Investigating Hydrologic Connections Between Aquifers and Surface Waters in the East Flathead Valley

Montana AWRA 2023

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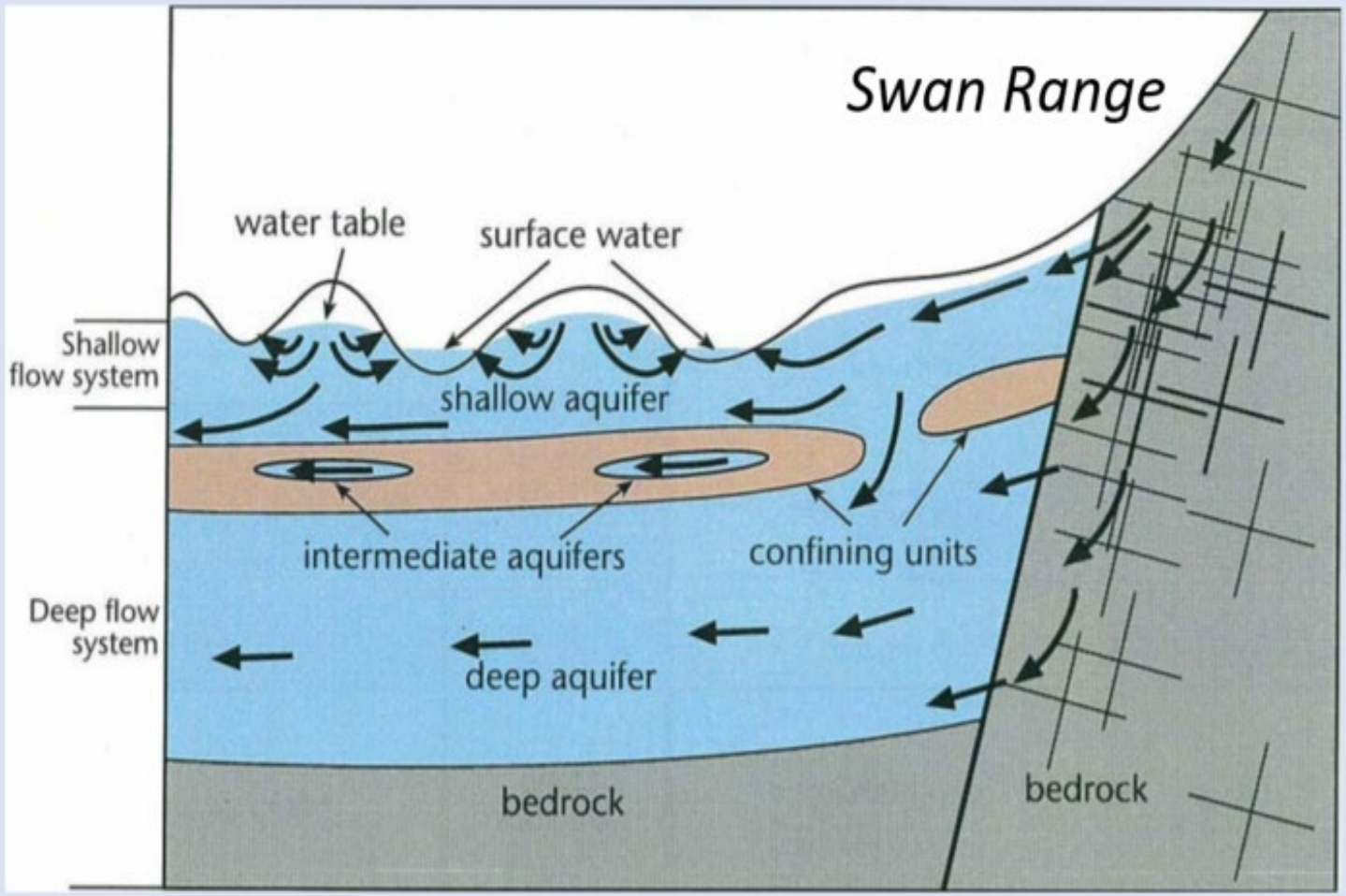
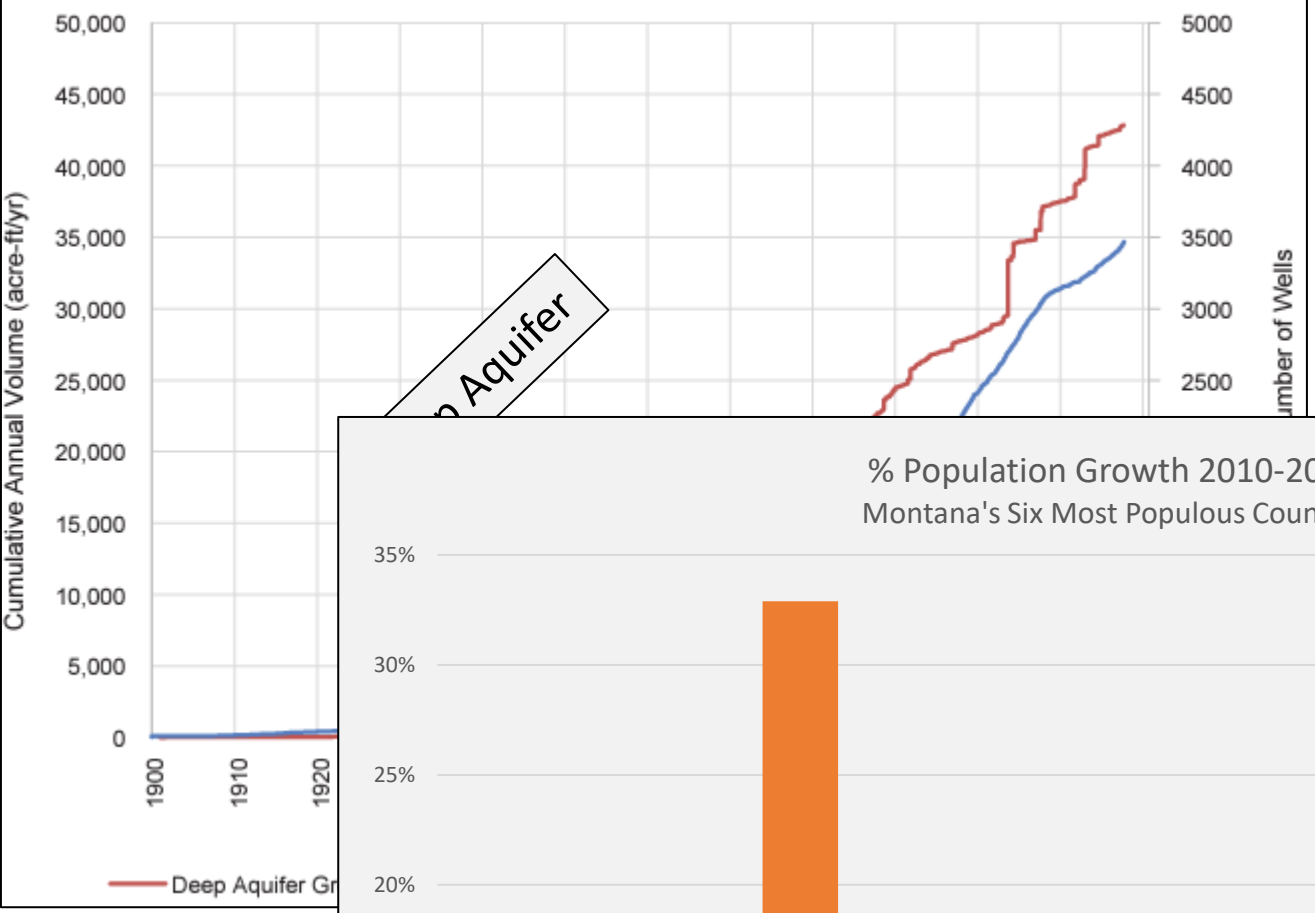
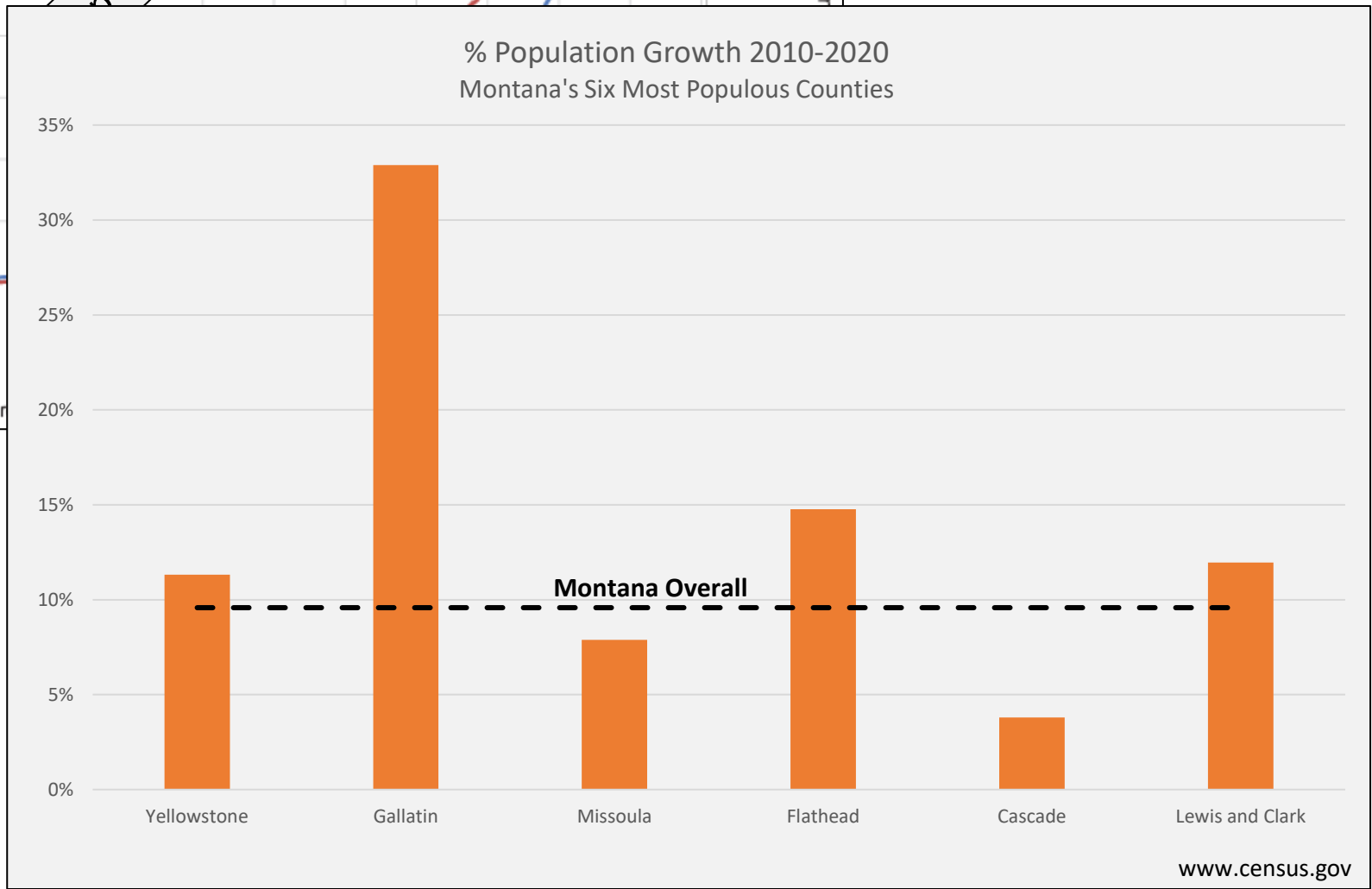
Ground Water Investigation Program (GWIP)

General Stratigraphy



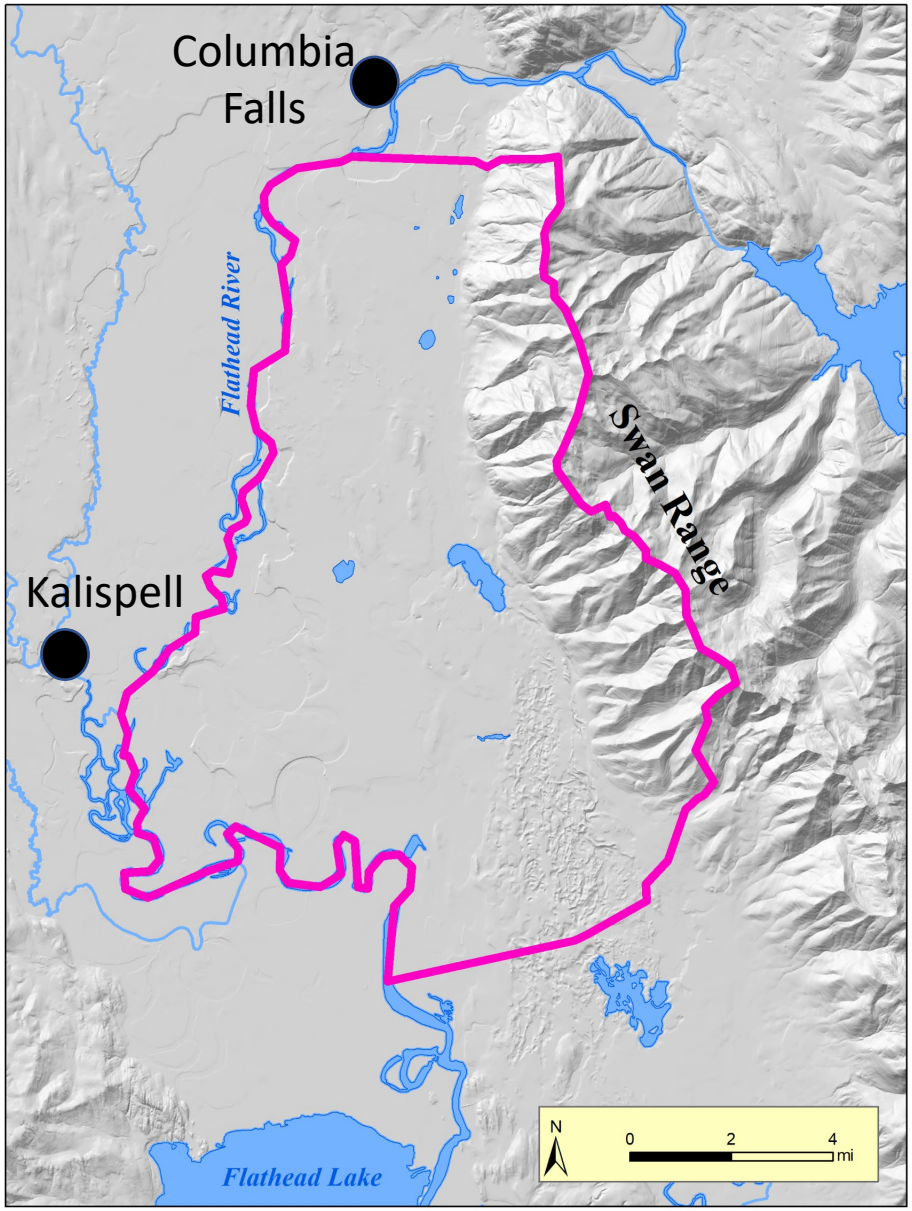
Conceptual diagram of flow systems in the Flathead Valley (reproduced from LaFave et al., 2004)


50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
Cumulative Annual Volume (acre-ft/yr)
5000
4500
4000
3500
3000
2500
umber of Wells
Aquifer
1900
1910
1920
Deep Aquifer Gr


% Population Growth 2010-2020
Montana's Six Most Populous Counties
35%
30%
25%
20%
15%
10%
5%
0%
Montana Overall
Yellowstone
Gallatin
Missoula
Flathead
Cascade
Lewis and Clark
www.census.gov

East Flathead Project

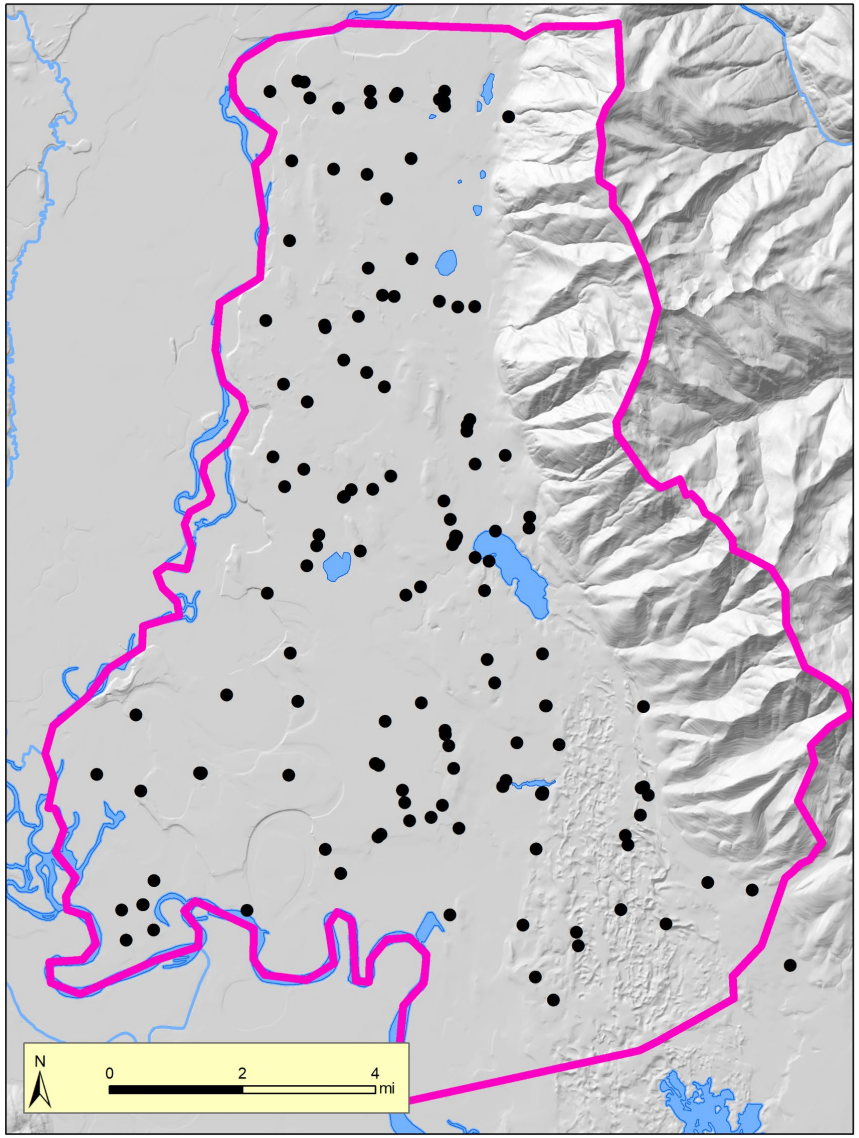
- Purpose
  - Provide detailed understanding of the interconnection between surface- and groundwater



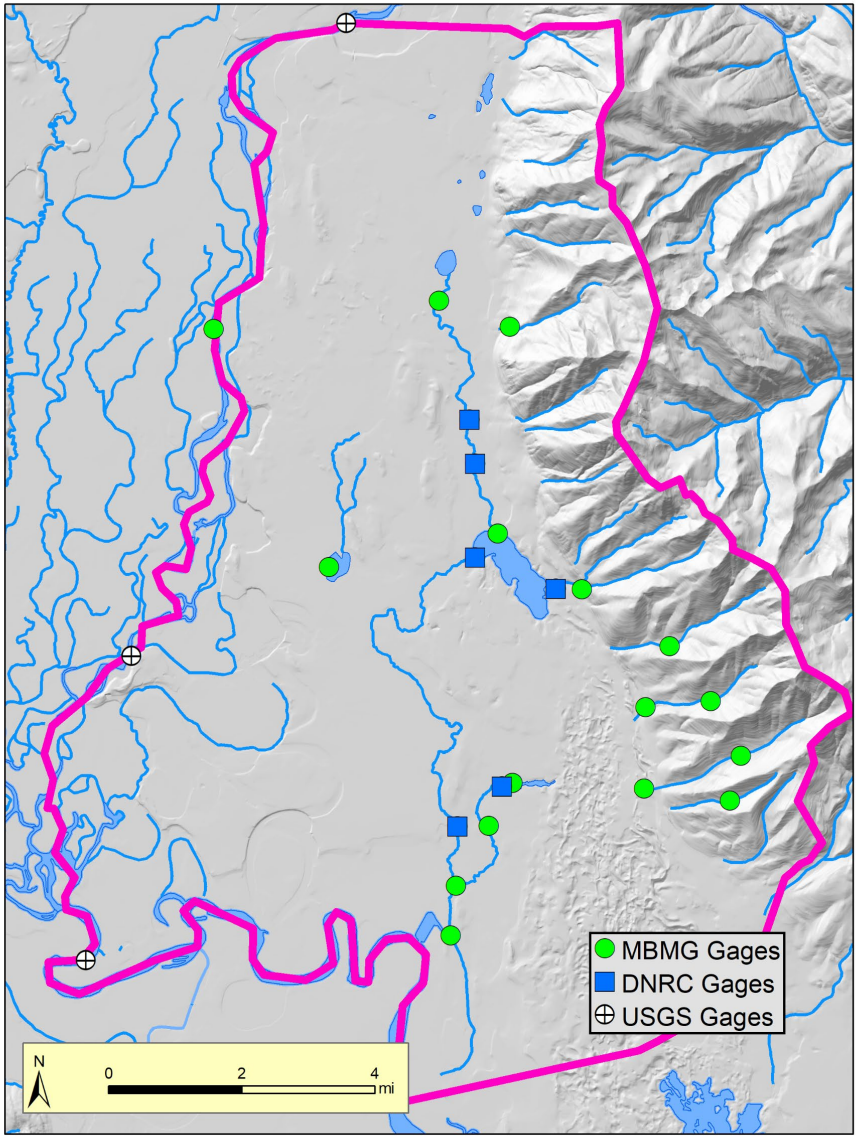
Monitoring (2019-2021)

MBMG Montana Bureau of Mines and Geology

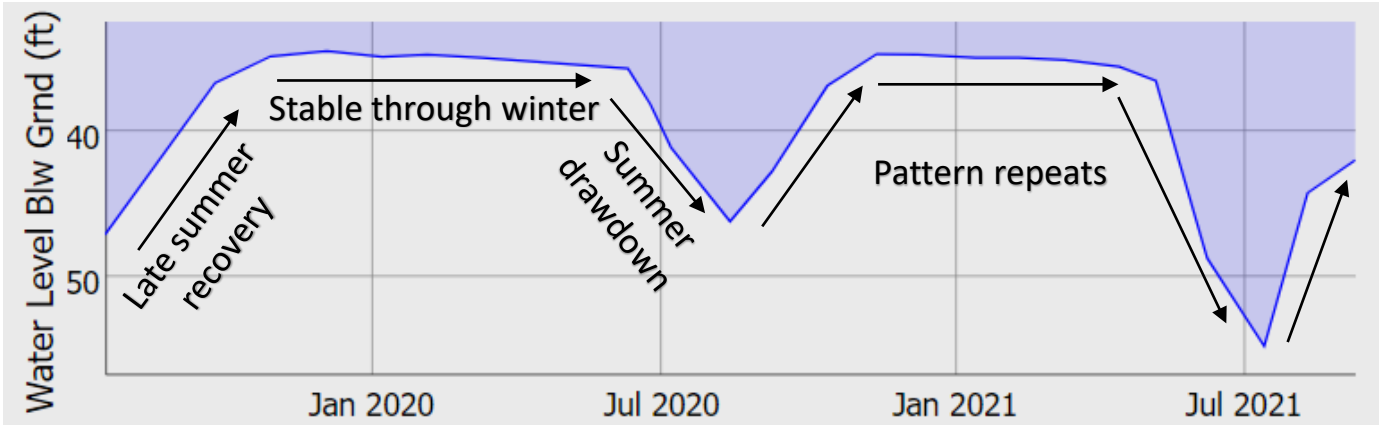
Groundwater Network (144 wells)



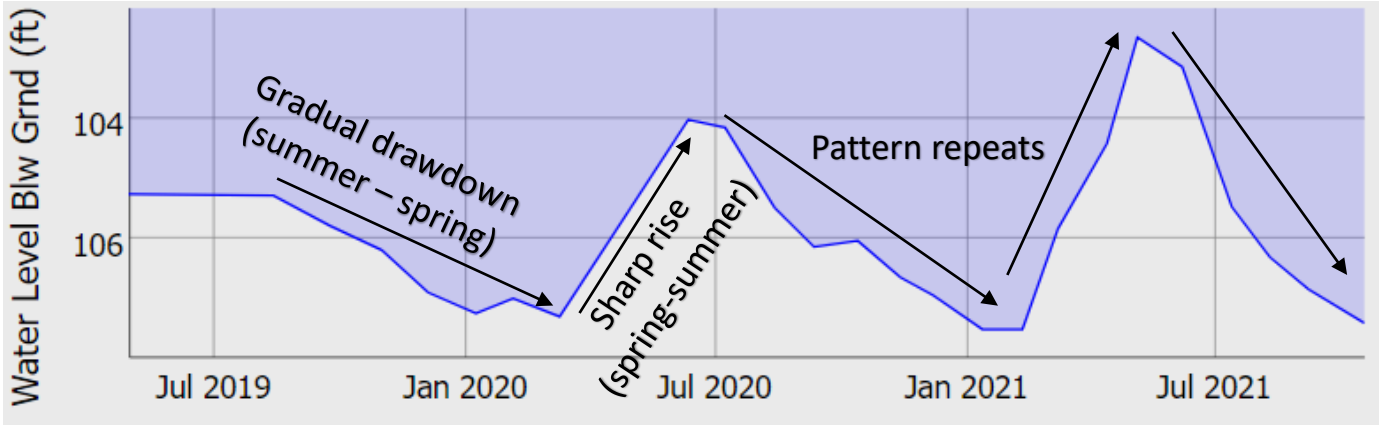
Surface-Water Network (27 sites)



“Plateau”-shape hydrographs – Summer Pumping



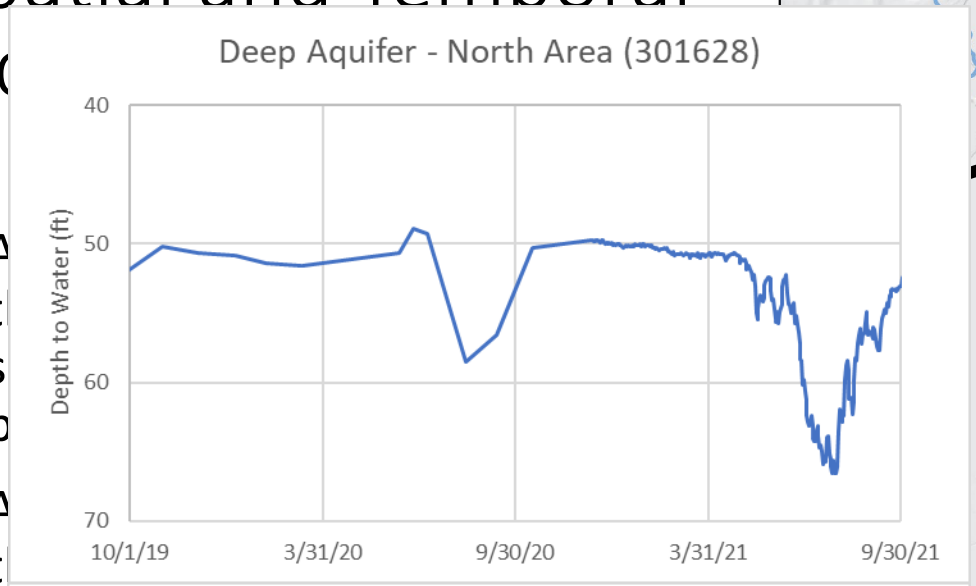
“Asymmetric”-shape hydrographs – Spring Recharge

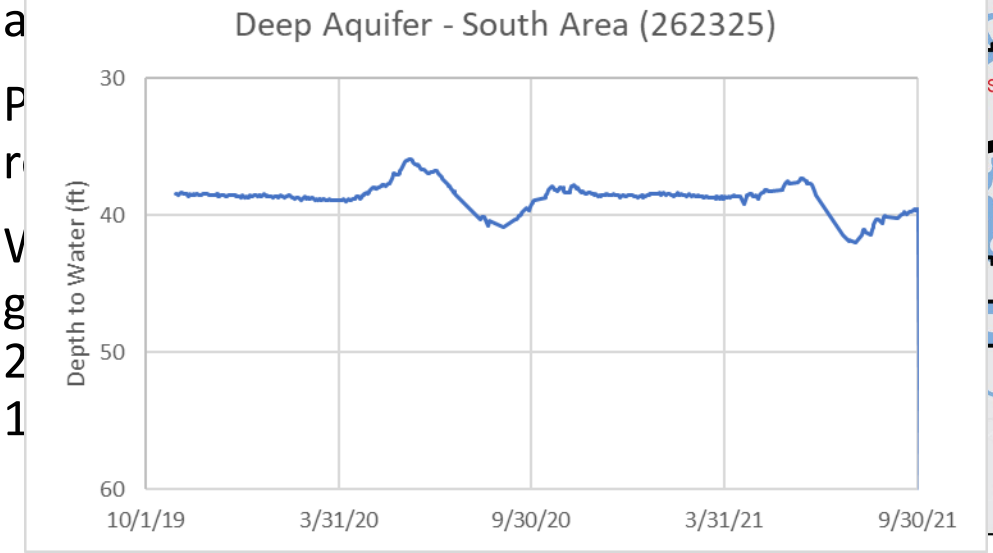


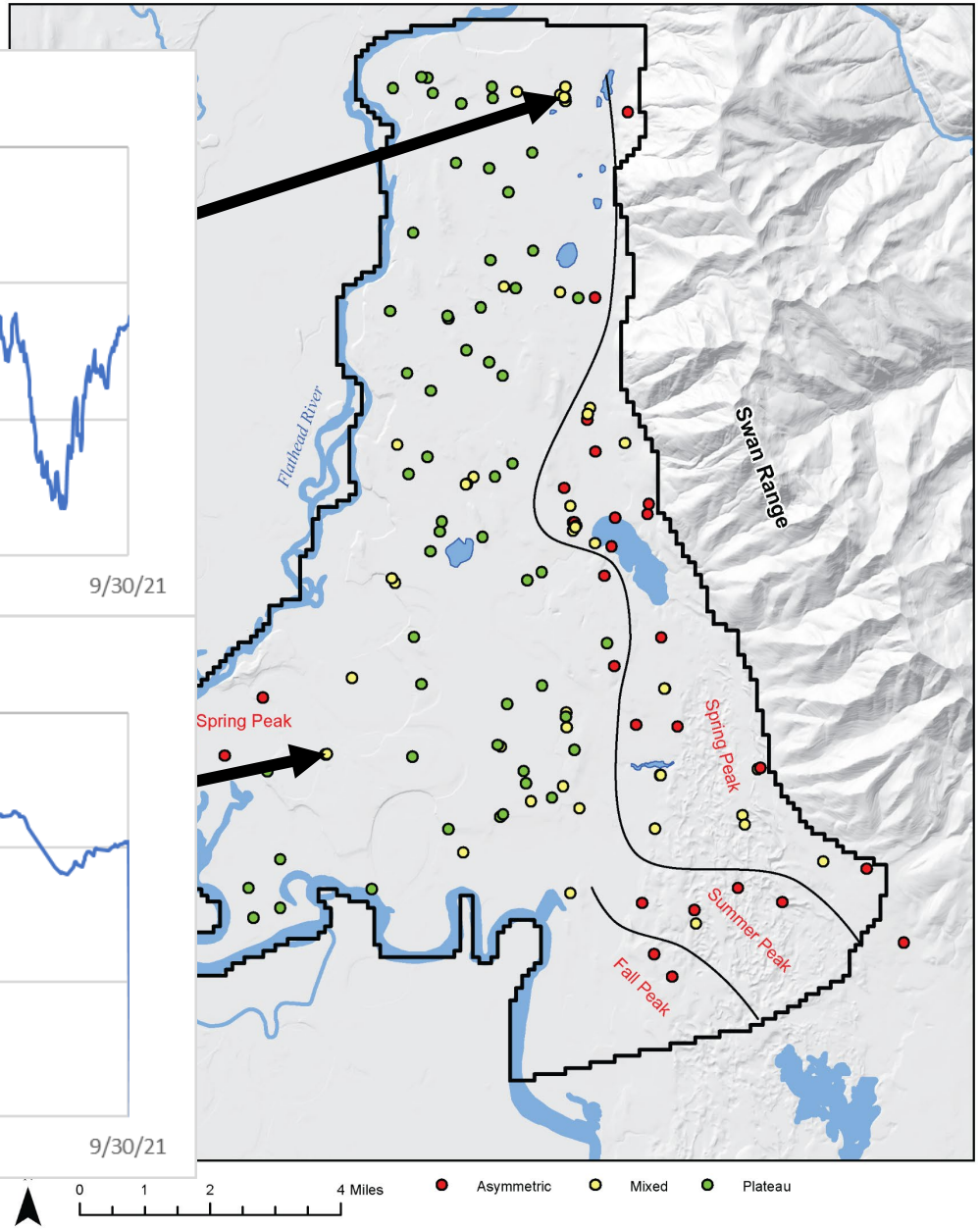
Preliminary Results Berglund and others, in prep

Spatial and Temporal Hyd

- A
  t
  s
  p
- A
  t
  a
- P
  r
- V
  g
  2
  1



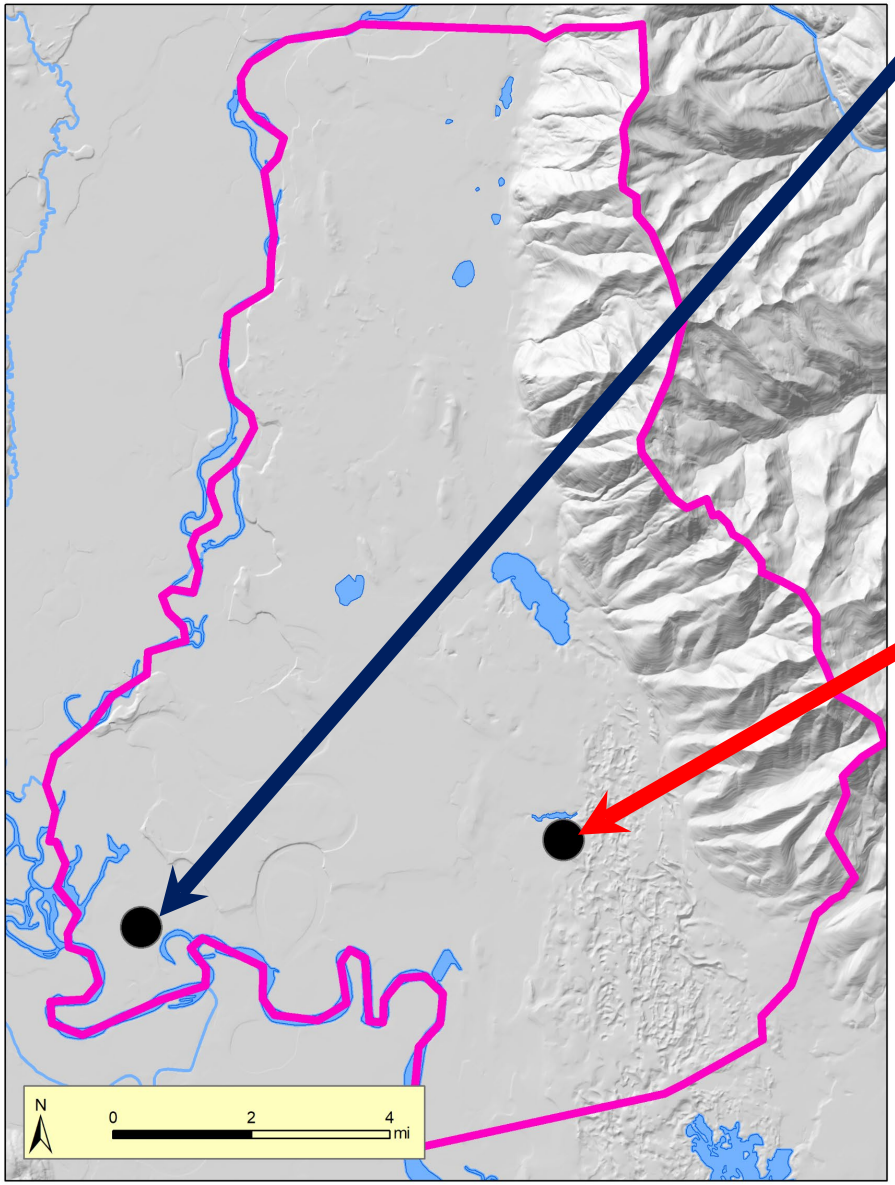




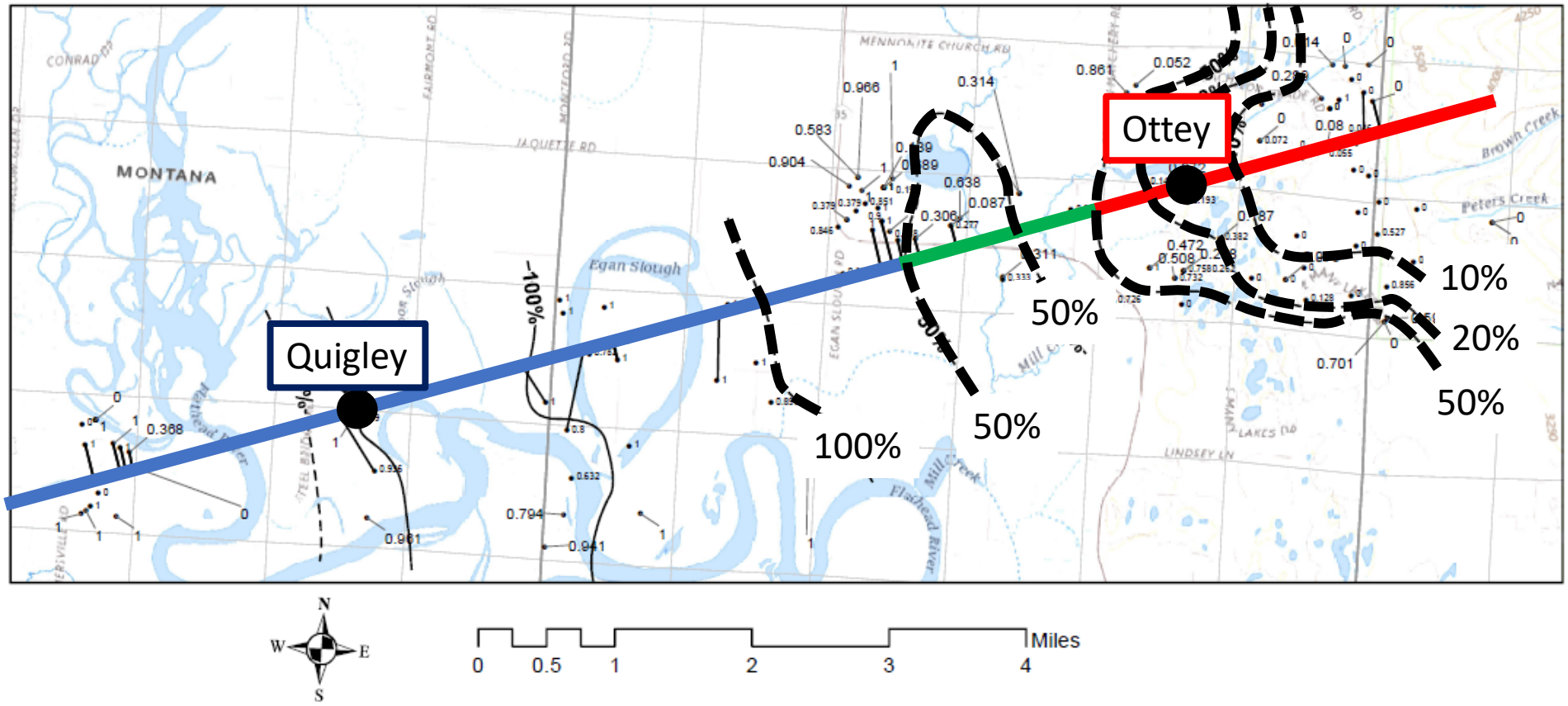
Preliminary Results Berglund and others, in prep

Drilling/RotoSonic

RotoSonic Drilling

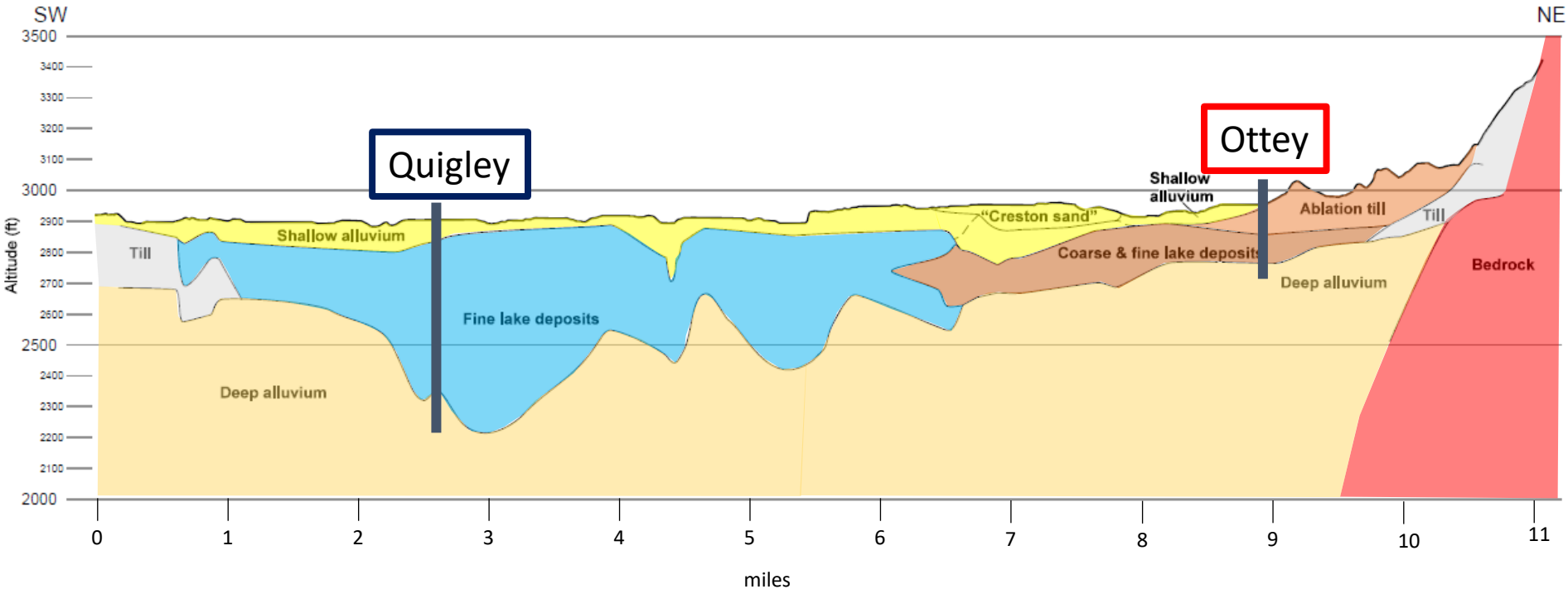


Percent Fine-Grained Sediments



Preliminary Results Bobst and others, in prep

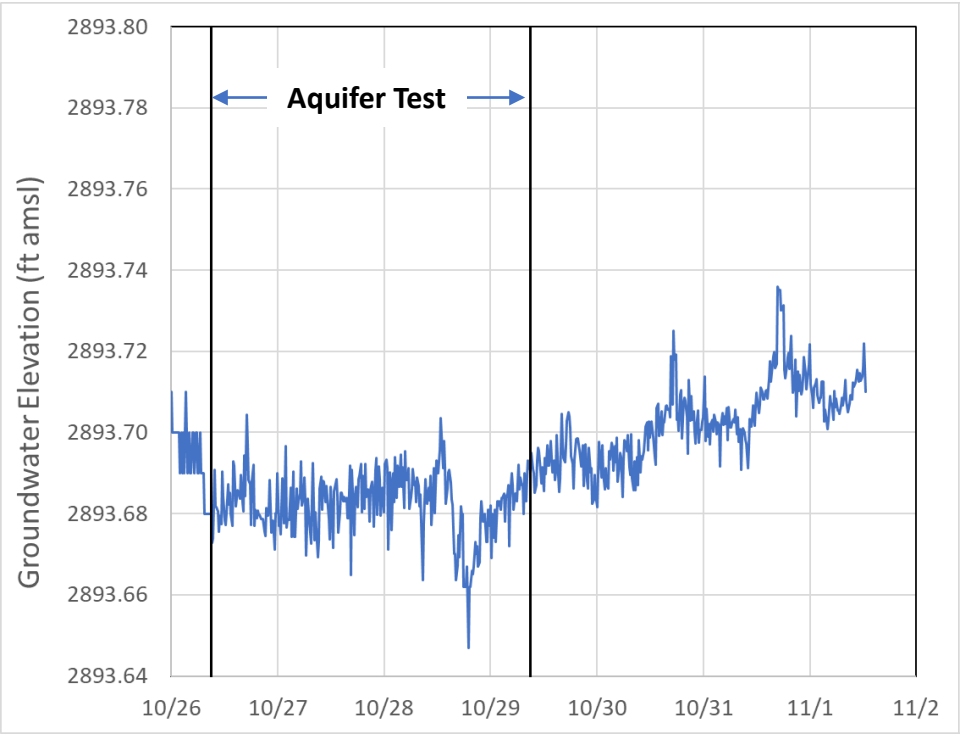
Lithologic Logs



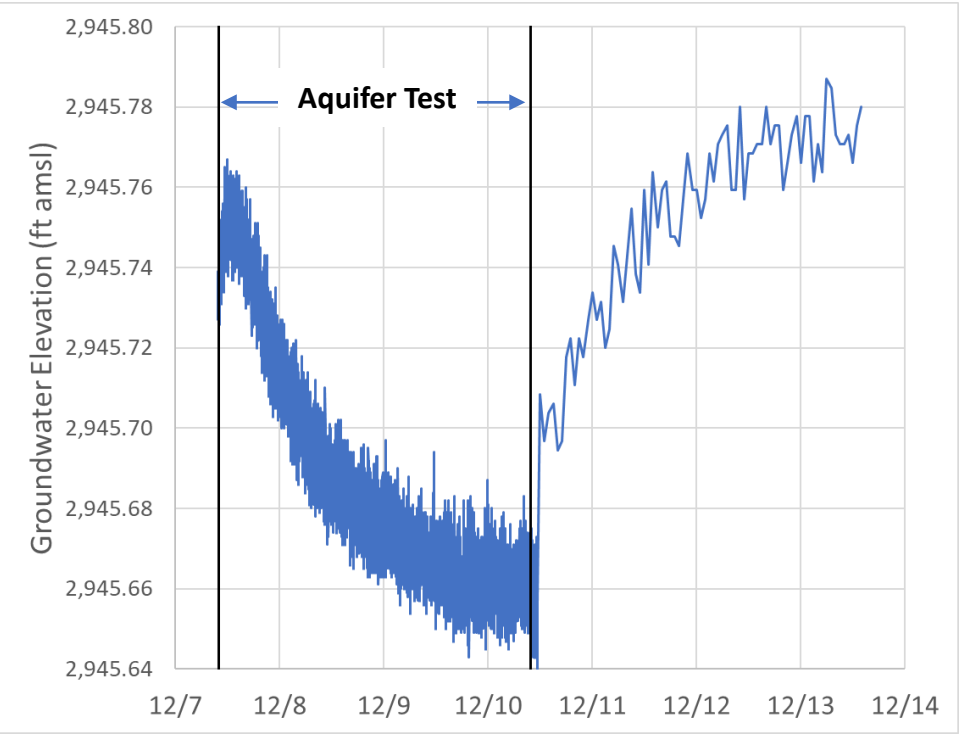
Preliminary Results Bobst and others, in prep
~12x vertical exaggeration

Aquifer Tests: Shallow Aquifer Response to Deep Pumping

Quigley

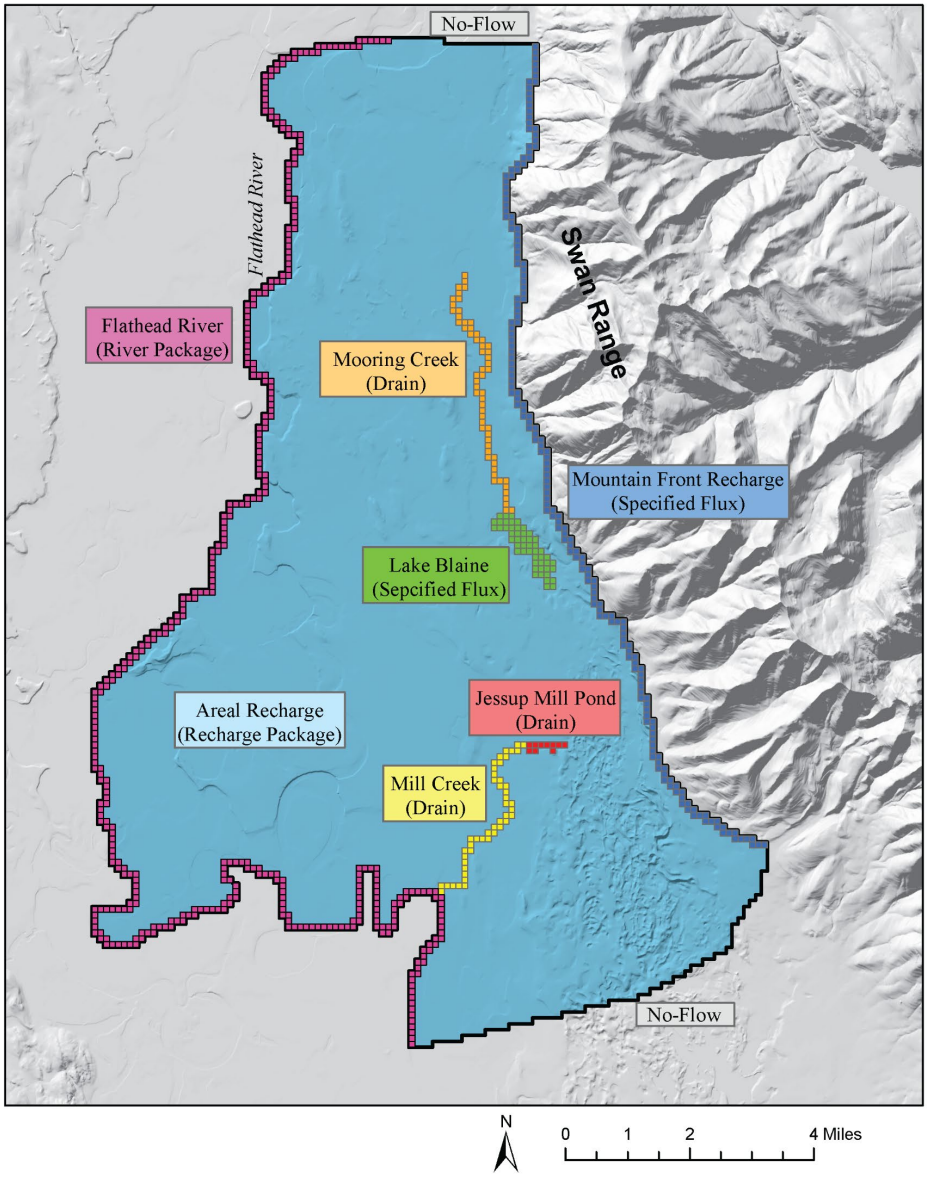


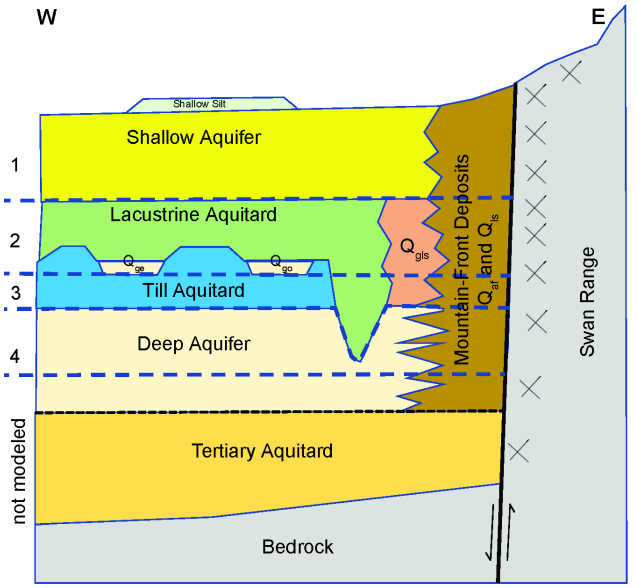
Ottey

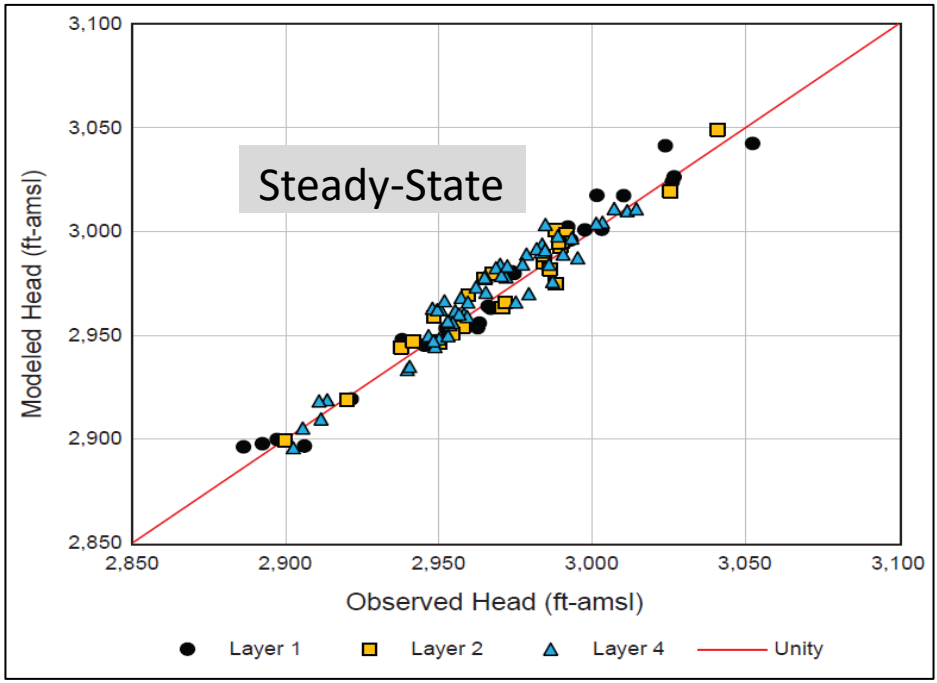


Myse and others, 2023

Groundwater Modeling

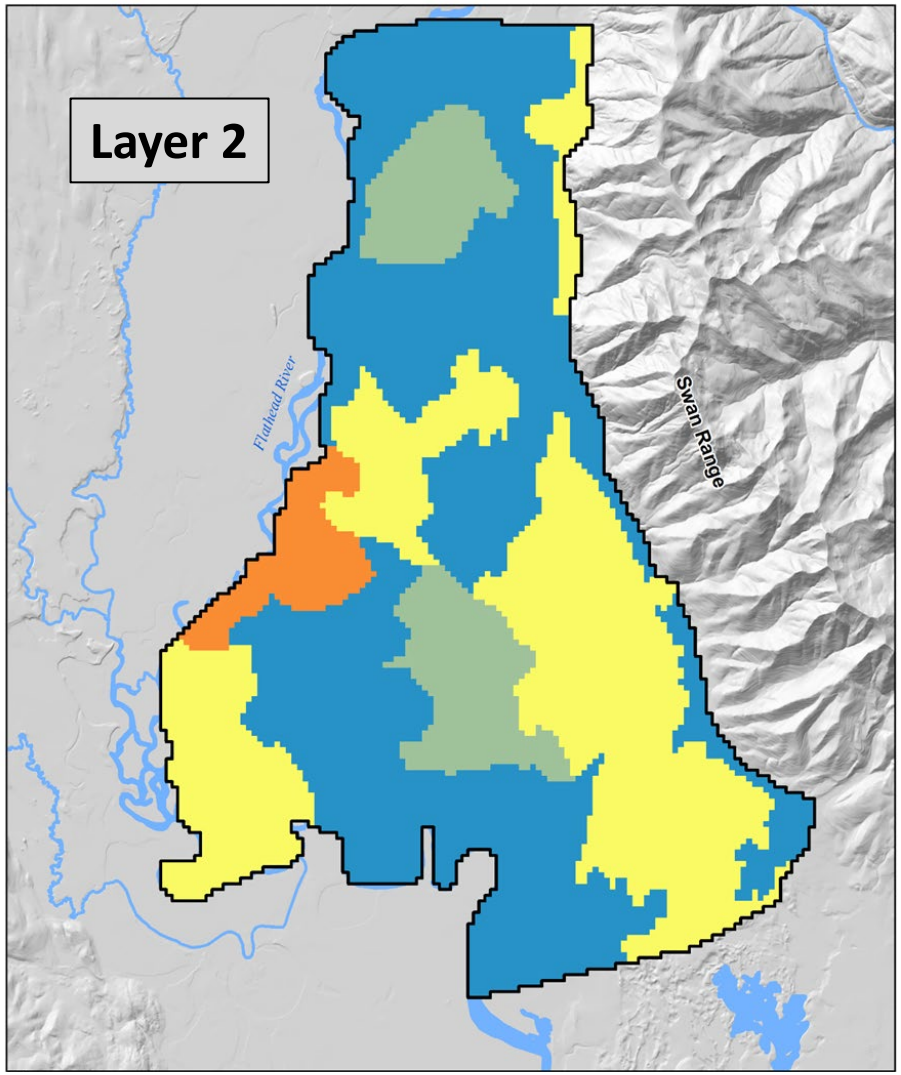


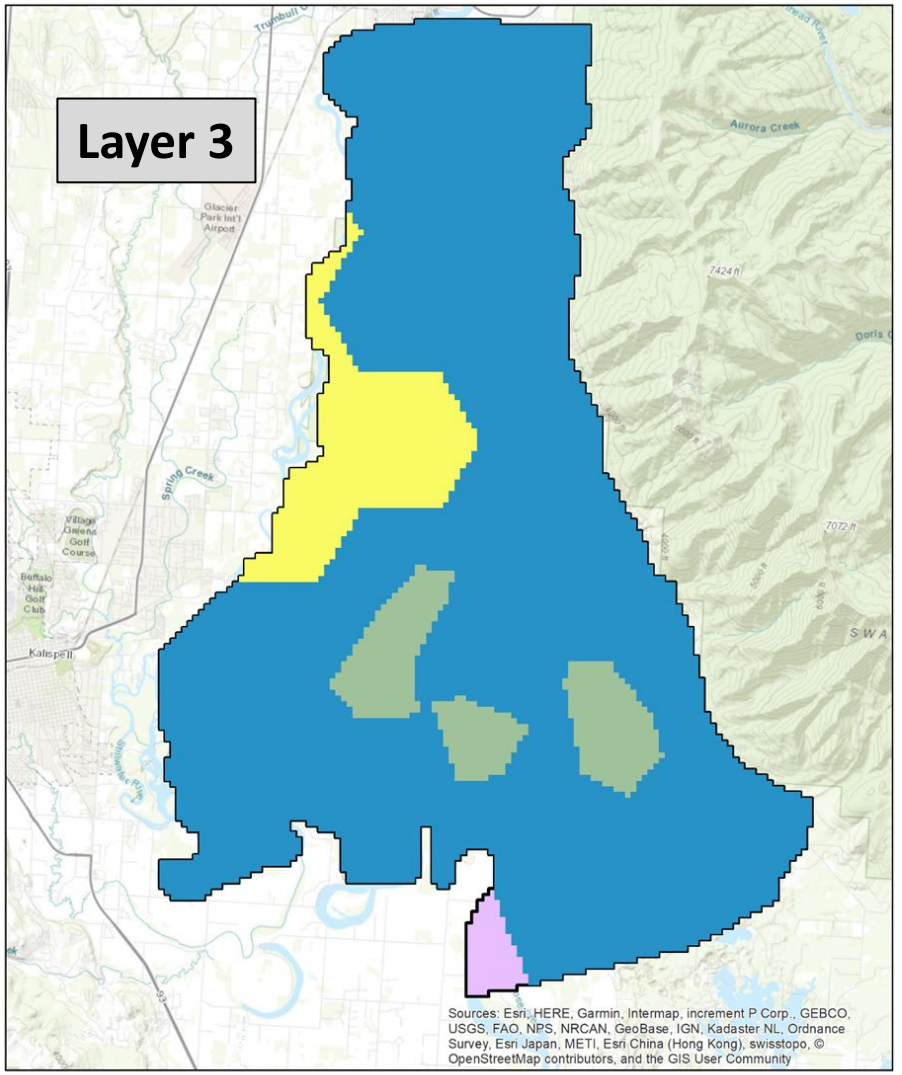




Preliminary Results Berglund and others, in prep

Groundwater Modeling-Calibrated K



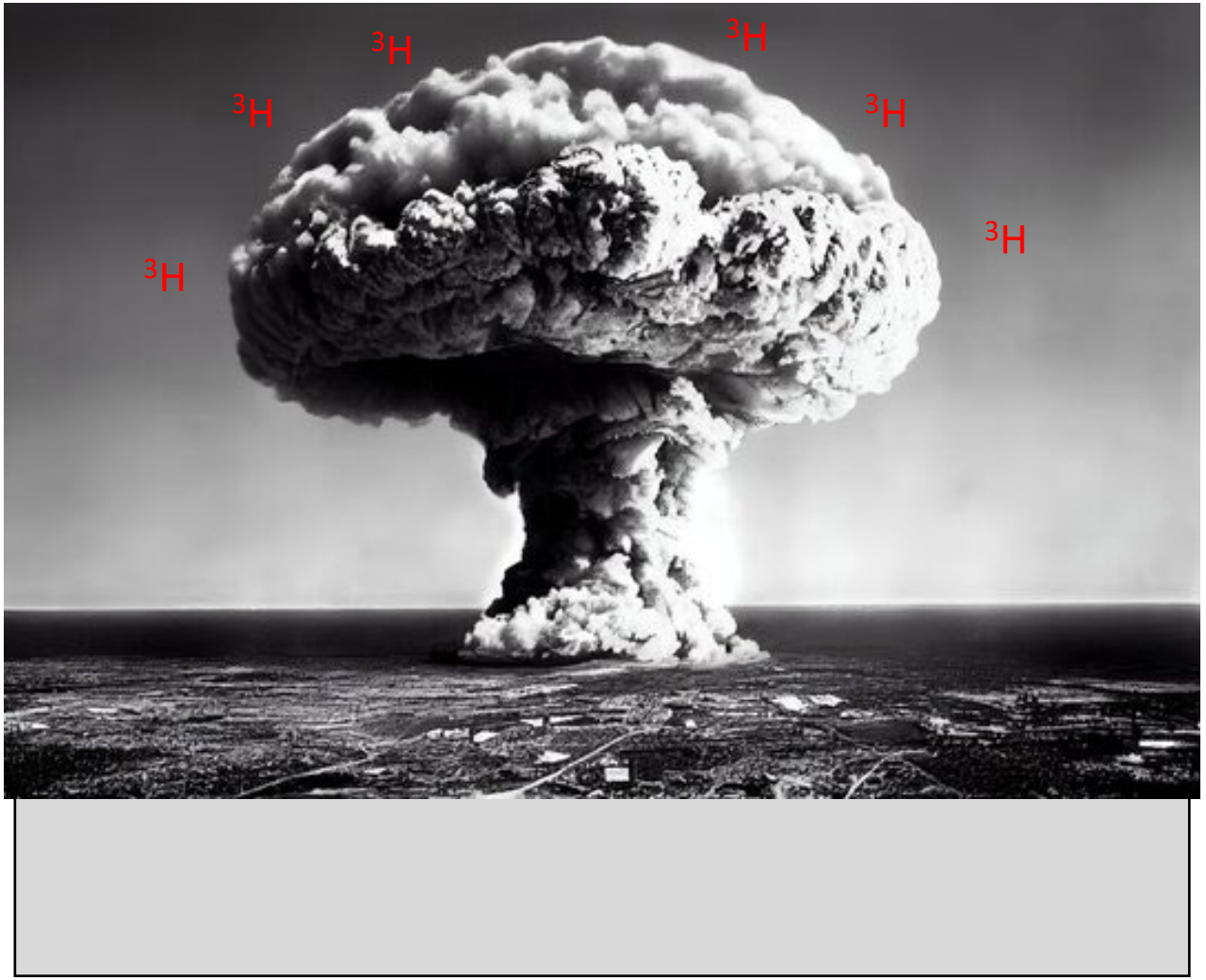


K Values (ft/d)

<5	5-10	10-50	50-100

Preliminary Results Berglund and others, in prep

Tracers



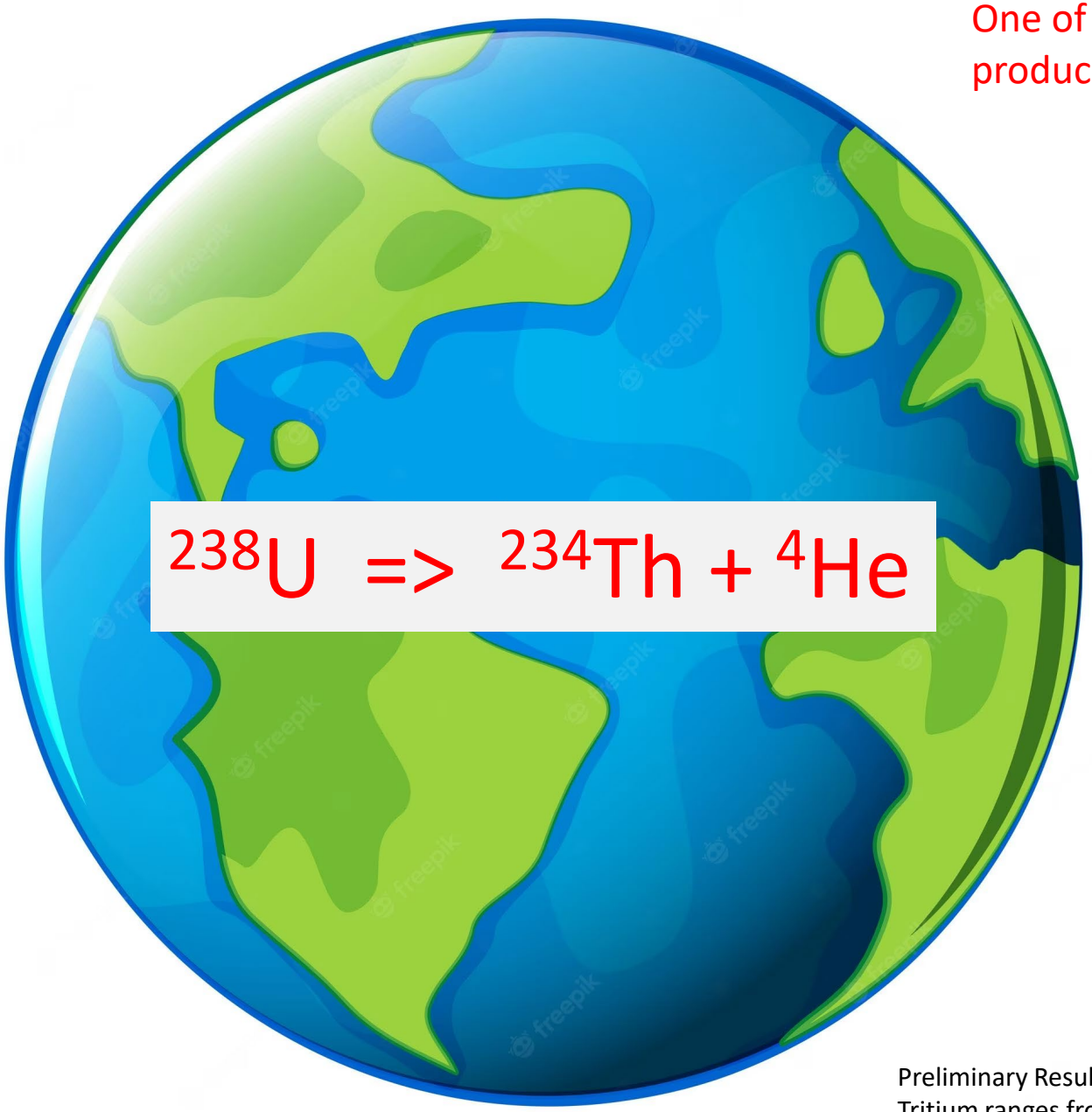
^3H half life
12.3 years

1963 Peak

Preliminary Results Bobst and others, in prep
Tritium ranges from Lindsay and others, 2019

Tracers

One of many decays that produce ^{4}He (α particles)



Preliminary Results Bobst and others, in prep
Tritium ranges from Lindsay and others, 2019

Preliminary Conclusions

- Shallow Aquifers and Surface Waters are Interconnected
  - Well documented (Konizeski and others, 1968; Noble and Stanford, 1986; Smith, 2004; LaFave and others, 2004; Rose, 2018; Rose and others, 2022)

- The Shallow Aquifers and the Deep Aquifer are Interconnected in some areas
  - Hydrograph Types
  - Sediment Descriptions
  - Aquifer Tests
  - Groundwater Modeling
  - Tracers

- Pumping from either the shallow or deep aquifers is likely to eventually result in surface-water depletion

Questions?

Recent and Upcoming MBMG Publications:

Bobst, A., Berglund, J., Smith, L., Bolhuis, K., and Gebril, A., in prep., Hydrogeologic Investigation of the East Flathead Valley, Montana Bureau of Mines and Geology Report of Investigation.

Berglund, J., Bobst, A., and Gebril, A., in prep., A groundwater flow model for the East Flathead Valley, Montana Bureau of Mines and Geology Report of Investigation.

Myse, T., Bobst, A., and Rose, J., 2023, Analyses of three constant-rate aquifer tests, East Flathead Valley, northwest Montana: Montana Bureau of Mines and Geology Open-File Report 757, 44 p.

Bobst, A., Rose, J., and Berglund, J., 2022, An evaluation of the unconsolidated hydrogeologic units in the south-central Flathead Valley, Montana: Montana Bureau of Mines and Geology Open-File Report 752, 16 p.

Rose, J., Bobst, A., and Gebril, A., 2022, Hydrogeologic investigation of the deep alluvial aquifer, Flathead Valley, Montana: Montana Bureau of Mines and Geology Report of Investigation 32, 44 p.

Rose, J., 2018, Three-dimensional hydrostratigraphic model of the subsurface geology, Flathead Valley, Kalispell, Montana: Montana Bureau of Mines and Geology Open-File Report 703, 44 p., 1 sheet.

Let us know if you have ideas for new GWIP Projects!