Beaverhead River Valley West
Ground Water Investigation Program

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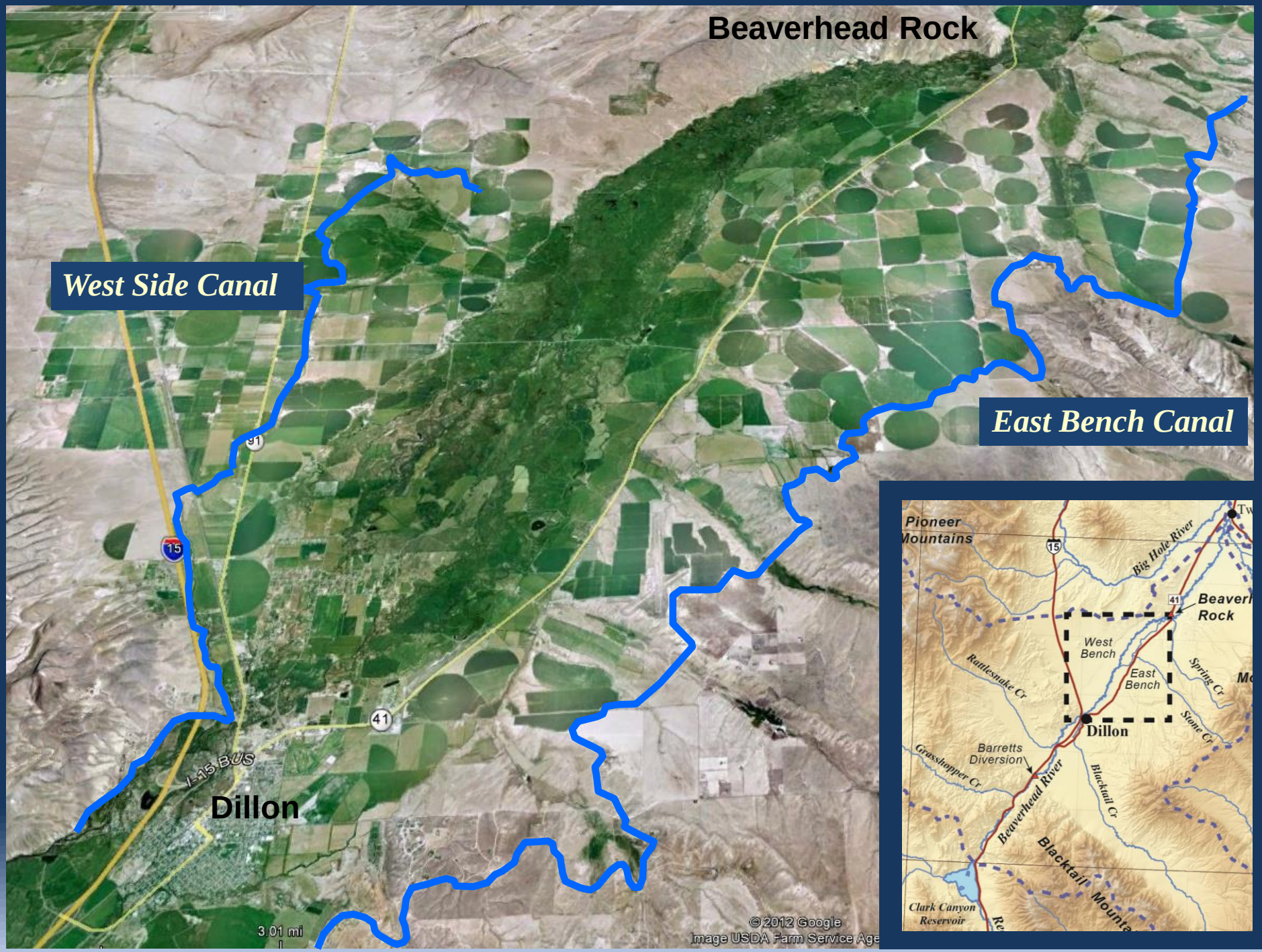
Project Purpose

Is groundwater drawdown and stream depletion occurring due to high-capacity irrigation pumping from aquifers?

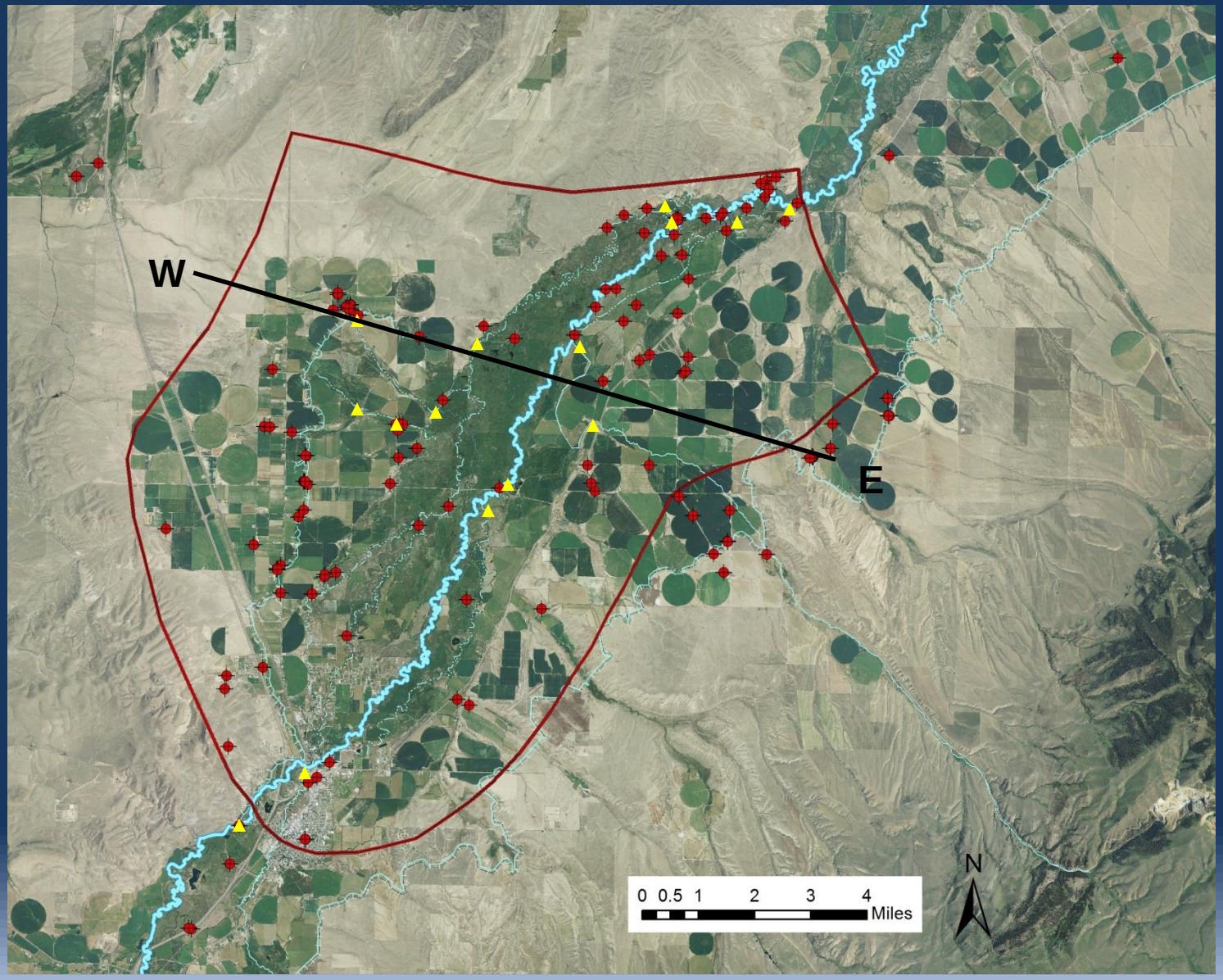
Evaluate possible impacts to sloughs and the Beaverhead River from future groundwater development.

Topics

- Groundwater movement and groundwater trends
- Water budget (More details)
- Quantify groundwater recharge from canals and irrigated fields
- Groundwater/surface-water interaction
- Evaluate potential stream depletion
- Water chemistry
- Vertical movement
- Aquifer testing


Beaverhead Rock
West Side Canal
East Bench Canal
Dillon
I-15 BUS
15
41
91
3.01 mi
© 2012 Google
Image USDA Farm Service Age
Pioneer Mountains
Big Hole River
Beaverhead Rock
West Bench
East Bench
Rattlesnake Cr
Spring Cr
Stone Cr
Dillon
Barretts Diversion
Grasshopper Cr
Beaverhead River
Blacktail Cr
Blacktail Mounta
Clark Canyon Reservoir

Monitoring Network



Hydrogeologic Framework

Volcanic Rock Aquifer

42,000 – 75,000 ft^2/day

Alluvial Aquifer

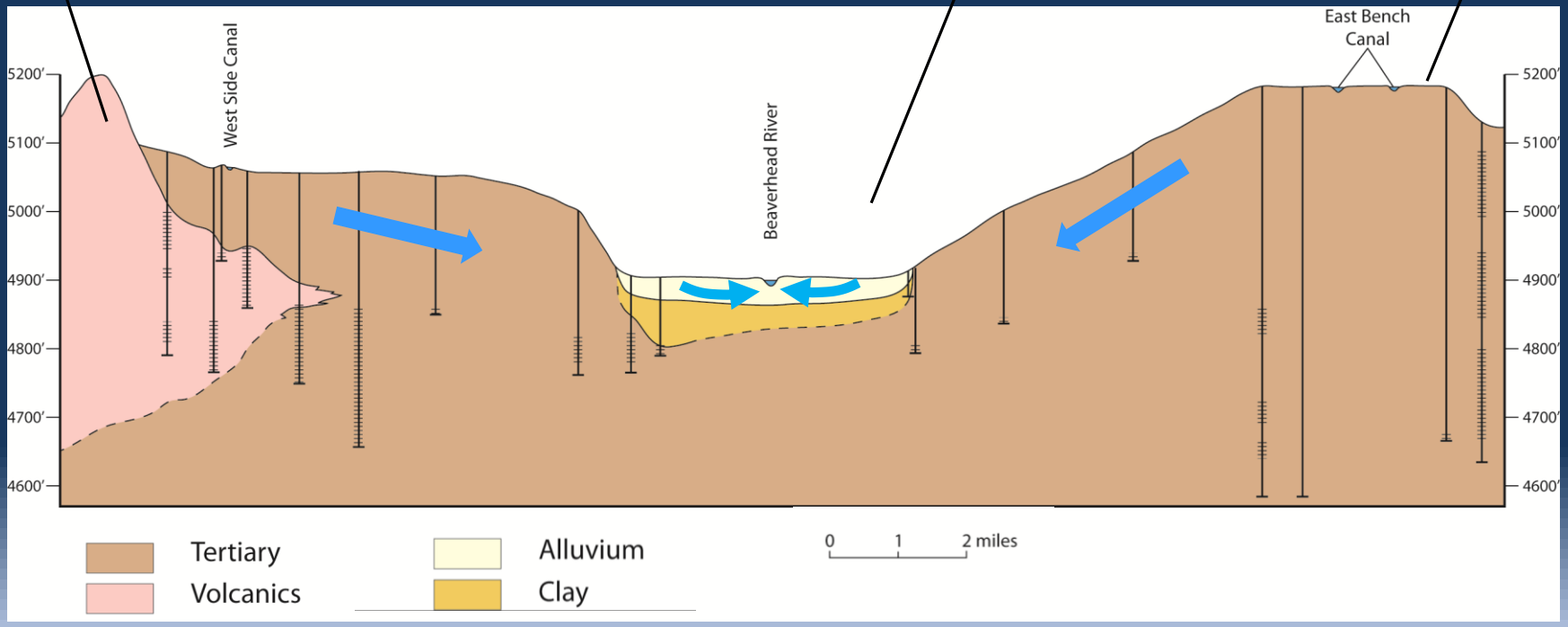
18,000 - 37,000 ft^2/day

Tertiary Sediment Aquifer

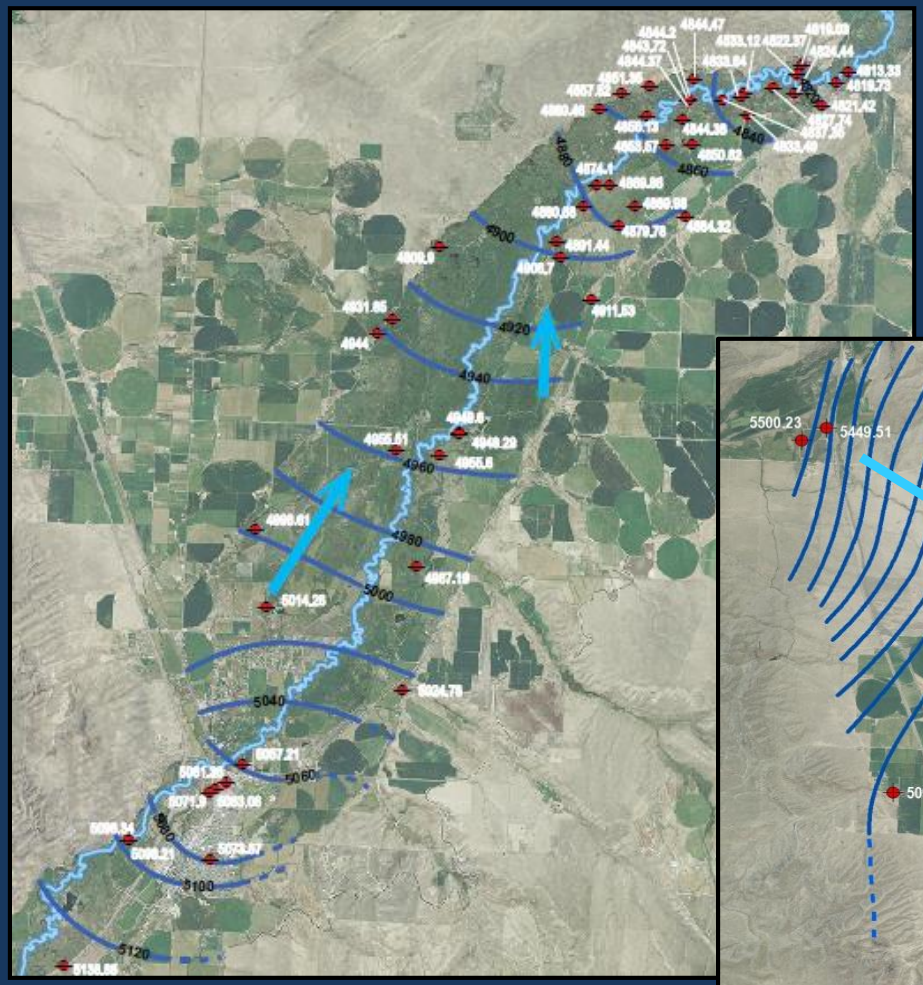
400 -2,900 ft^2/day

W

E

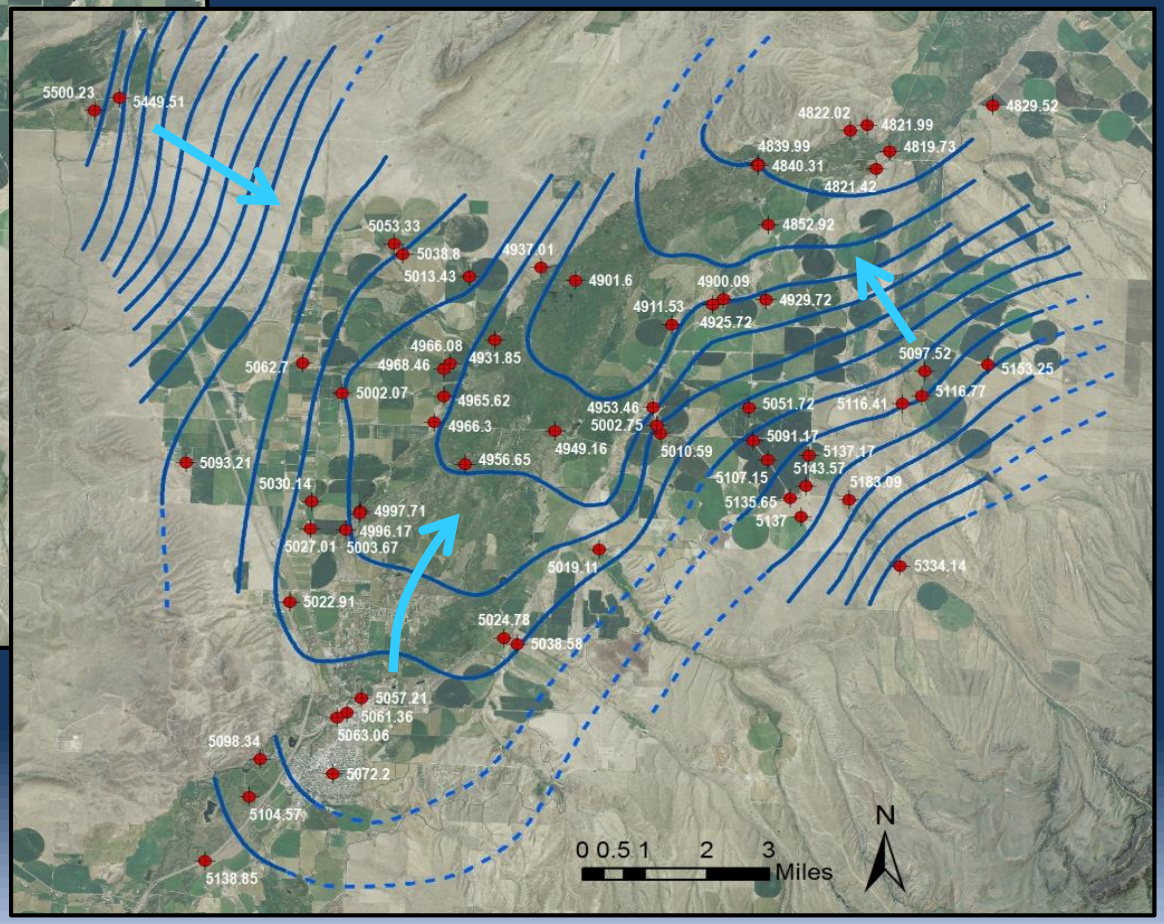


Groundwater Movement

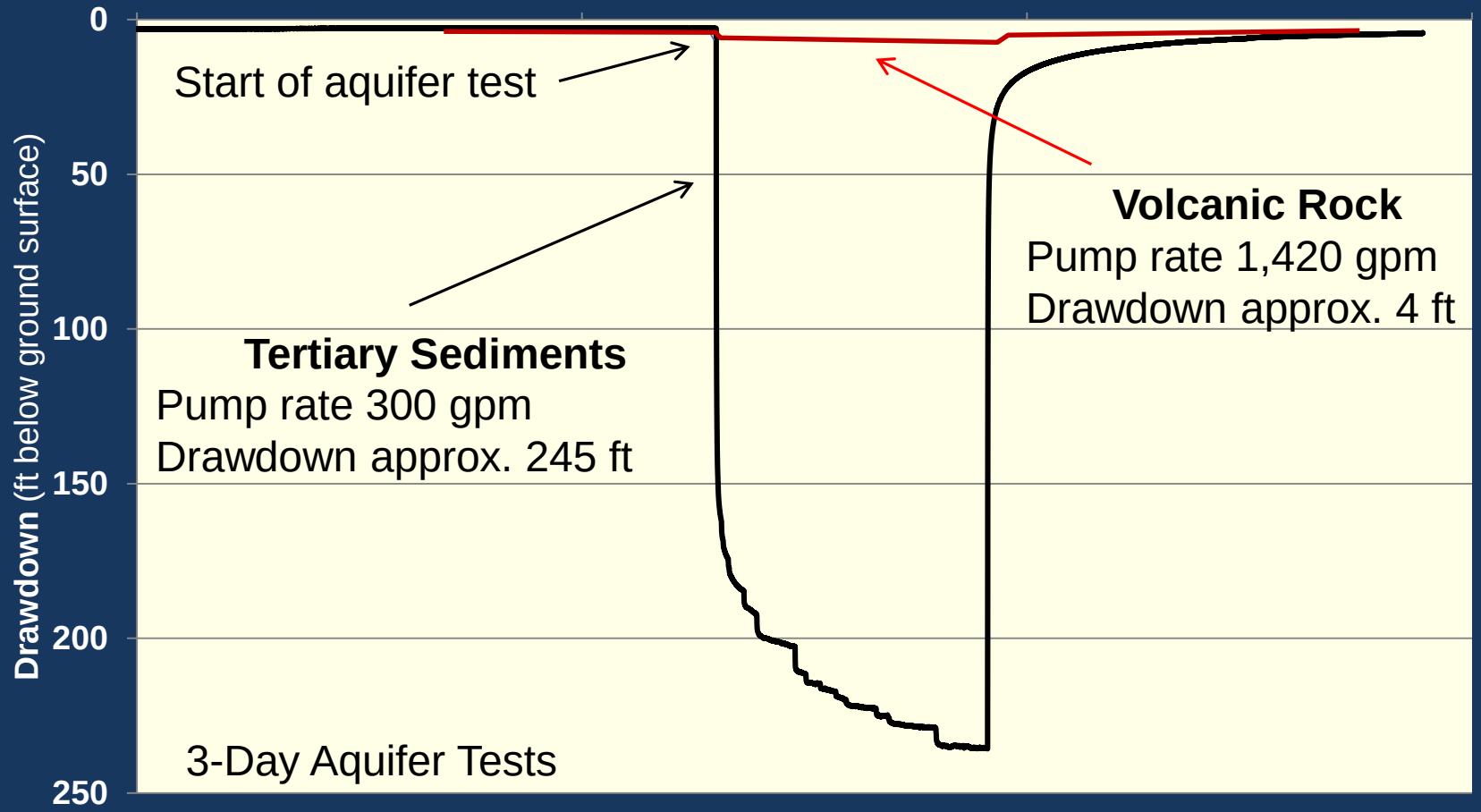


Alluvial Aquifer

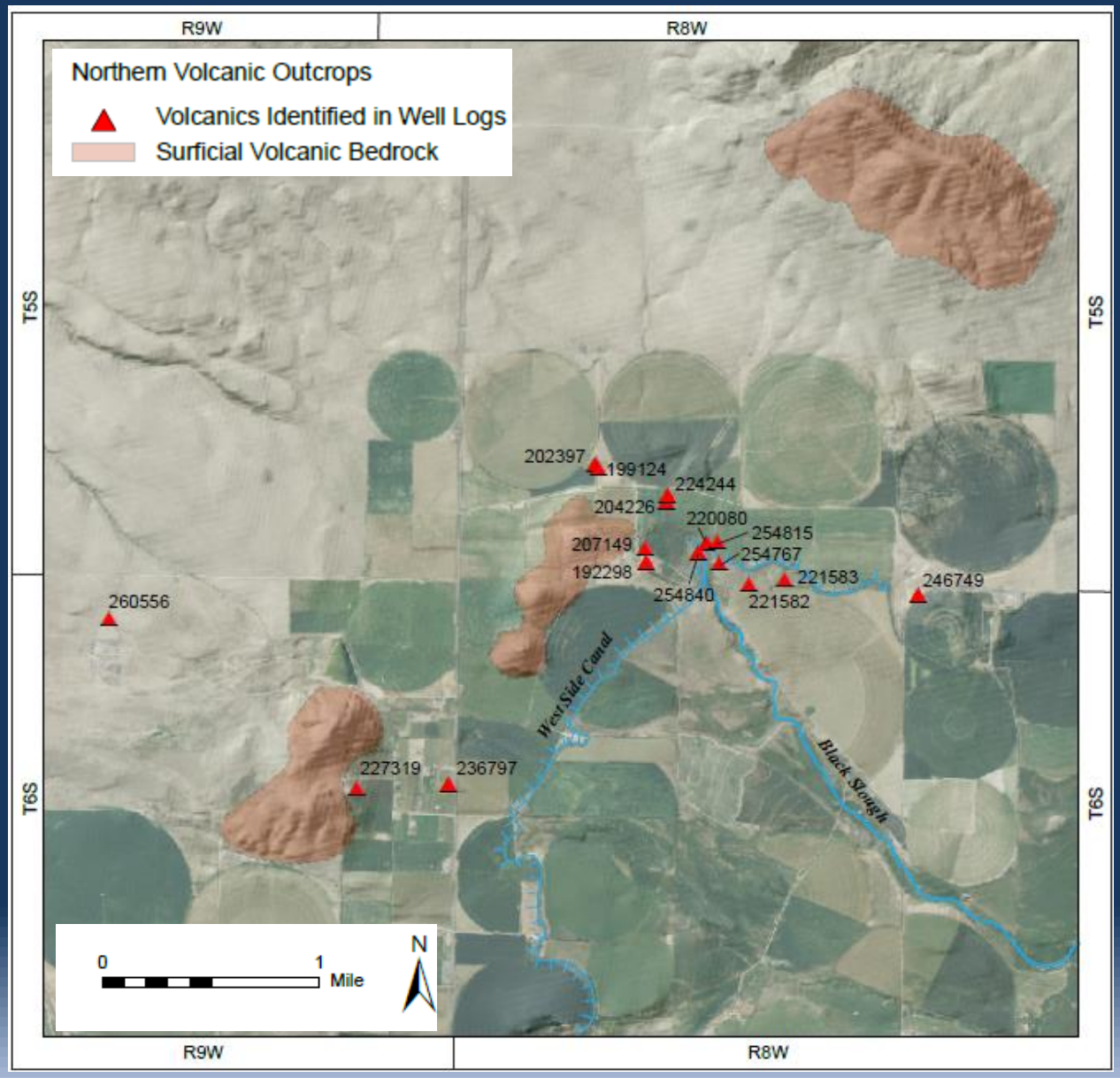
Tertiary Aquifer

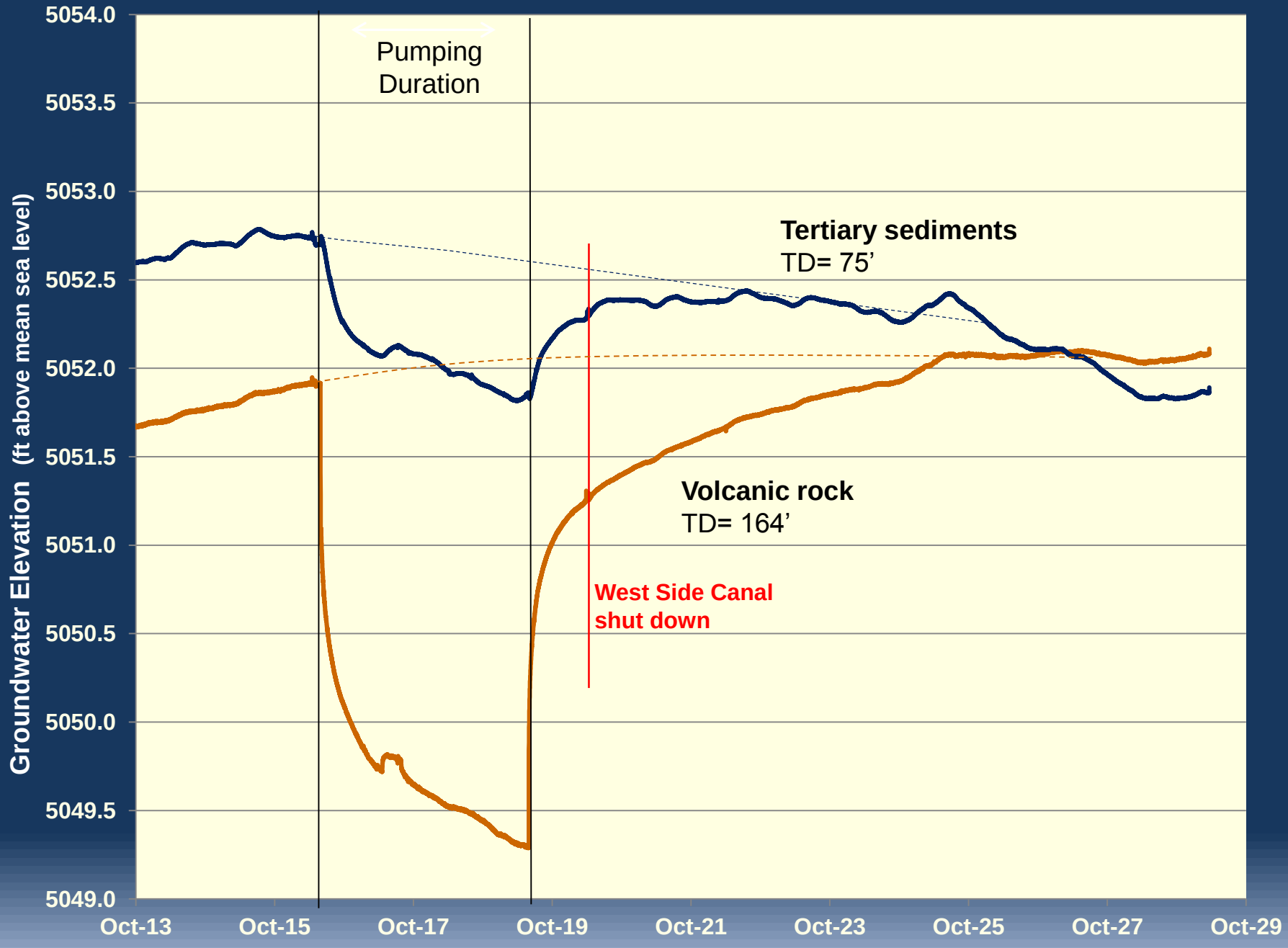


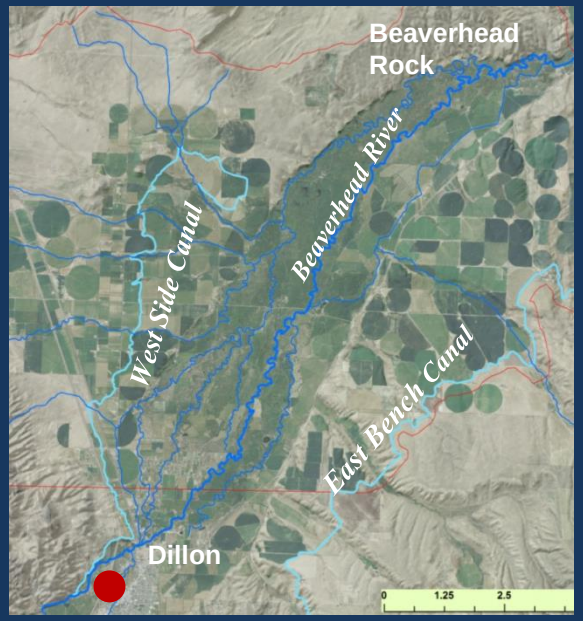
Drawdown
Volcanic rock and Tertiary sediment aquifers



Volcanic Rock Aquifer



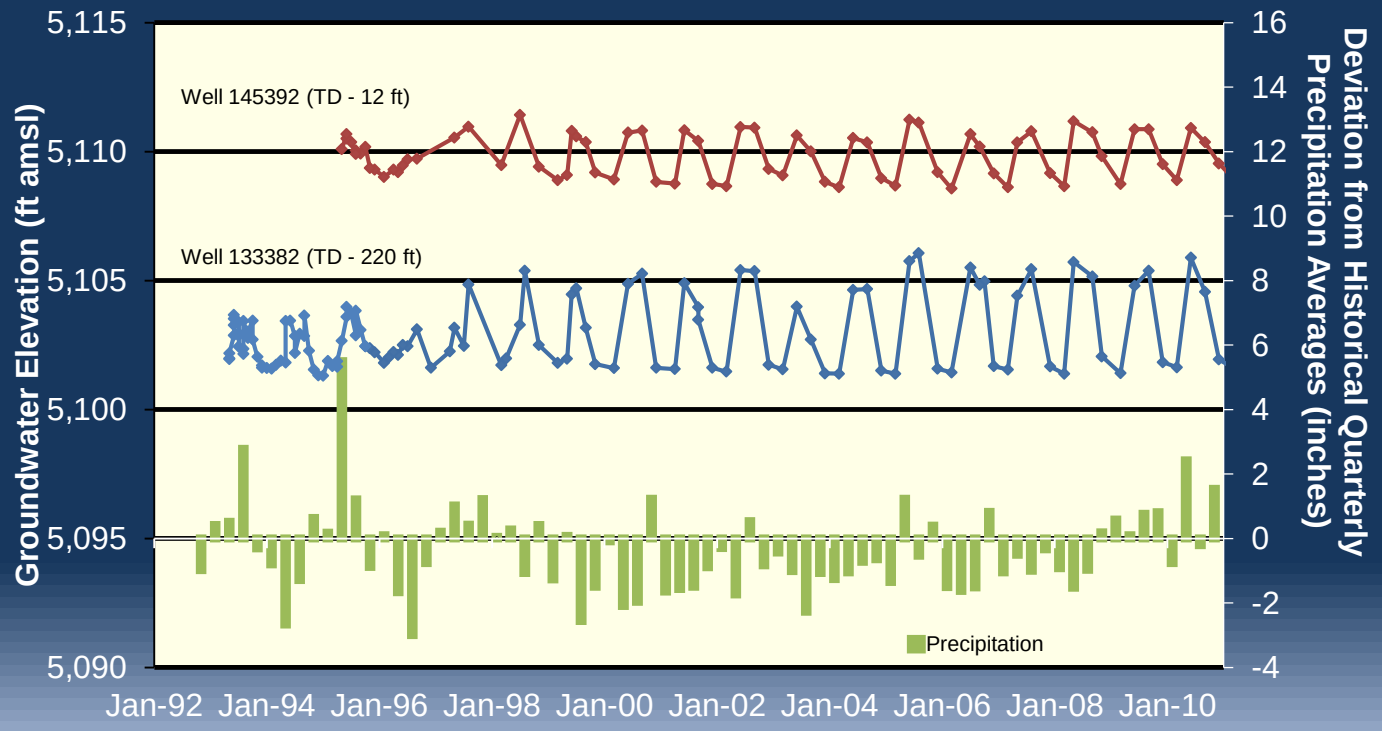

Groundwater Elevation (ft above mean sea level)
5054.0
5053.5
5053.0
5052.5
5052.0
5051.5
5051.0
5050.5
5050.0
5049.5
5049.0
Oct-13
Oct-15
Oct-17
Oct-19
Oct-21
Oct-23
Oct-25
Oct-27
Oct-29
Pumping Duration
Tertiary sediments
TD= 75’
Volcanic rock
TD= 164’
West Side Canal shut down

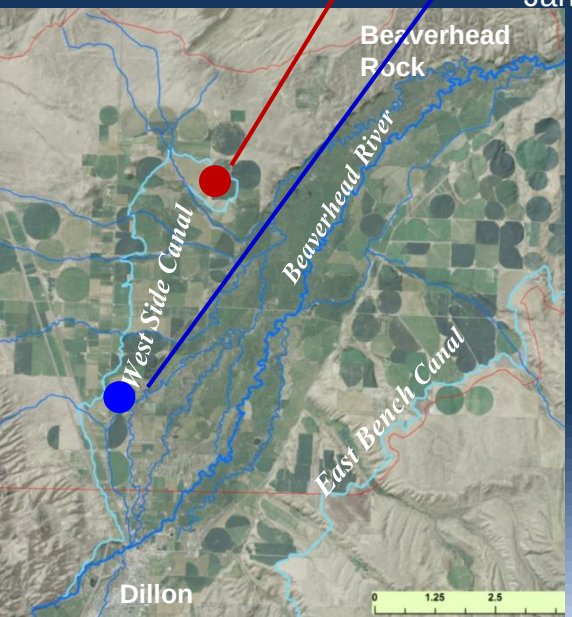


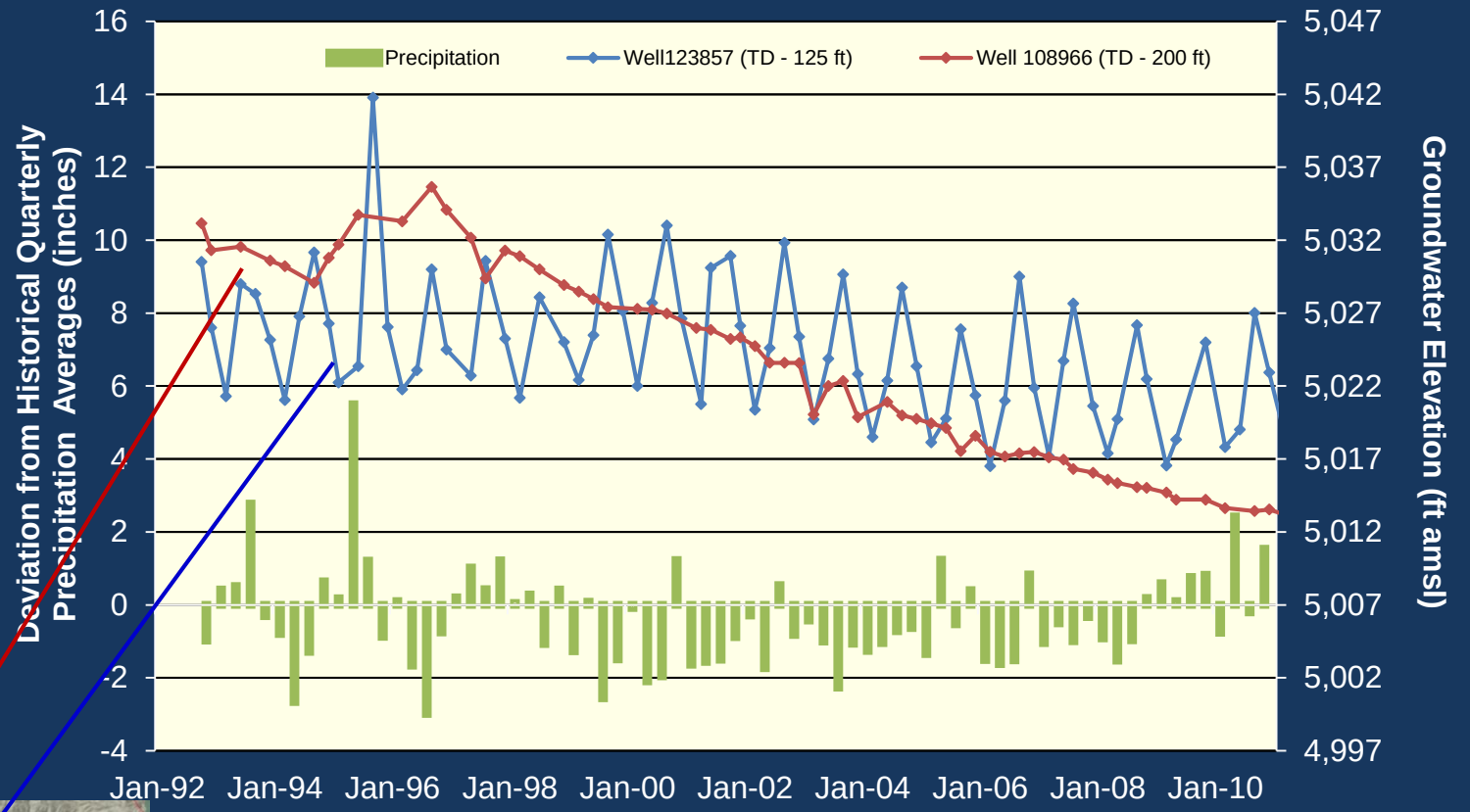
Groundwater Trends

Floodplain

Near stream hydrographs

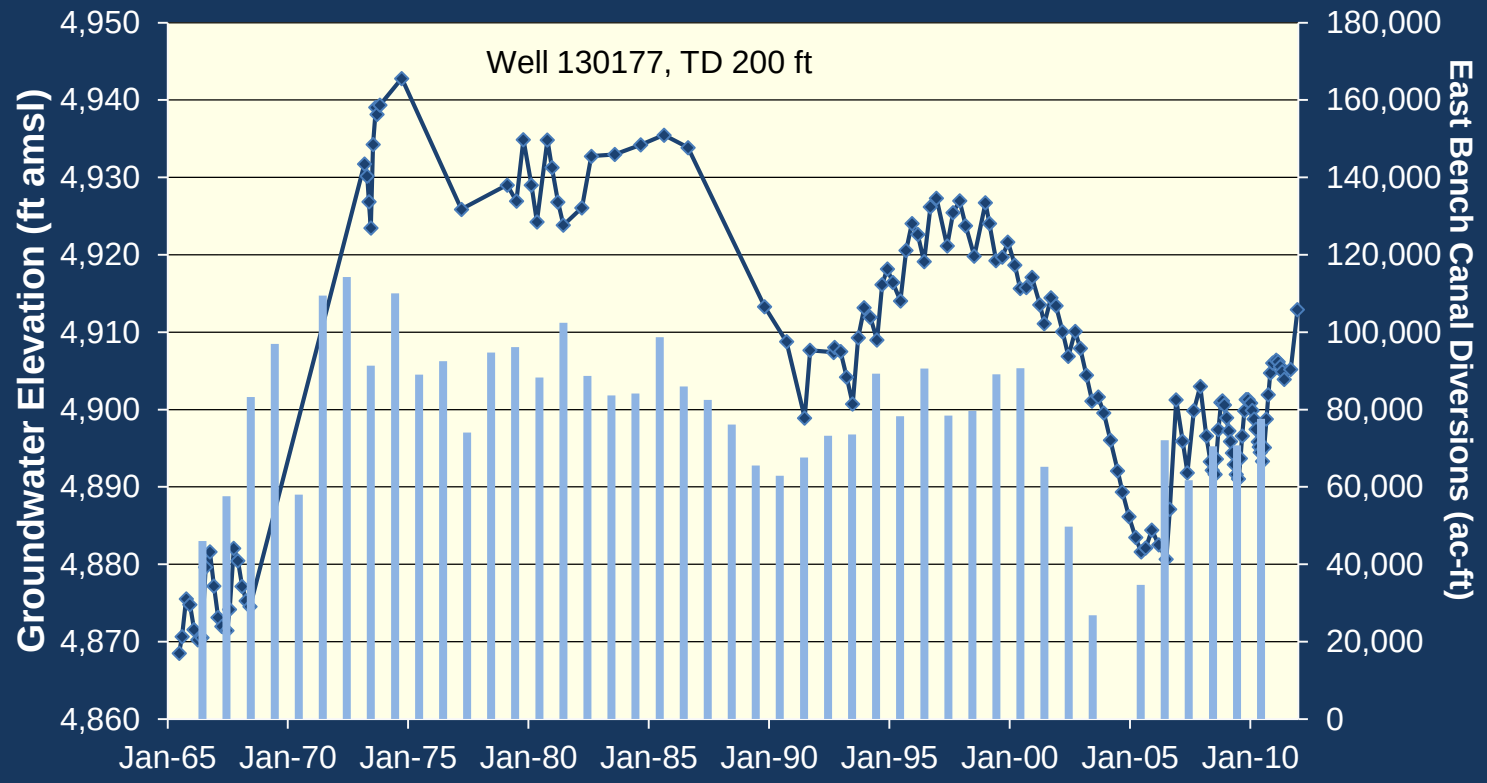


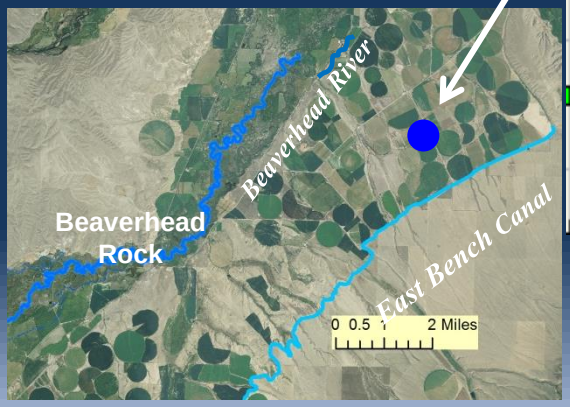


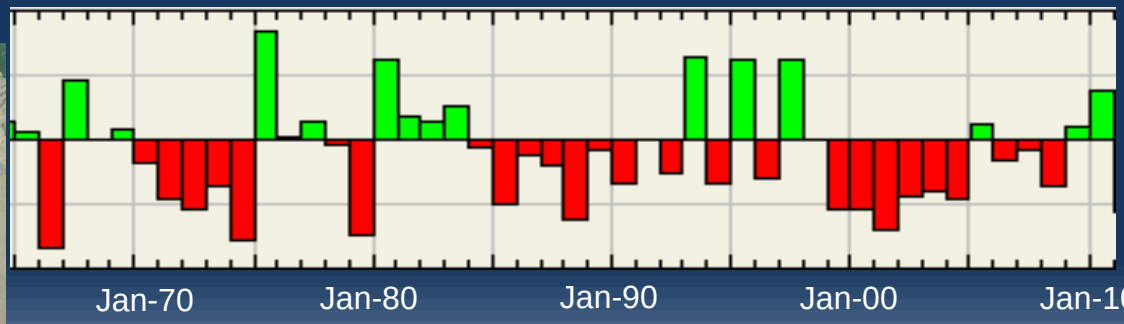


West Bench
Tertiary Sediment Aquifer

East Bench Canal and Tertiary Sediments Aquifer



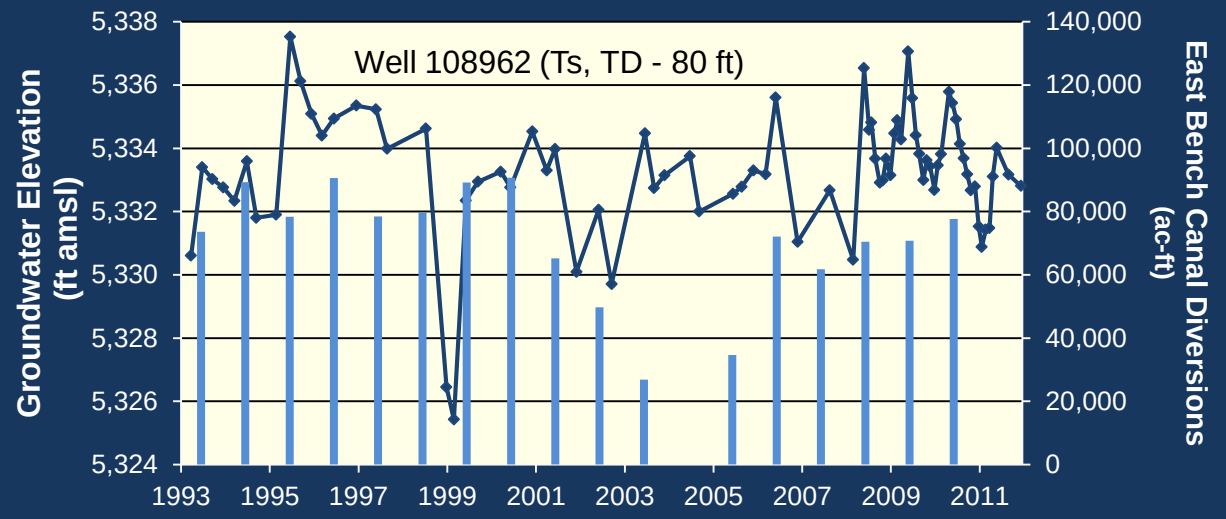




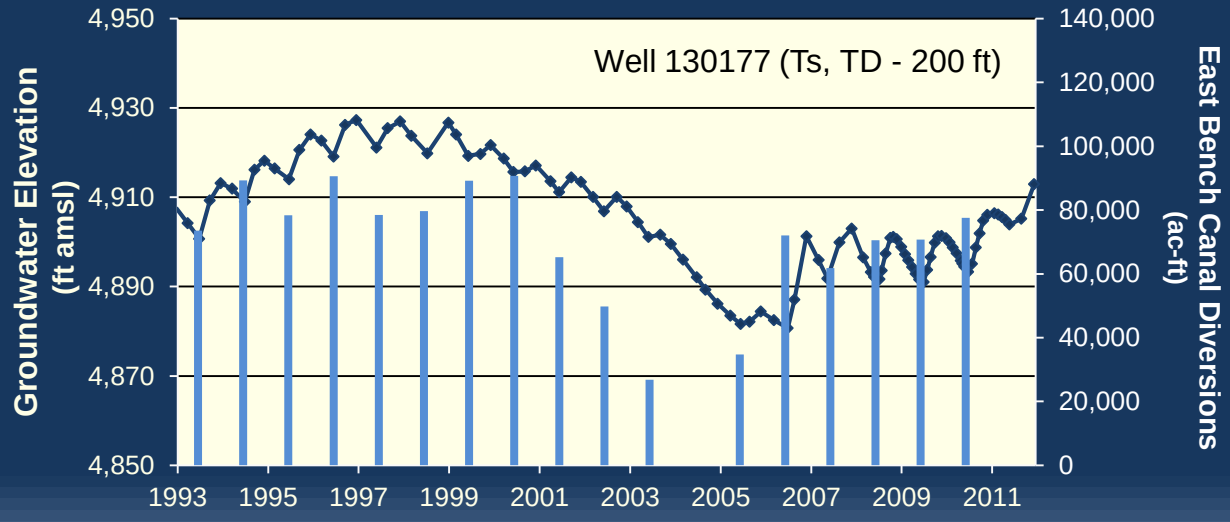
Departure from Annual Average Precipitation

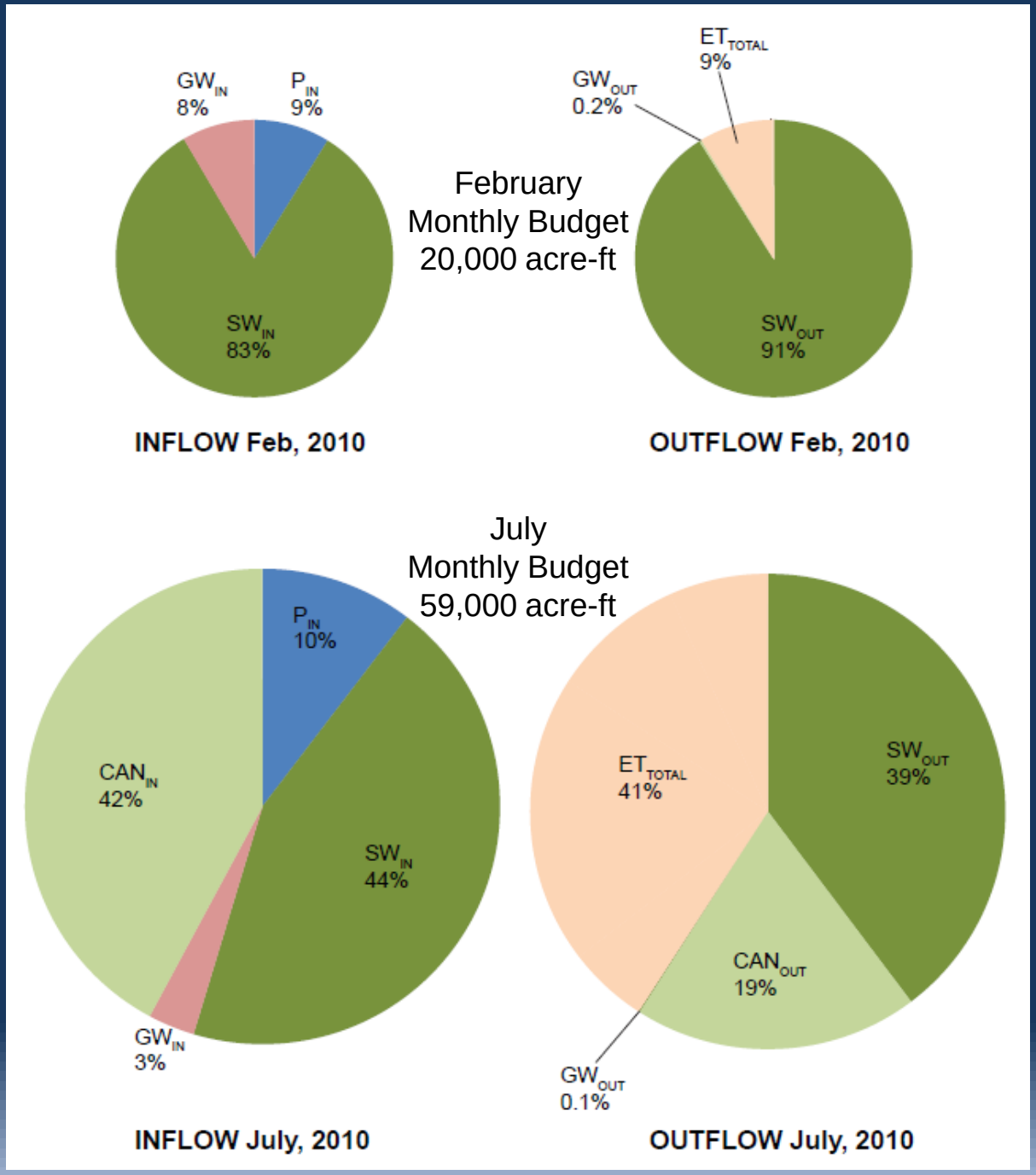
Tertiary Sediment Aquifer

Above canal



Below canal





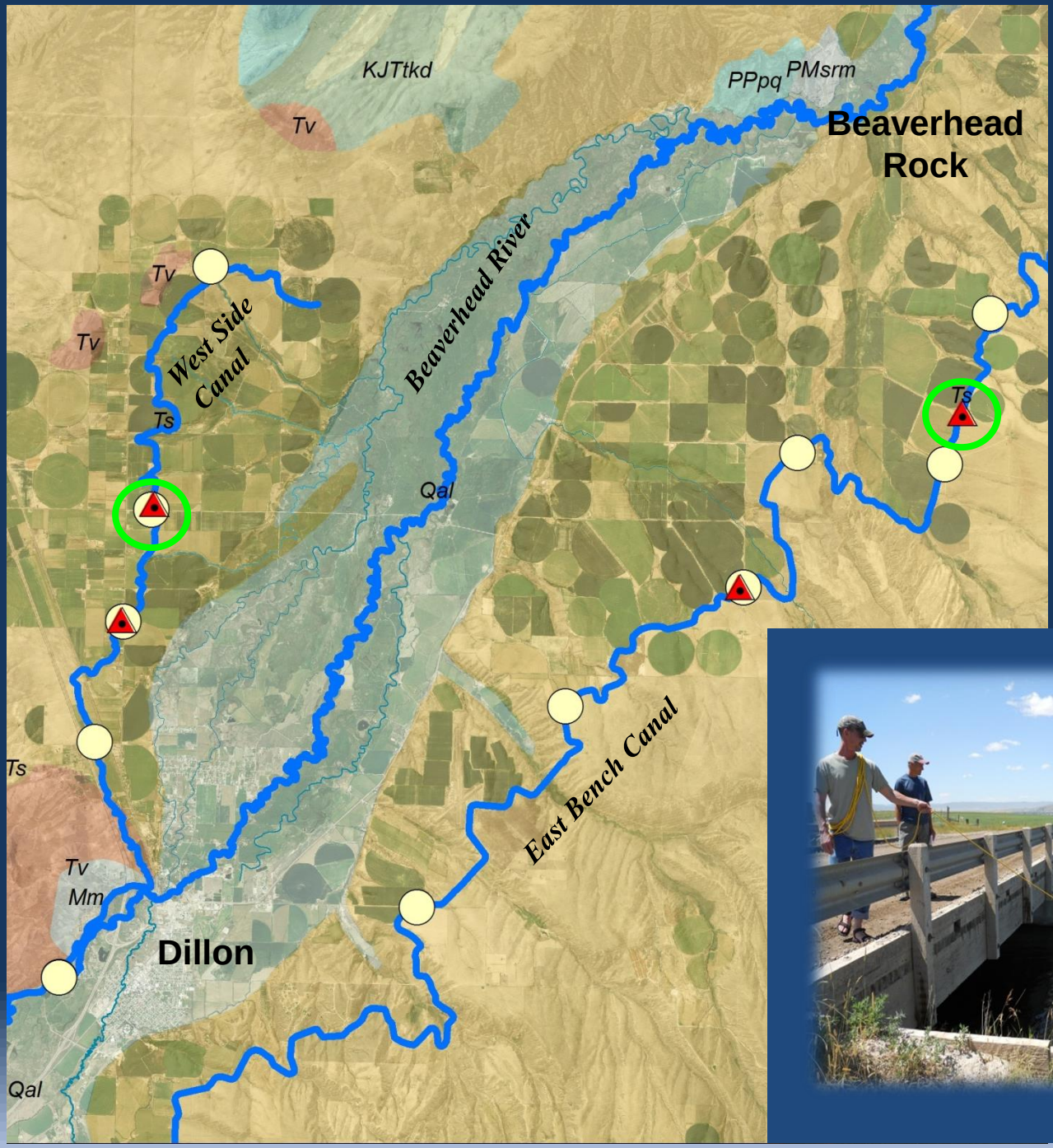
Water Budget

Annual Budget

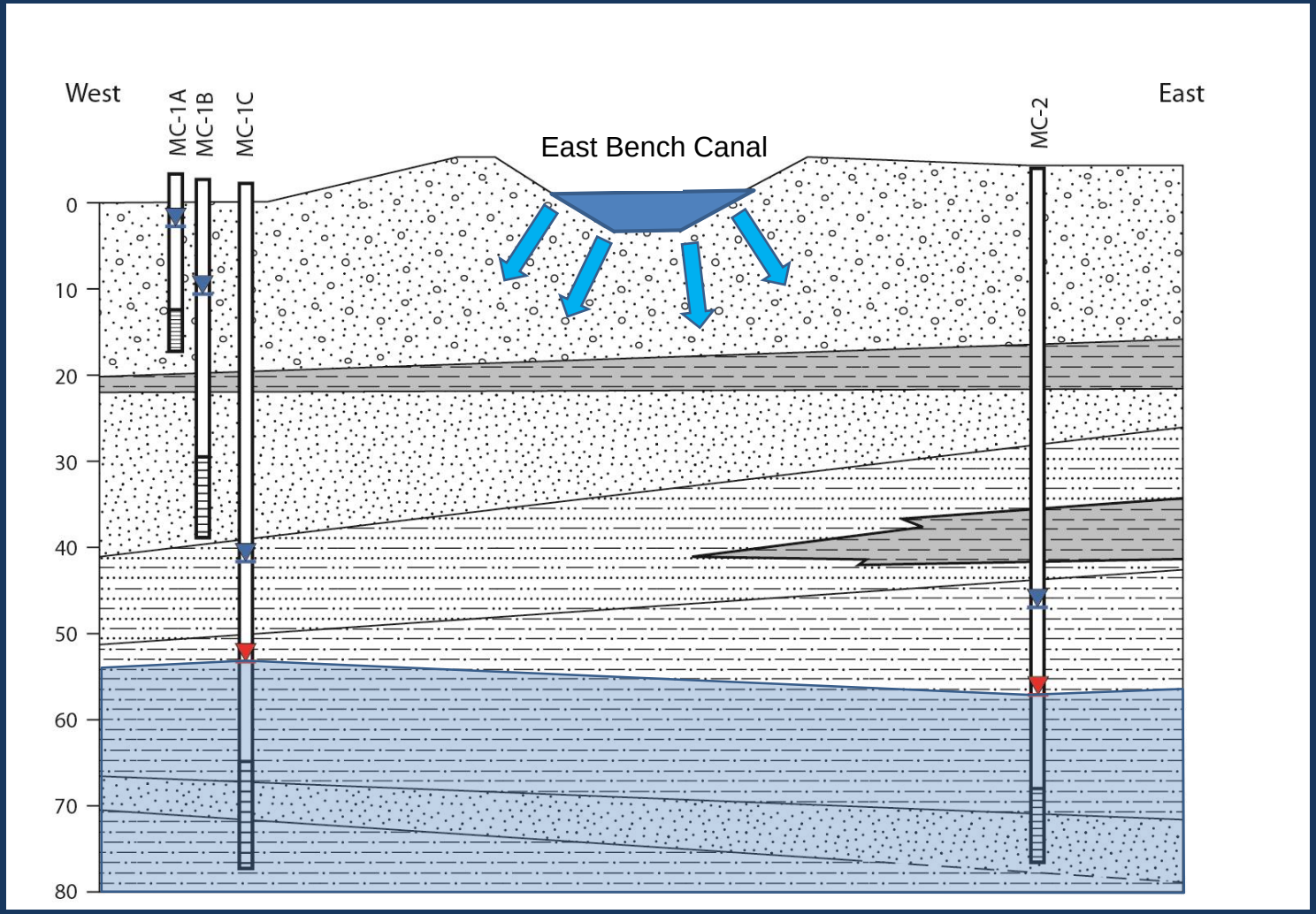
475,000 acre-ft

Canal Seepage

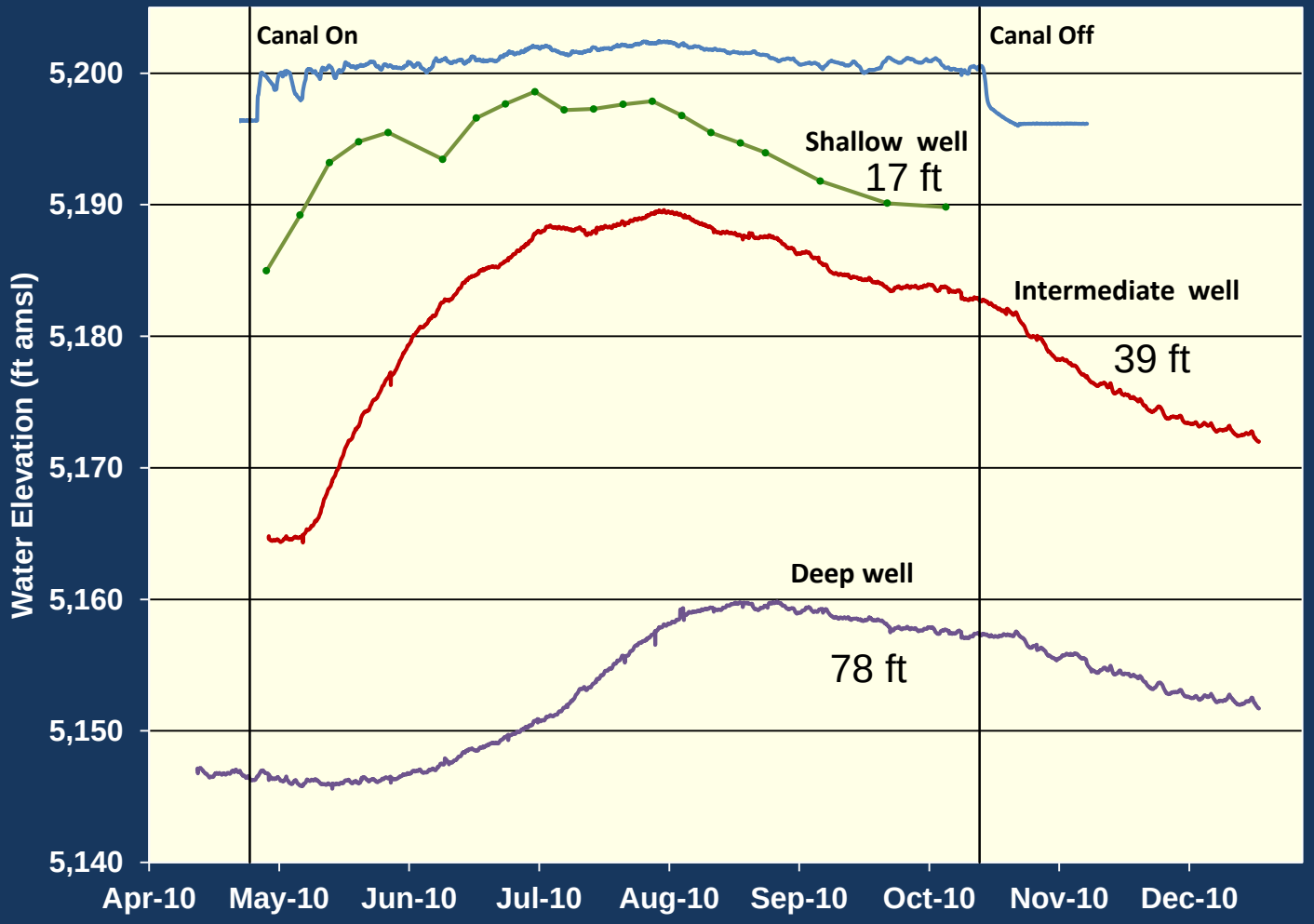
- West Side Canal
  1.2 cfs/mile
- East Bench Canal
  2.2 cfs/mile



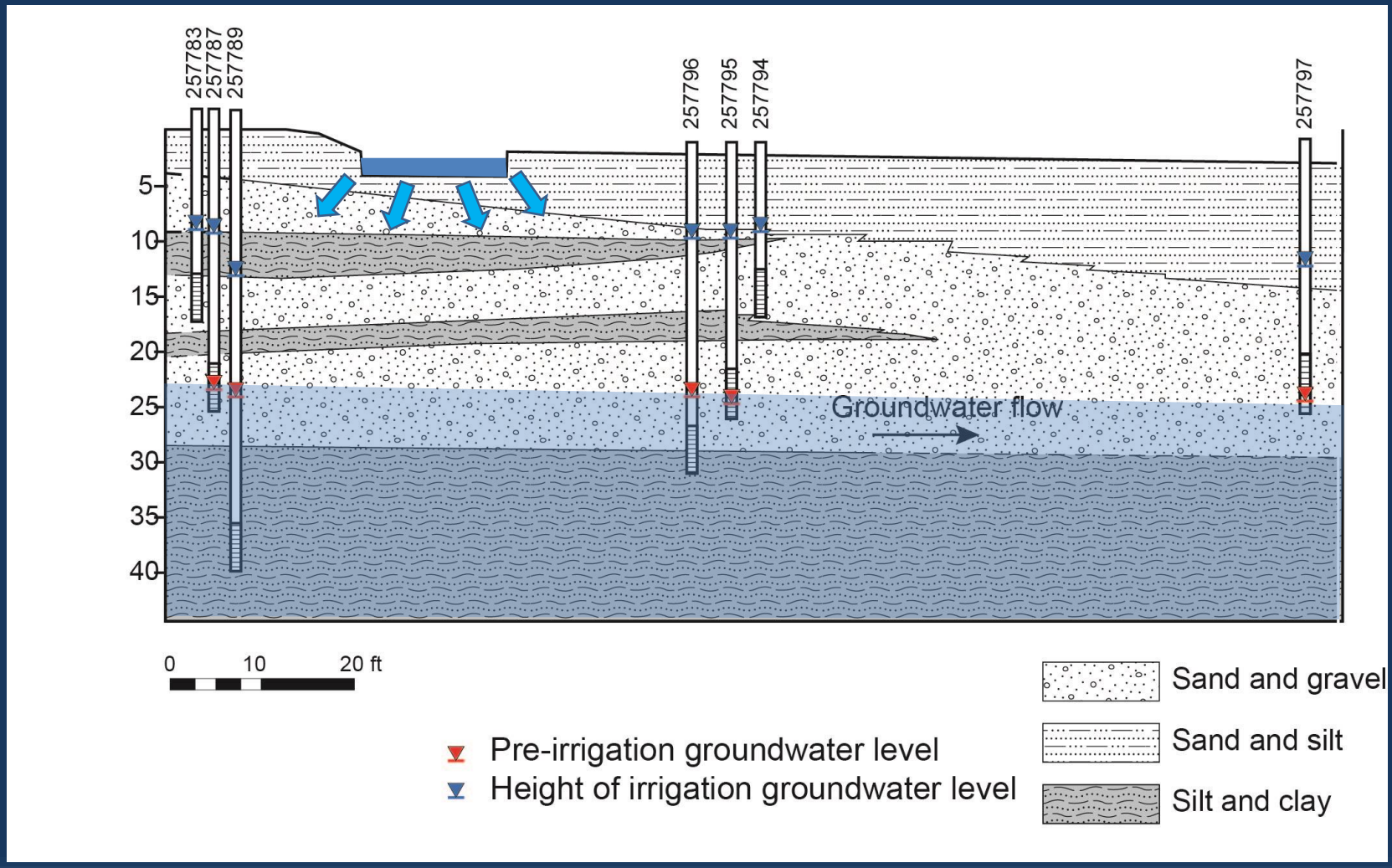
Canal Seepage



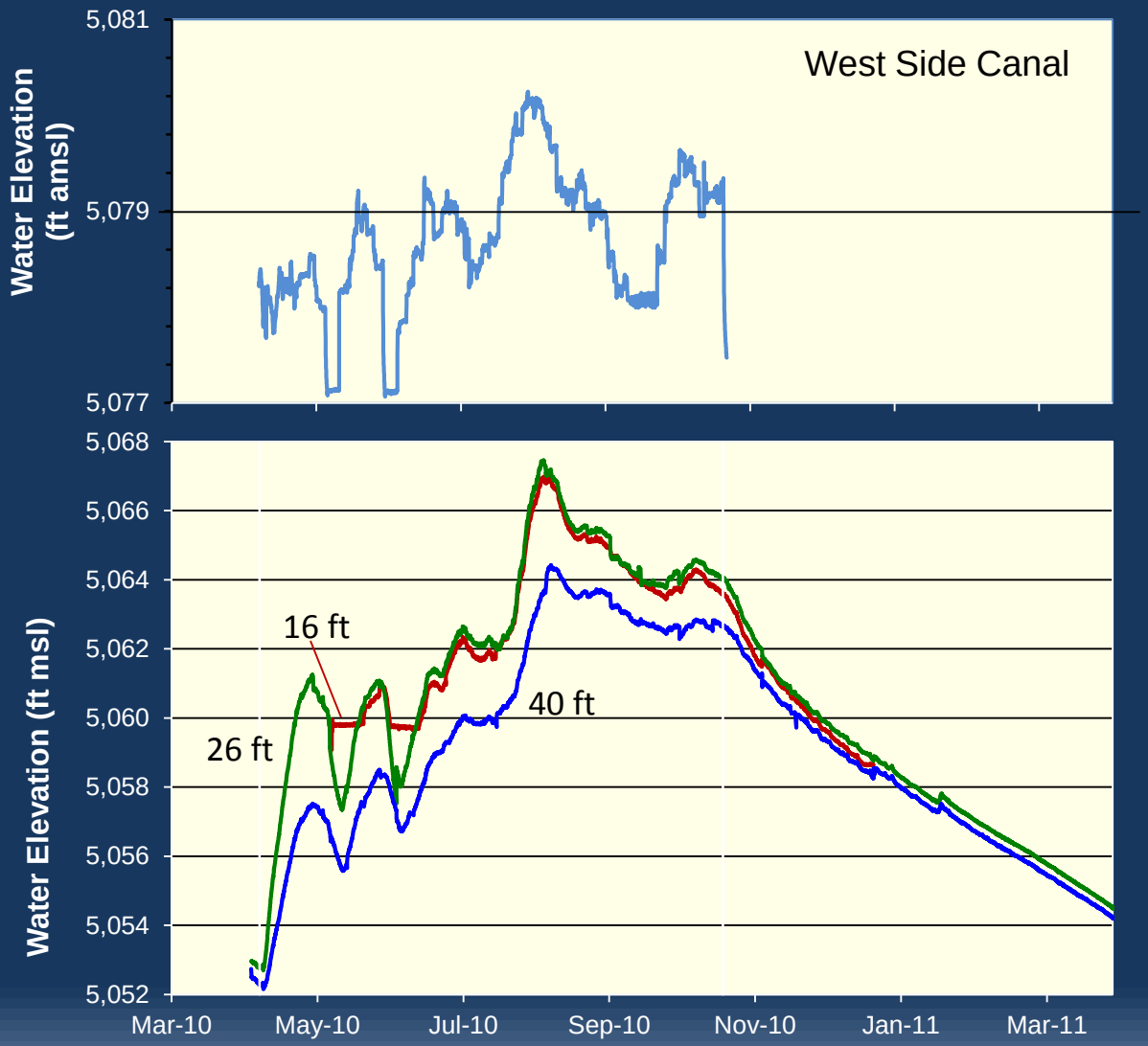
East Bench Canal



West Side Canal

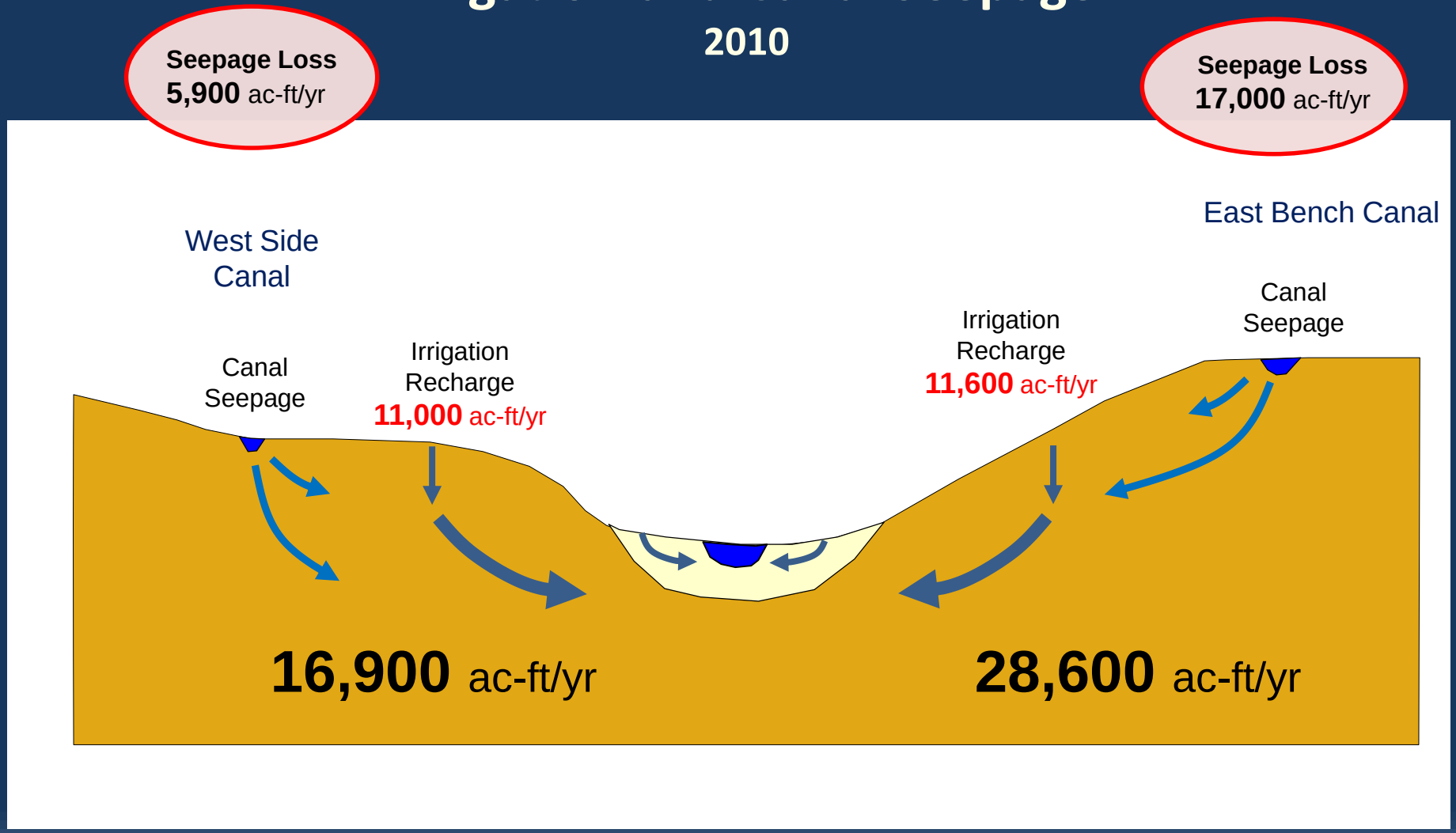


Hydrographs

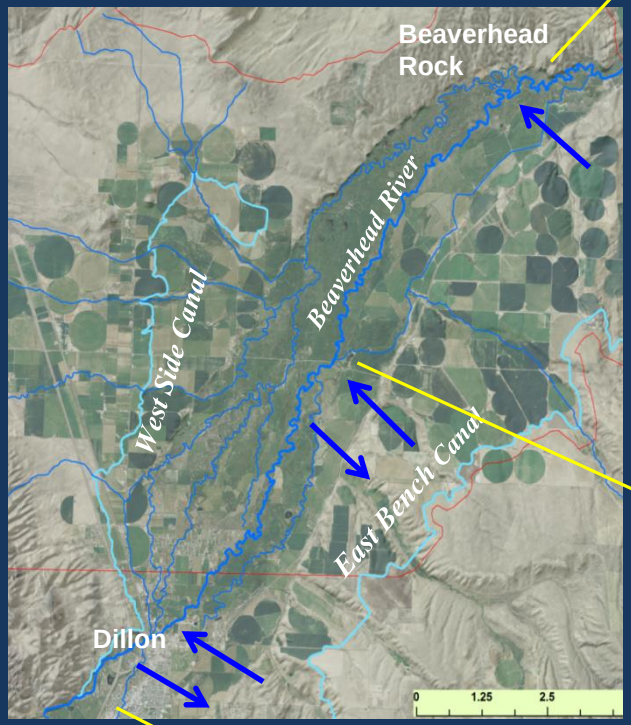


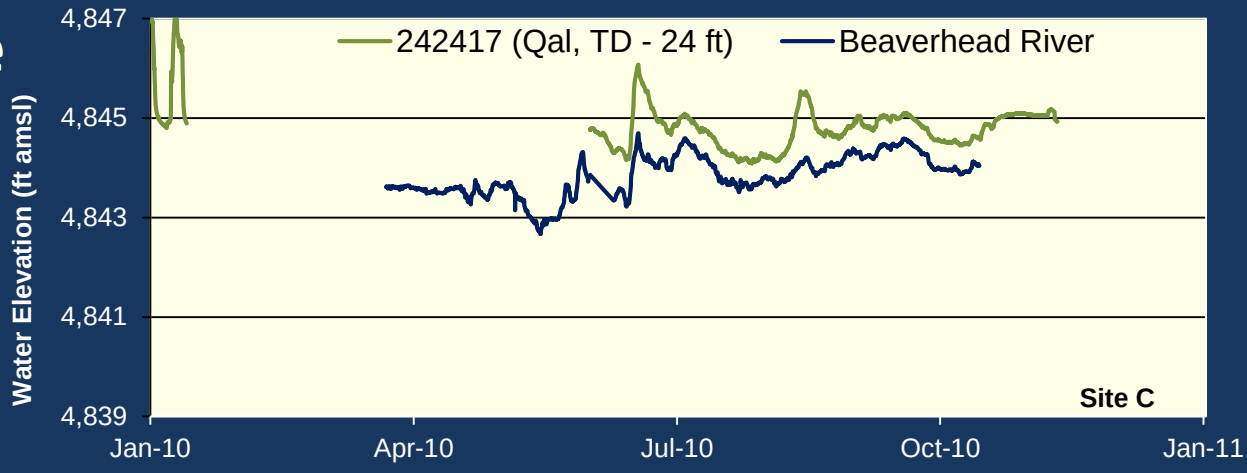
Groundwater Recharge from Irrigation and Canal Seepage

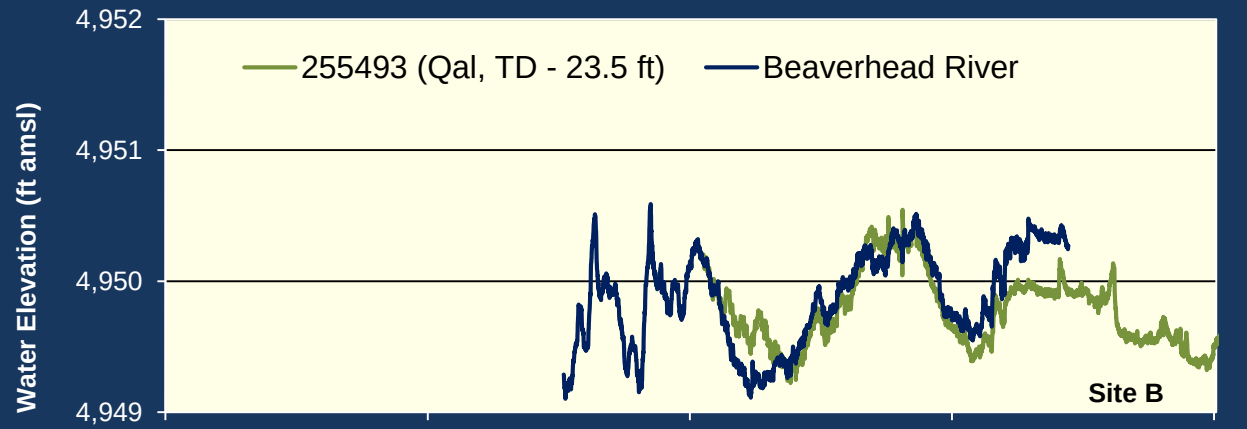
2010

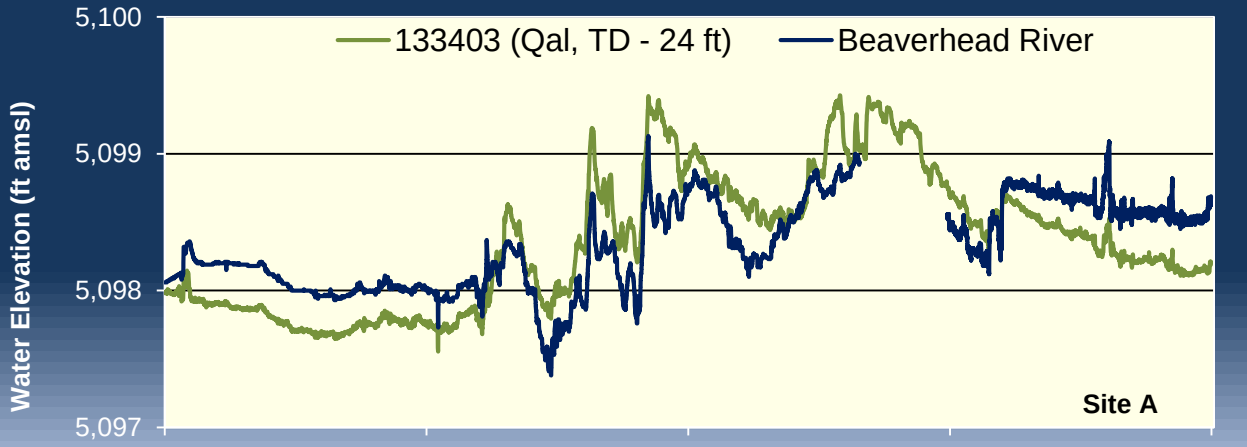


Groundwater-Surface Water Interaction

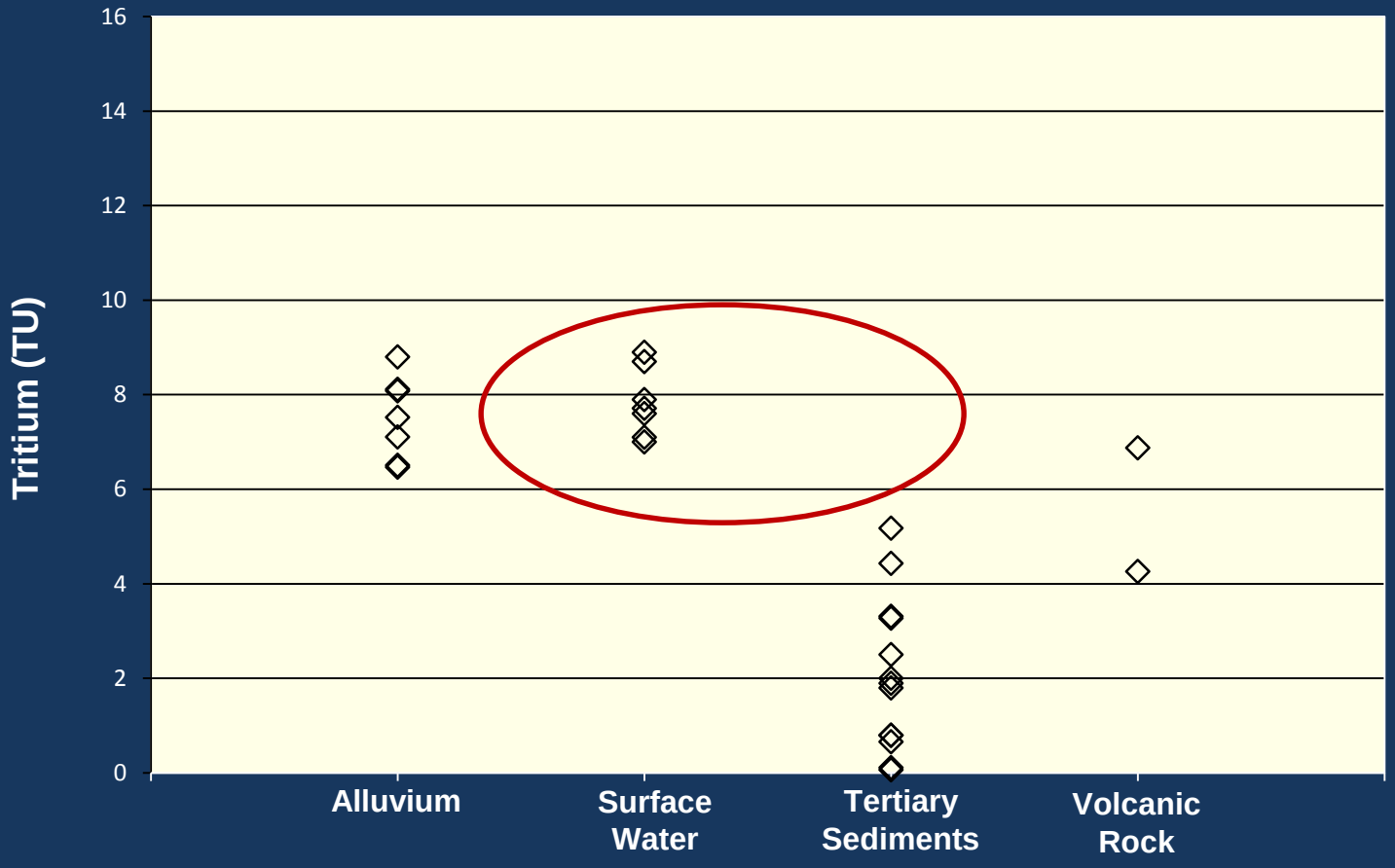








Groundwater Age Dating - relative

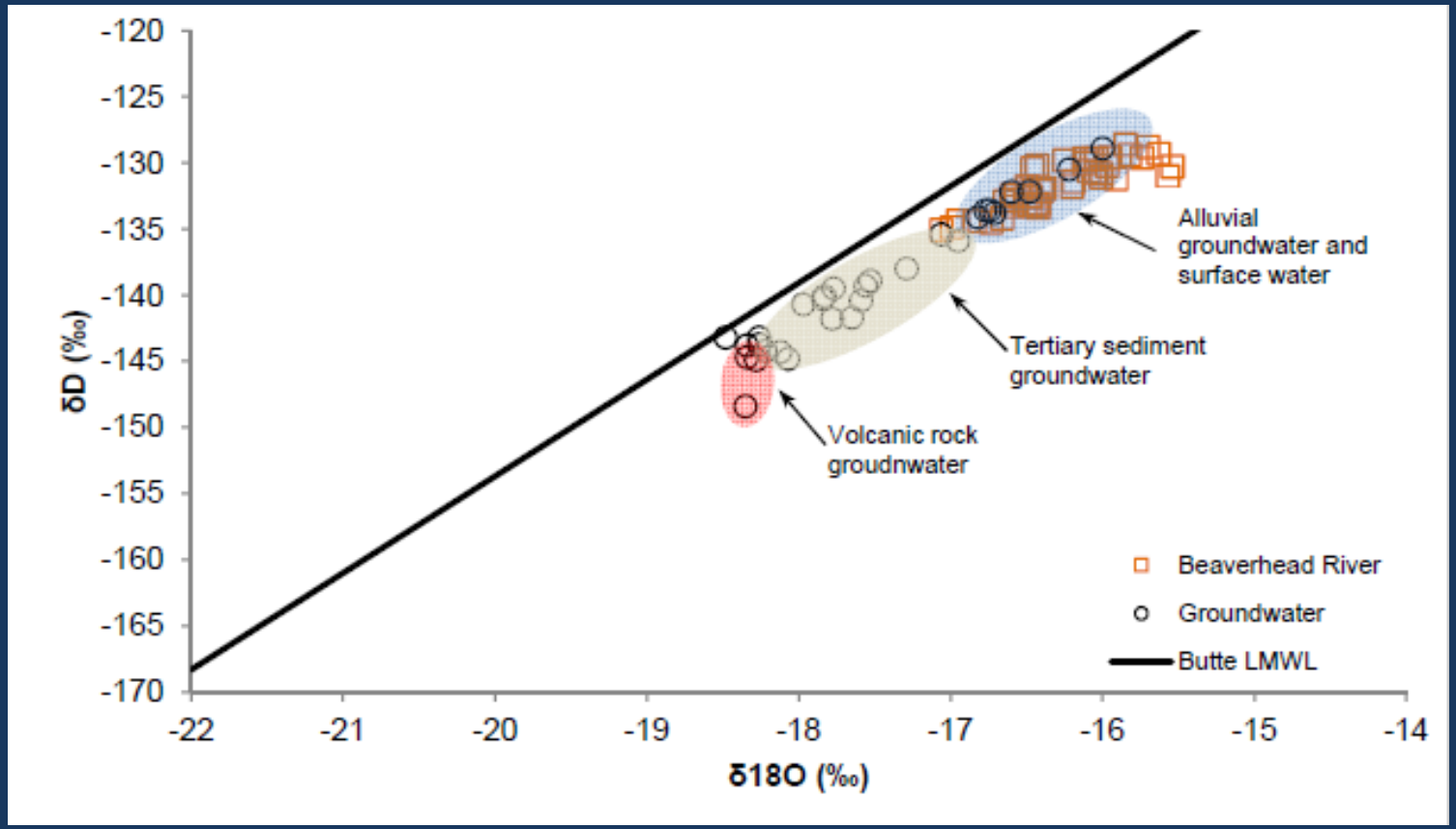


YOUNG
Recharged
After bomb
testing ended

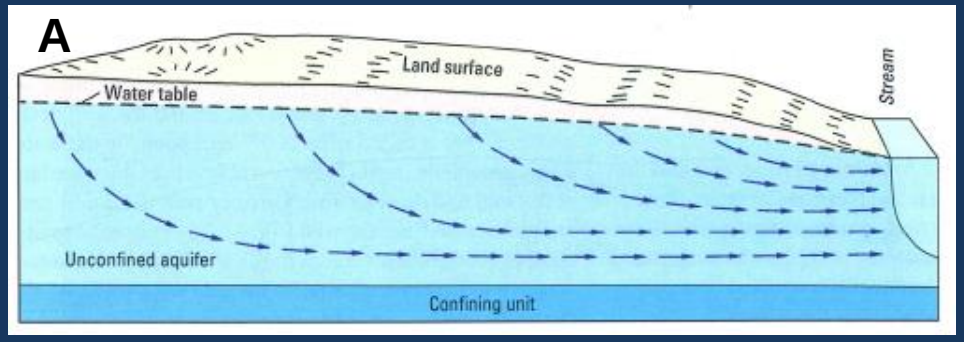
Mixed

OLDEST
Recharged
before bomb
testing started

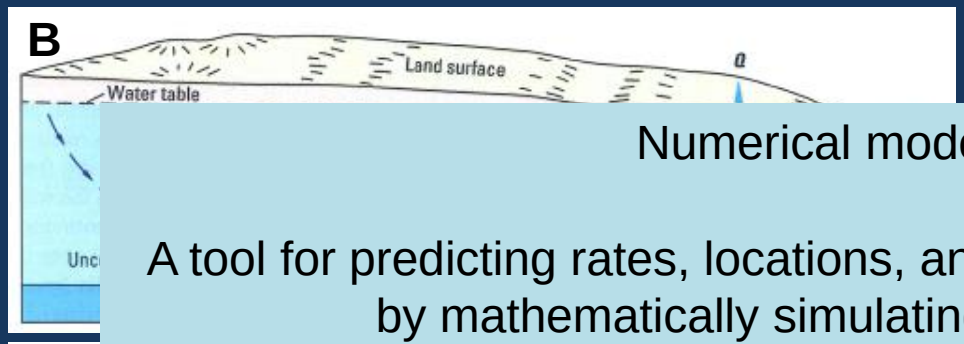
Isotopic Composition of Groundwater and Surface Water



Stream Depletion



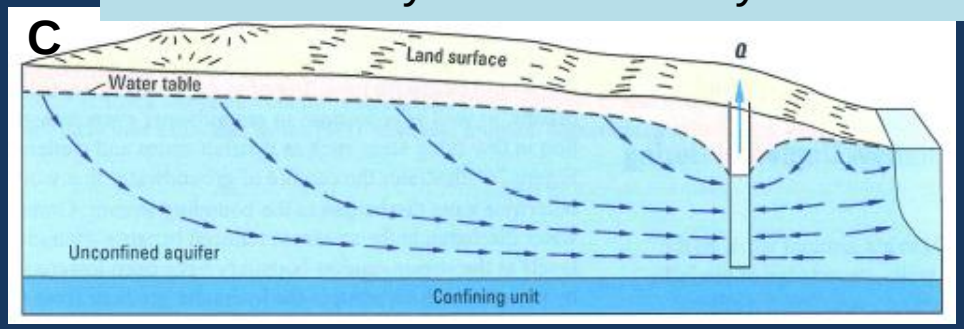
Natural conditions



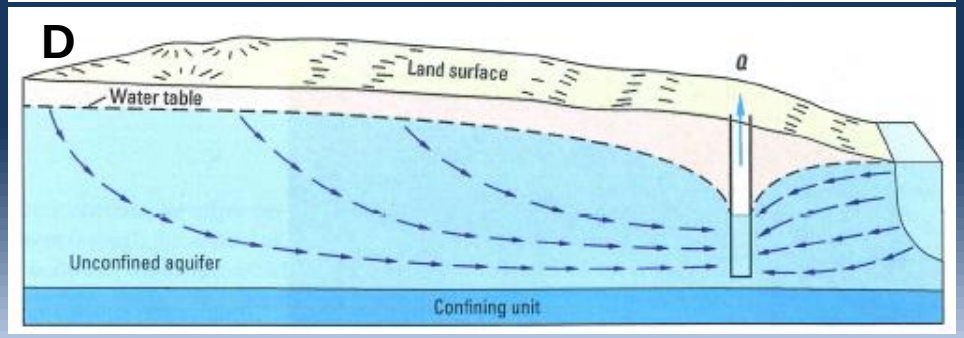
Water pumped from the

Numerical modeling:

A tool for predicting rates, locations, and timing of stream depletion by mathematically simulating the flow system



Well begins to capture groundwater that would otherwise discharge to the stream; baseflow decreases



Pumping rate may be large enough to cause water to flow from the steam to the aquifer

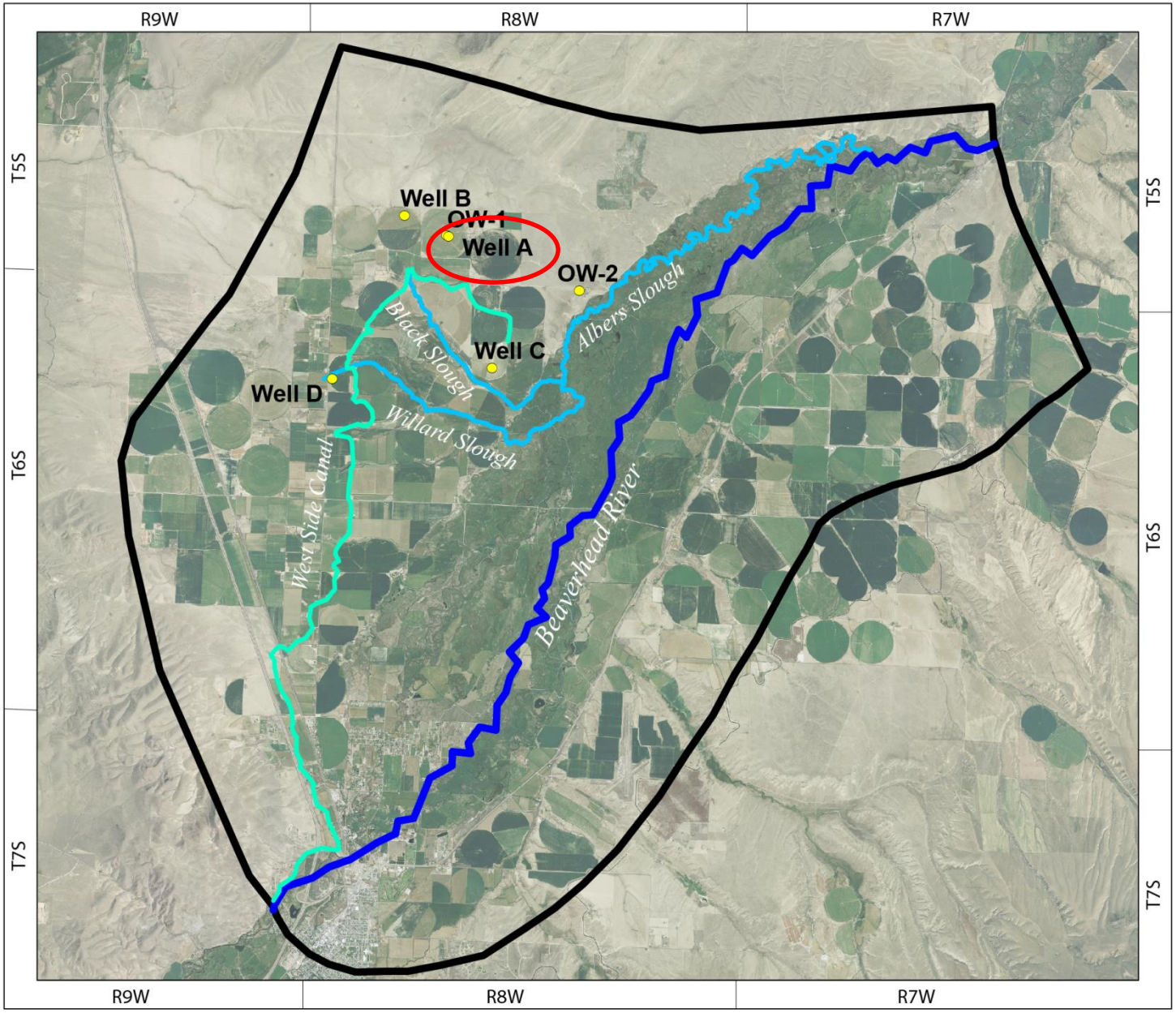
USGS, Circular 1376, 2012

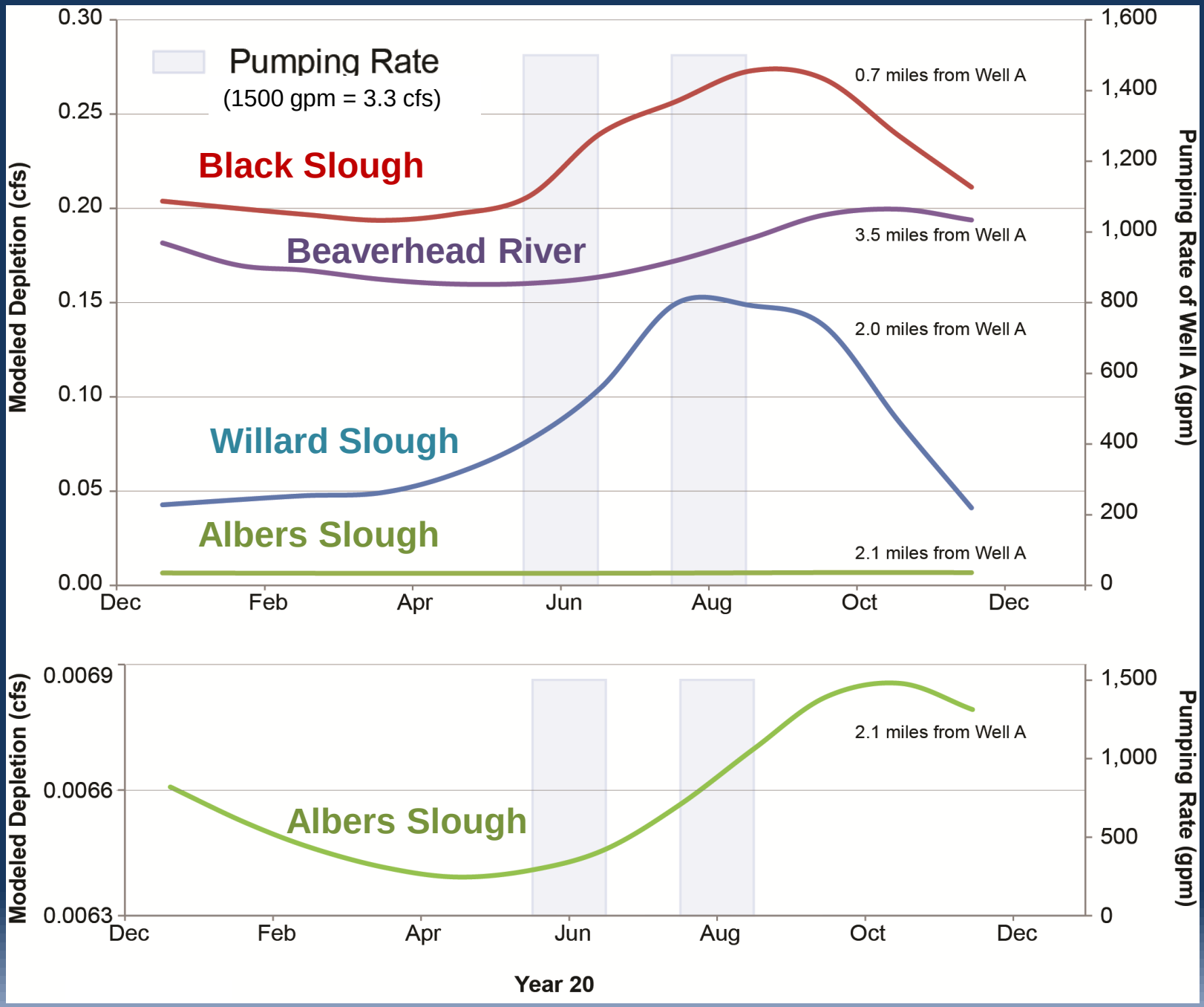
What is a groundwater flow model?

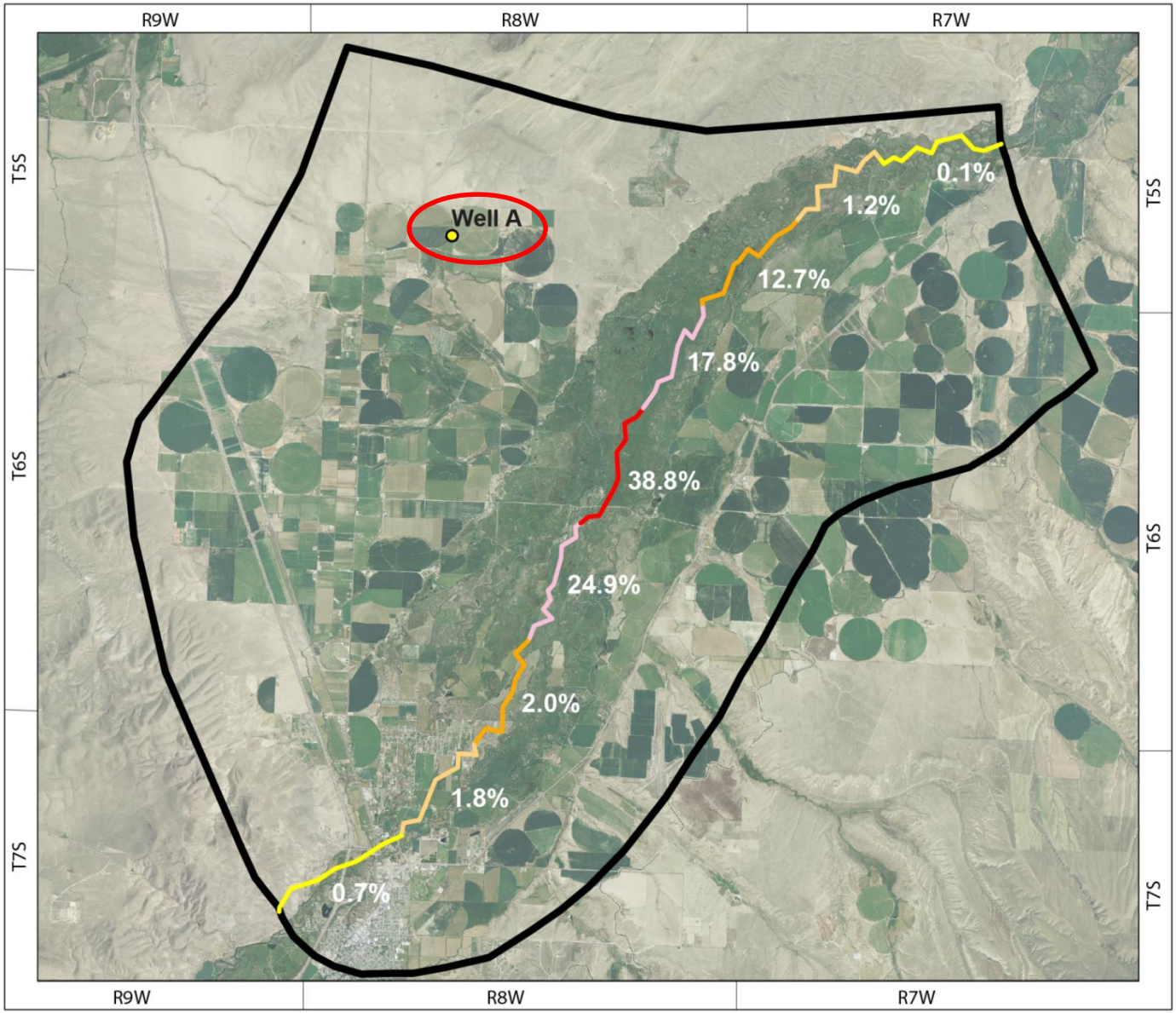
- A numerical representation of an aquifer system
- A numerical model mathematically approximates the system
- Field data calibrate and reduce uncertainty of model results

Objectives

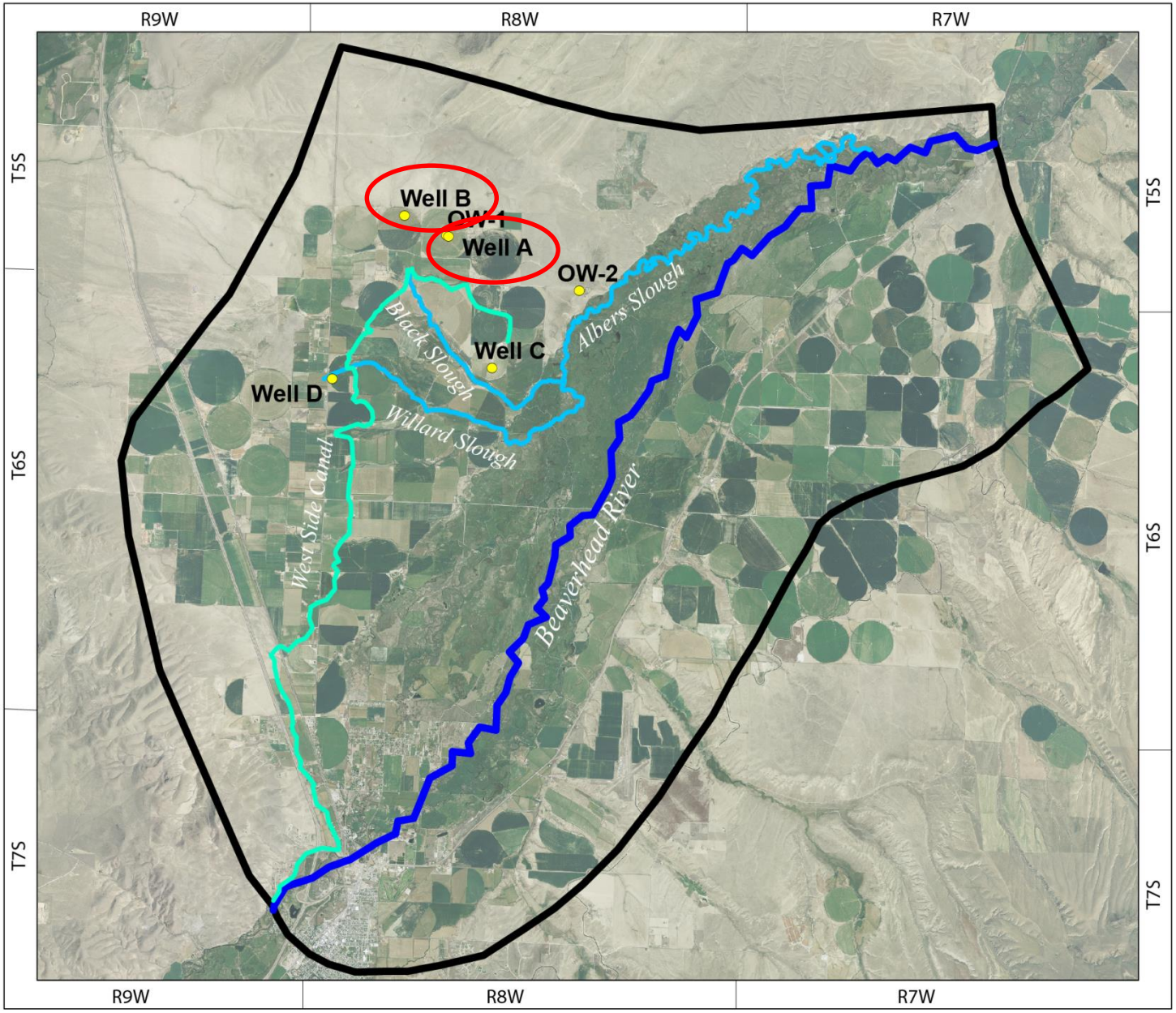
- Develop predictive tools
  - Evaluate effects of groundwater development on stream flow
    - *Difficult to measure in stream*
  - Evaluate effects of canal leakage on stream impacts
- Improve management of the aquifer system


R9W
R8W
R7W
T5S
T6S
T7S
Well B
OW-1
Well A
OW-2
Well C
Well D
Black Slough
Willard Slough
Albers Slough
West Side Canal
Beaverhead River
Explanation
Well locations
Model Border
0
1
2
Miles
N


Pumping Rate
(1500 gpm = 3.3 cfs)
Black Slough
0.7 miles from Well A
Beaverhead River
3.5 miles from Well A
Willard Slough
2.0 miles from Well A
Albers Slough
2.1 miles from Well A
Modeled Depletion (cfs)
Pumping Rate of Well A (gpm)
0.30
0.25
0.20
0.15
0.10
0.05
0.00
1,600
1,400
1,200
1,000
800
600
400
200
0
Dec
Feb
Apr
Jun
Aug
Oct
Dec
Albers Slough
2.1 miles from Well A
Modeled Depletion (cfs)
Pumping Rate (gpm)
0.0069
0.0066
0.0063
1,500
1,000
500
0
Dec
Feb
Apr
Jun
Aug
Oct
Dec
Year 20



Distribution of the decrease in groundwater discharge to river



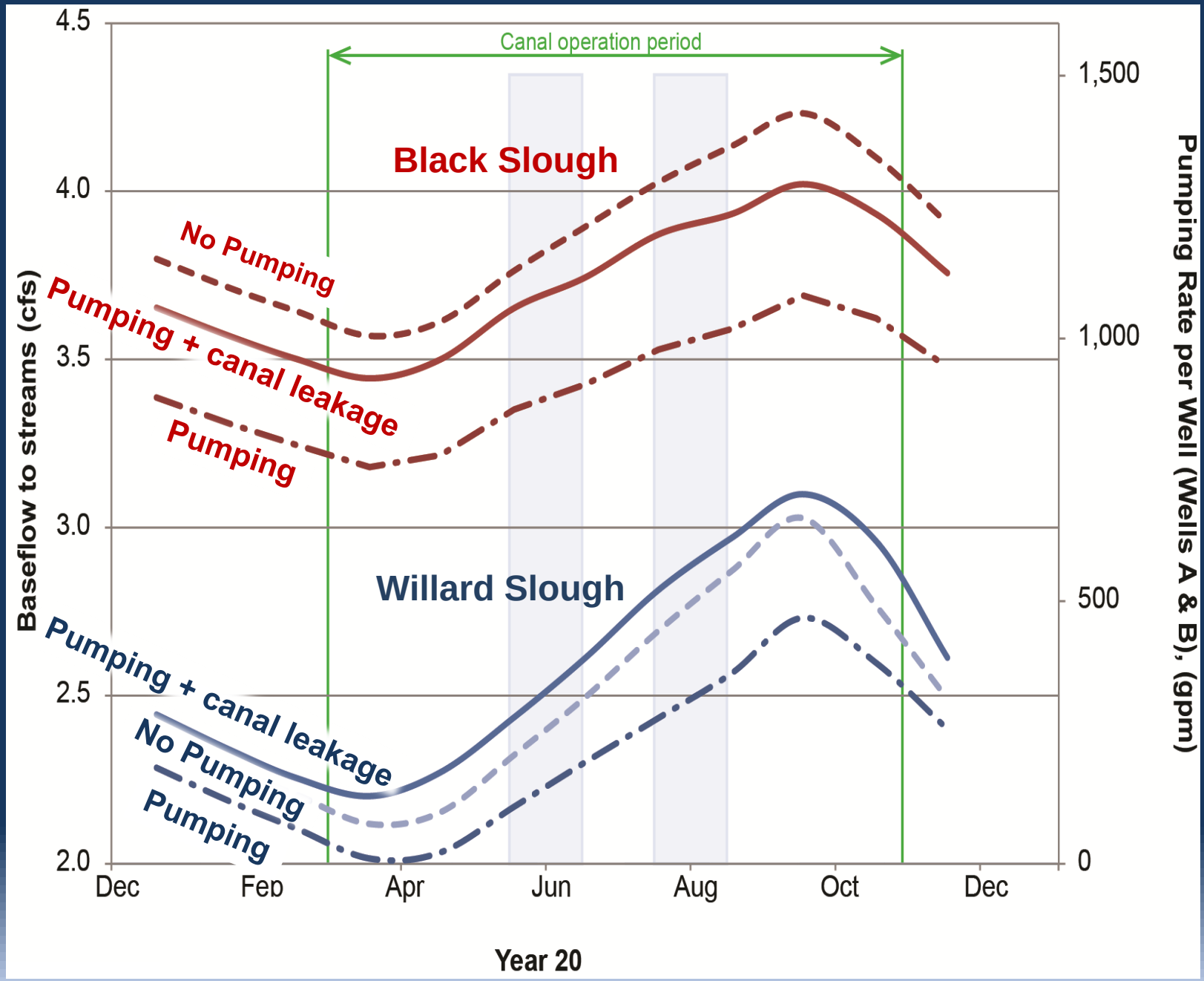
Explanation

- Well locations
- Model Border

0 1 2 Miles

N

Offsetting stream depletion with additional canal seepage



Limitations

- Scale (temporal and spatial)
- Parameter uncertainty
- Short-term data record

Project Summary

- The volcanic rock aquifer is a good producer.
- Groundwater levels fluctuate seasonally. Long-term groundwater trends primarily responded to climate, irrigation recharge, and canal seepage losses.
- Precipitation is the major inflow and ET is the major outflow.
- Irrigation water and canal seepage are a significant source of groundwater recharge.
- Groundwater and surface water interact along the Beaverhead River.
- Numerical modeling illustrated stream depletion and that it could be offset with additional groundwater recharge.

Applications of Results

- Numerical modeling, part of an aquifer management plan
  - Use as a tool for predicting pumping and canal recharge scenarios
  - Apply other tools in certain circumstances
  - Incorporate long-term and/or site-specific data
- Consider canal leakage as recharge in water management planning
- Consider the timing of steam depletion responses from pumping when designing a mitigation plan

Recommendations

- Better characterize the extent of the volcanic rock aquifer
- Collect long-term groundwater and surface water monitoring data