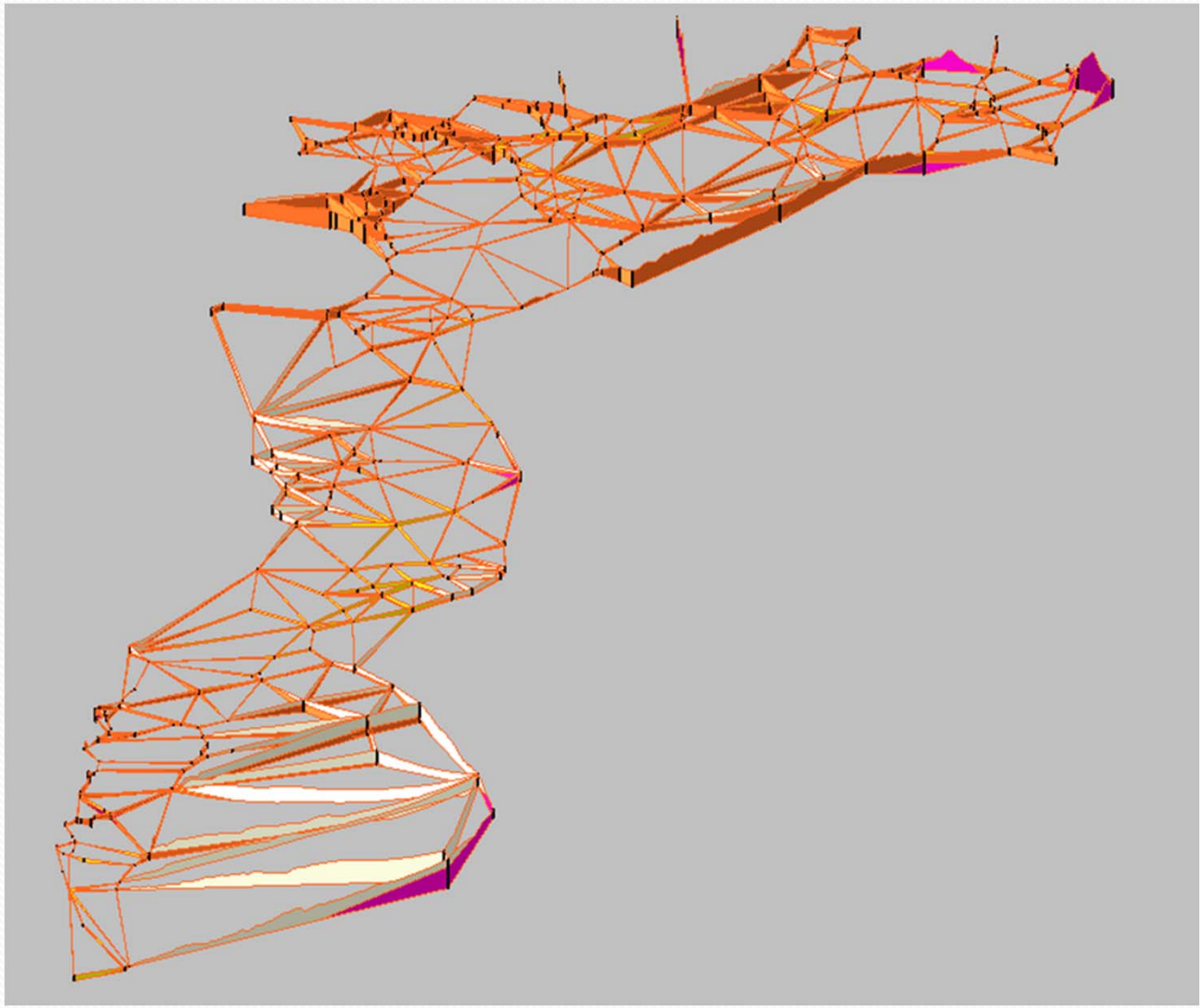


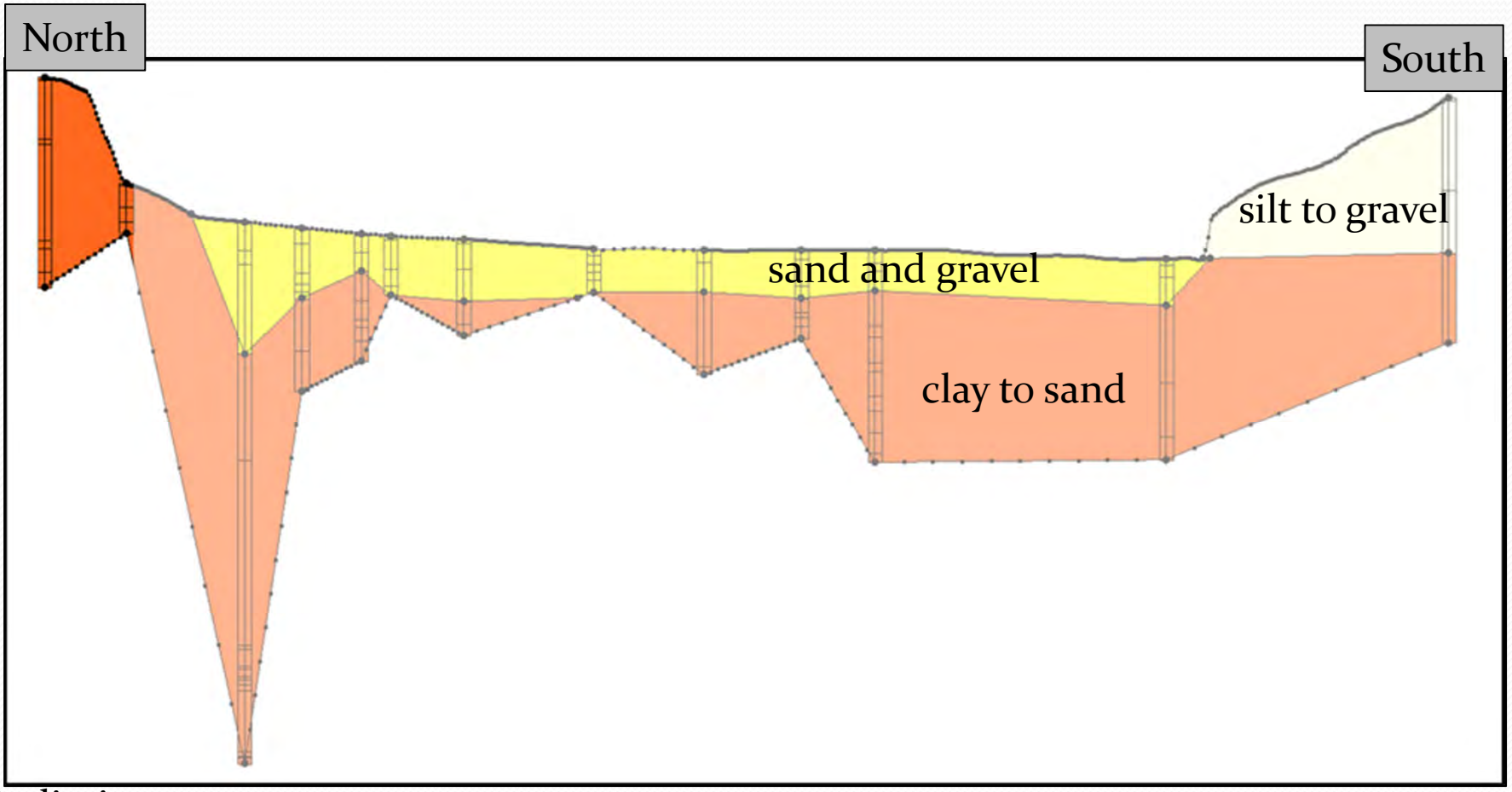
Levels peak in May through September
Lowest levels in Winter

Hydrogeologic Model

- 1,247 Wells in GWIC used to develop a network of cross sections

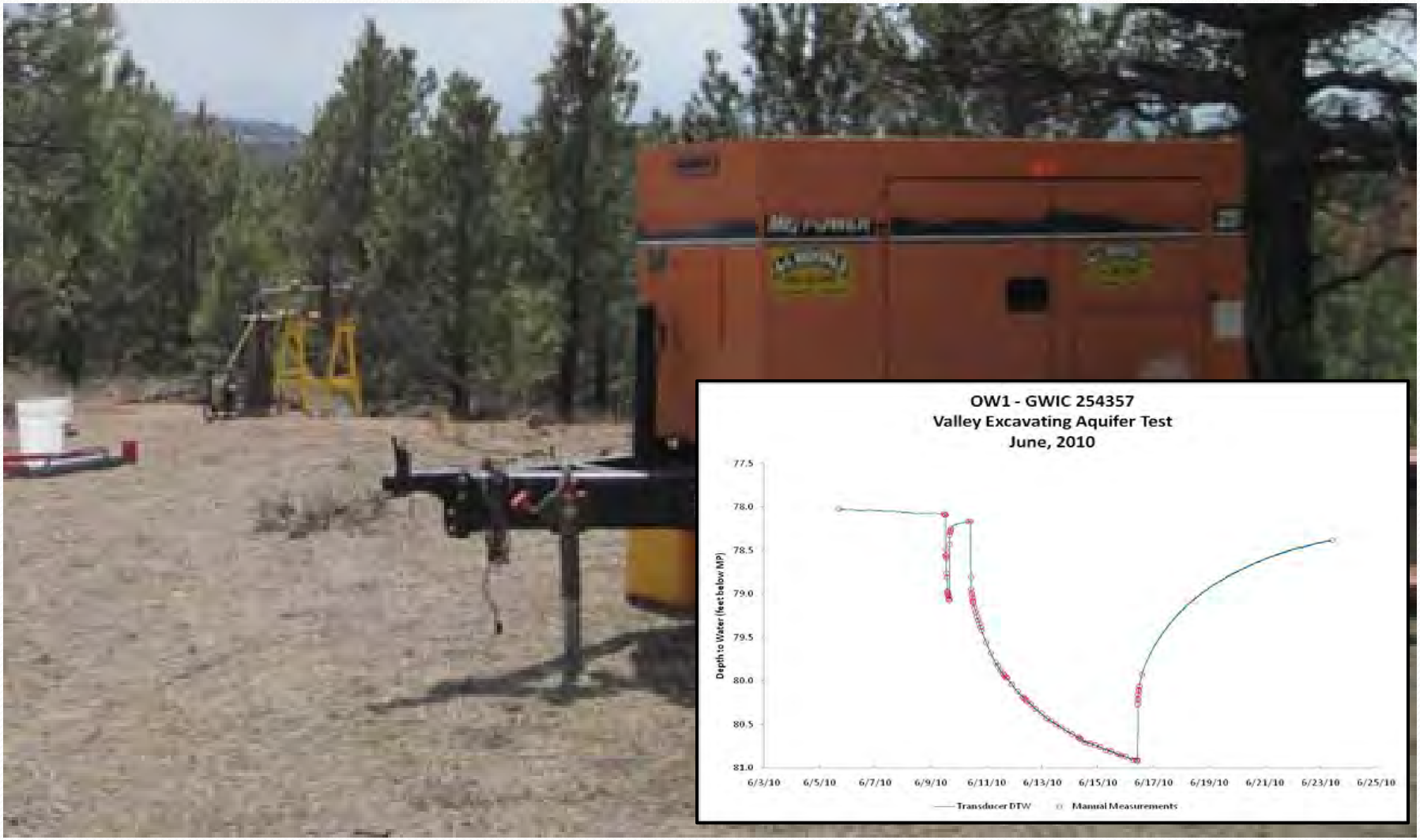


Hydrogeologic Model Example Cross-Section

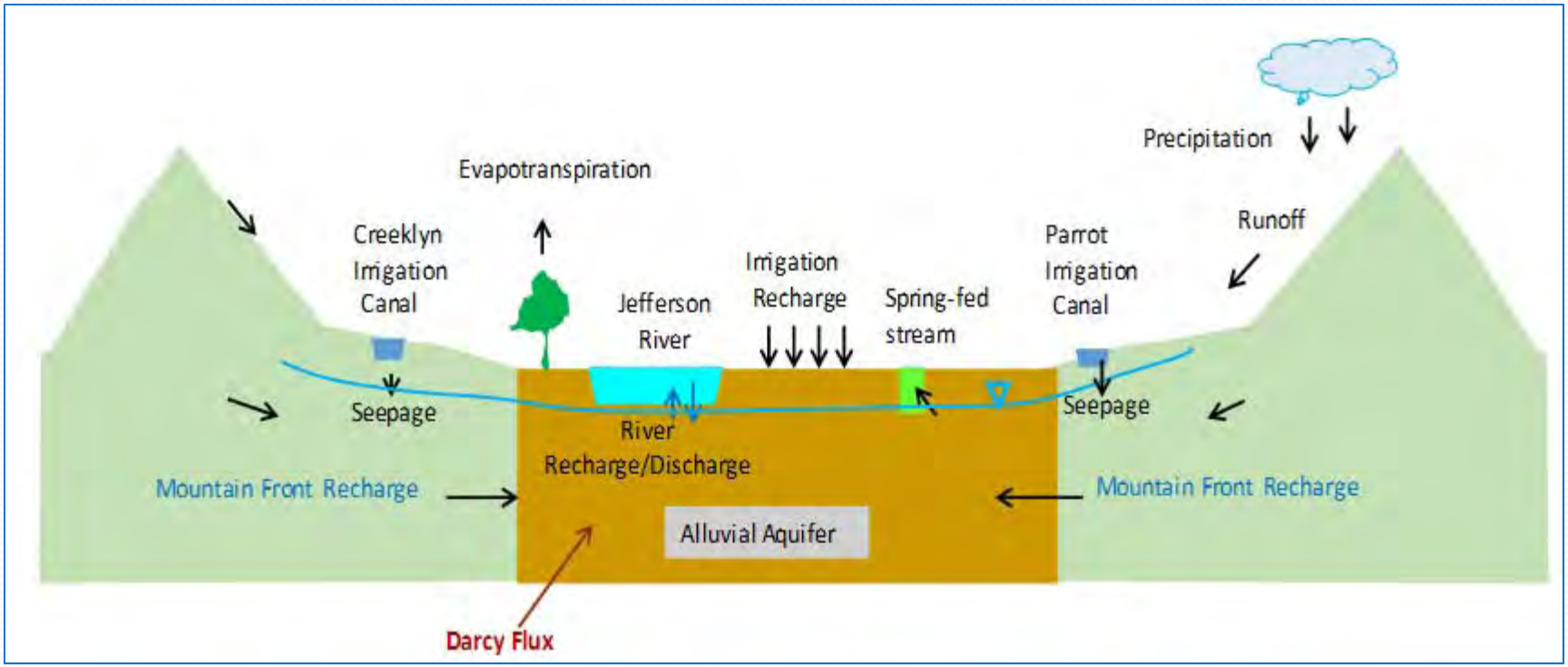


Preliminary

Aquifer Tests



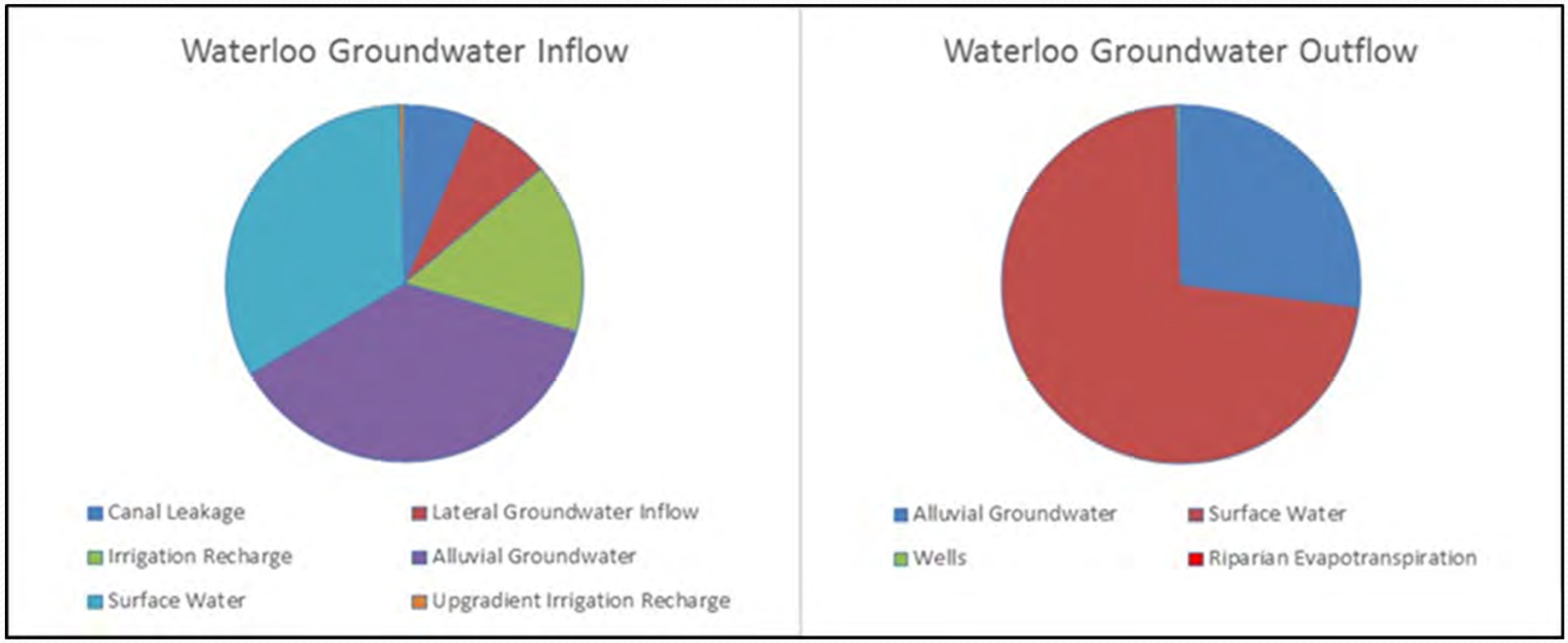
Annual Groundwater Budget



Flow In = Flow Out ± Changes in Storage

Stable Groundwater Levels, so Change in Storage ~ 0

Groundwater Budgets



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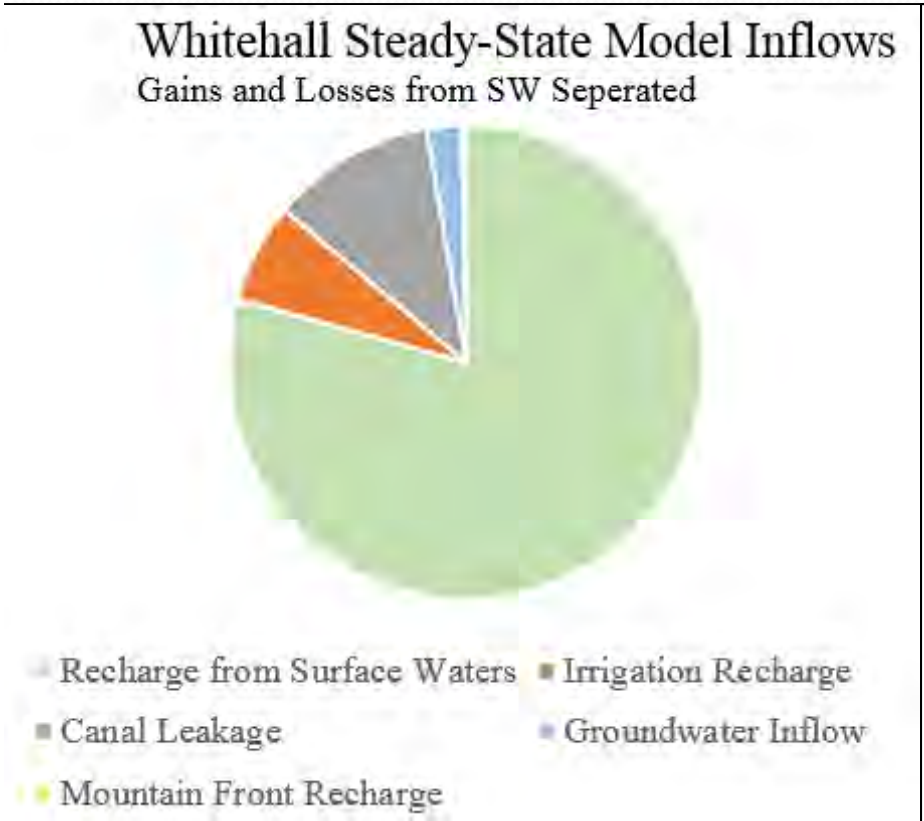
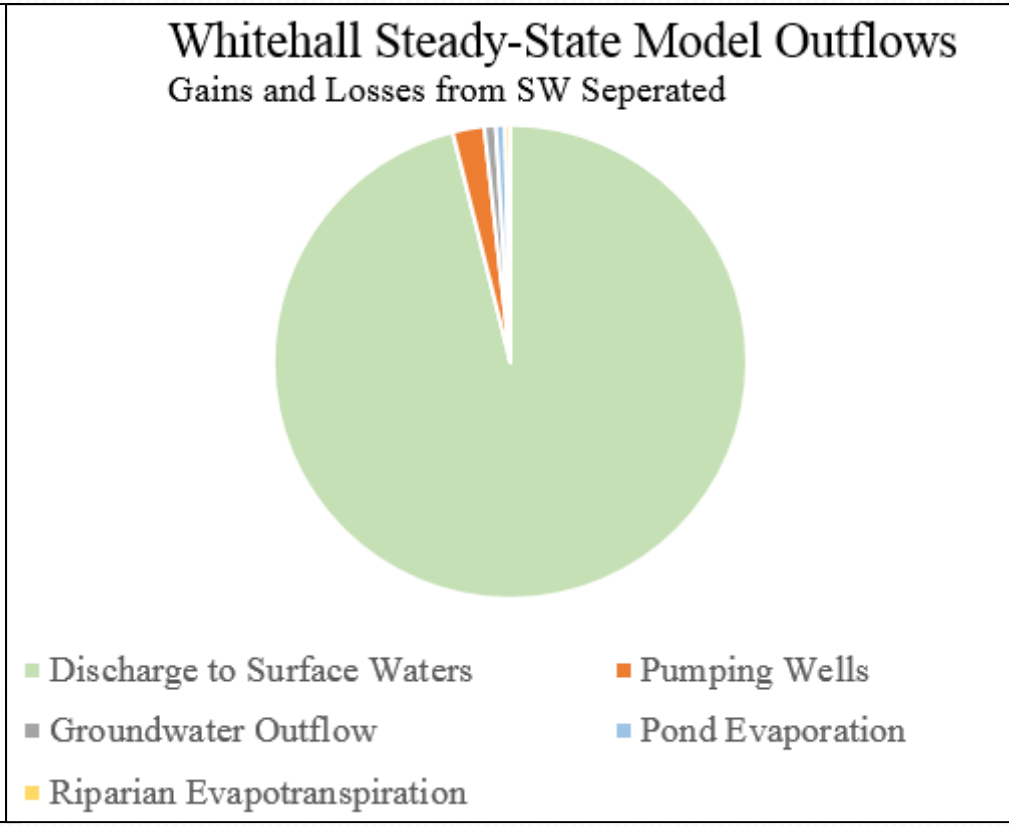
Groundwater Budgets





Preliminary

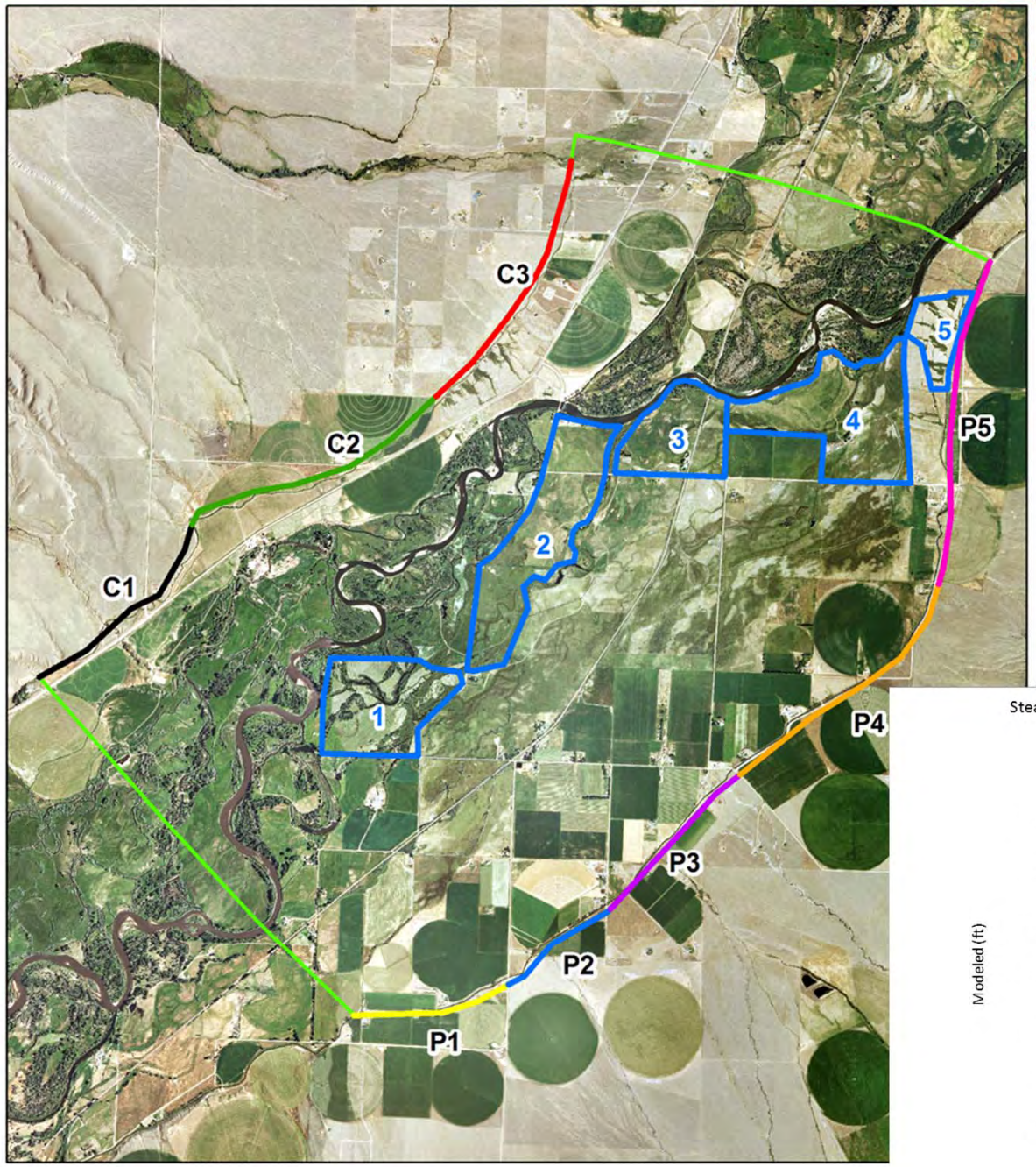
Groundwater Flow Modeling

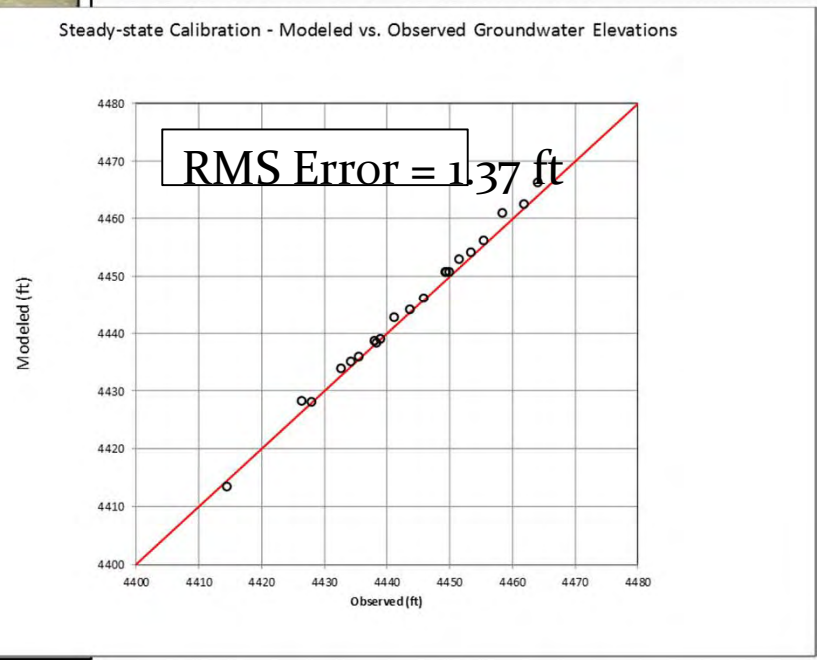
- Conceptual Model
  - Hydrogeologic Model/Aquifer Properties
  - Potentiometric Surfaces
  - Hydrographs
  - Groundwater/Surface-Water Interactions
  - Budget
- Numerical Model
  - Develop a numerical representation of the system
    - Calibrate using:
      - distribution and properties of the hydrogeologic units
      - groundwater levels, and
      - groundwater budget

Models

- Waterloo Area
  - Groundwater/Surface-Water Interactions
    - Willow Springs
    - Parson's Slough
    - Jefferson River
  - Changing from Flood to Pivot Irrigation
  - Lining Canals
- Whitehall Area
  - Groundwater/Surface-Water Interactions
    - Jefferson River
    - Jefferson Slough
    - Other Tributaries
  - Impacts from increased groundwater development
    - Housing Developments

Waterloo Model



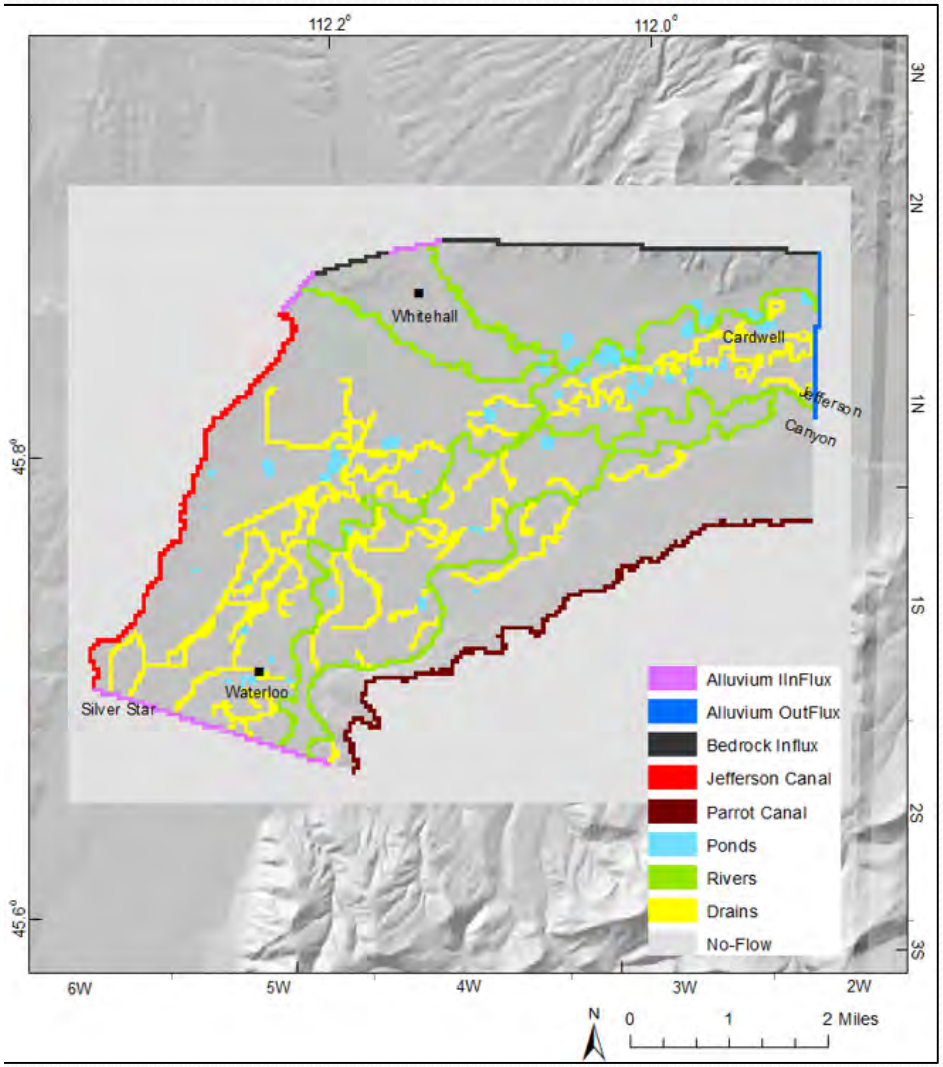


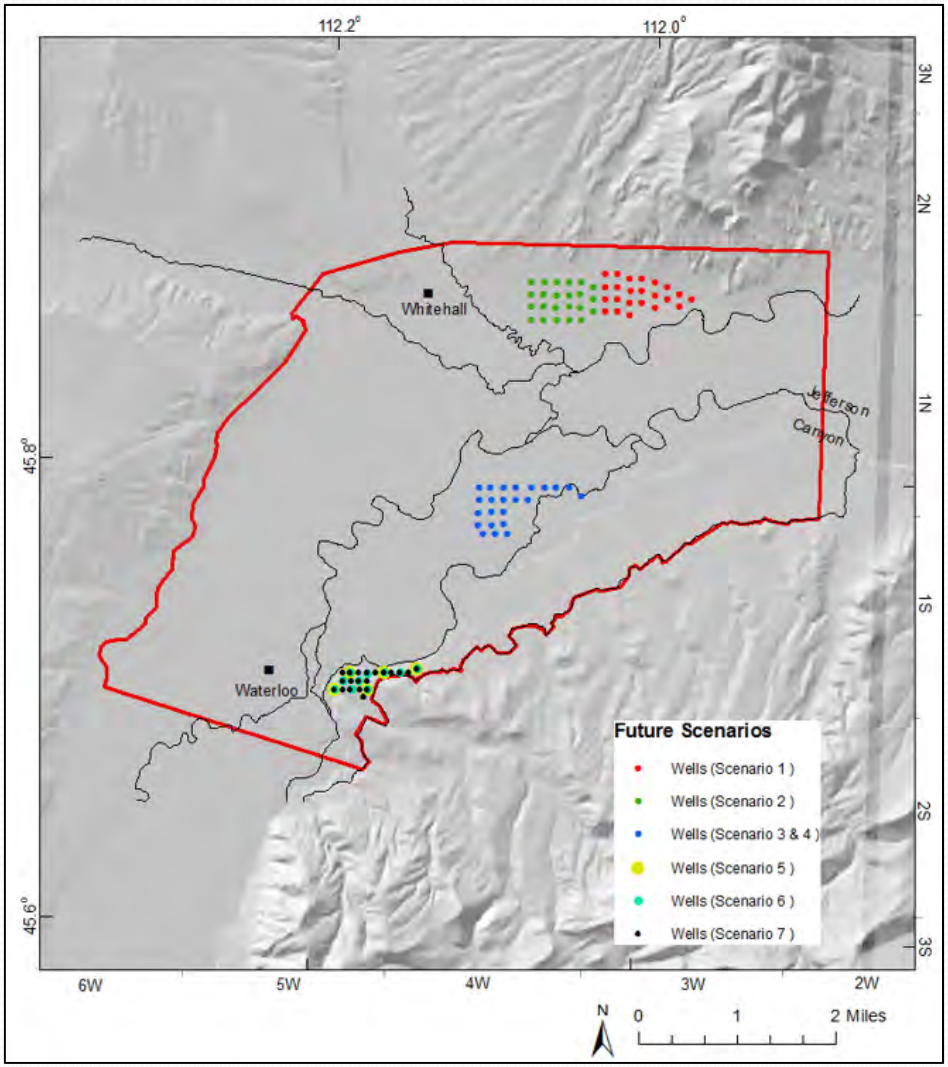
DRAFT Waterloo Model Results

Changes in Mean Monthly flow in the Jefferson River

Scenario	Description	July Reduction in Net Stream Gain (cfs)	August Reduction in Net Stream Gain (cfs)
1	No Canal Leakage	11.9	17.0
10	Areas 1-5 – Convert Flood to Pivot	10.2	12.8
16	Convert Areas 1-5 and No Leakage	22.0	29.7
17	Areas 1-5 - Split Season Irrigation	7.4	12.1
18	All Fields - Split Season Irrigation	0.6	10.3

Whitehall Model





DRAFT Whitehall Model Results
Changes in Surface-Water outflow

Changes in Mean August Stream Flows after 10 years

		Change in Flow		
Scenario	**Description**	**ft^3/d**	**cfs**	**gpm**
1	23 homes - Non-Irrigated Bench	812	0.009	4.2
2	23 homes - Irrigated Bench	14,437	0.167	75.0
3	23 homes - Non-Irrigated Alluvium	2,351	0.027	12.2
4	23 homes - Non-Irrigated Tertiary	2,241	0.026	11.6
5	5 homes - Non-Irrigated Bench	92	0.001	0.5
6	10 homes - Non-Irrigated Bench	196	0.002	1.0
7	20 homes - Non-Irrigated Bench	400	0.005	2.1

Preliminary Conclusions

- Groundwater and Surface Waters are tightly coupled in the Jefferson Valley – A single resource

- Changes in irrigation management can noticeably affect low flows in the Jefferson River.
  - Loss of Groundwater Recharge
  - Less Aquifer Storage

- To increase/maintain Late-Summer Stream Flows
  - Emphasize groundwater recharge when water is abundant
    - Increase Aquifer Storage
  - Emphasize efficient irrigation methods when flows are low
    - Pivot Irrigation – Apply just what the crop needs
    - Biodegradable canal sealant?
  - Split-Season Irrigation can help mitigate effects of conversion


Questions?
MBMG