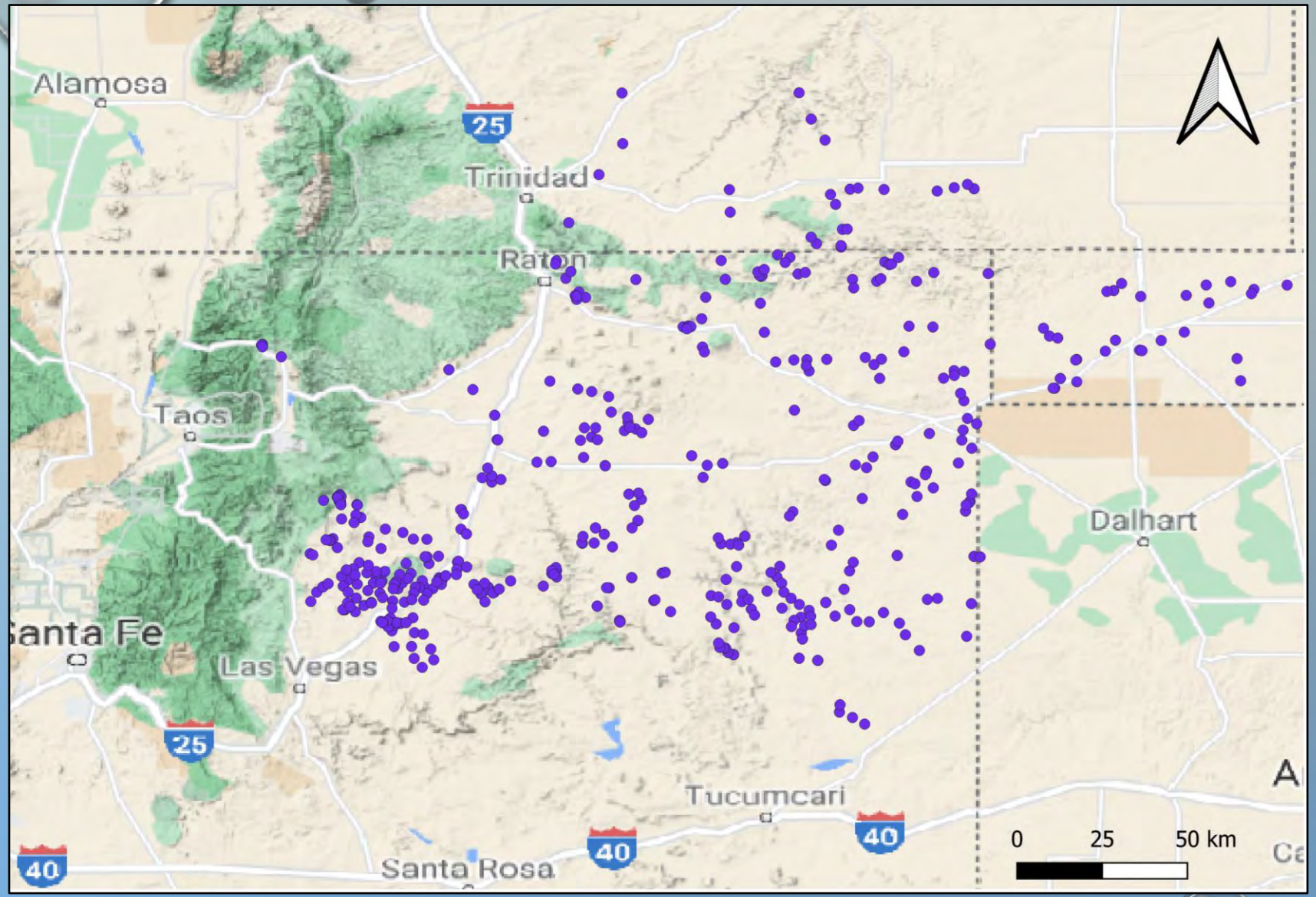
MANAGING GROUNDWATER: AN INVISIBLE RESOURCE

ZEIGLER GEOLOGIC CONSULTING, LLC

WESTERN GEOINFORMATICS

An invisible resource …

- Groundwater: Precious resource, but rarely understood!
  - Especially for rural agricultural communities.
- In northeastern New Mexico and southeastern Colorado, how much surface water is there?
- In the face of drought and variability in weather, much of eastern New Mexico and Colorado rely heavily on groundwater.
  - The concept of "oceans of water" beneath our feet – how true is this?
  - Groundwater resources
    - a limiting factor for agricultural production
    - Impacts on people, livestock and wildlife



Participating SWCDs:

- Northeastern
- Mora-Wagon Mound
- SW Quay
- Colfax
- Ute Creek
- Mesa
- Branson-Trinchera
- Spanish Peaks-Purgatoire River
- Cimarron

Partners:

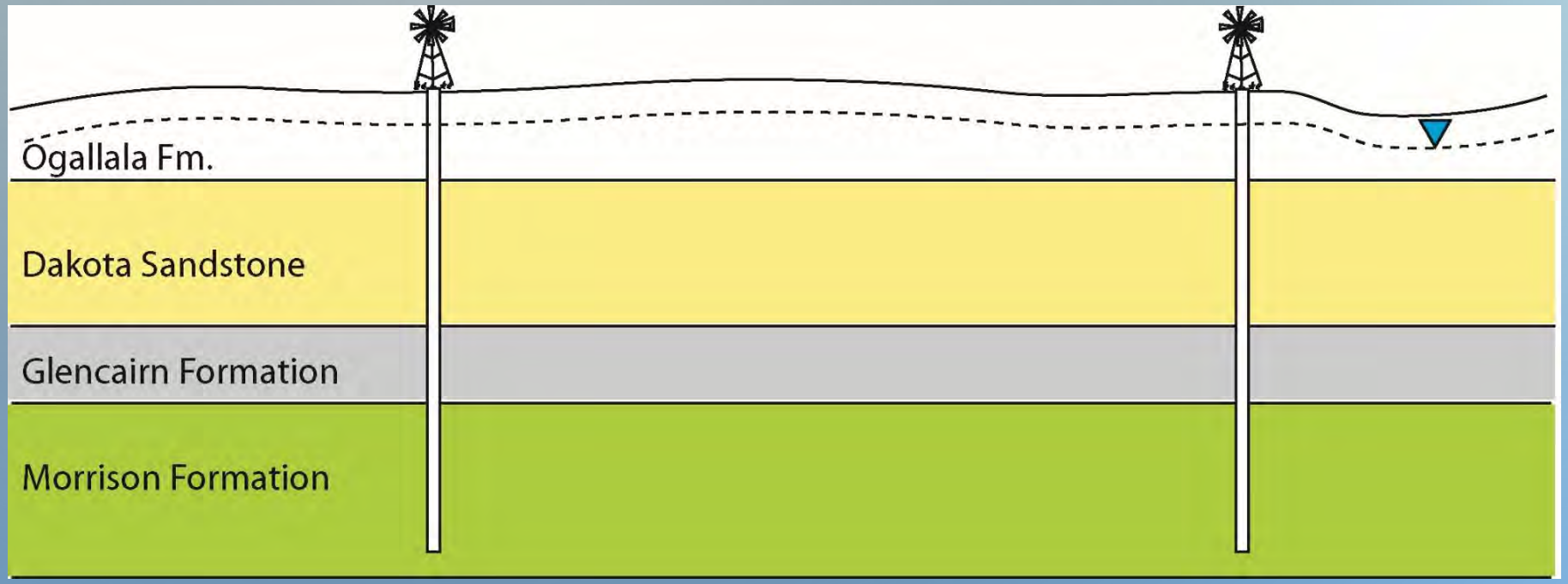
- El Llano Estacado RC&D
- Twin Willows Ranch
- DeHaven Ranch
- JX Ranch
- Tequesquite Ranch
- Ute Creek Cattle Co.
- Yesterday's Valley Ranch
- Sauble Ranch
- Trigg Ranch
- Fort Union Ranch
- Weaver Ranch
- Grasslans Foundation
- High Plains Grasslands Alliance
- NM State University

GEOLOGY AND GROUNDWATER

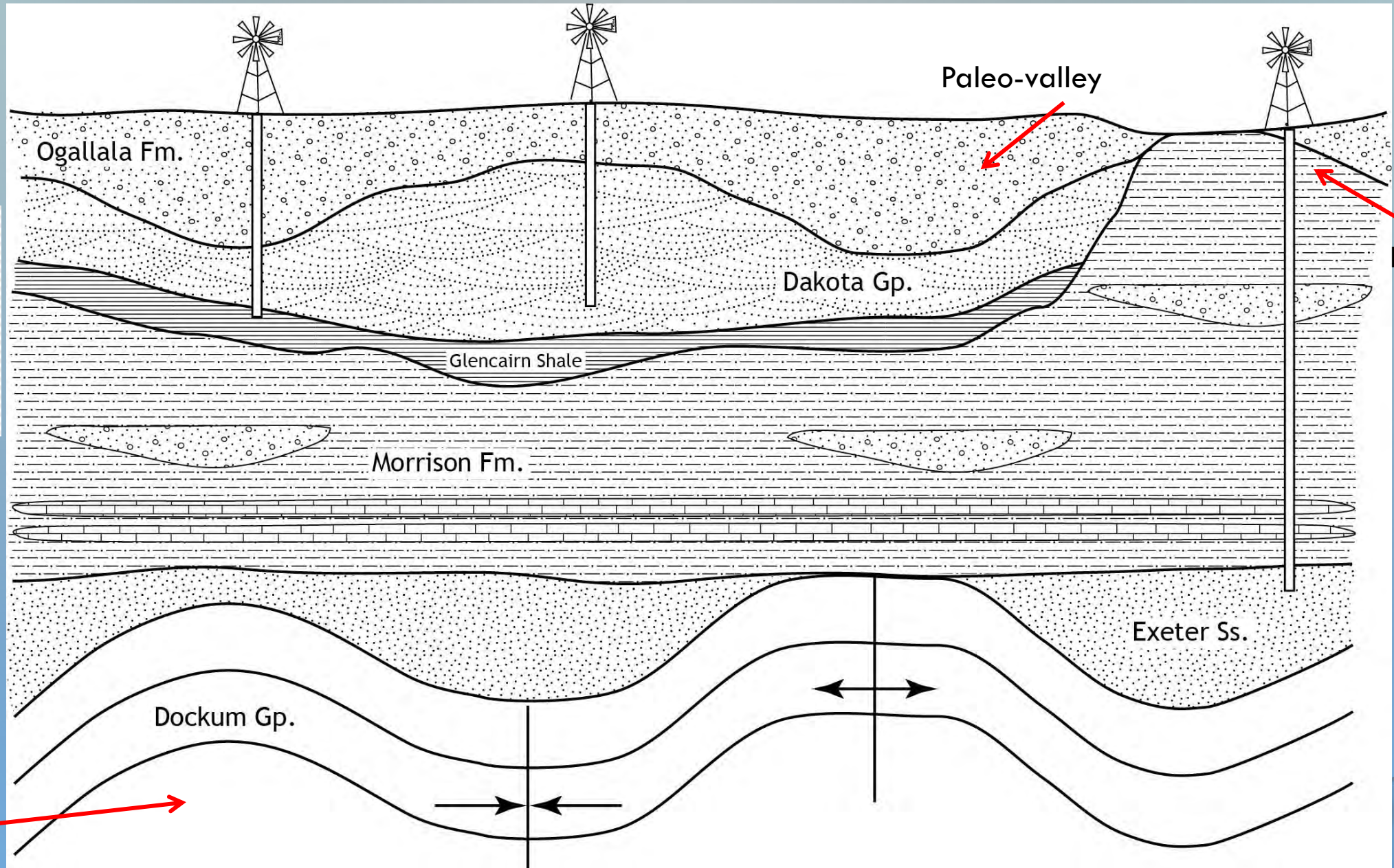
- An example: Union County
  - Majority of the county is rangeland with Hereford and Angus cattle production
  - Center pivot irrigation
    - Sedan, Seneca and Gladstone
- Why is irrigated farmland where it is? Why can't we farm everywhere?
- When we do get good rain or snow, is it doing the groundwater system any good?

WHAT WE THOUGHT WE HAD

Layer-cake geology: all rock units, and thus all potential aquifer units, are the same thickness, same rock type throughout, and the same depth below the ground.



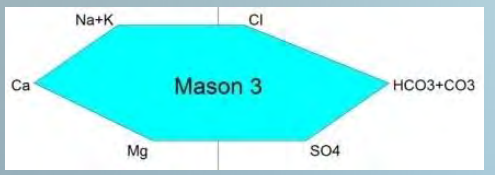
WHAT WE REALLY HAVE (SIMPLIFIED!)



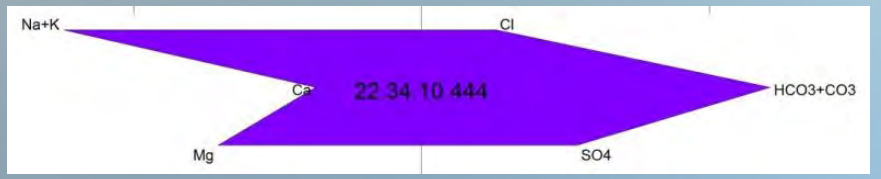
Folding: anticlines & synclines

BASIC GROUNDWATER DATA SETS

- BASIC DATA SETS THAT HELP US UNDERSTAND THE AQUIFER(S) AT PLAY:
  - **RADIOISOTOPIC DATING: ^{14}C AND TRITIUM**
  - **STATIC WATER LEVEL MEASUREMENTS**
  - WATER CHEMISTRY
  - REVISED AND NEW GEOLOGIC MAPS
  - PETROLEUM AND WATER WELL LOGS



Ogallala/Dakota well

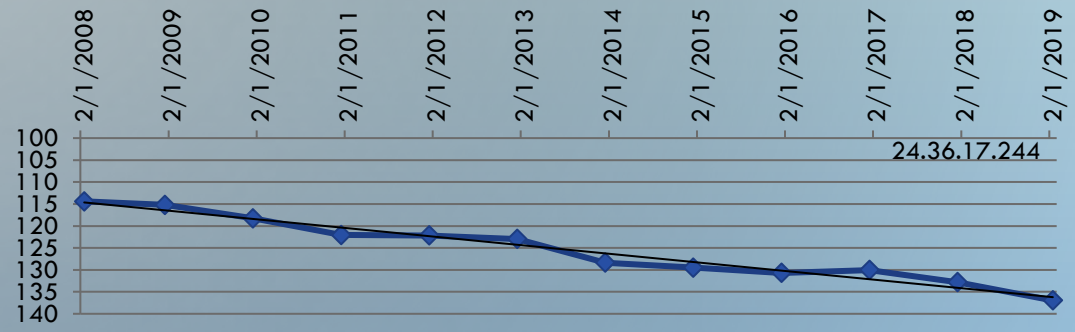


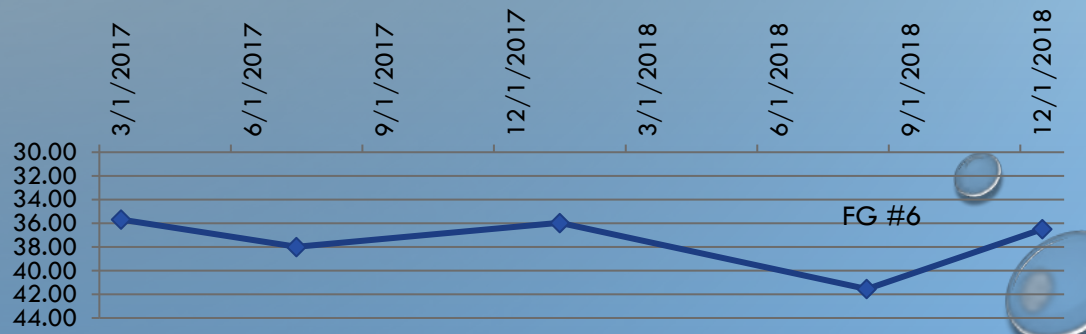
Morrison well

- →PARTNER HYDROLOGY WITH GEOLOGY FOR A COMPLETE PICTURE OF LOCAL AQUIFER SYSTEMS, THEN COUPLE GROUNDWATER DATA + AG MANAGEMENT PLANNING.
- →GROUNDWATER MANAGEMENT AS A COMPONENT OF CROP/RANGE MANAGEMENT PLANS & TO SUPPORT WILDLIFE HABITAT REHABILITATION.

STICKING TO THE BASICS: STATIC WATER LEVELS

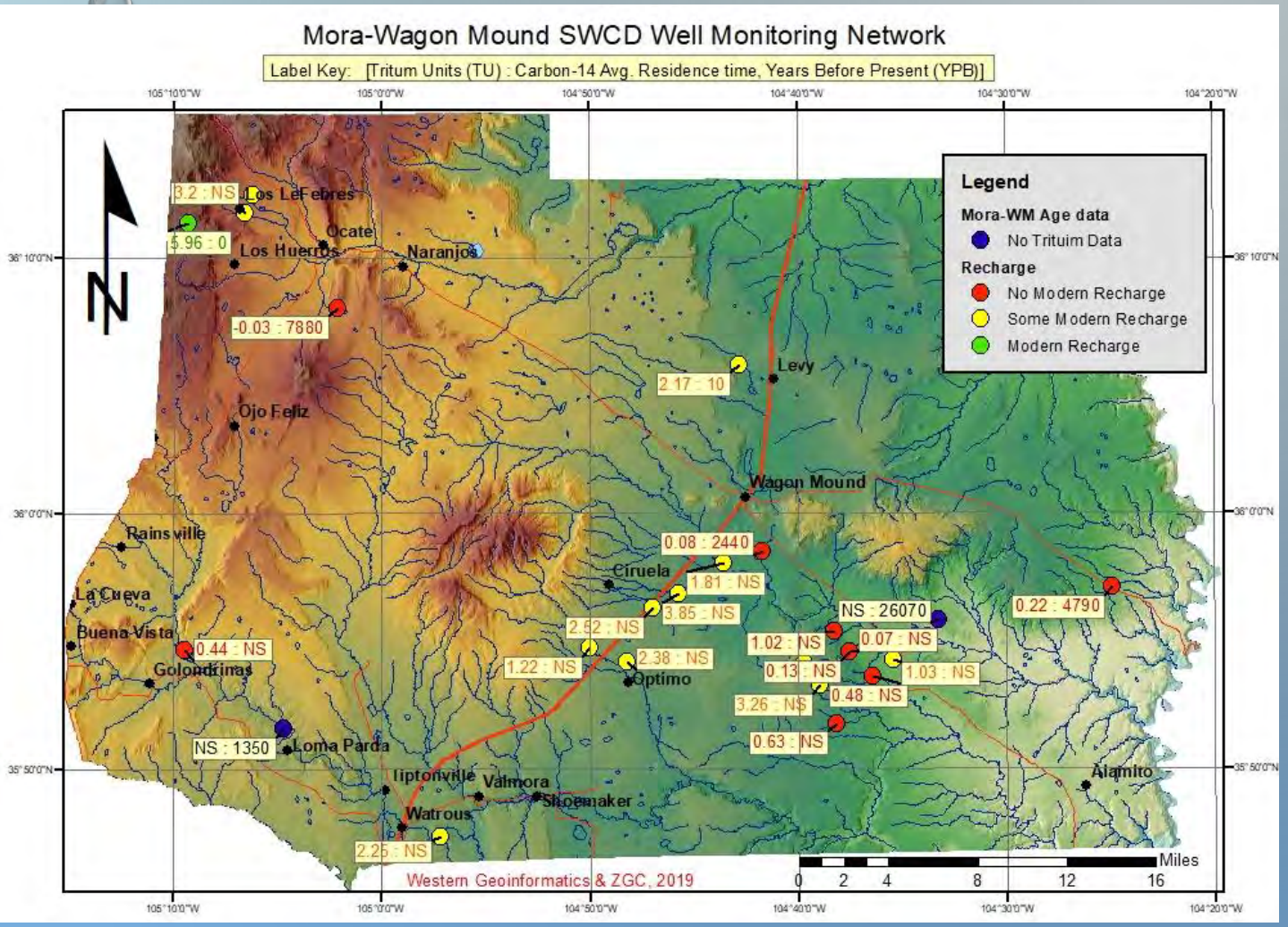
- MEASURING STATIC WATER LEVELS IS A FUNDAMENTAL DATA POINT:
  - HOW DEEP IS THE WATER TABLE BELOW LAND SURFACE?
  - HOW DOES THE WATER LEVEL CHANGE OVER TIME?
    - MAXIMUM USE DURING SUMMER VERSUS MINIMUM USE DURING WINTER
    - DOES THE WATER TABLE RECOVER DURING MINIMUM USE SEASON?
    - DOES THE WATER TABLE APPEAR TO BE PERMANENTLY CHANGED OVER THE COURSE OF SEVERAL YEARS?
  - → ONE OF YOUR FIRST INDICATORS ABOUT WATER TABLE BEHAVIOR

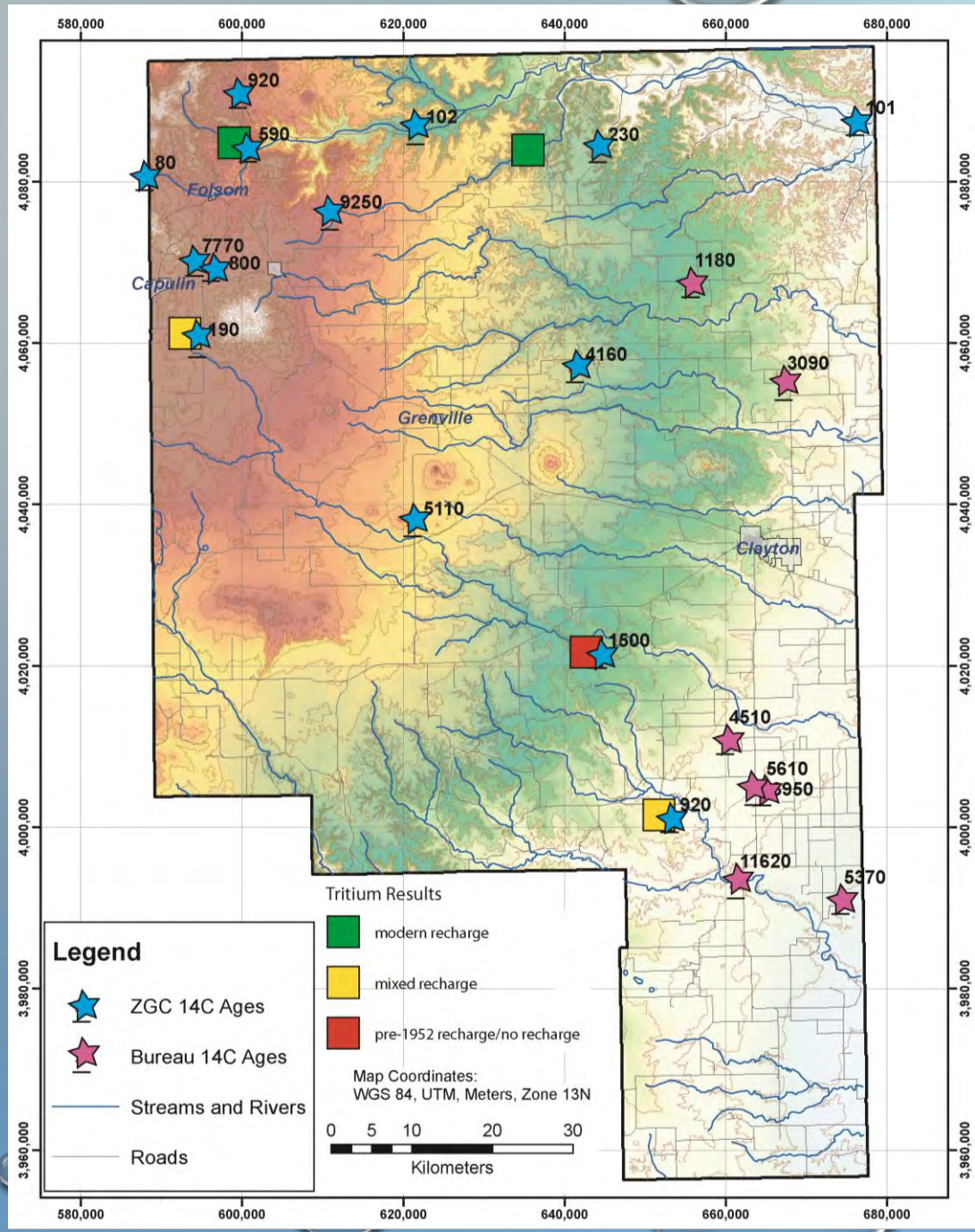




RECHARGE

- 14-Carbon: an average residence time of water molecules within a body of groundwater
  - Mixing of water input → no discrete "date" the water entered the aquifer
  - Presence of limestone or calcite cement in significant volumes will cause an inaccurate, artificially older "age"
- Tritium: isotope of hydrogen introduced into the atmosphere in large quantities during atomic bomb testing in the 1950s
  - No tritium = no significant modern recharge
  - Limited tritium = some recharge and/or drought suppression of recharge
  - Moderate tritium = reasonable recharge possibilities


Mora-Wagon Mound SWCD Well Monitoring Network
Label Key: [Tritum Units (TU) : Carbon-14 Avg. Residence time, Years Before Present (YPB)]
Legend
Mora-WM Age data
No Trituim Data
Recharge
No Modern Recharge
Some Modern Recharge
Modern Recharge
3.2 : NS
5.96 : 0
-0.03 : 7880
2.17 : 10
0.08 : 2440
1.81 : NS
3.85 : NS
2.62 : NS
1.22 : NS
2.38 : NS
NS : 26070
1.02 : NS
0.07 : NS
0.13 : NS
1.03 : NS
3.26 : NS
0.48 : NS
0.63 : NS
0.22 : 4790
0.44 : NS
NS : 1350
2.25 : NS
Los LeFebres
Ocate
Los Huertos
Naranjos
Levy
Ojo Feliz
Wagon Mound
Rainsville
La Cueva
Buena Vista
Golondrinas
Ciruela
Optimo
Loma Parda
Tiptonville
Valmora
Shoemaker
Watrous
Alamito
Western Geoinformatics & ZGC, 2019
Miles
0 2 4 8 12 16


920
590
102
230
101
80
Folsom
9250
7770
800
1180
Capulin
190
4160
3090
Grenville
5110
Clayton
1500
4510
5610
3950
920
11620
5370
Tritium Results
modern recharge
mixed recharge
pre-1952 recharge/no recharge
Legend
ZGC 14C Ages
Bureau 14C Ages
Streams and Rivers
Roads
Map Coordinates:
WGS 84, UTM, Meters, Zone 13N
0 5 10 20 30
Kilometers

WHAT WE'VE LEARNED SO FAR …

- Areas of greatest water level decline tend to be centered on irrigated cropland BUT rates of decline in irrigated areas have slowed significantly in many areas
  - Complex geology combined with other data sets suggest complicated flow paths and partly to fully partitioned aquifer units
    - Each to his own bathtub ….
  - Shallow wells near drainages recharge but deeper wells farther from drainages do not receive replenishment in a human lifetime
    - Aquifers probably are eventually recharging, but withdrawal >> recharge

How do we cope with this knowledge?

- Community Response and Plans: Changes in land management practices once producers have accurate information
  - Changes in crop types and planting schedules
    - High grade corn versus milo, sileage corn, hay varieties
    - Short growth-window varieties
  - Shutting off windmills when a pasture isn't in use
  - Conversion to solar-powered pumps + float valves + timers
    - Manage every drop
  - Reverting cropland to grassland
- How does this impact the financial aspect of production?

Further Thoughts

- Projects at all scales (county to ranch) are critical for the overall picture
  - Water doesn't care about political boundaries
  - One person's use may or may not impact their neighbor
- Long-term monitoring of water levels will help define an area's response to the continuation of the drought
- Partnering with landowners working on Rangeland and wildlife habitat restoration via crop and range management strategies
- Take care of the land (water) and the Land (water) will take care of you
  - How to continue multigeneration traditions in this landscape

THANK YOU!