Addressing Groundwater Goals of the Missouri Regional Planning Area: Phase 2

Progress Report

January 5, 2023

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KU KANSAS GEOLOGICAL SURVEY
The University of Kansas

Phase 2 Objectives

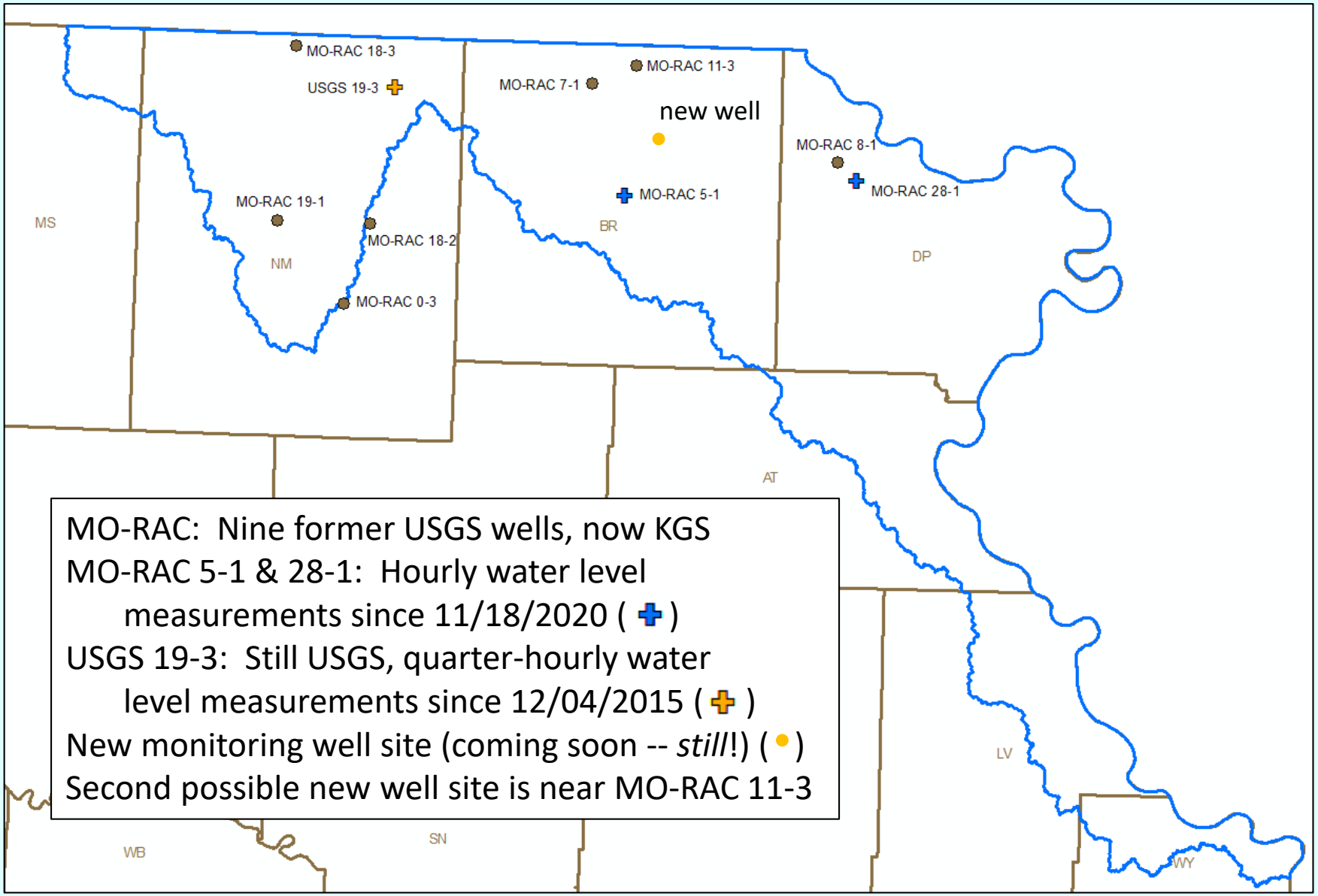
- Establish a groundwater level and groundwater quality monitoring network in the Missouri Regional Planning Area (MRPA)
- Provide improved estimates of safe yield and establish a groundwater quality baseline

Progress since last report

1. Continued continuous water level monitoring in two of the former USGS wells
2. Manually measured water levels and obtained water samples in all nine former USGS wells
3. Updated chemical analyses
4. Attempted to install new monitoring well NE of Hiawatha; made arrangements for another attempt
5. Identified a second possible new well location

The Quest for Monitoring Wells

Well Locations



MO-RAC: Nine former USGS wells, now KGS

MO-RAC 5-1 & 28-1: Hourly water level measurements since 11/18/2020 (✚)

USGS 19-3: Still USGS, quarter-hourly water level measurements since 12/04/2015 (✚)

New monitoring well site (coming soon -- *still*!) (●)

Second possible new well site is near MO-RAC 11-3

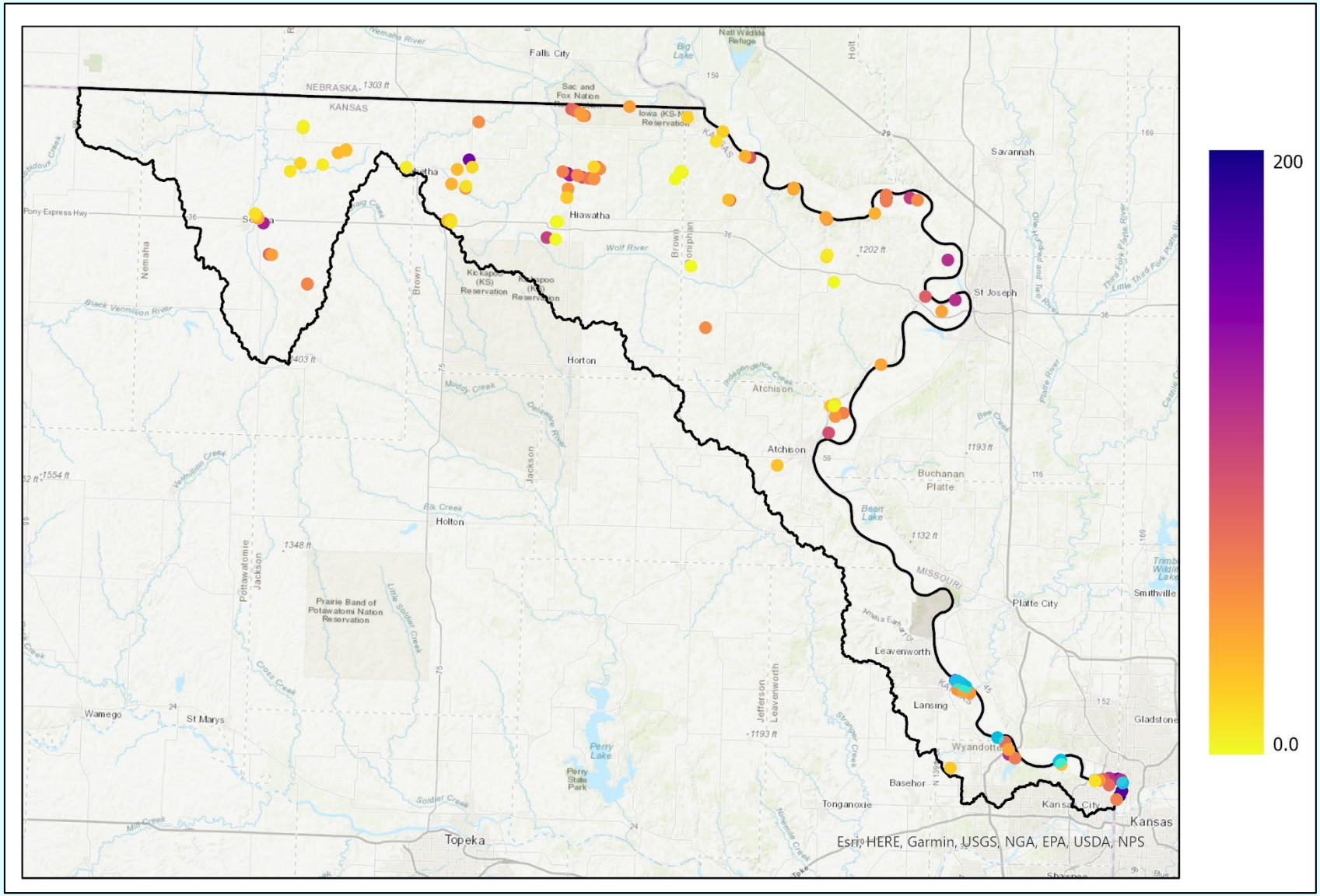
Monitoring Well NE of Hiawatha

- Told you a year ago that it was coming soon
- Tried to install a well in April using direct push but sticky clay thwarted our efforts
- Tried again in August using small-diameter augers, but sticky clay won again
- Have since made arrangements with a driller who works in this area
- Hopefully actually soon this time . . .

Monitoring Well Hurdles

- Difficult drilling environment
- Landowner permission
- Few candidate locations because . . .
- Groundwater use is patchy
  - From isolated patches of permeable material
  - *Not* from a regionally extensive aquifer

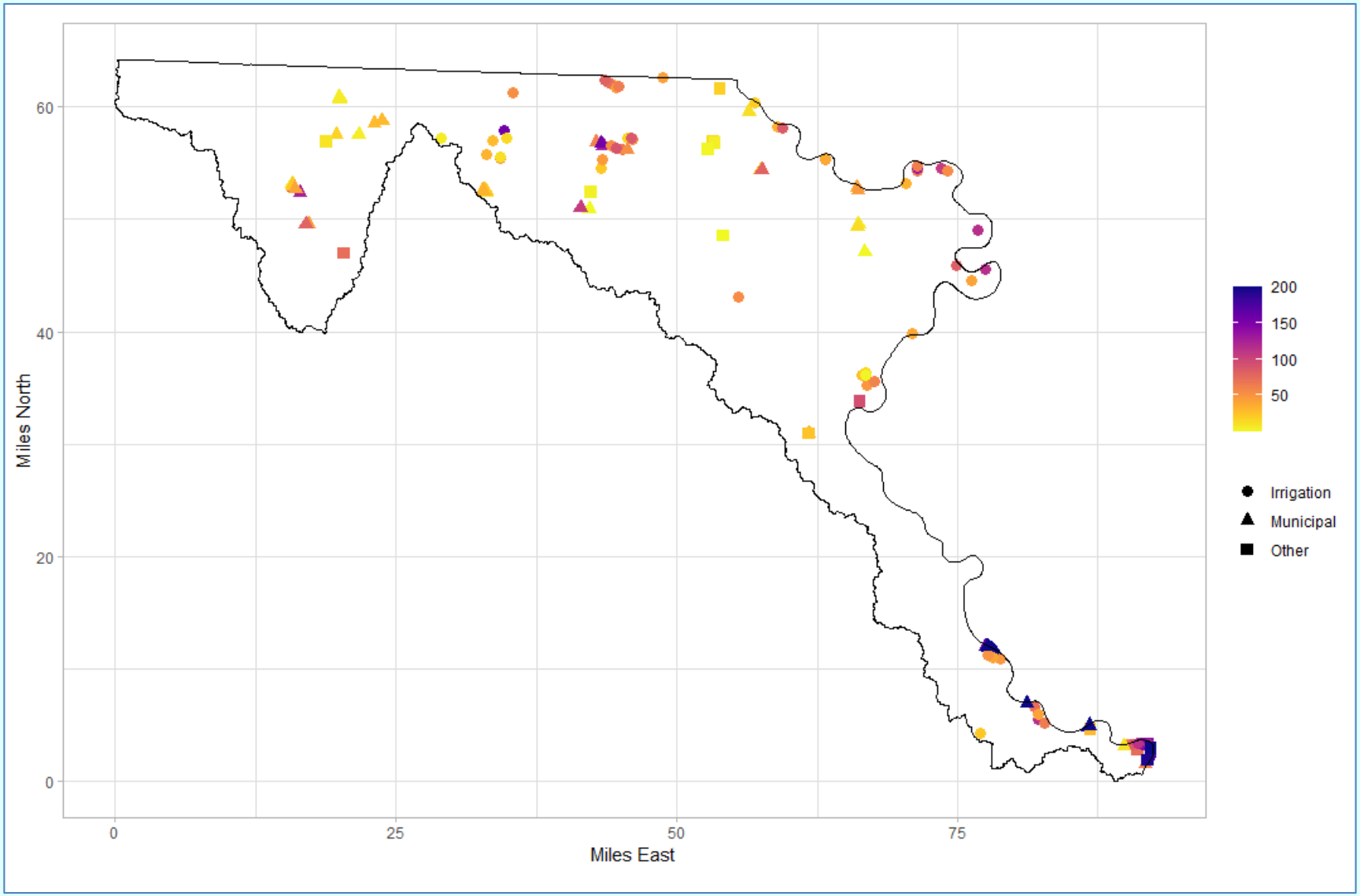
Average Annual Groundwater Use [acre-feet], 2017-2021



13* values > 200 AF (all in MO River valley, KC area) are represented as 200 AF

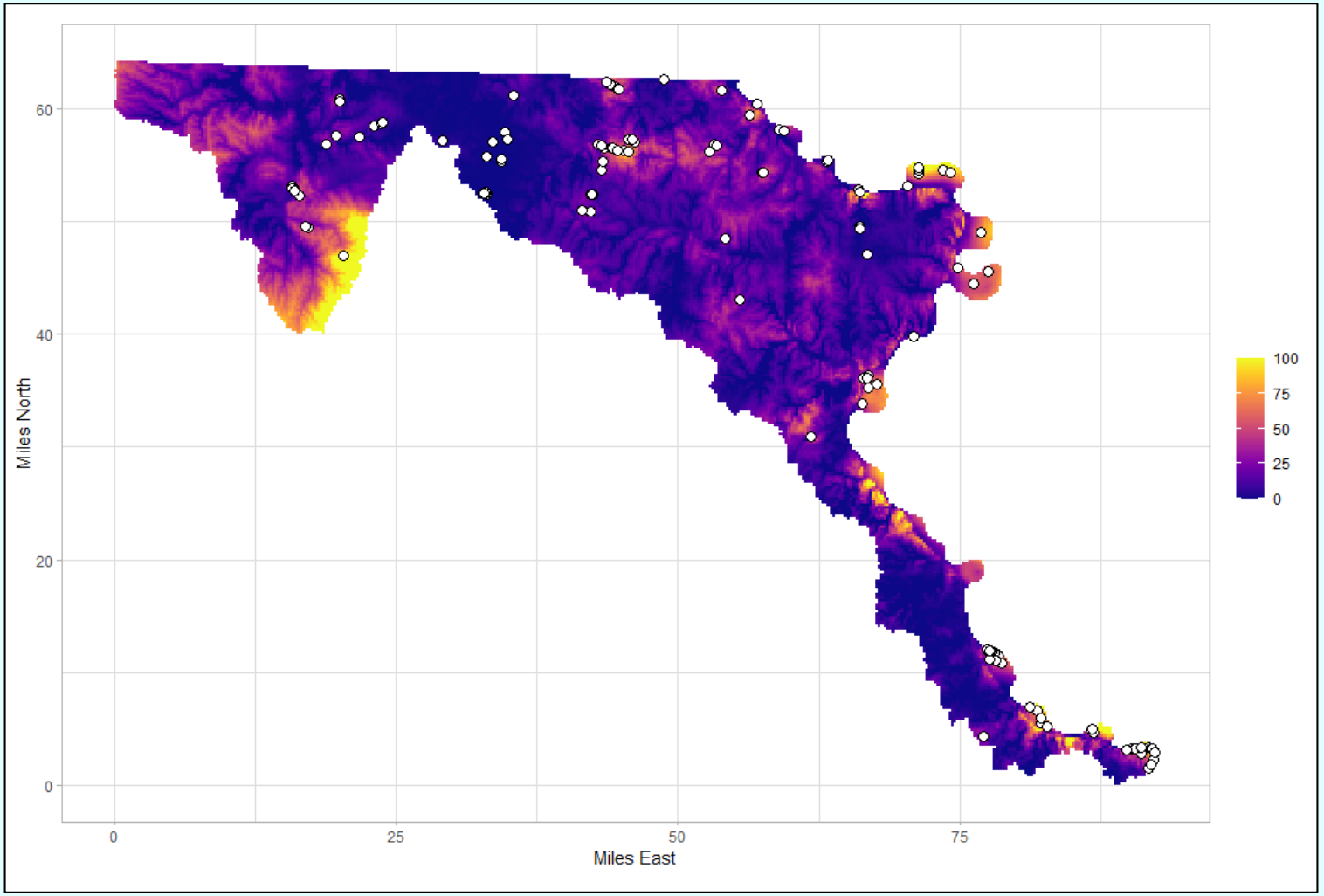
* of 138 total

Average GW Use [AF] and Type, 2017-2021



Other = stock, industrial, recreation

Footage Coarse (Above Bedrock)



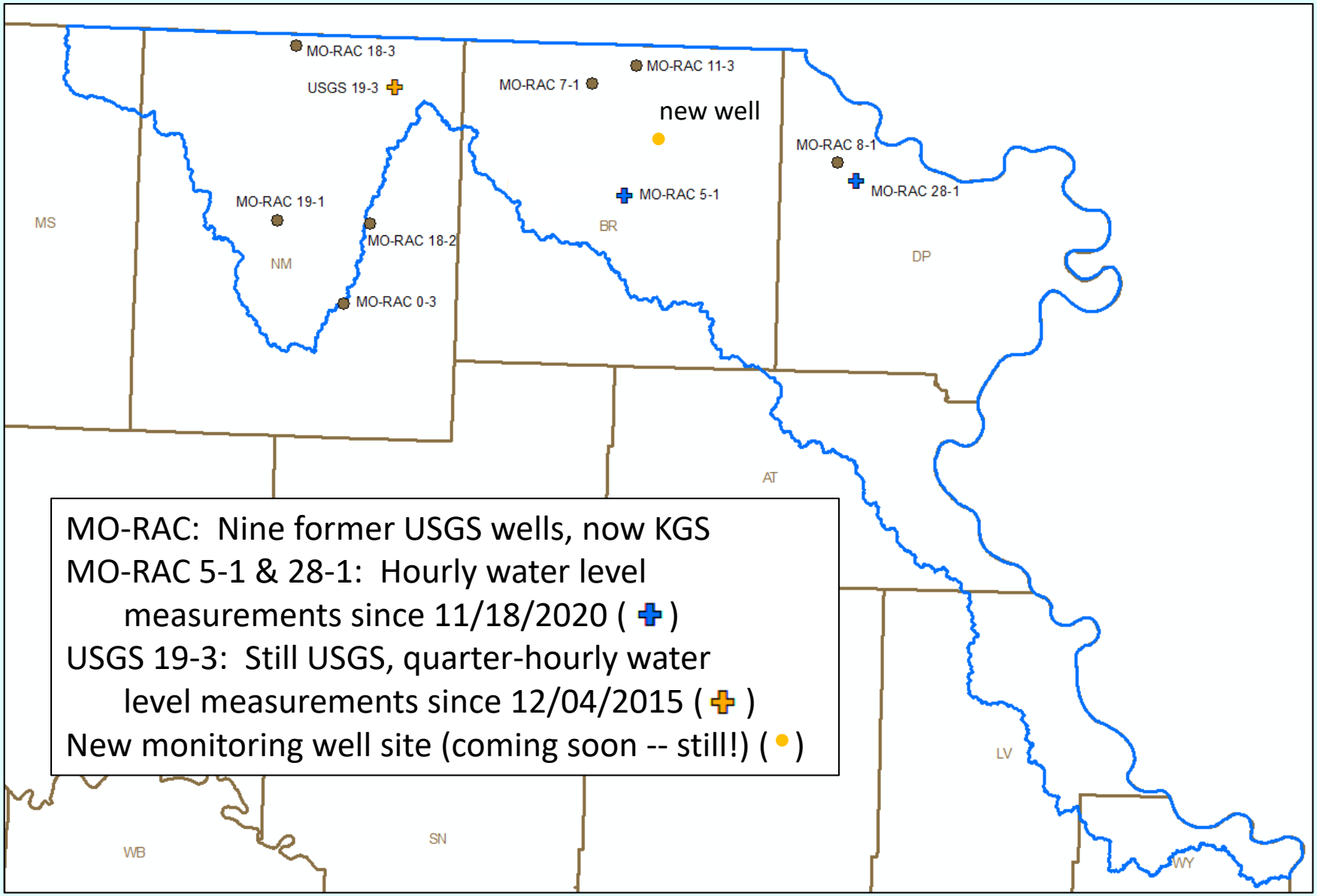
White circles are groundwater pumping locations.
Footages > 100 feet (1.2% of total) are shown as 100 feet.
Some wells draw from bedrock (fractured shale and/or limestone).

Eeyore Speaks

- Given the patchy nature of the permeable materials, responses to pumping are probably fairly localized
- Siting monitoring wells that respond to pumping will involve some luck
- Might not be meaningful to talk about safe yield in a regional sense

Water Levels

Well Locations



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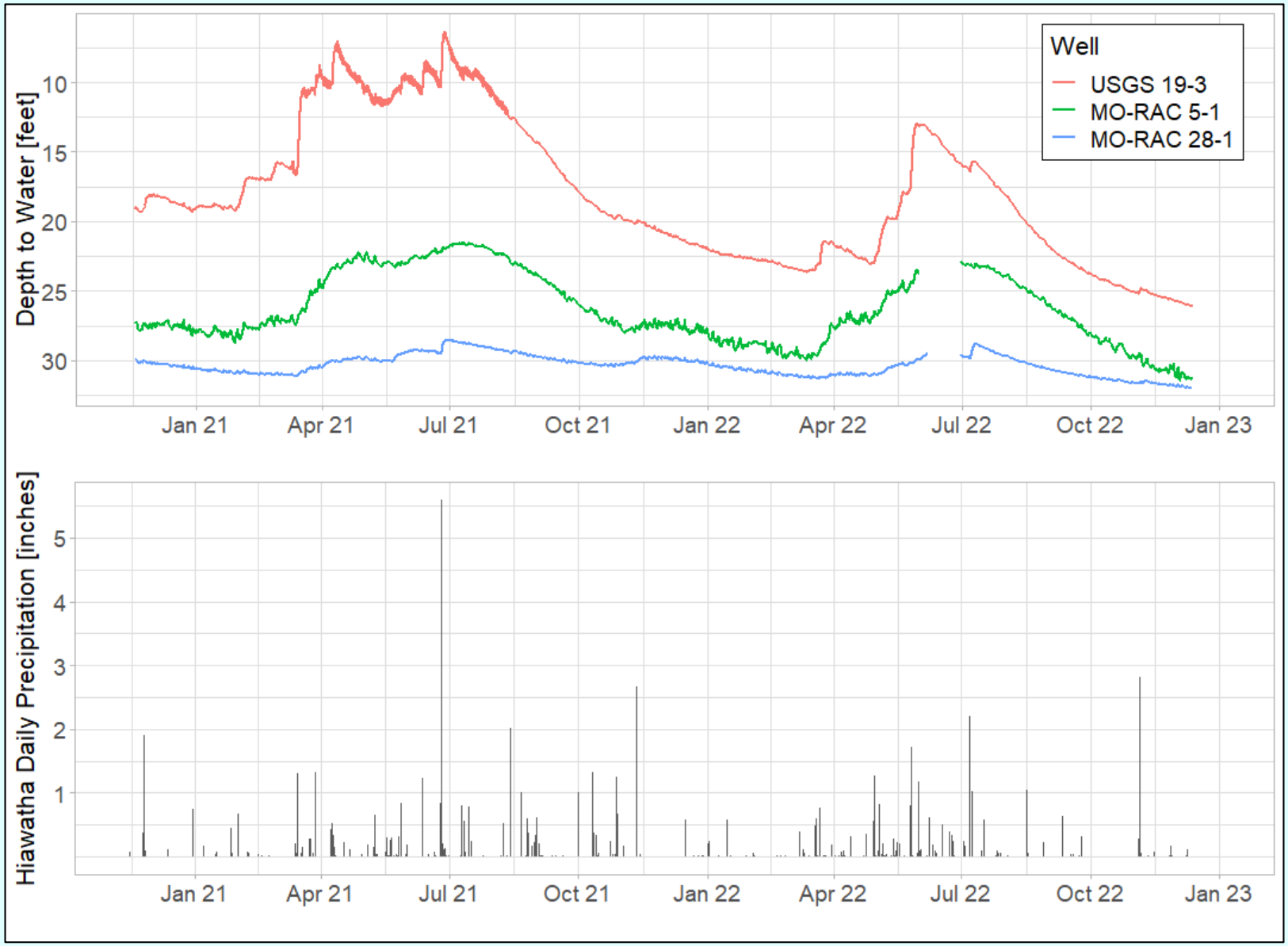
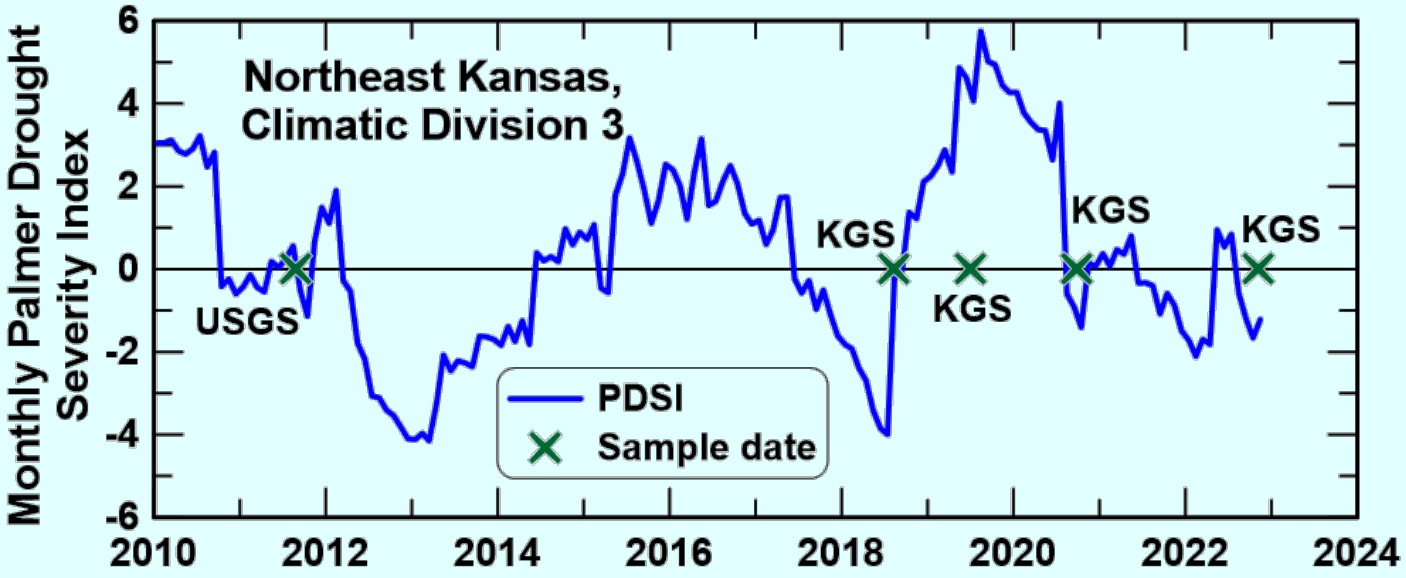
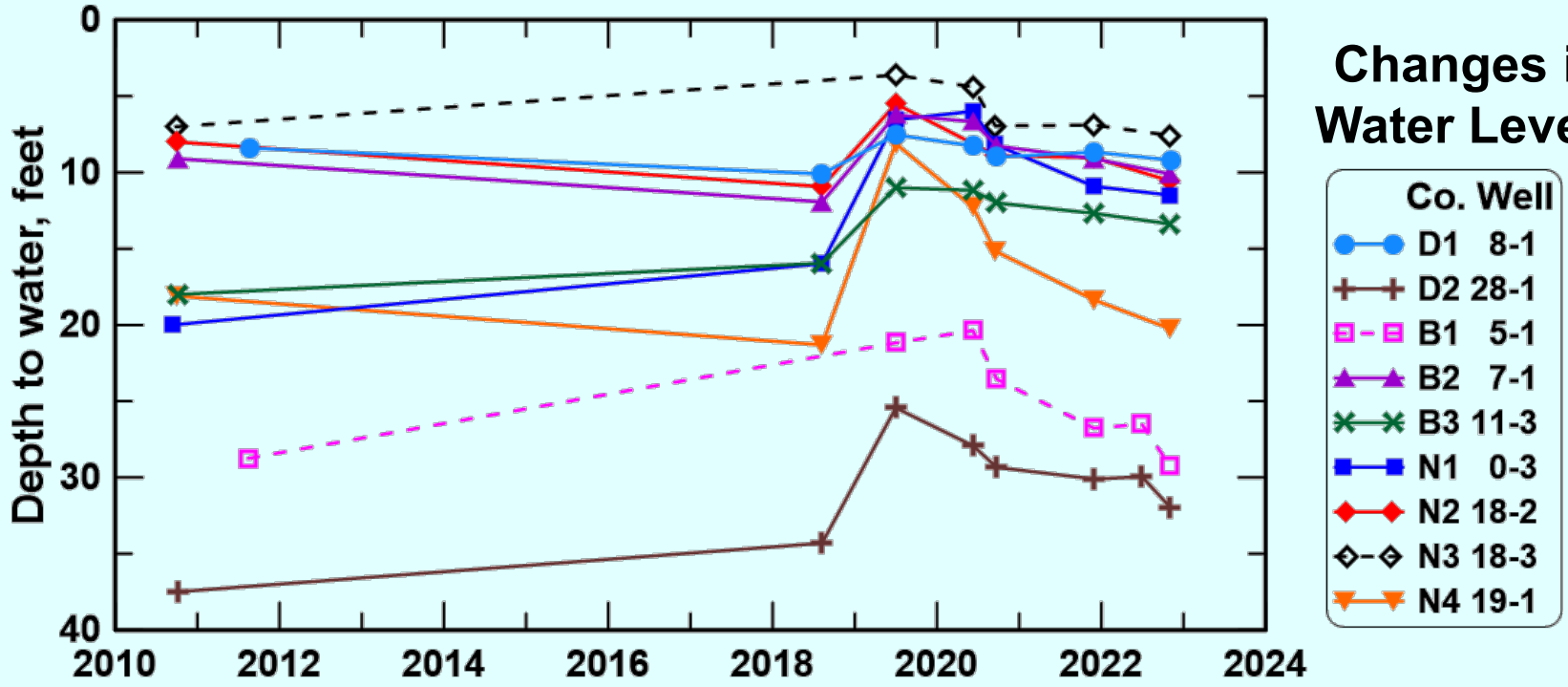
Continuous Measurements 11/18/20 – 12/12/22





Climate Conditions and Sampling Dates

Positive values indicate wetter than normal; negative values drier than normal.



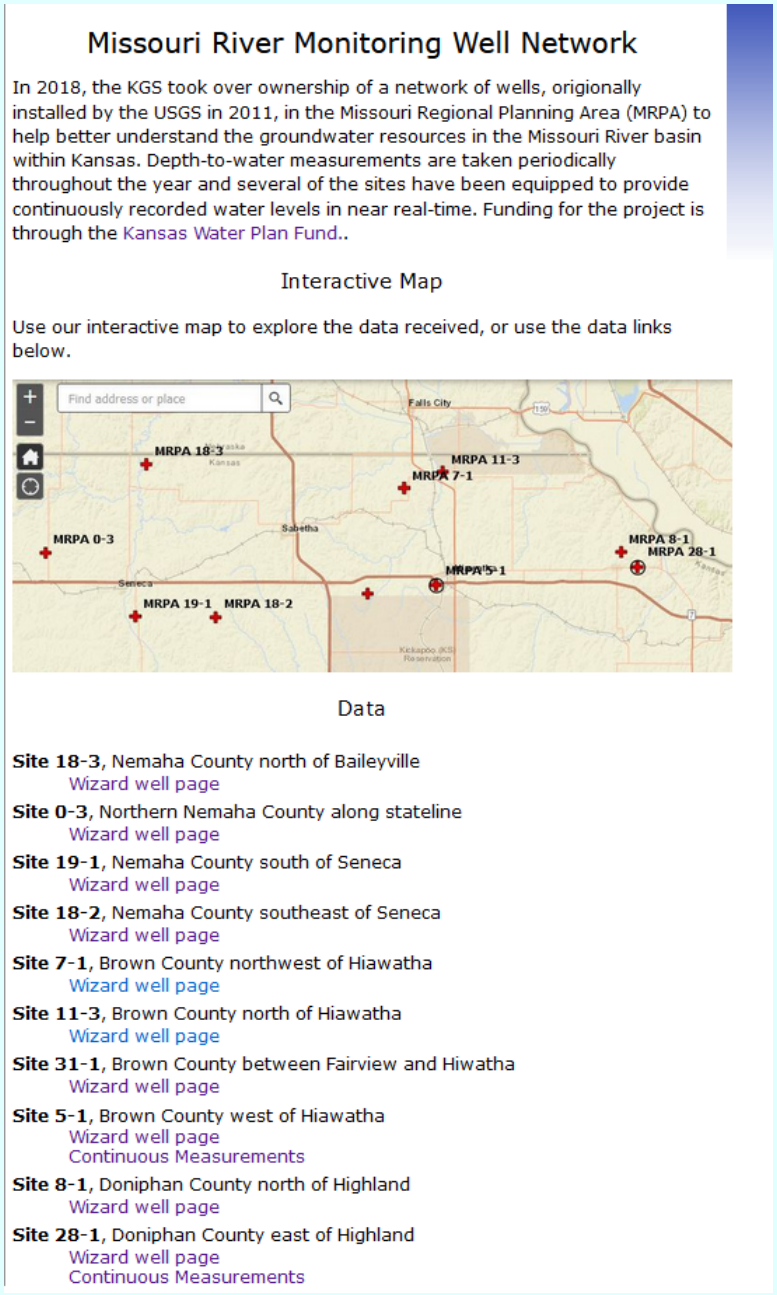
Changes in Water Levels

Water Level Data Page

https://www.kgs.ku.edu/Hydro/Missouri/mrpa/index.html

"Wizard well page" leads to manual measurements (in Wizard database)

"Continuous measurements" leads to continuous measurements



Missouri River Monitoring Well Network

In 2018, the KGS took over ownership of a network of wells, origionally installed by the USGS in 2011, in the Missouri Regional Planning Area (MRPA) to help better understand the groundwater resources in the Missouri River basin within Kansas. Depth-to-water measurements are taken periodically throughout the year and several of the sites have been equipped to provide continuously recorded water levels in near real-time. Funding for the project is through the Kansas Water Plan Fund..

Interactive Map

Use our interactive map to explore the data received, or use the data links below.

Data

Site 18-3, Nemaha County north of Baileyville
Wizard well page

Site 0-3, Northern Nemaha County along stateline
Wizard well page

Site 19-1, Nemaha County south of Seneca
Wizard well page

Site 18-2, Nemaha County southeast of Seneca
Wizard well page

Site 7-1, Brown County northwest of Hiawatha
Wizard well page

Site 11-3, Brown County north of Hiawatha
Wizard well page

Site 31-1, Brown County between Fairview and Hiwatha
Wizard well page

Site 5-1, Brown County west of Hiawatha
Wizard well page
Continuous Measurements

Site 8-1, Doniphan County north of Highland
Wizard well page

Site 28-1, Doniphan County east of Highland
Wizard well page
Continuous Measurements

Status Update

Phase II Project Tasks

- Water Quantity
  1. Assess robustness of existing (Phase I) data interpretation
  2. Improve location accuracy for some wells
  3. *Identify* and equip existing wells for continuous water level monitoring
  4. *Install new monitoring wells* in critical locations
  5. *Interpret groundwater level surface* and estimate aquifer storage and safe yield
- Water Quality
  1. Interpret existing water-quality data and trends
  2. *Select groundwater quality monitoring locations and collect samples*
  3. *Analyze samples*
  4. *Interpret new data* and plan for future sampling
- Information Dissemination
  1. Make information publicly available through project website

Focus for Next Few Months

- Install new monitoring well northeast of Hiawatha
- Possibly install second new monitoring well near MO-RAC 11-3
- Work on locating additional monitoring wells
- Consider reframing project objectives

Schedule

We've been stuck here a while

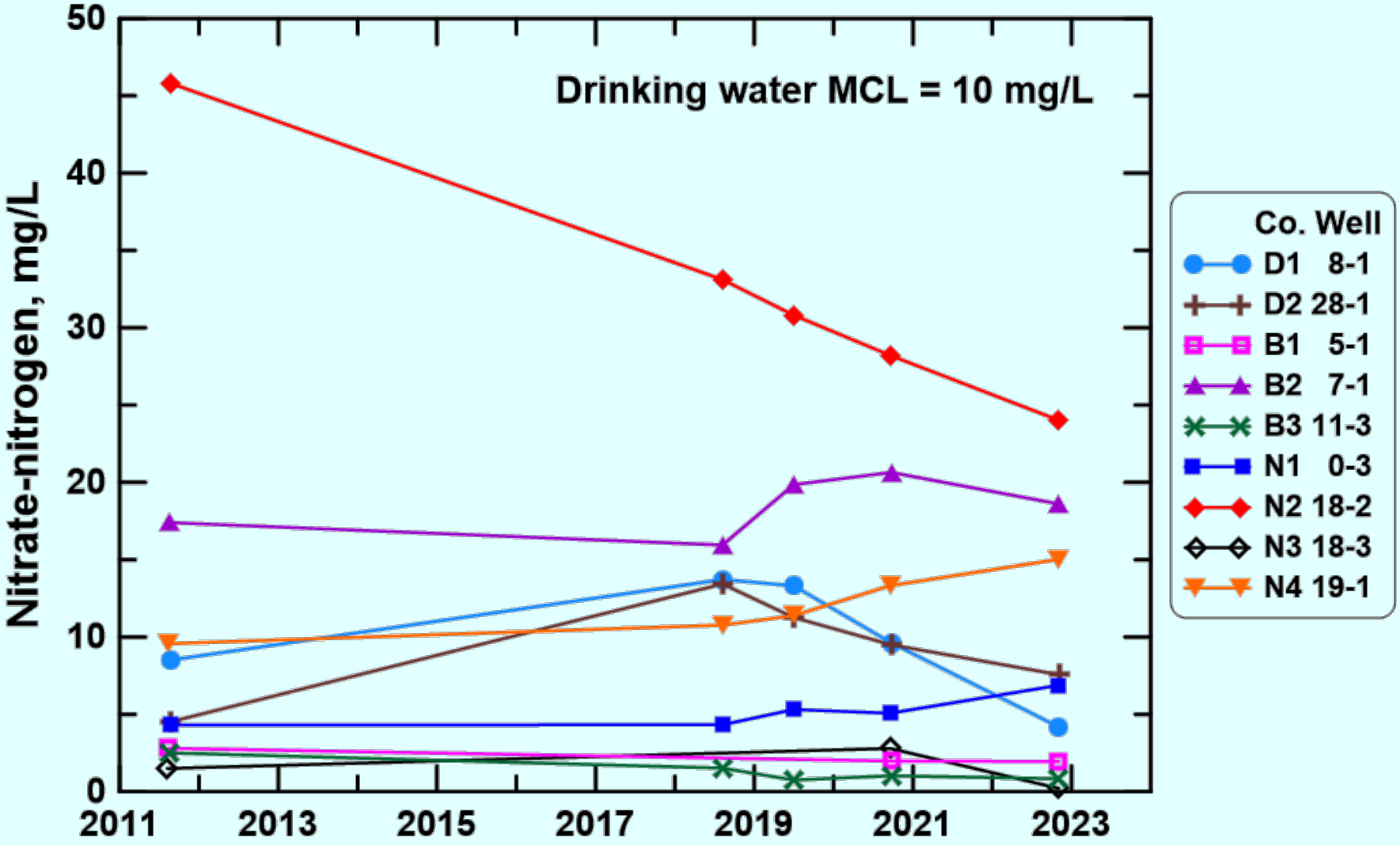
Task	Year 1	Year 2	Year 3	Year 4	Year 5
Water Quantity 1	✓				
Water Quantity 2	✓				
Water Quantity 3		✓			
Water Quantity 4					
Water Quantity 5	✓	✓			
Water Quality 1	✓				
Water Quality 2	✓	✓			
Water Quality 3	✓	✓			
Water Quality 4		✓			
Info. Dissemination	✓	✓			

Project web site:

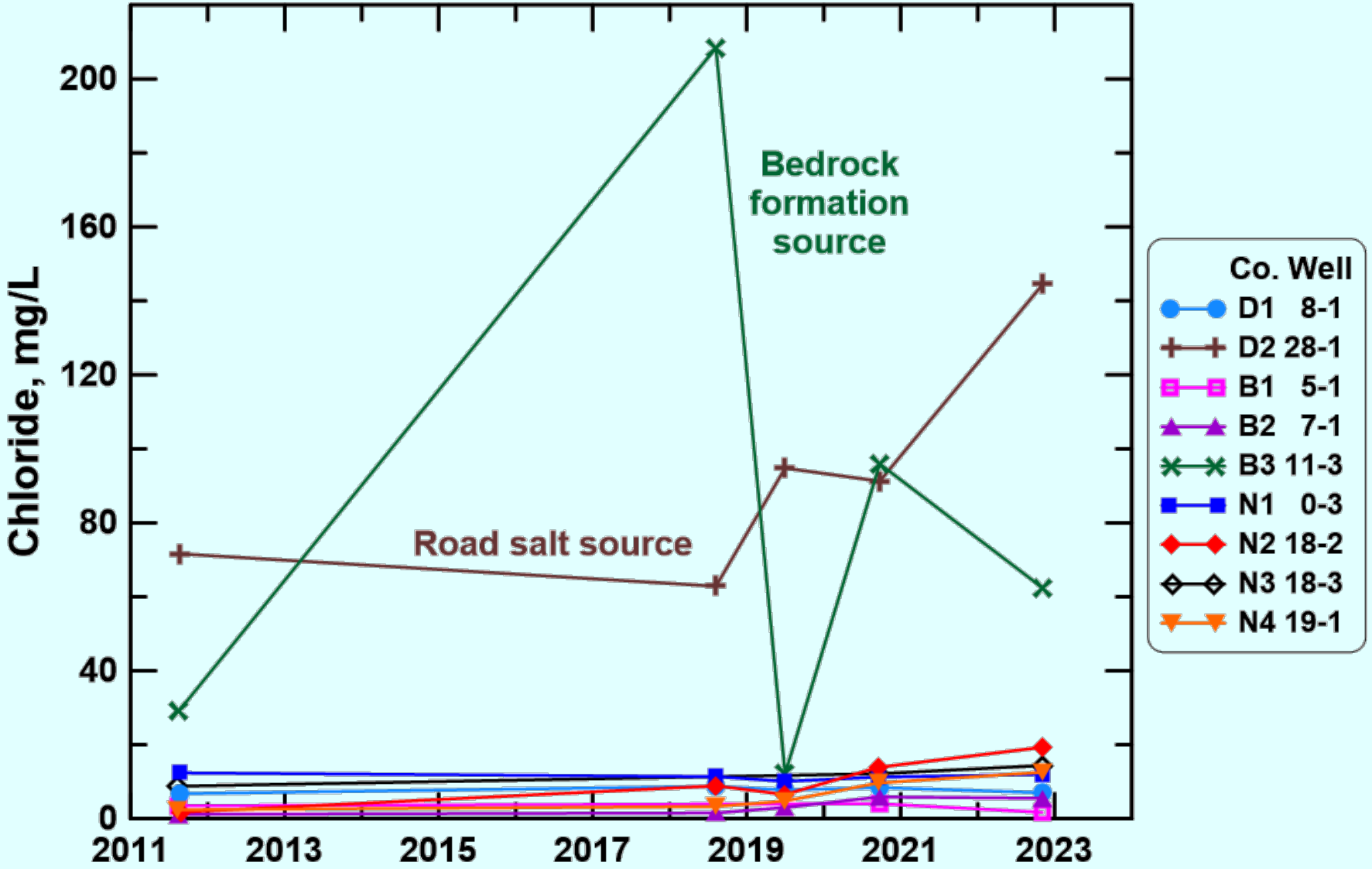
http://www.kgs.ku.edu/Hydro/Missouri/index.html

Variations in Water Quality, Factors Controlling Variations, and Sources of Nitrate and Chloride

Variation in Nitrate Concentration in Monitoring Wells



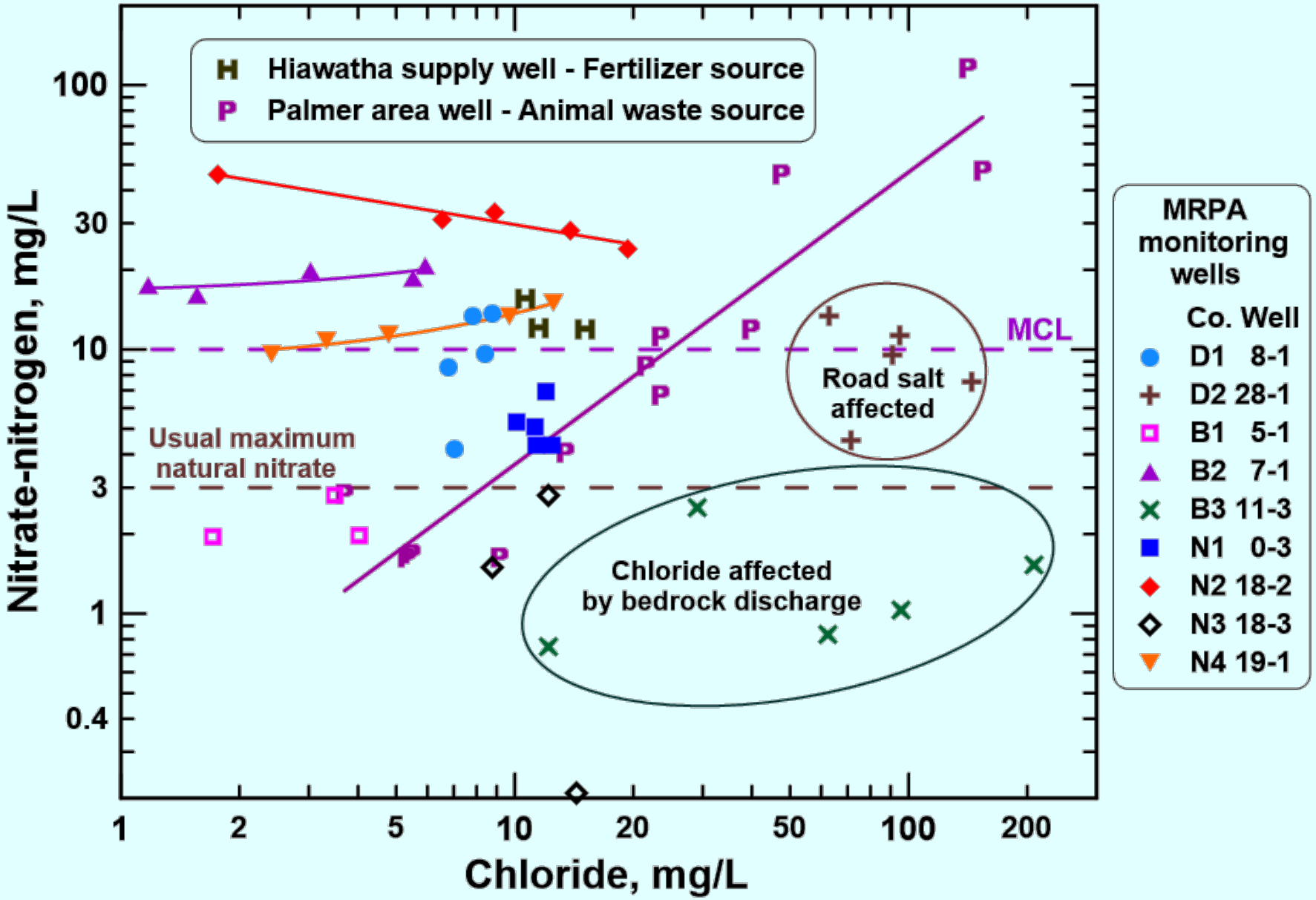
Variation in Chloride Concentration in Monitoring Wells



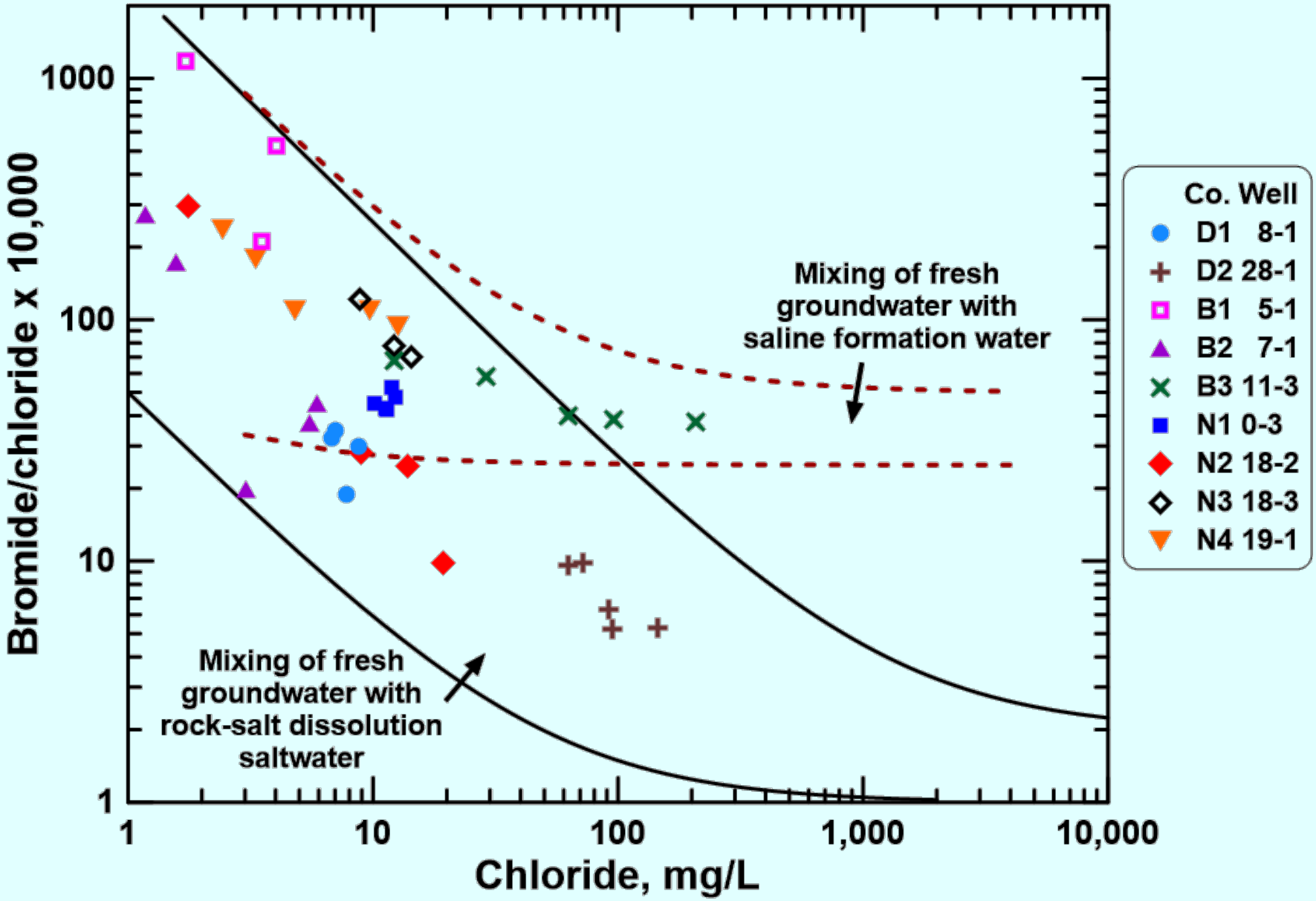
Dilution of saline bedrock water by precipitation recharge.

Infiltration of precipitation recharge that dissolved road salt.

Nitrate Source Based on Nitrate Versus Chloride Concentration



Chloride Source Based on Freshwater and Saline Water Mixing



OVERALL IMPLICATIONS

- Examination of aerial photos over time for monitoring well sites indicates that most are surrounded by agricultural fields, whereas the other sites appear to be in grasslands or riparian strips or water ways in fields adjacent to agricultural fields. The substantial differences in nitrate concentrations and variations suggest that rates of fertilizer application may vary substantially.
- Those monitoring wells in riparian areas or water ways in fields tend to have lower nitrate concentration. Well head protection by keeping unfertilized grassland or grass strips or treed areas around wells could be valuable for keeping nitrate concentrations lower.
- Wells screened above bedrock containing saline or mineralized water may tend to have higher dissolved solids concentrations during droughts.
- A slow increase in chloride concentration over extended time may occur in shallow aquifers in the areas near paved roads to which road salt is applied.