

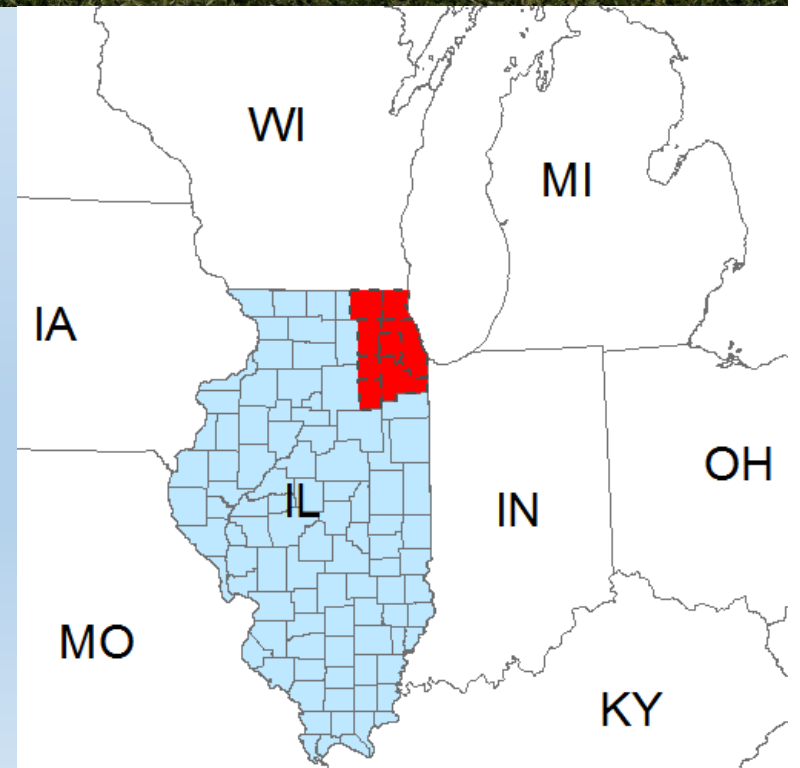
# Desaturation of Sandstone Aquifers in Northeastern Illinois



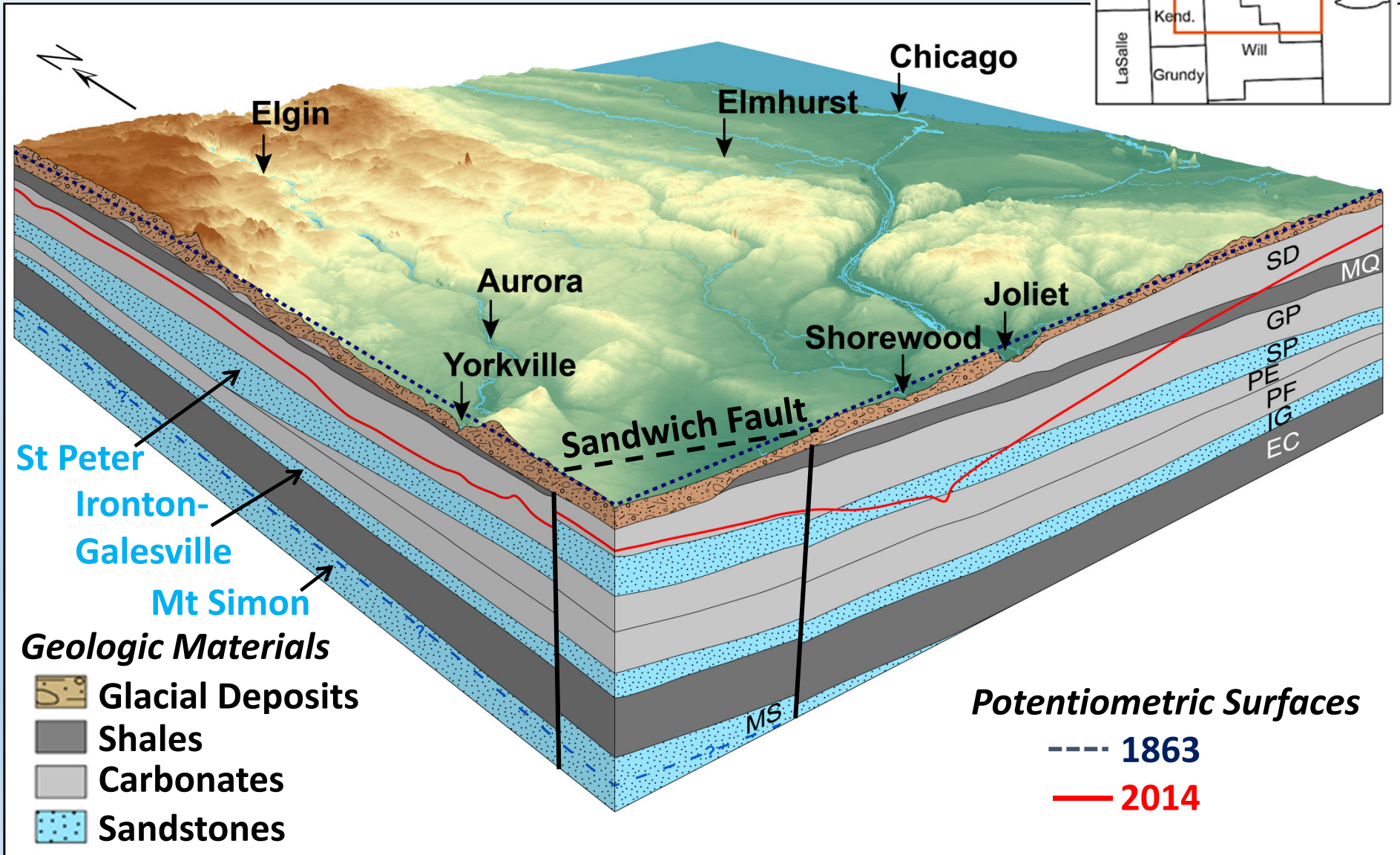
**Daniel Abrams**  
**Groundwater Flow Modeler**



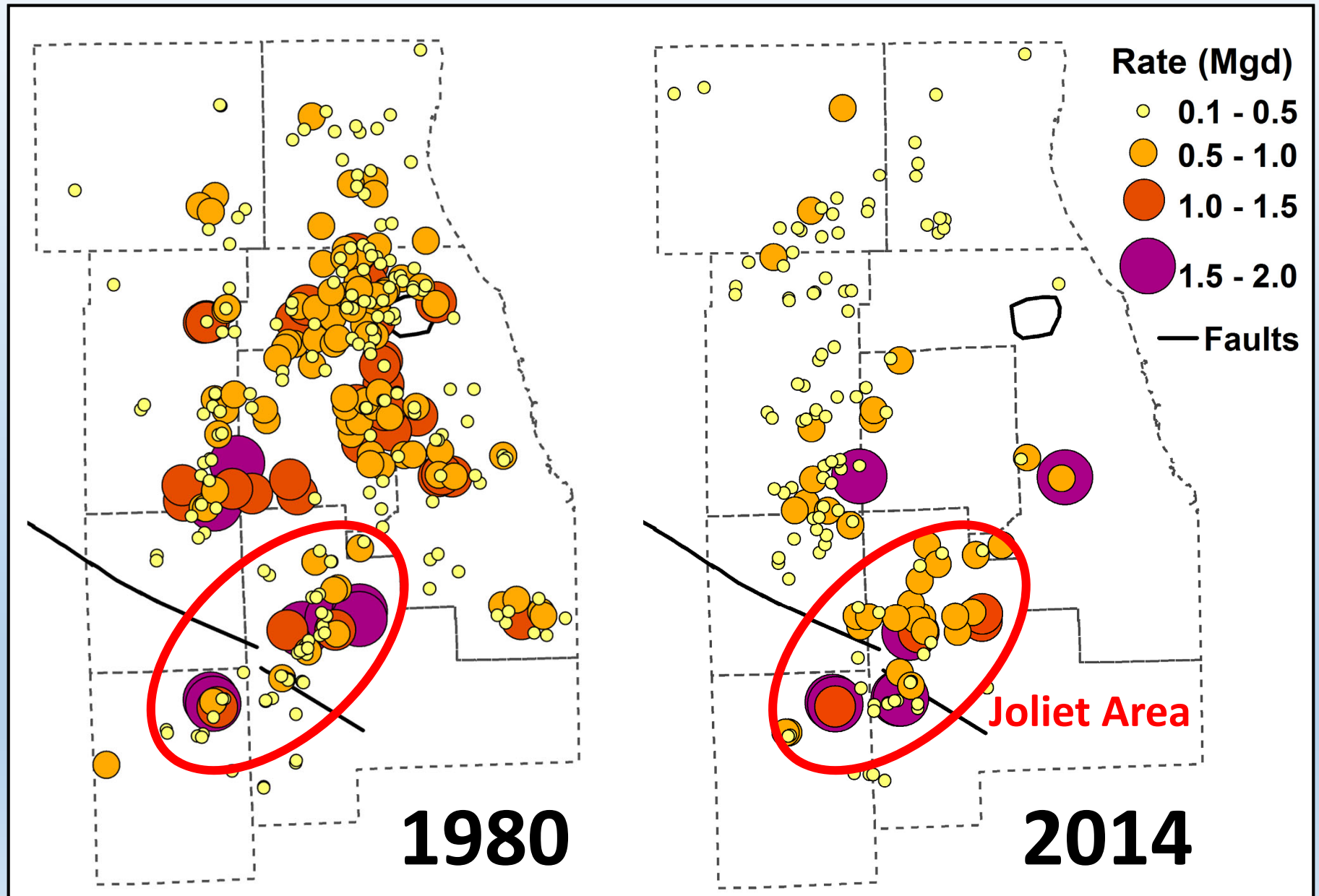
**ILLINOIS**  
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN



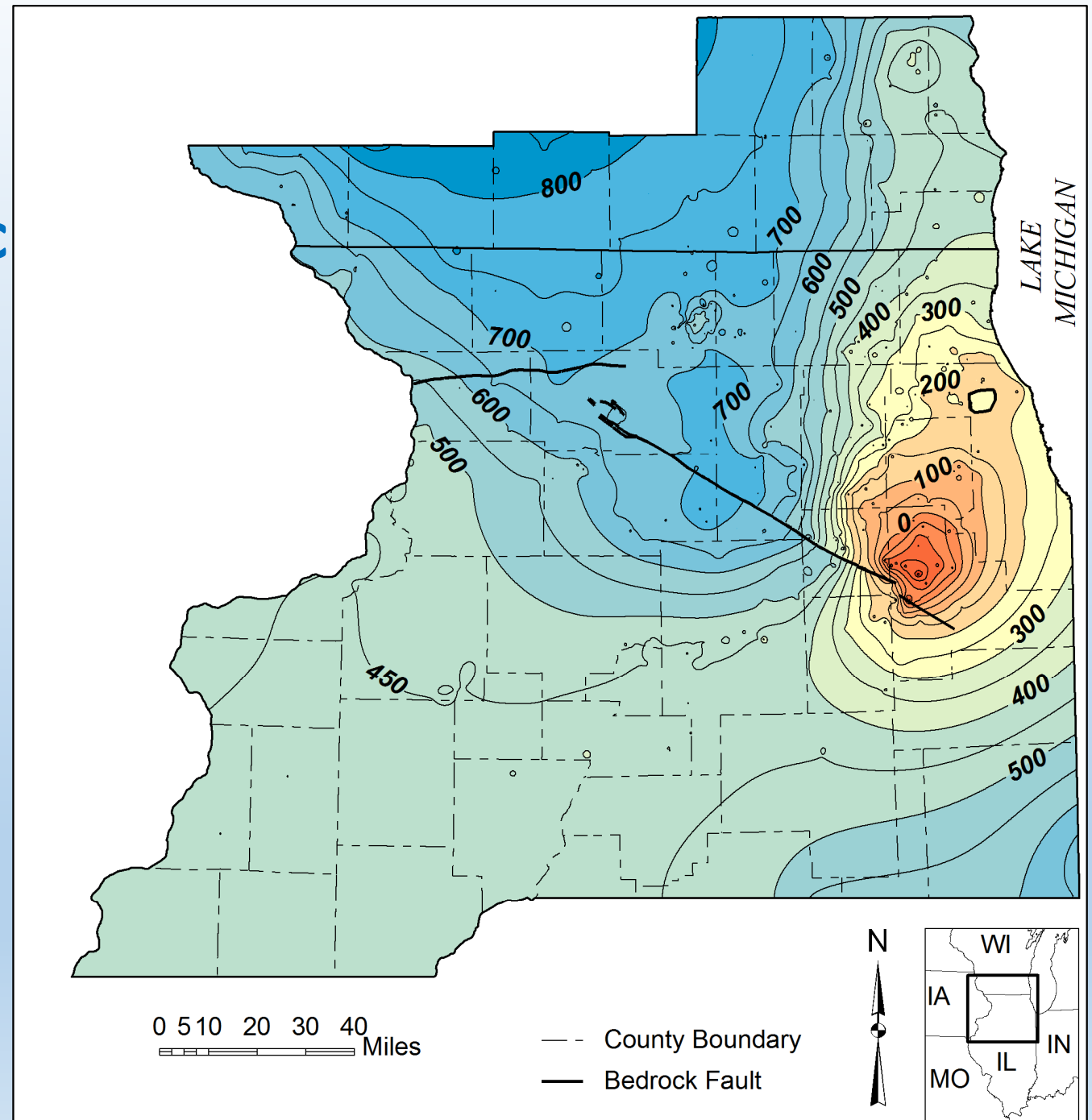
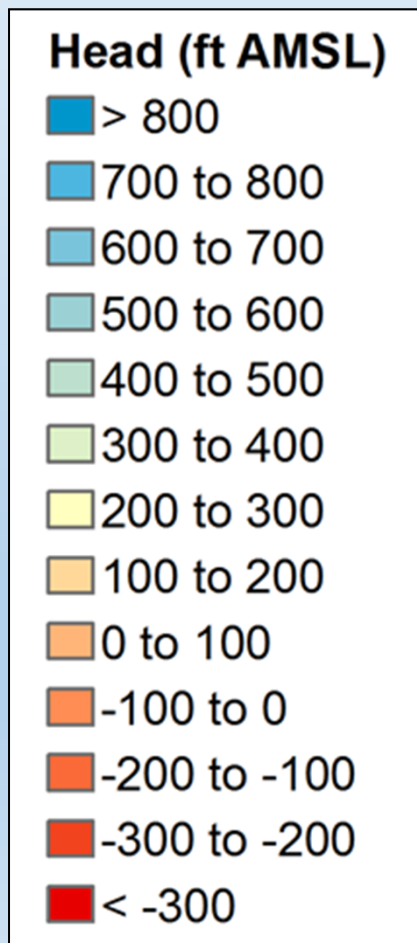
# Regional Bedrock Geology



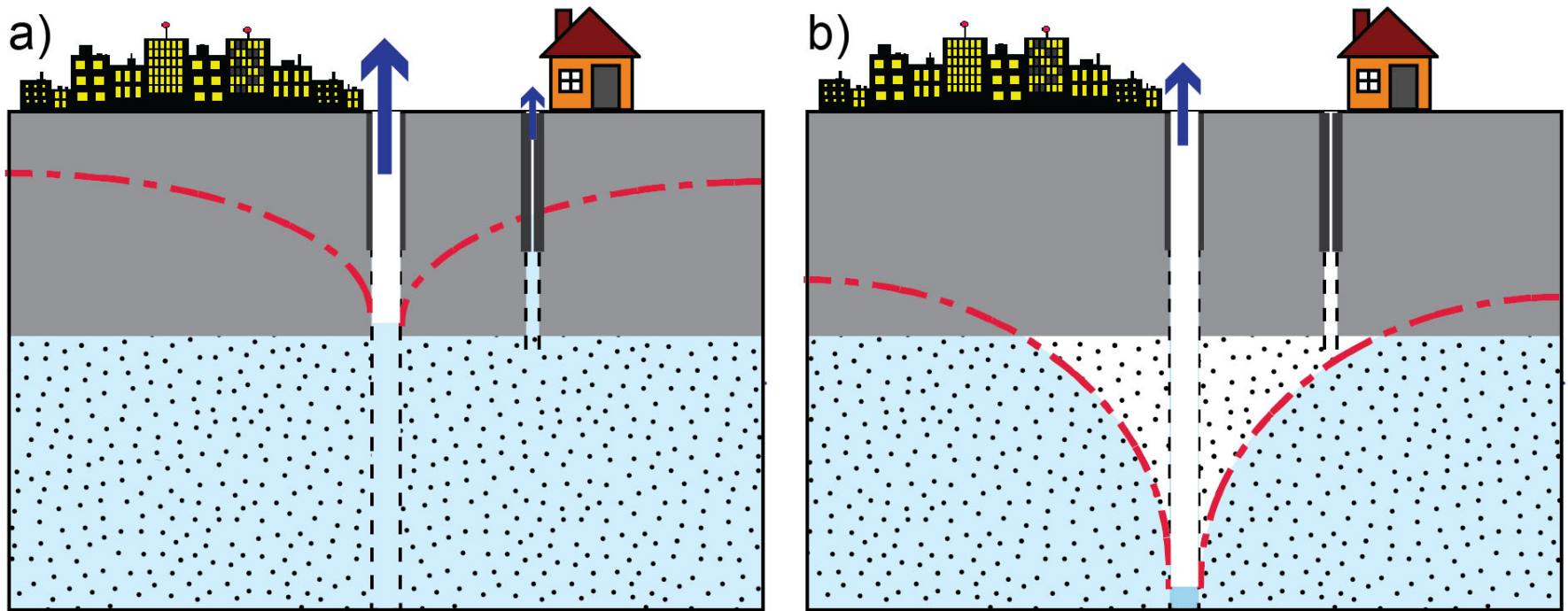
# Sandstone Aquifer Withdrawals



# 2014 Potentiometric Surface



# Desaturation of sandstone



Most of the ISWS work on the sandstone before 2016 examined desaturation of the St. Peter. However, risk in the deeper Ironton-Galesville Sandstone has become more prevalent and must also be understood.



# Impacts of desaturating sandstone

	St. Peter	Ironton-Galesville
<b>Lost well capacity (including dry wells)</b>	Residential; Some public and industrial	Most public and industrial
<b>Water quality impacts</b>	Arsenic (Wisconsin)	Unknown
<b>Caving potential (well pumps sand)</b>	Generally when pumping equipment lowered into sandstone	Observed when pumping equipment is near the top of the sandstone

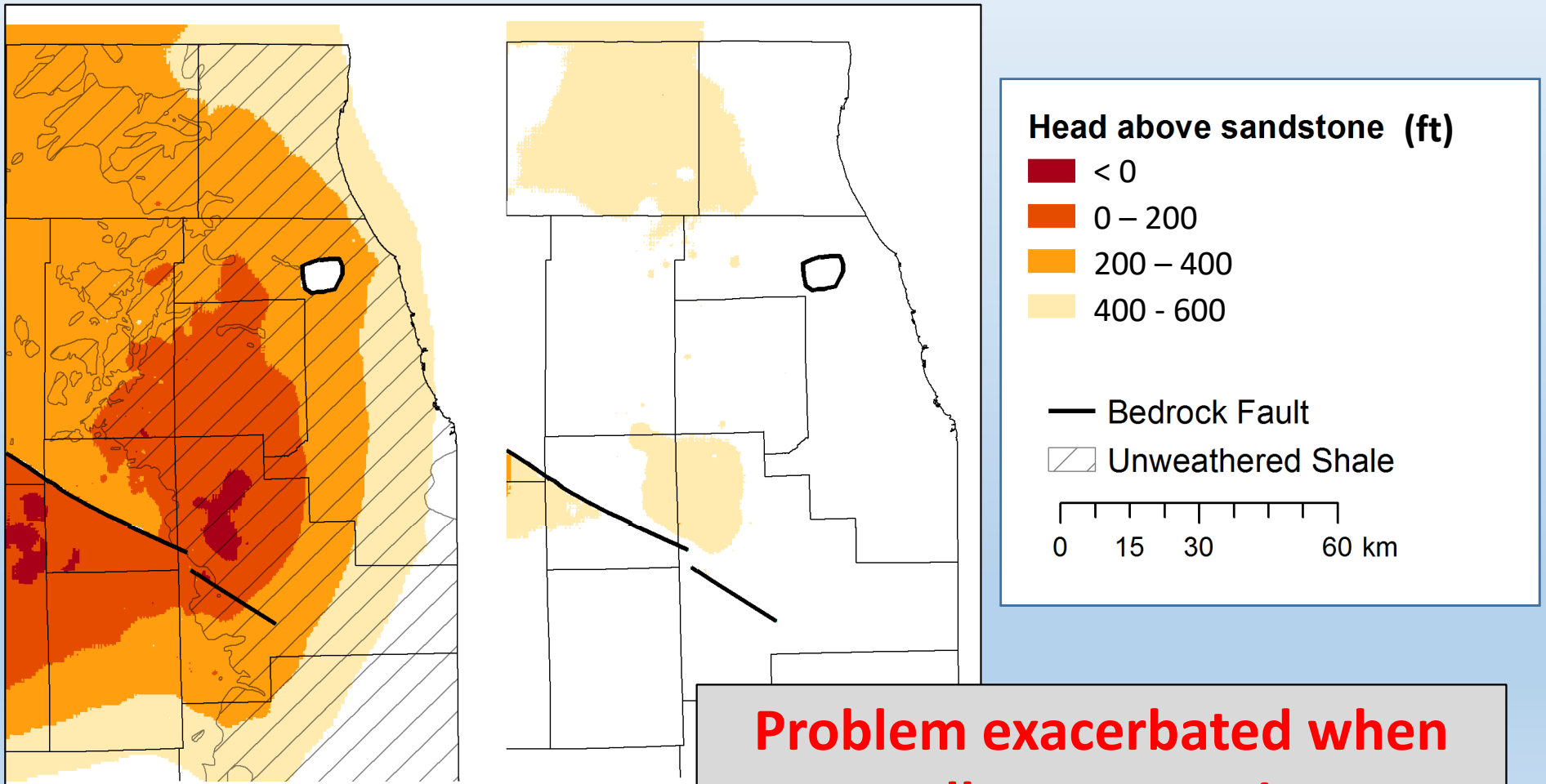


# Desaturation (static water levels)

St. Peter

Ironton-Galesville

2014



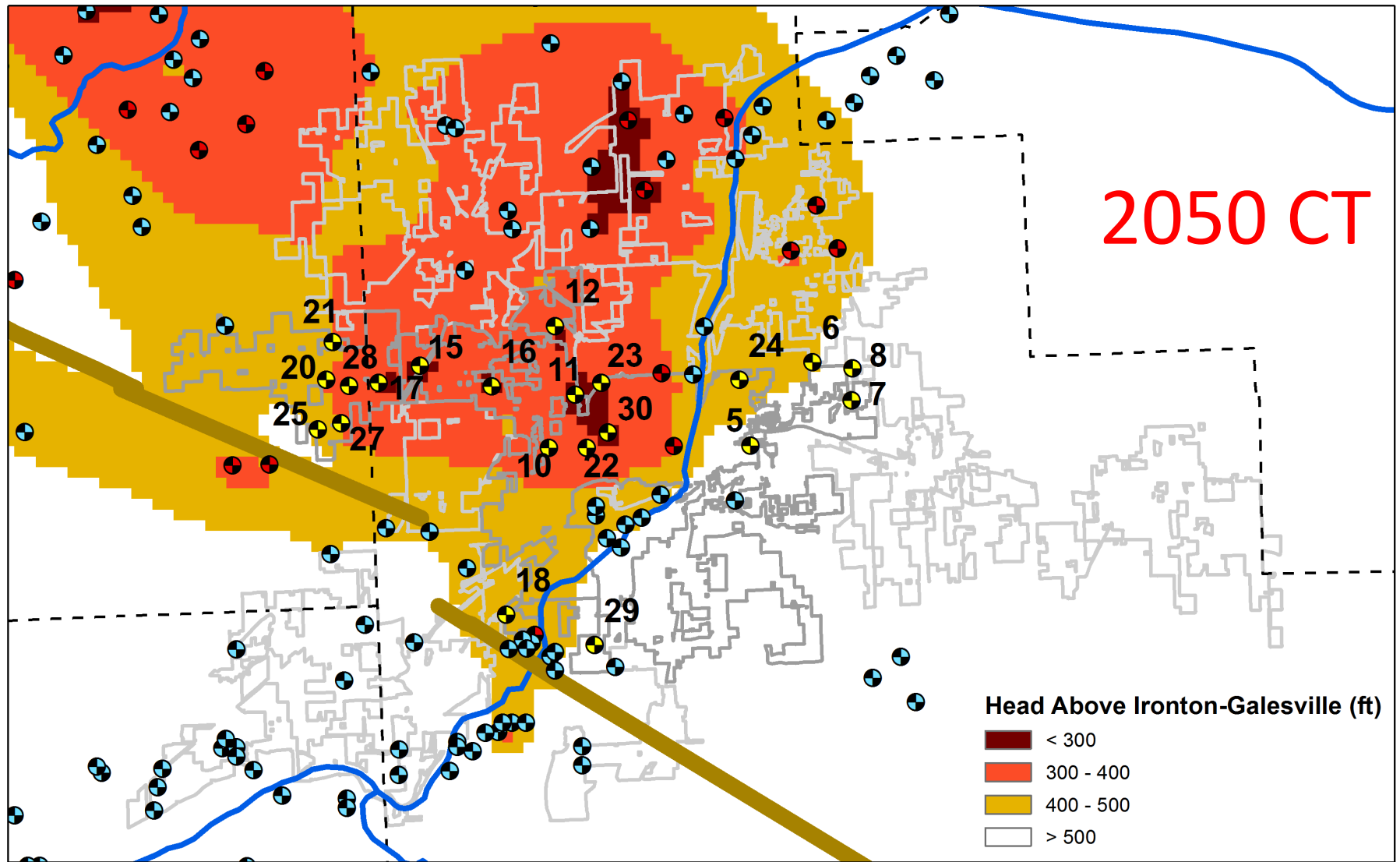
**Problem exacerbated when wells are pumping**

# Model updated with CMAP demands

- Regional demands are based on CMAP future demand scenarios
- Original model assumes that all sandstone users stay on the deep aquifer
- Model assumes some demands switch from shallow to deep in Will County due to the Hine's Emerald Dragonfly issue







Explanation

Locations of Active and

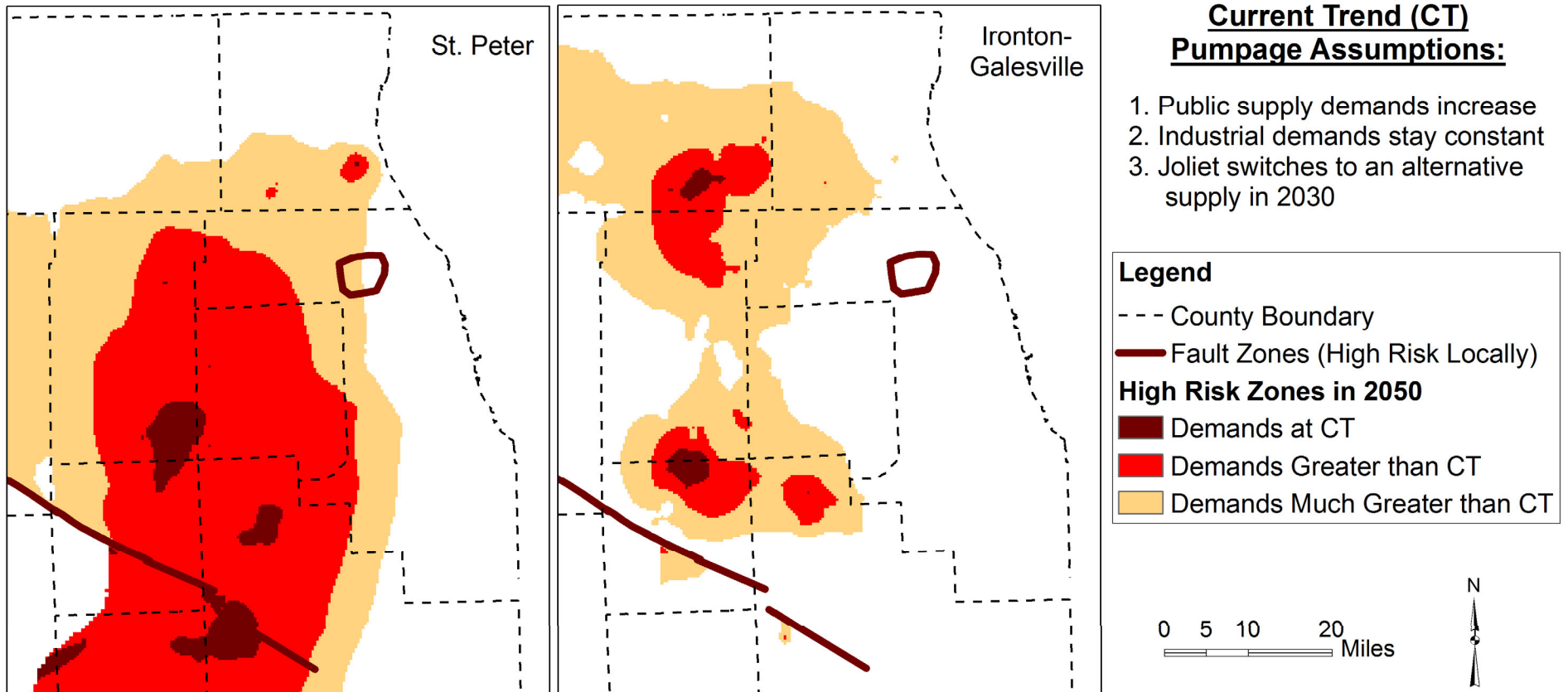
## Year 2030

- The result of the Phase 1 Water Supply study in Joliet indicates that an alternative source should be in place by 2030 to avoid supply interruptions.
  - This is based on the Current Trend Scenario; water conservation efforts can help extend the life of the aquifer for a few years, as shown by the LRI scenario
  - Regardless, an alternative supply will eventually be needed
- So what does a switch to an alternative supply by Joliet mean for the region?



# Updated Risk

## 2050 Sandstone Risk



- The issue remains regional in nature, even if Joliet switches from the sandstone to an alternative supply.
- The biggest beneficiary appears to be industry, although this is complicated by the fault zone.

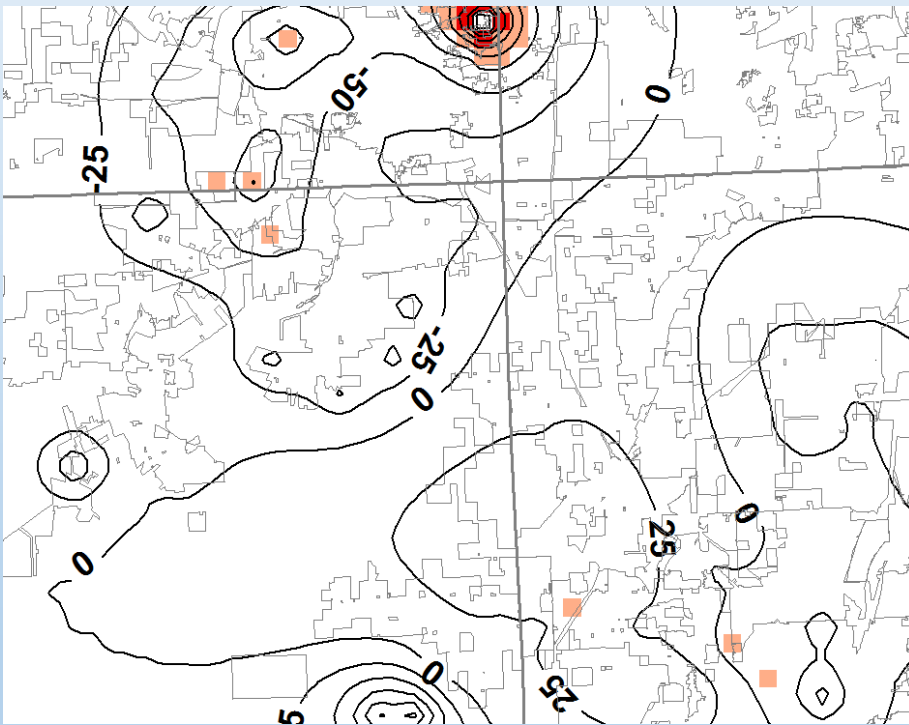
# Important caveats

- **Fault zone adds an additional local complexity**
  - Model simulates the fault zone as a regional feature
  - Complexities within the fault zone can heavily influence (and exacerbate) drawdown at an individual well
- **Model simulation assumes very limited growth in industrial pumpage**
  - Contrast to an increase in ~5 Mgd during the 2000's
- **Simulation did not include impacts if sandstone is still used as a back-up supply, which will increase risk**

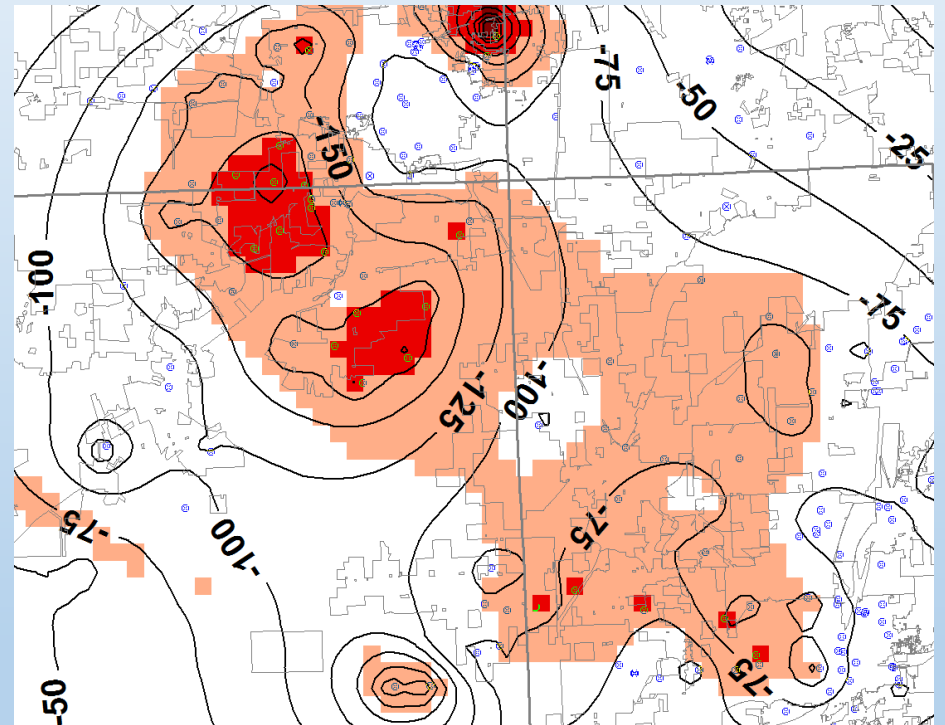


# Sandstone as a back-up supply?

1 Month Drought

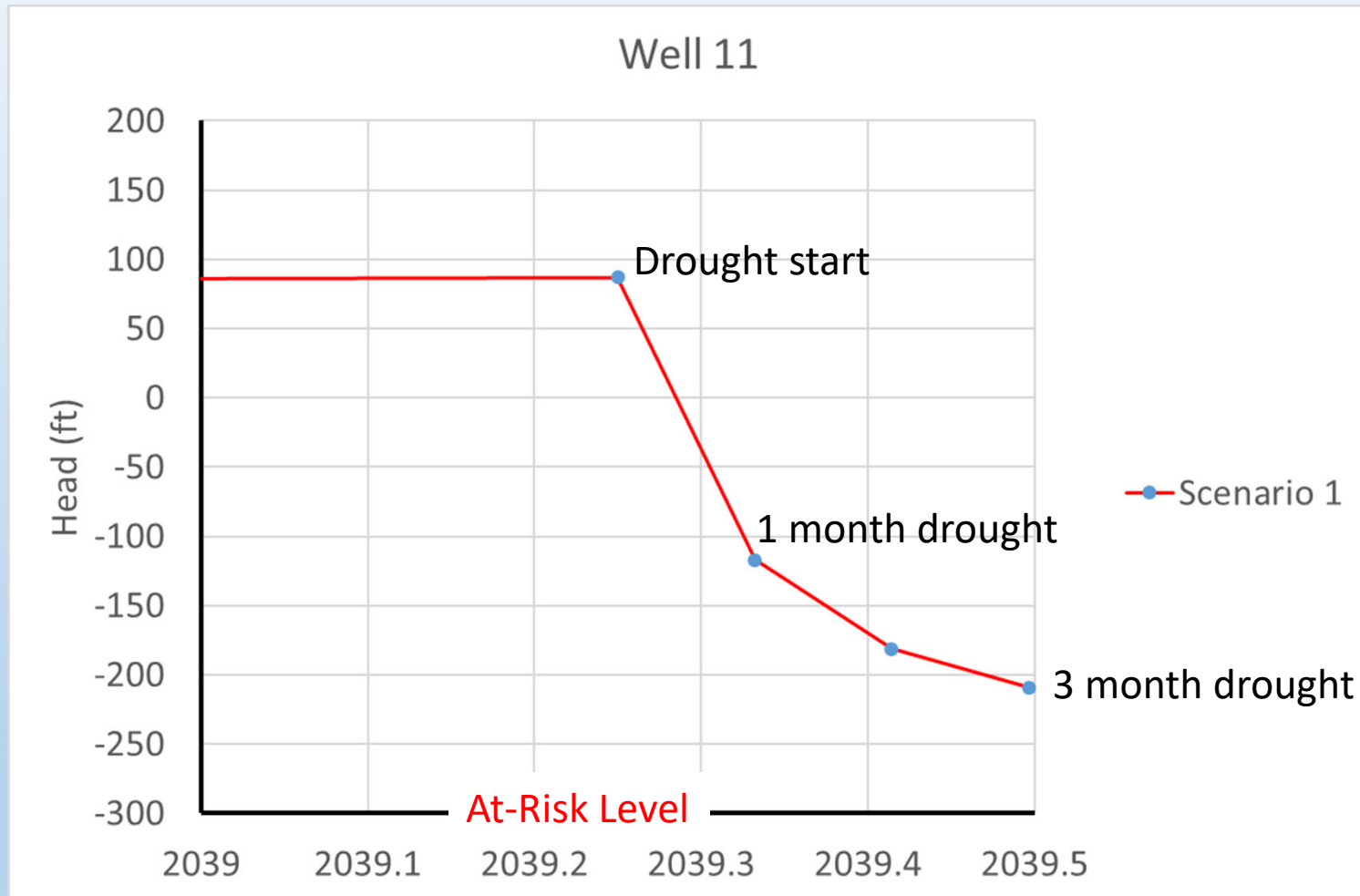


6 Month Drought



Dependent on length of future droughts. Red indicates a strong likelihood of service interruptions.

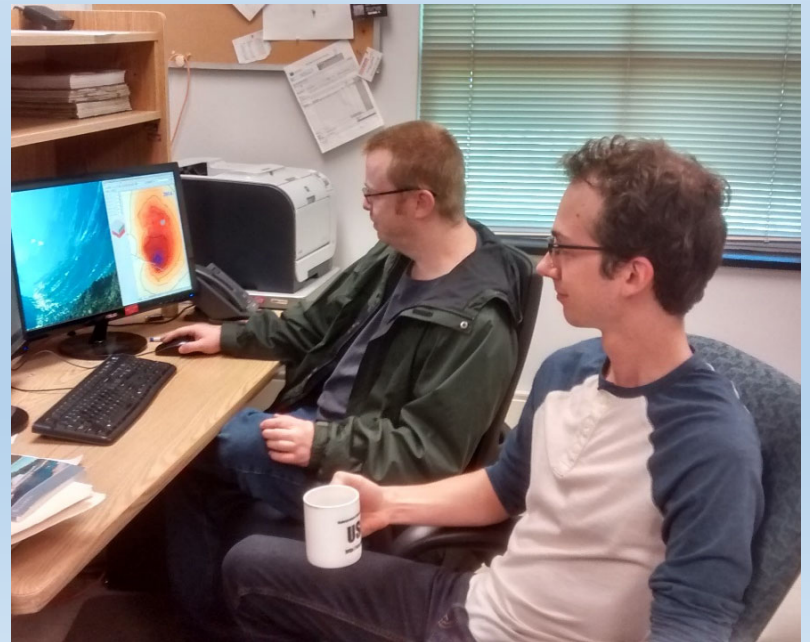
# Hydrograph



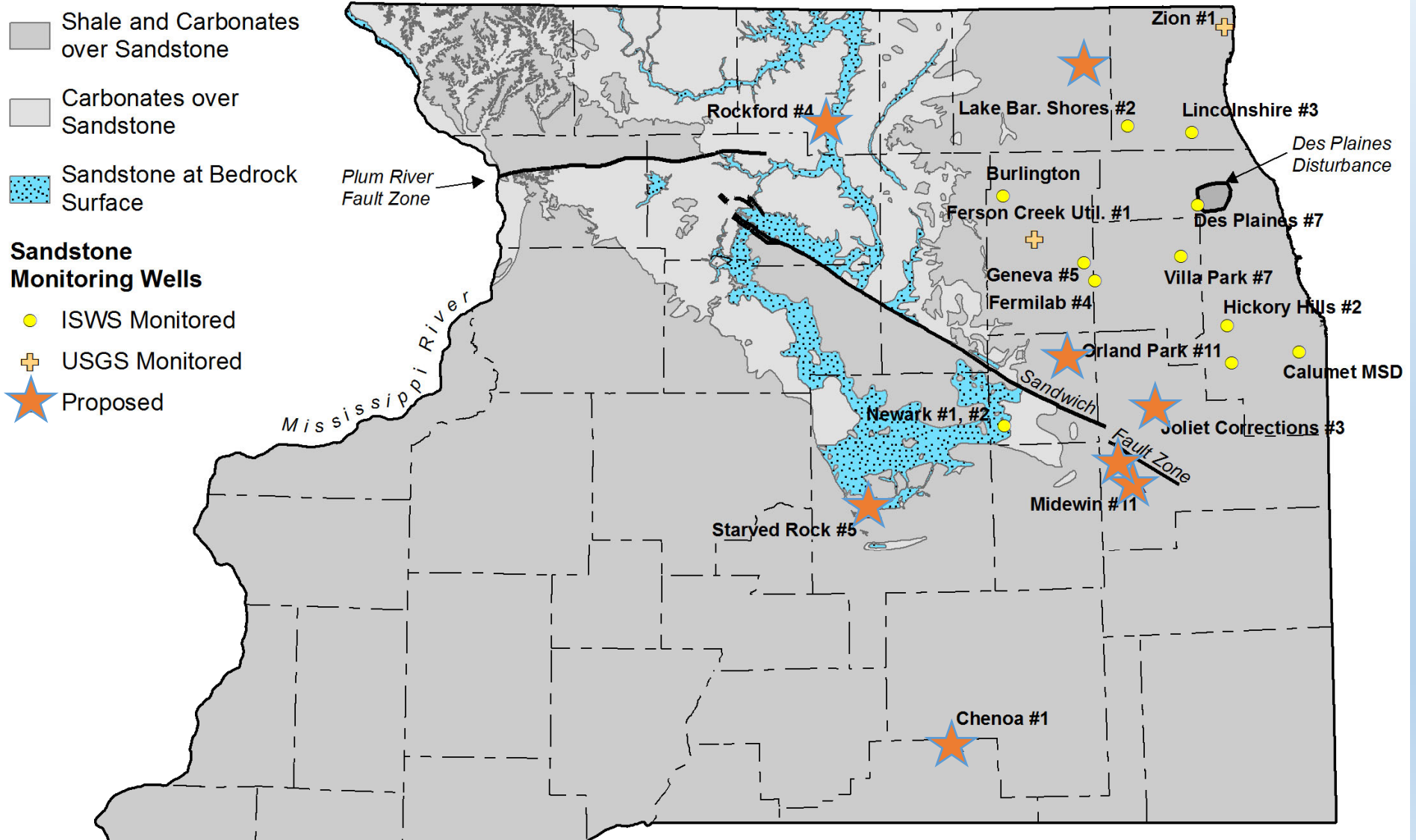
Head response is rapid, but not instantaneous

# Work in the region

1. Collaborative study with the Southwest Water Planning Group (near future)
  - a) Understand water use, future plans, frequently update the groundwater flow model, data collection, water quality, shallow aquifer investigation
2. Installation of water level monitoring equipment at Exxon and Elwood (ongoing)
3. Real-time data from communities (ongoing)
4. Analysis of a pump test at Flint Hills Resources (complete)
5. Analysis of a 1942 Pump Test (complete)



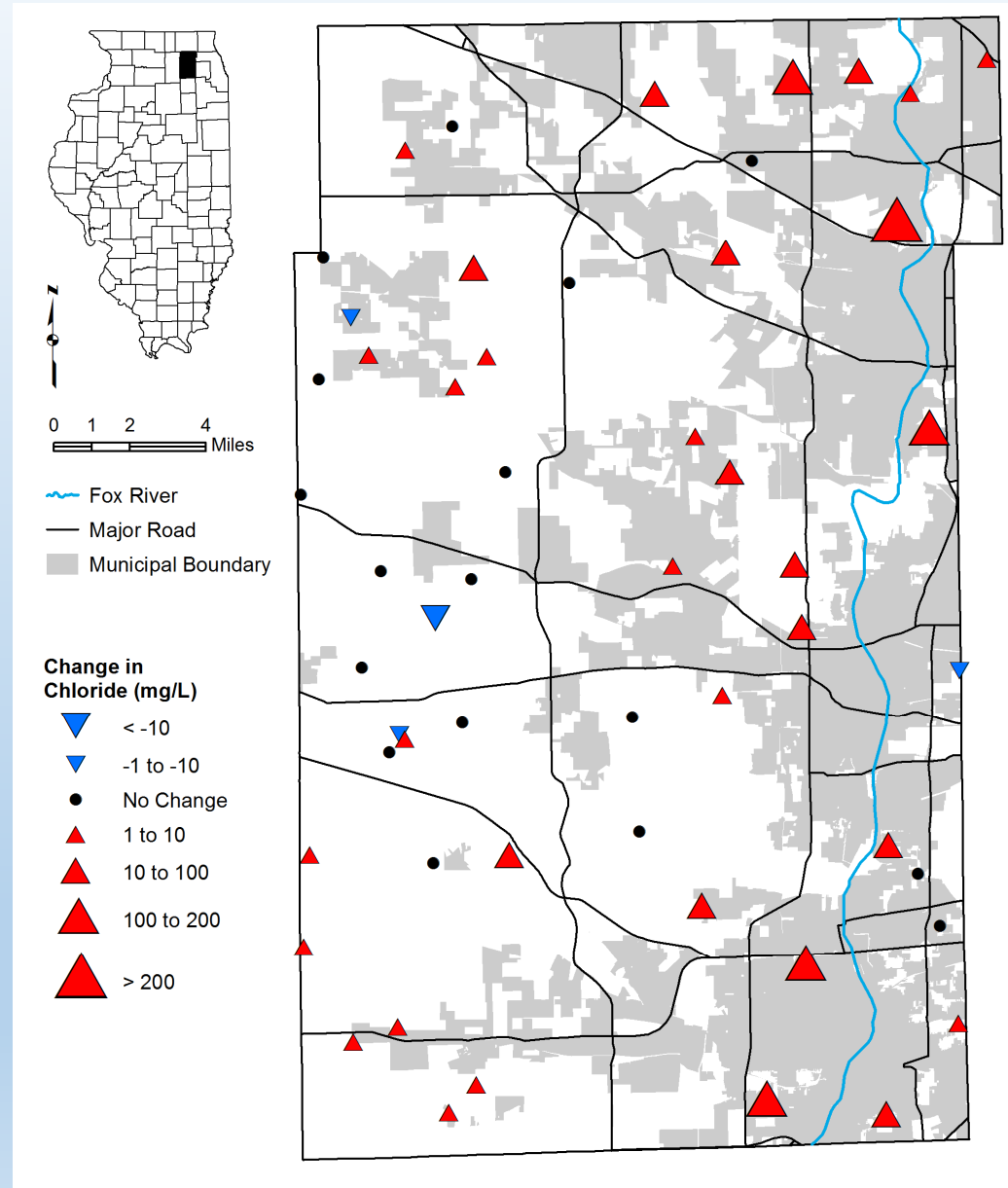
# Deep Sandstone Observation Wells





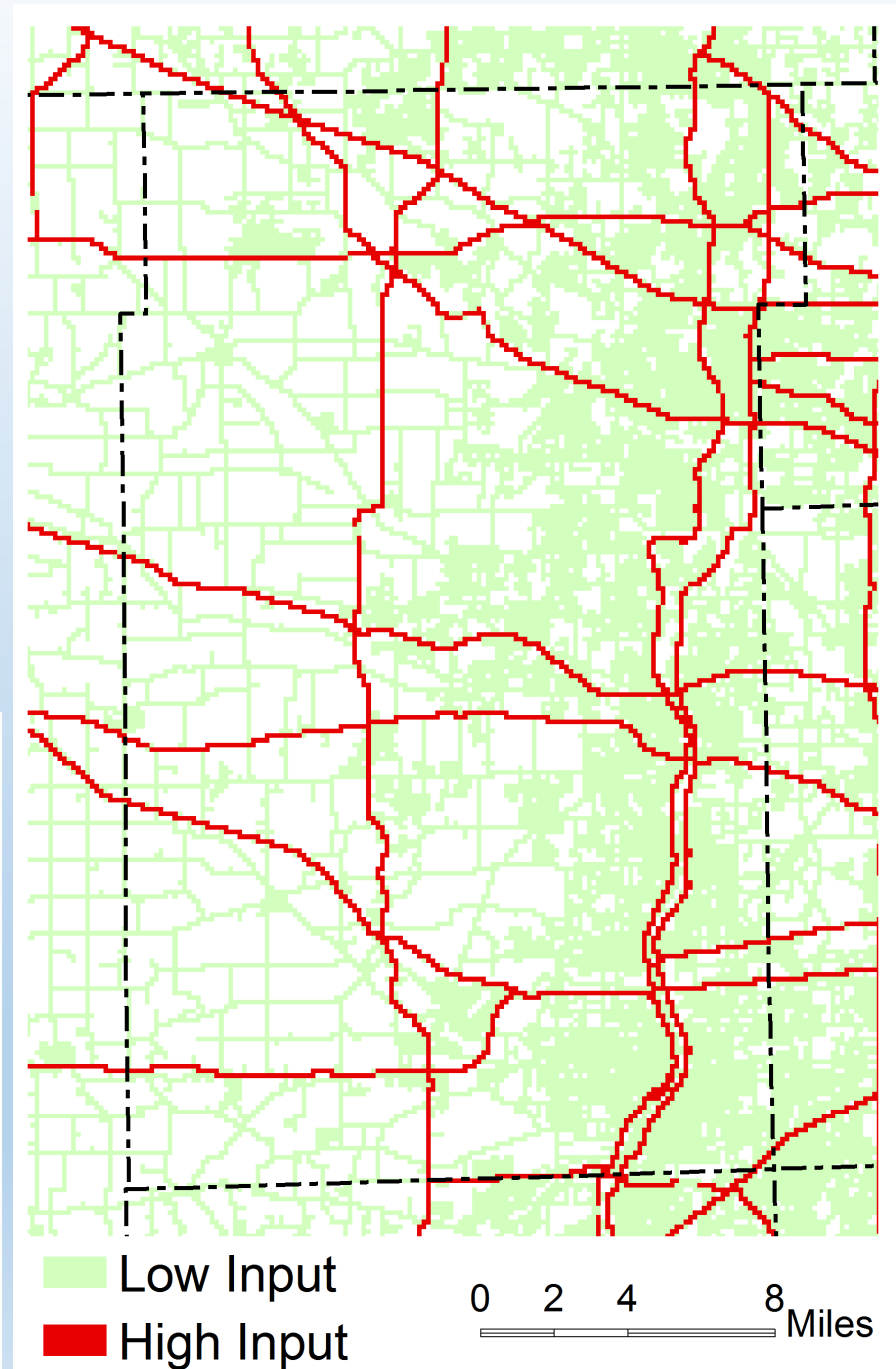
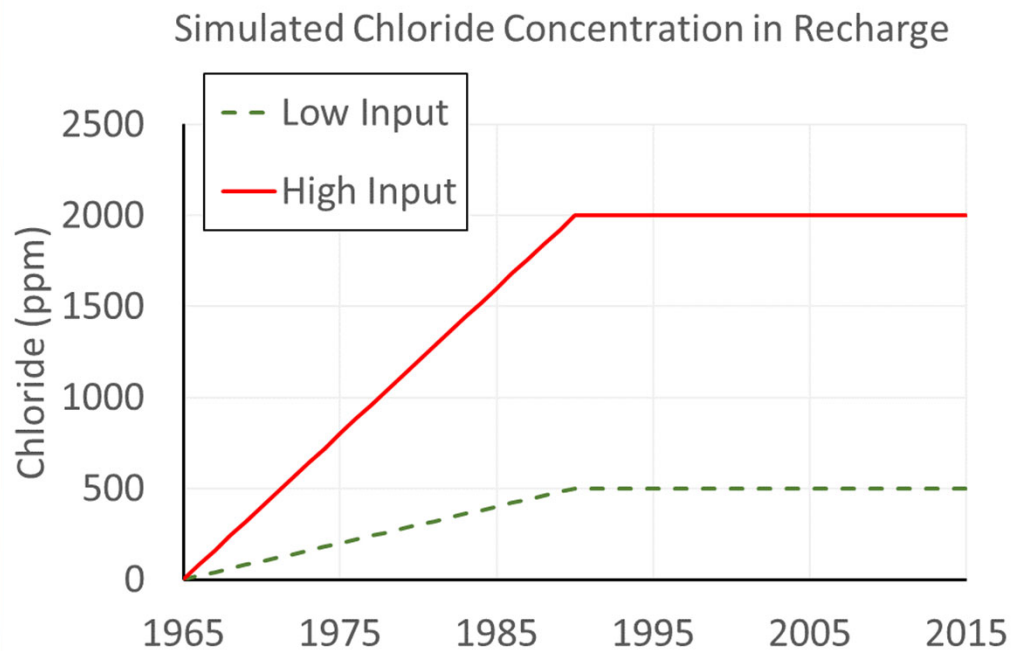
# Chloride study

Building off of Kelly et al. 2015, can we simulate future trends in chloride based on different road salt strategies?



# How we model

Assign chloride recharge concentrations based on the road network and other likely paved areas.

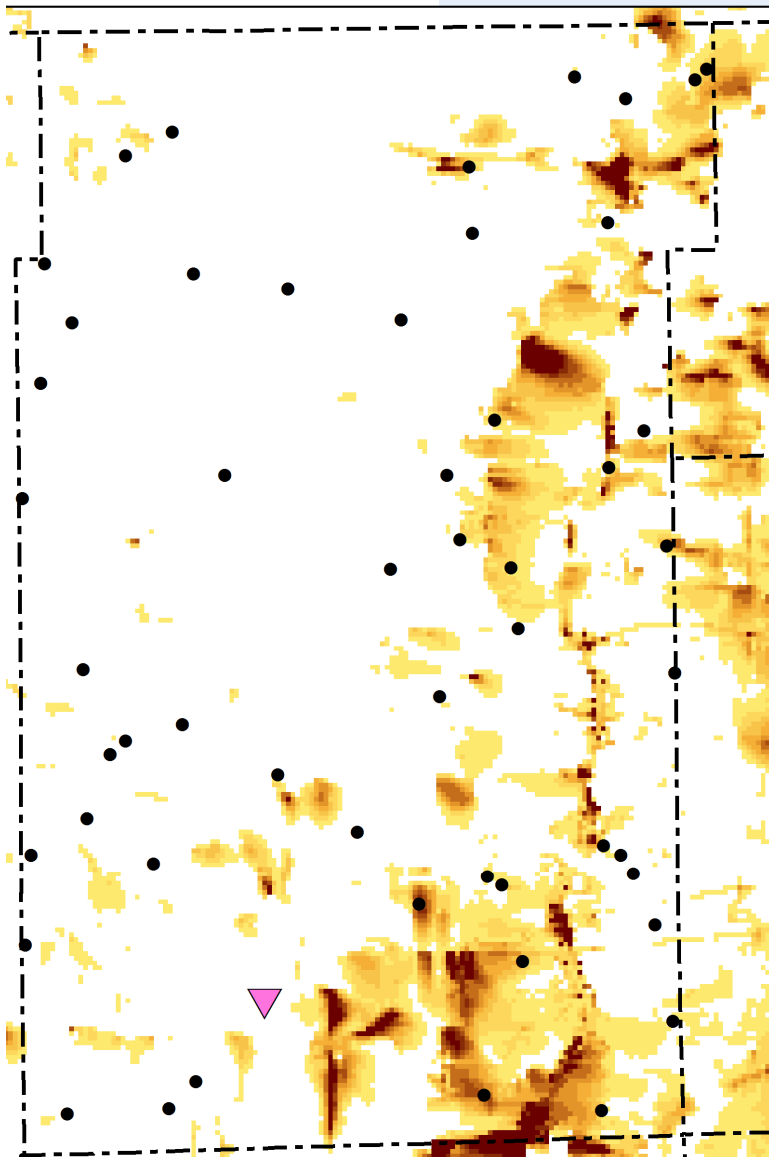


## Simulated Error

- ▲ Too High
- Within 30 ppm
- ▼ Too Low

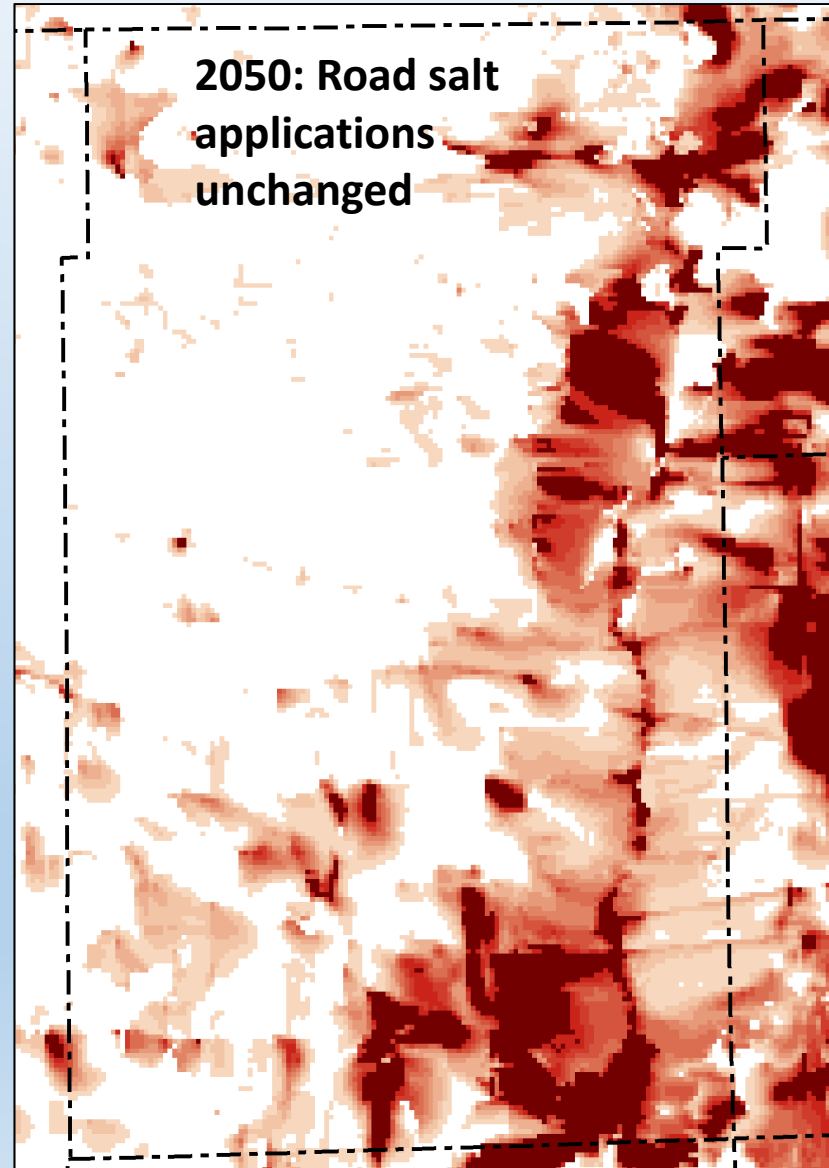
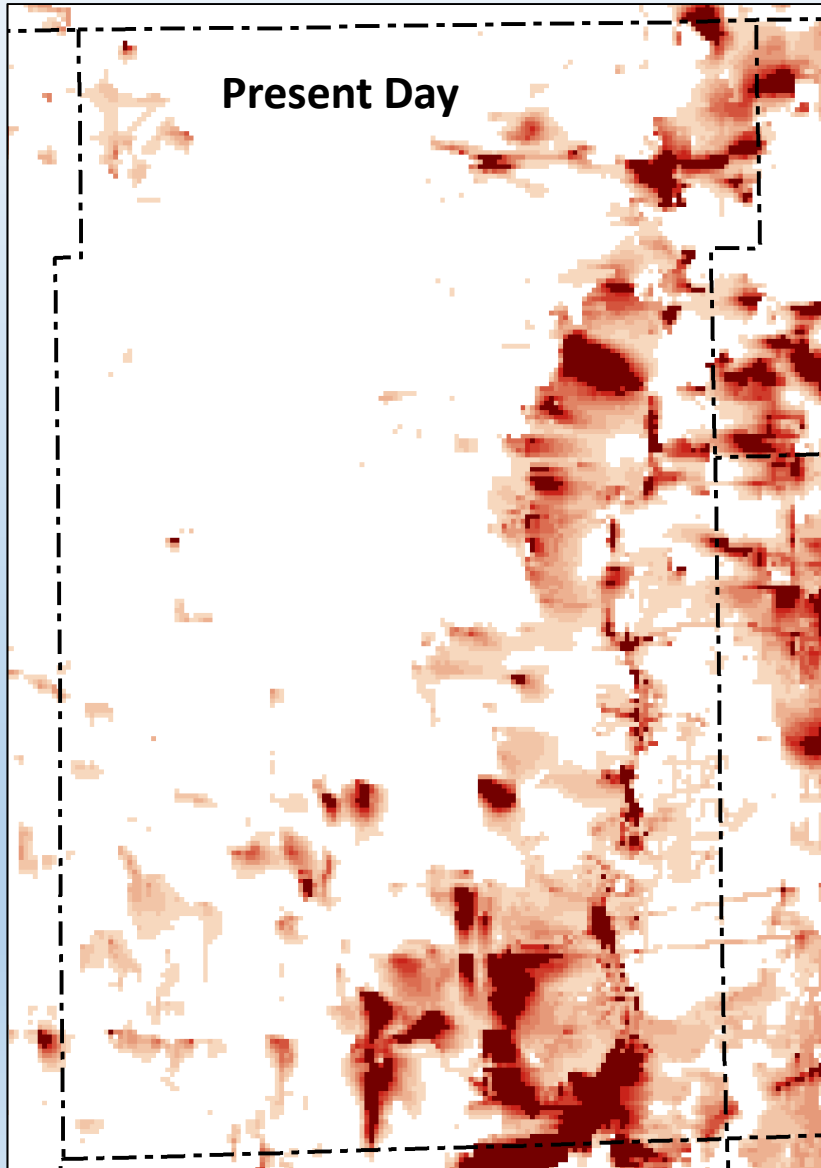
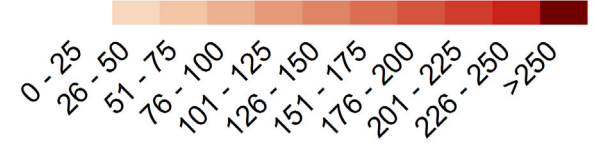
# Model calibration

Many simulated values fall above or below 30 ppm. Given the scattered distribution of high and low observations, this likely indicates the importance of unmodeled heterogeneity, not unexpected in this bedrock aquifer. To assess performance of the model on a regional scale, a 2 cell buffer (~ 0.25 mile) was assigned around each observation and paired with the best-match simulated value within that buffer. Only one observed value differed by more than 30 ppm.



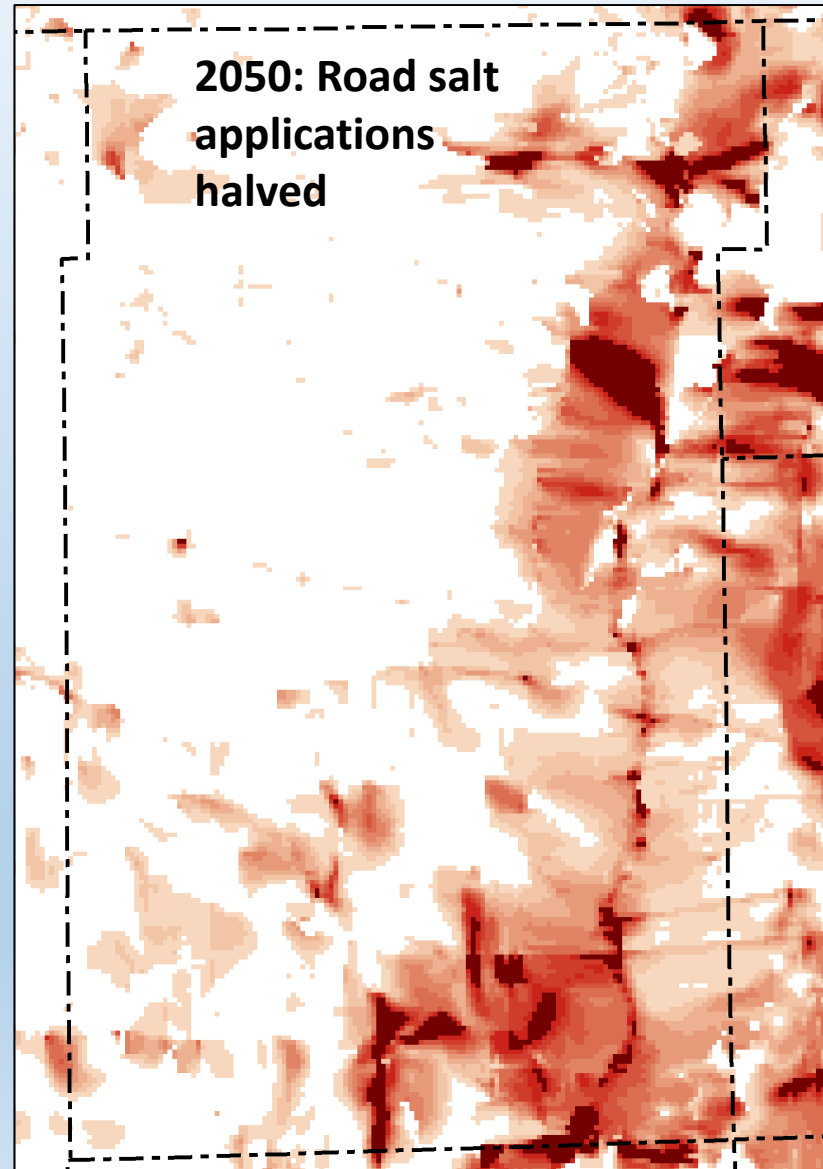
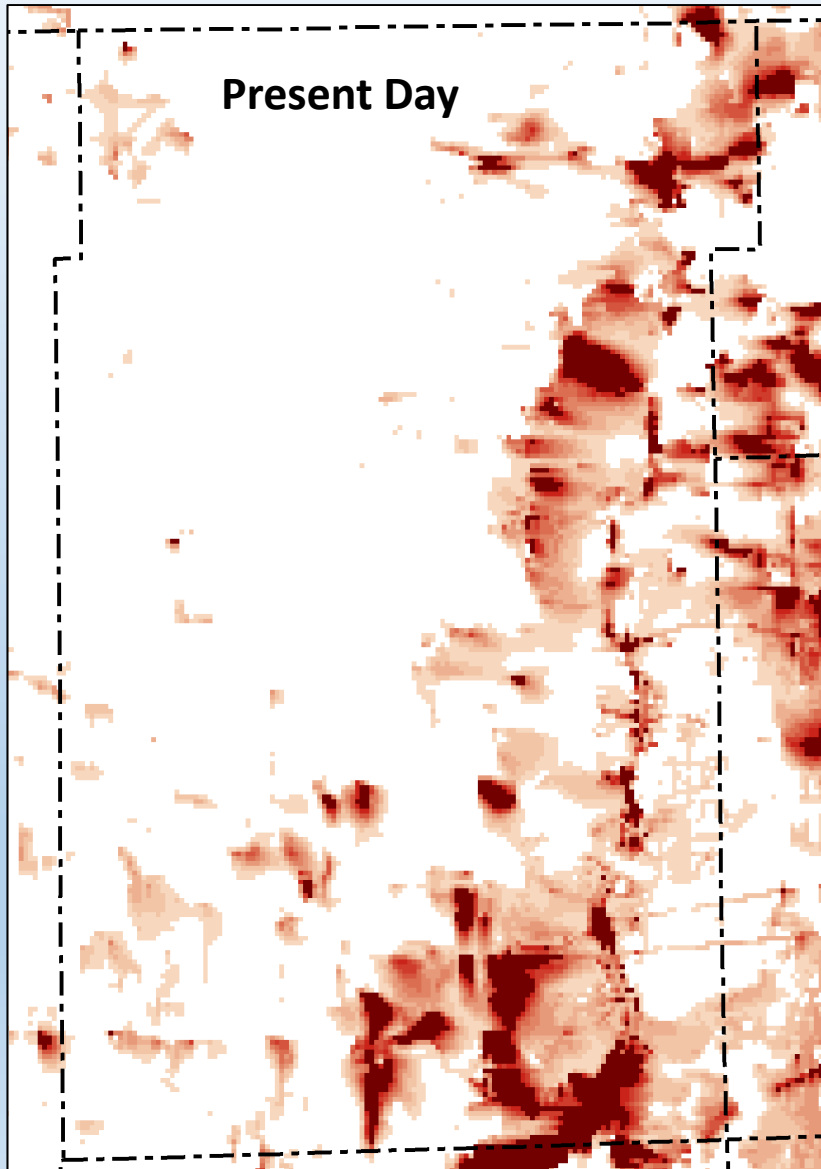
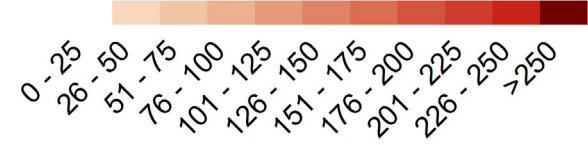
# Future simulations

Chloride in GW (ppm)



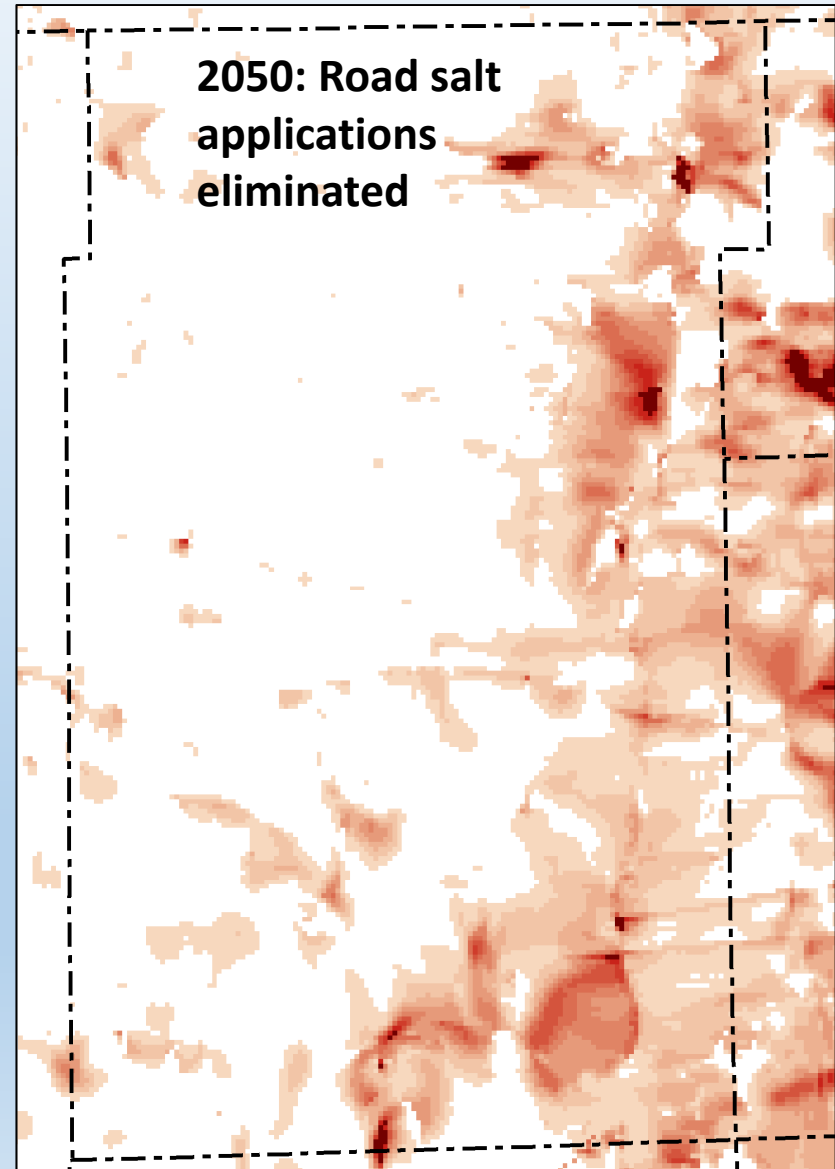
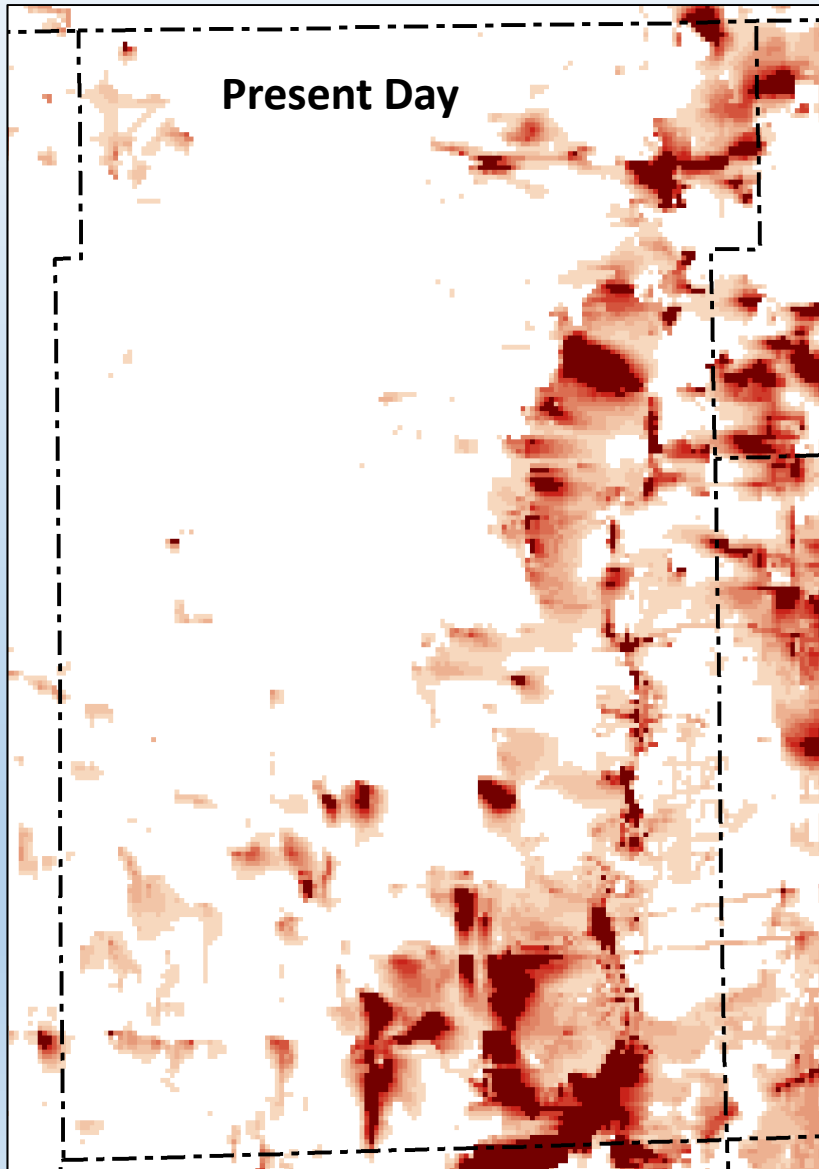
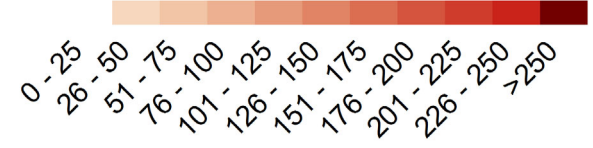
# Future simulations

Chloride in GW (ppm)



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Chloride in GW (ppm)



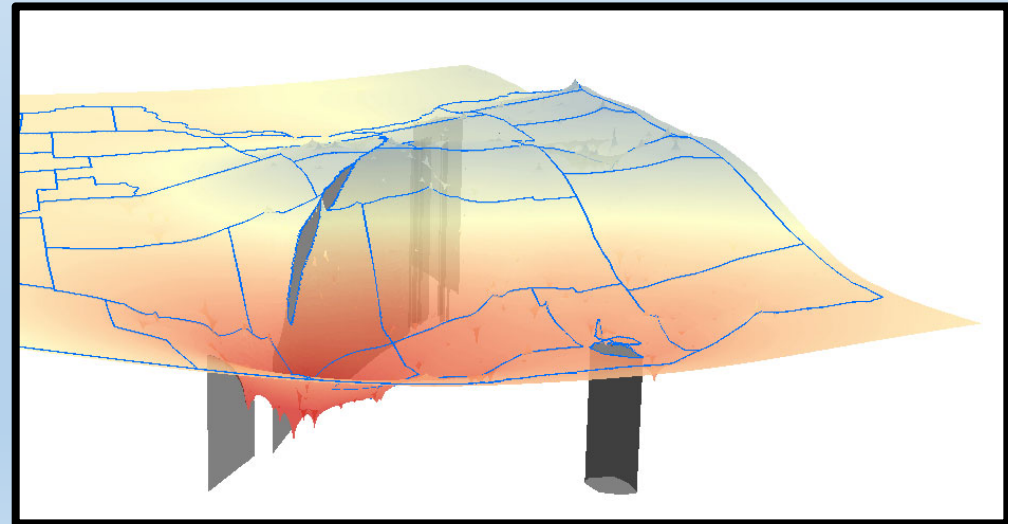
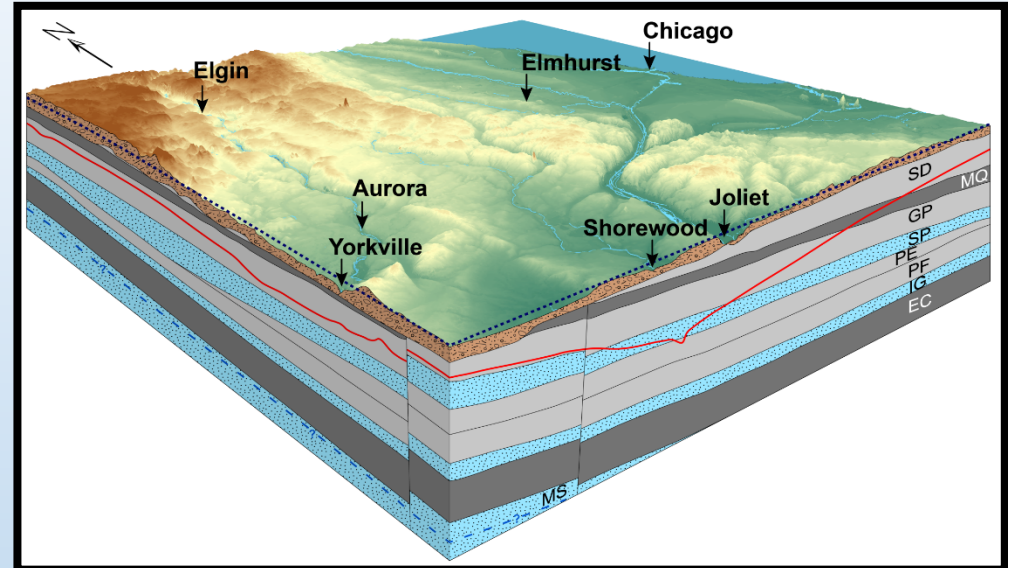
# Contact Information

Daniel Abrams  
Groundwater Modeler  
[dbabrams@illinois.edu](mailto:dbabrams@illinois.edu)  
217-244-1520

Daniel Hadley  
Hydrogeologist  
[drhadley@illinois.edu](mailto:drhadley@illinois.edu)  
217-300-0402

George Roadcap  
Hydrogeologist  
[roadcap@illinois.edu](mailto:roadcap@illinois.edu)  
217-333-7951

Walt Kelly  
Groundwater Science Section Head  
Groundwater Geochemist  
[wkelly@illinois.edu](mailto:wkelly@illinois.edu)  
217-333-3729



# Thank You



**Douglas Feltman**

