



Evaluating Playas in Western Kansas: Land Use, Recharge to the High Plains Aquifer, and Economics of Cropping

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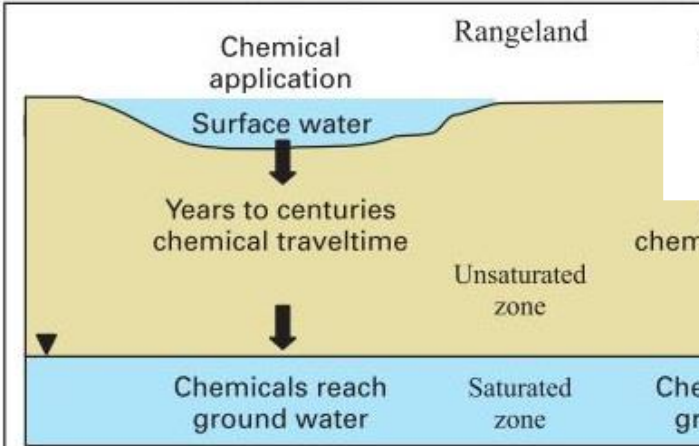
Rationale: Improved estimates of water availability and management of the HPA requires (1) identification of recharge pathways and (2) quantification of recharge rates

Last research project: determined playas are point sources of recharge to the High Plains aquifer

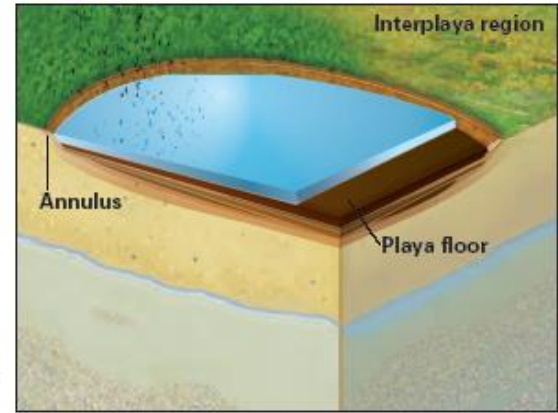
Goal of this research: identify effects of land use on playa recharge rate, upscale recharge rate measurements and calculations to the GMD scale, and evaluate costs of farming through playas

Rech

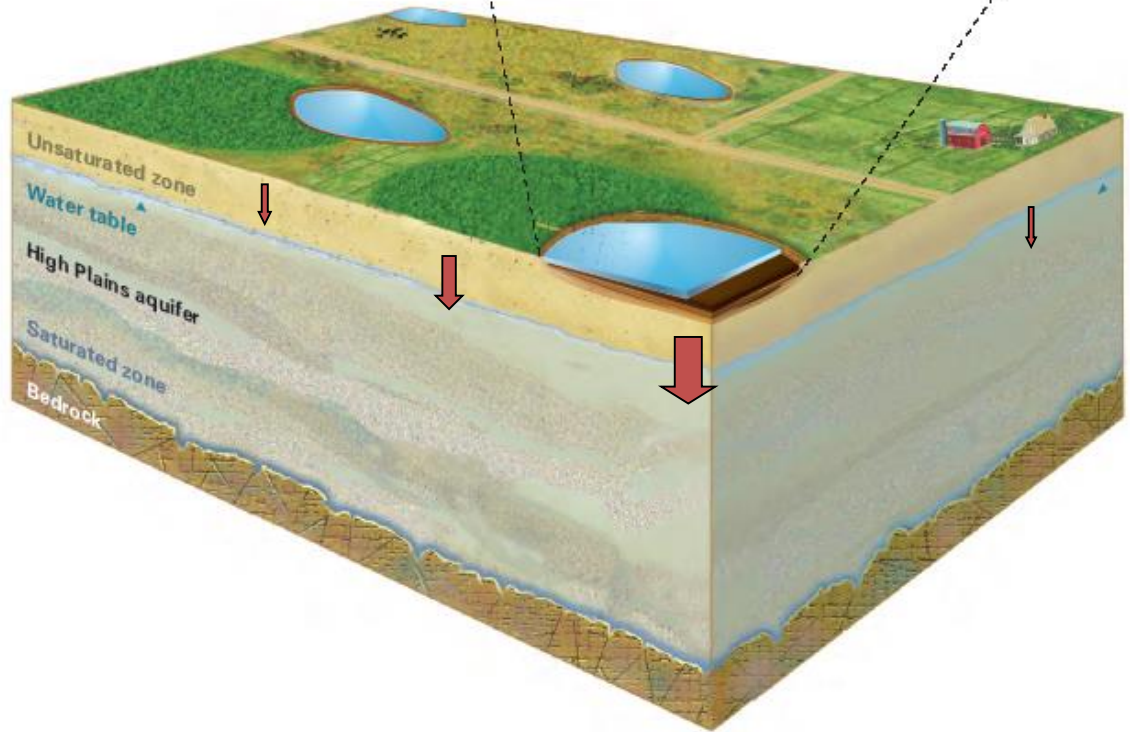
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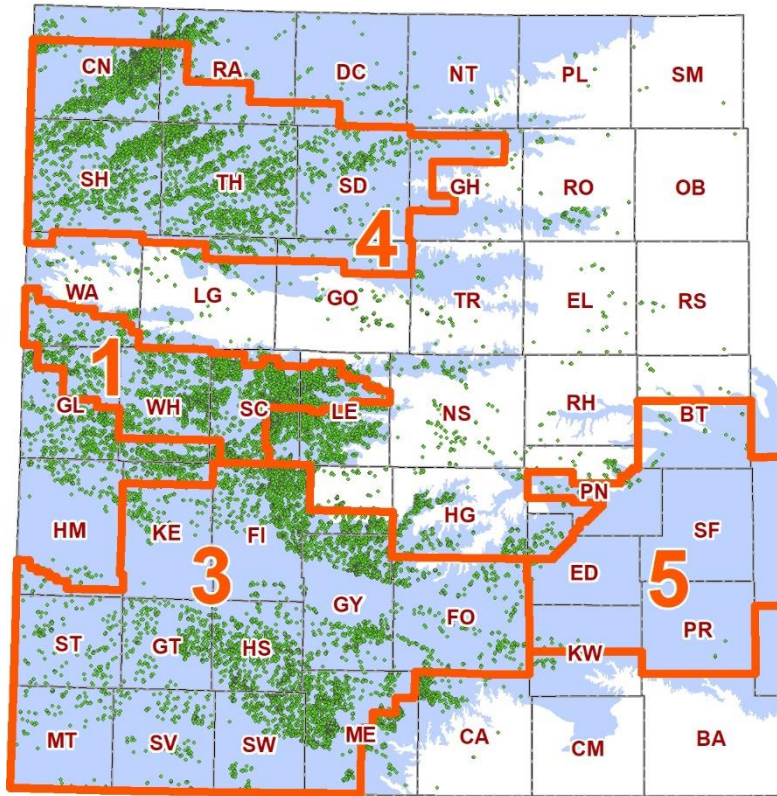
USGS Circular 1333



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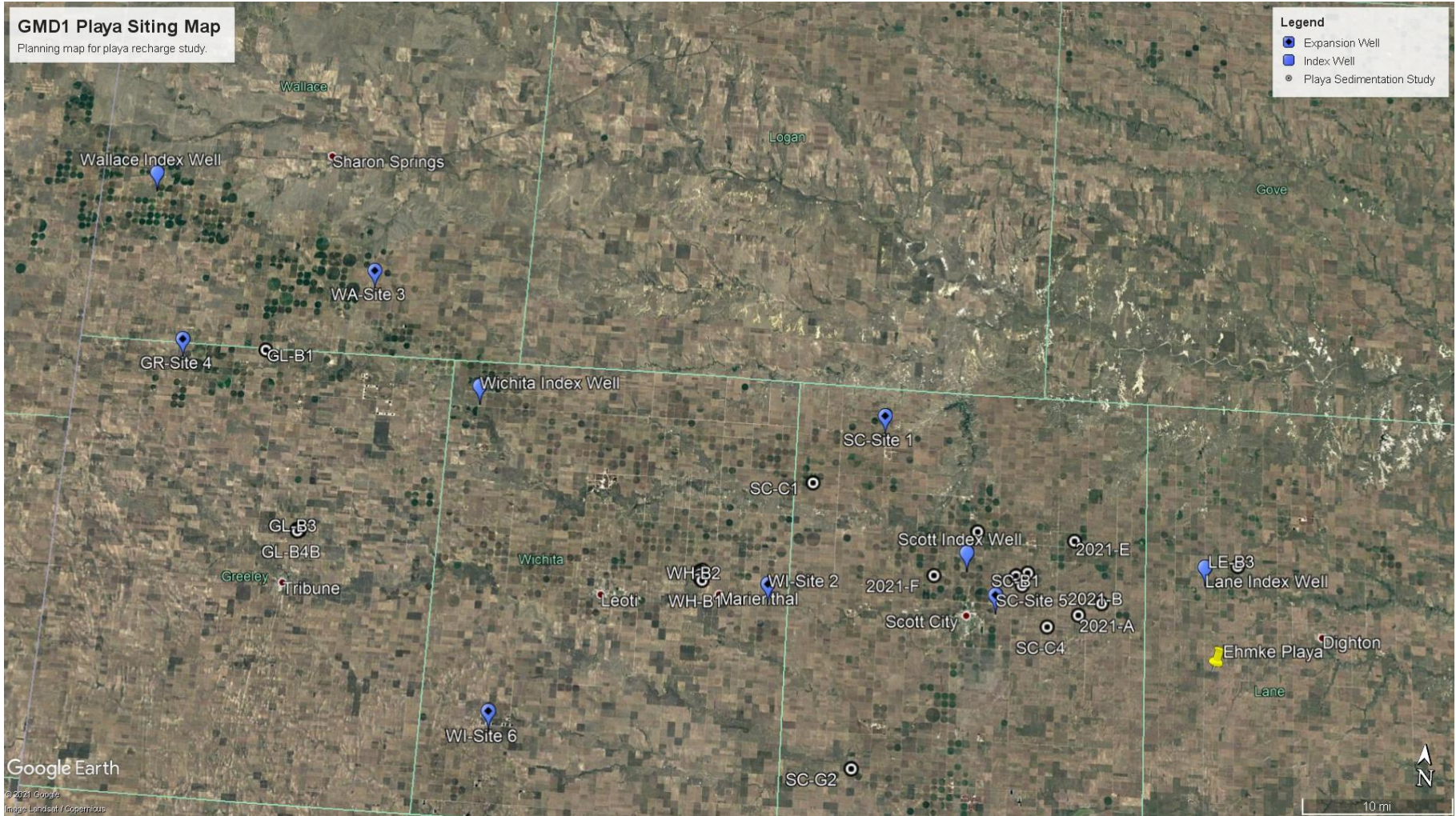


GMD #1



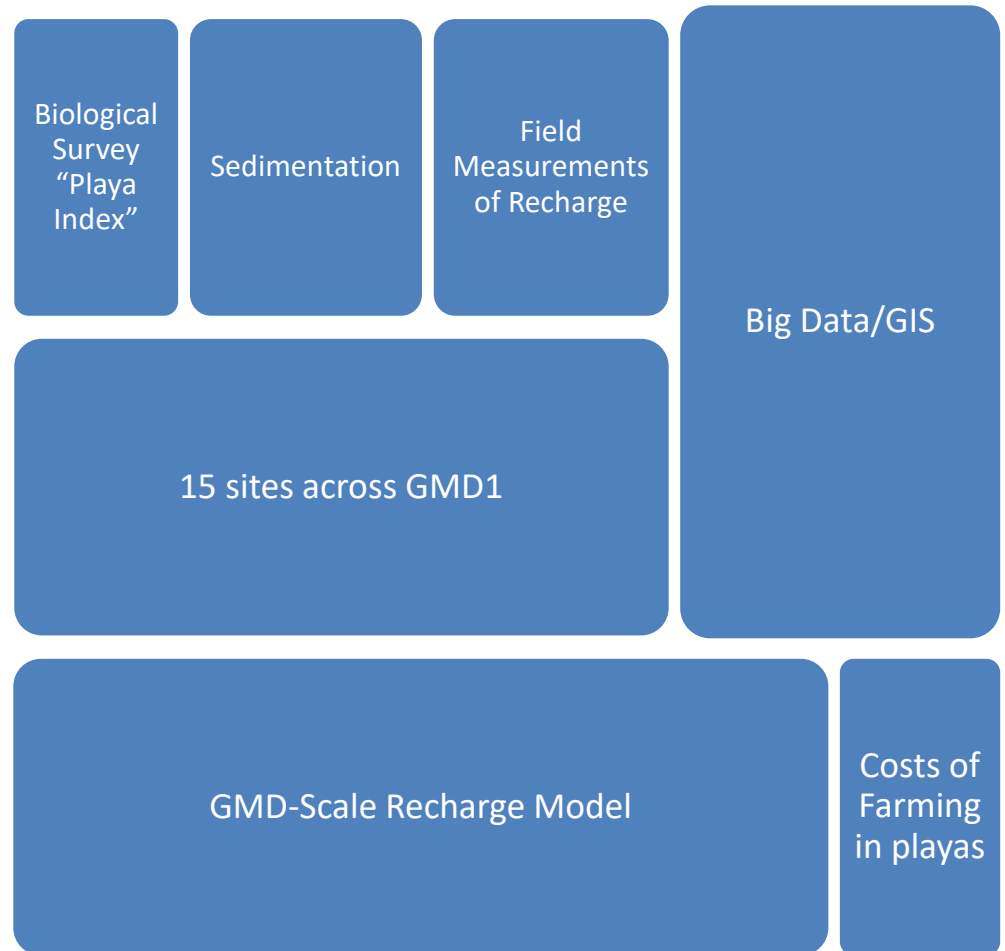
GMD	PLJV-PP count
Western Kansas GMD #1	3730
Equus Beds GMD #2	0
Southwest Kansas GMD #3	6500
Northwest Kansas GMD #4	5905
Big Bend GMD #5	114
TOTAL	16,249

Existing Study Locations



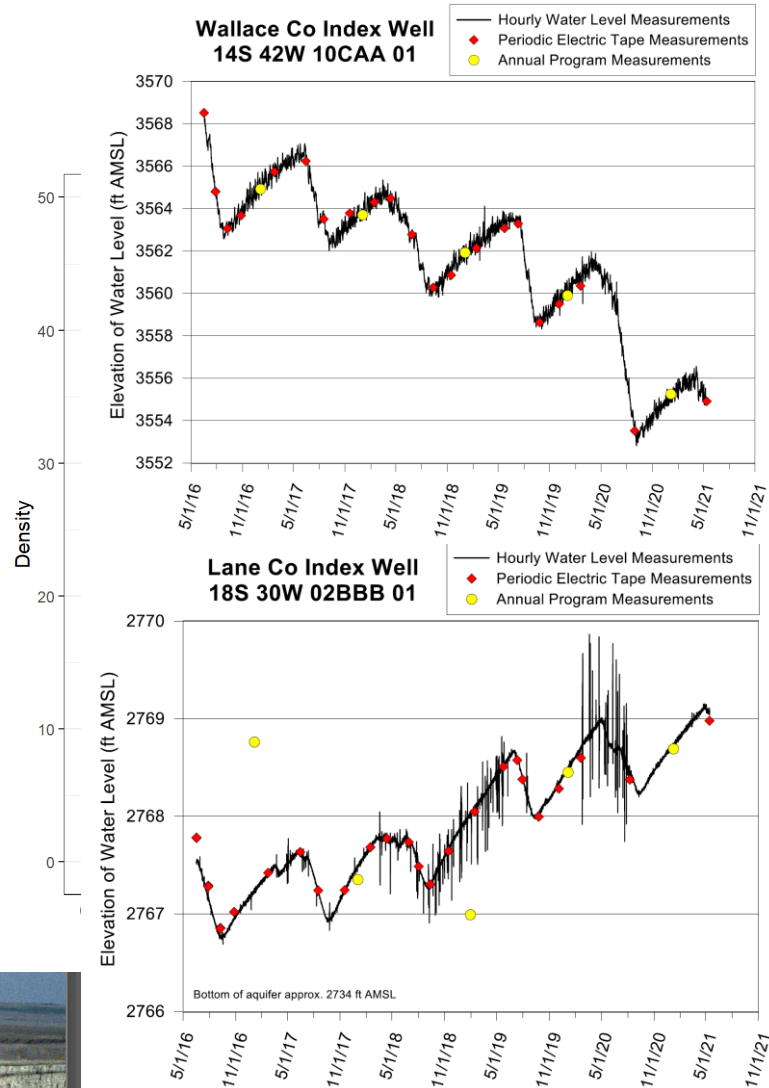
Study Design

- Study of 15 playas
 - Factors
 - Physical characteristics
 - Land use
 - Biological survey
 - Sedimentation
 - Recharge rates
- “Big data” and GIS
 - Playa characteristics
 - Representativeness of study sites
 - Crop yields
- Upscale results to GMD-wide model
- Evaluation of costs for farming

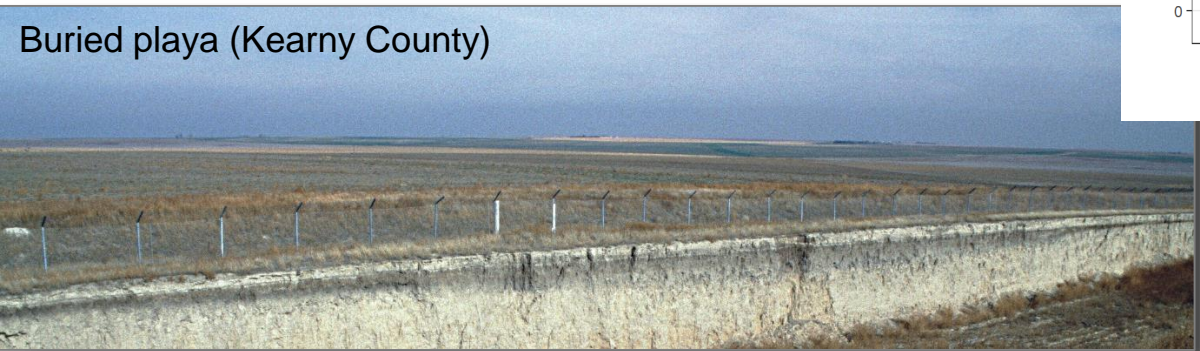


Factors

- Land use
 - Cropping and/or irrigation
 - Sedimentation/infilling
 - - Level of impairment -
- Playa size
- Playa:watershed ratio
- Precipitation gradient
- Increased depth to water in areas with more irrigation
- Subsurface geology
- Others?



Buried playa (Kearny County)

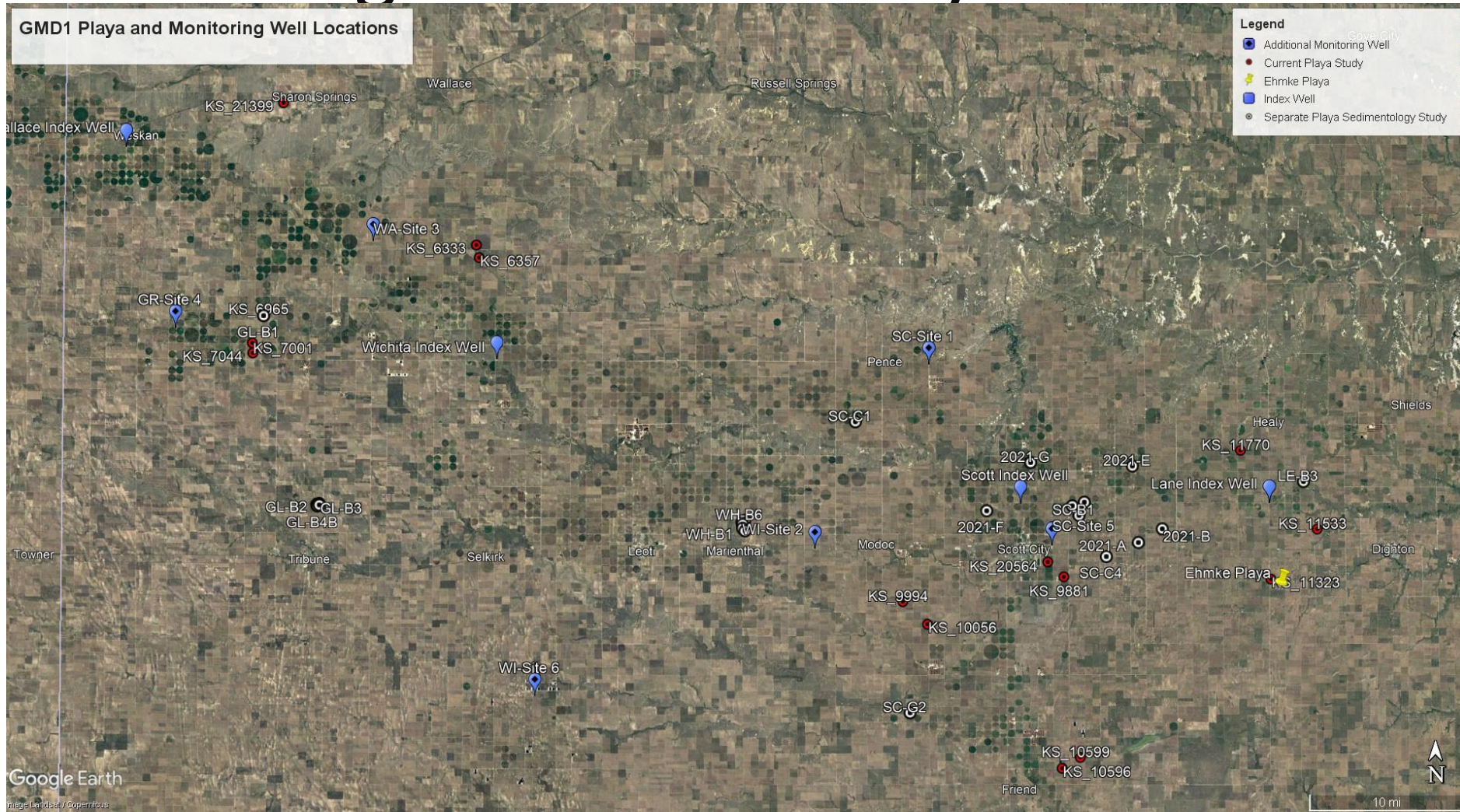


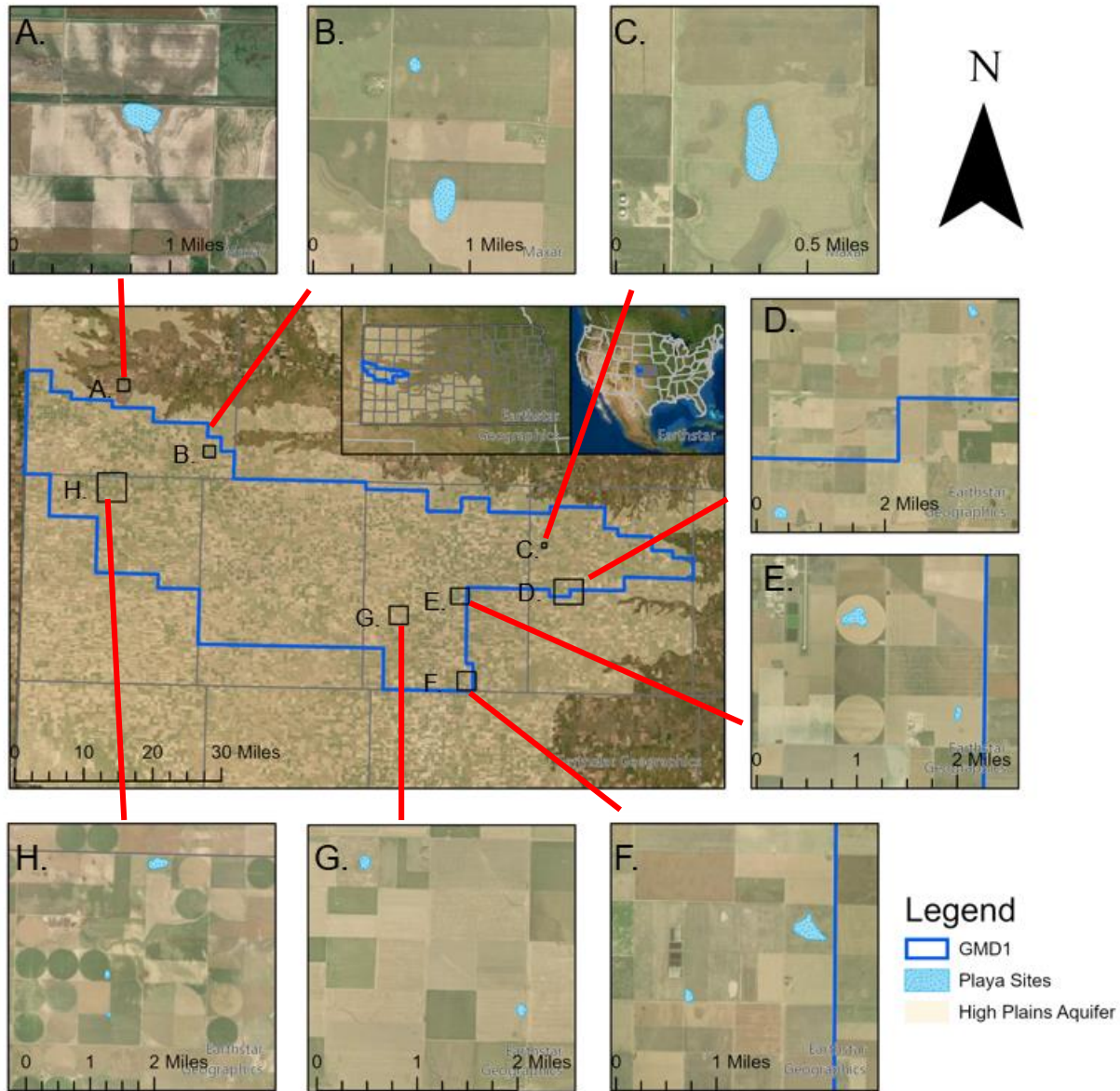
Playa Survey (15 Playas)

- Biological survey
 - Wet/dry, hydric soils
 - Macro & micro fauna, invertebrates
 - Vegetation & land use
 - Playa “index”
- Sedimentation study
 - Sediment thickness
 - Storage loss
 - Sedimentation rates
 - Amount of impairment
- Recharge
 - Core to the water table (chemical tracers = recharge rates)
 - Collect surface infiltration measurements
 - Subset, monitoring well & environmental tracers

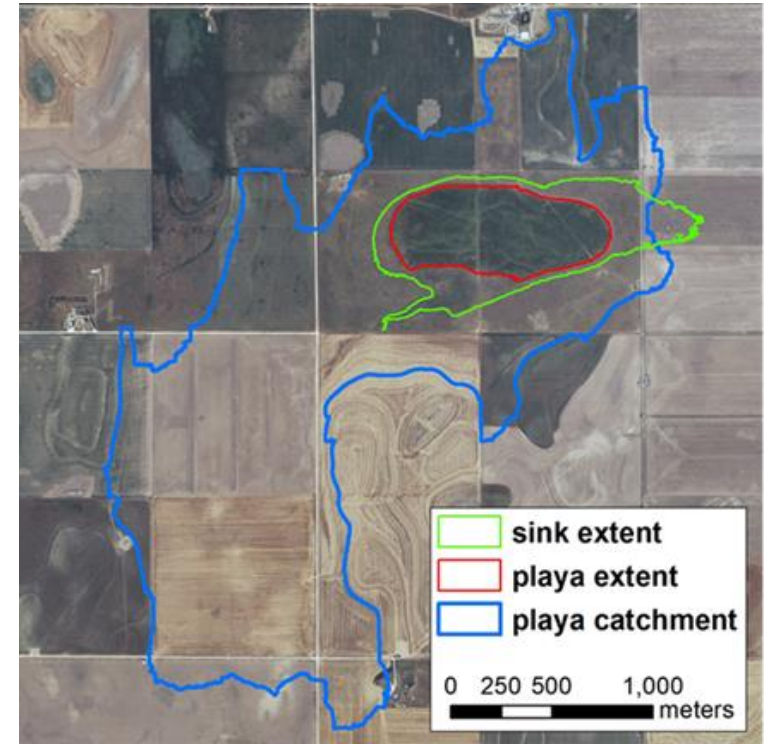
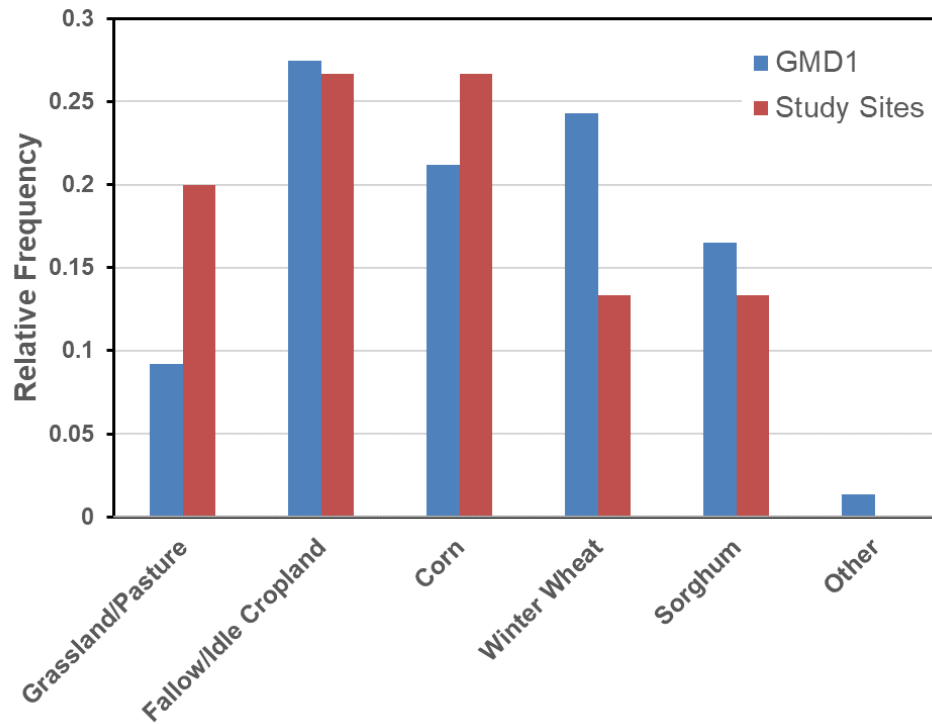


Existing and New Study Locations





Studied Playas vs. GMD1



Biological Survey

- **Goal:** evaluate ecological condition of the playas
- **Activities:**
 - All 15 playas:
 - Bird and amphibians noted
 - Wet playas (May):
 - sample water chemistry
 - D-frame net sweep
 - Dry playas (August):
 - collect four soil samples (2cm deep x 15 cm radius circle) to look for invertebrates
 - Vegetation and cover class identified in **10** distinct **25 x 50 cm** plots along playa axis





Wilson's phalaropes & stilt sandpipers

Inset – tadpole shrimp

Ecological Assessment

To evaluate condition of natural and cropped playas.

- May 2021 In situ water quality, birds, macroinvertebrates.
- Aug. 2021 Vegetation – to evaluate abundance of obligate & facultative wetland plants.
- Will use data to calculate a 'playa index' which quantifies to what extent a shallow depressional waterbody shows characteristics of a playa.

Sedimentation Survey

- **Goal:** Determine impairment
- **Activities:**
 - Excavate **nine** small shovel pits **20"** deep
 - Center of playa
 - $\frac{1}{2}$ radius at four cardinal and four ordinal directions
 - Collect a 4' soil core from playa center (Giddings)
 - Select cores: date historical sediment layer (Pb-210)



Sediment Depth

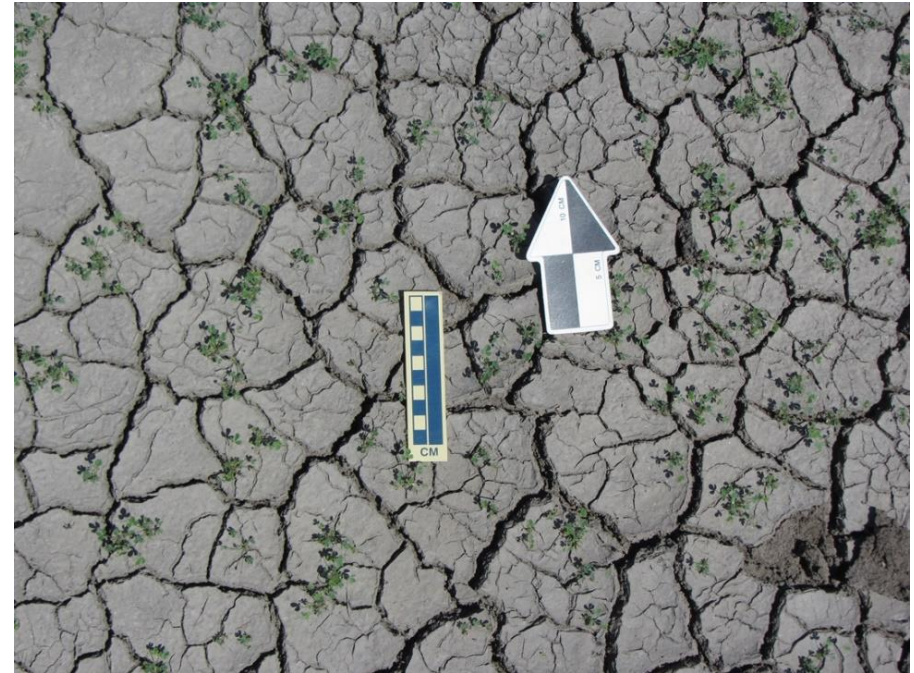


	Sediment Depth (cm)
Max (playa average)	11.7
Min (playa average)	1.3
Average	5.4
Max (sample location)	20.0
Min (sample location)	0.5

12 of 15 playas, 108 sample locations
(3 inaccessible due to water storage)

Sediment and Land Use

- Average sediment depth:
 - CRP/Conservation: 2.9 cm
 - Farmed: 8.9 cm
- Sediment depth might be greater in some locations (recent vs. historical)



Scientific Coring

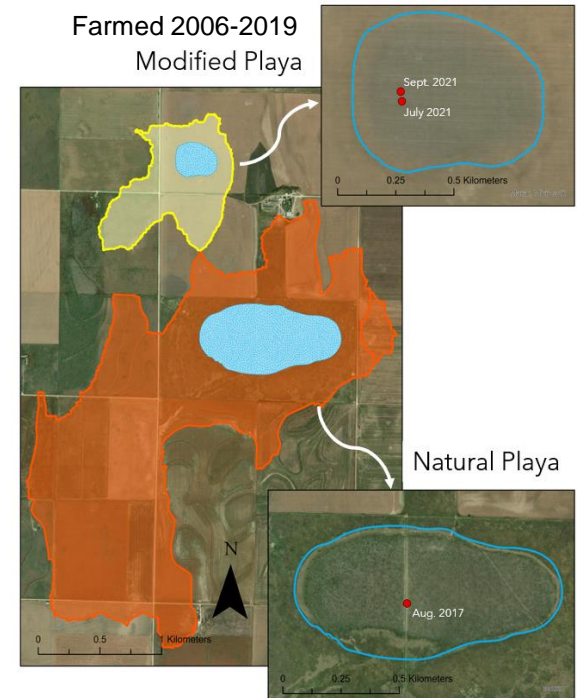
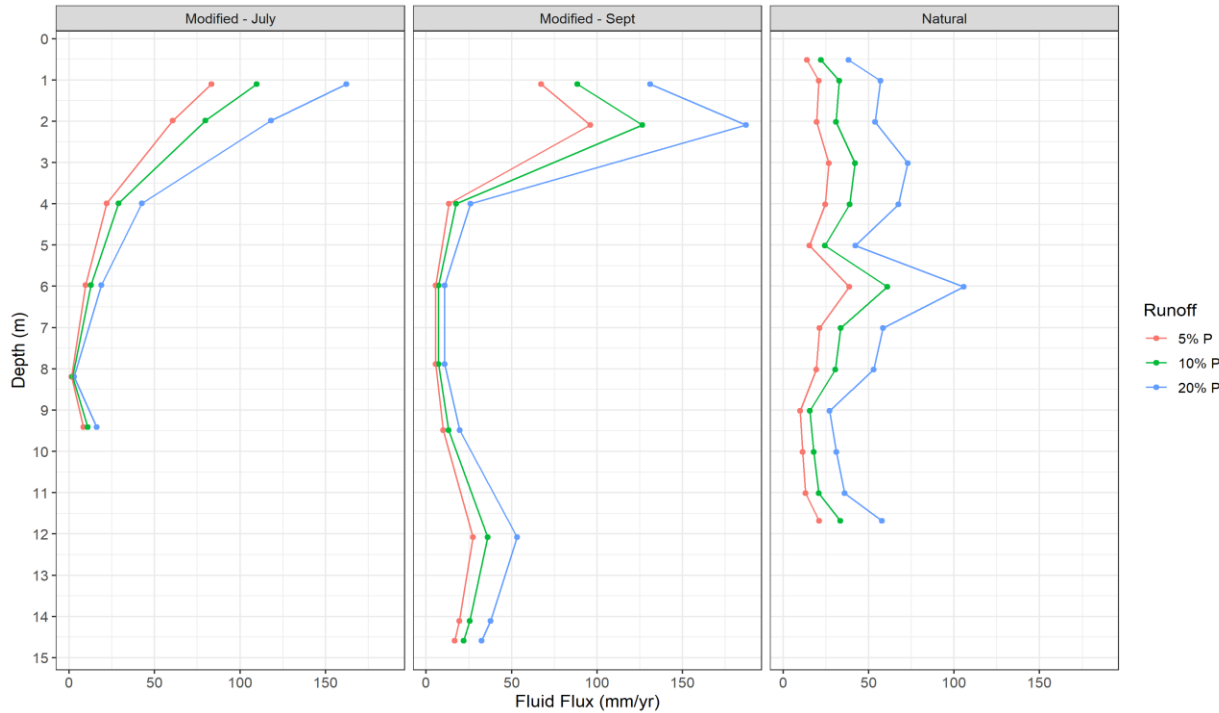
- 6 playas cored (+4 currently)
- Monitoring well installed



Hollow-stem auger w/ wireline splitspoon sampler

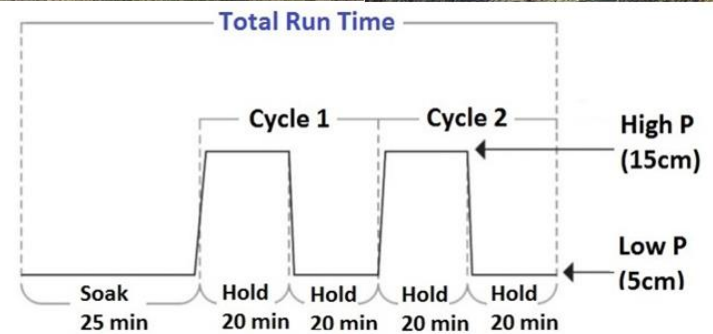


Recharge rates

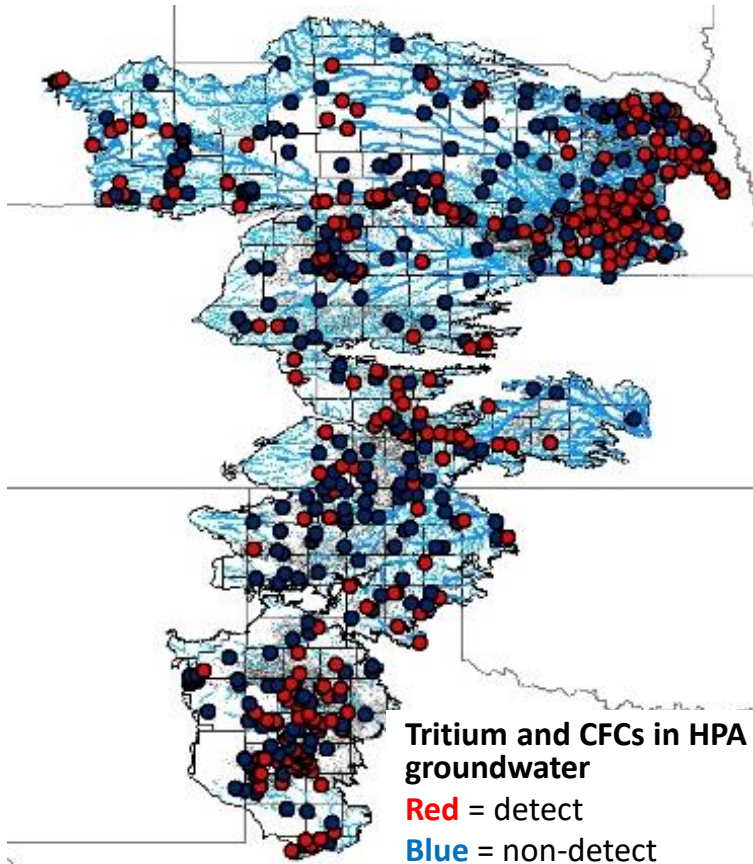


- Recharge rates are 26 to 41 years faster in the natural playa.

Surface Infiltration Rates

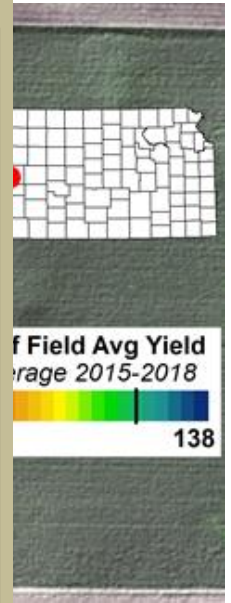
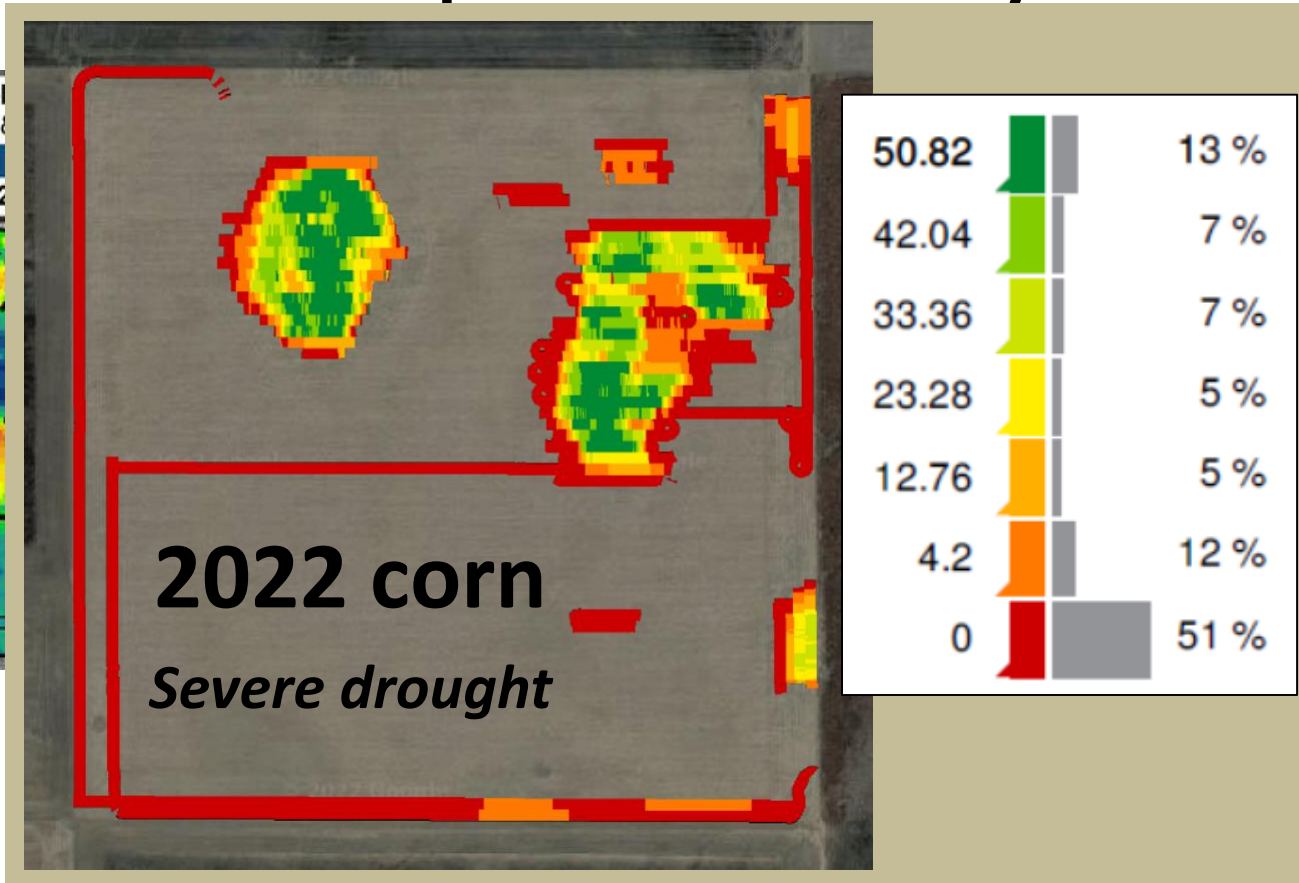
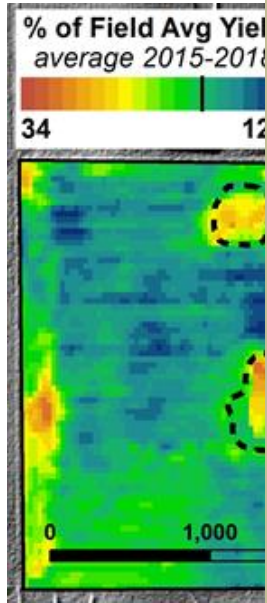


— Scaling: “Big Data” on the Regional Scale —



- Environmental tracers
 - Stable isotopes: climate
 - Tritium (^3H), CFCs: recharge since 1950
 - Radiocarbon (^{14}C): recharge 500 – 35,000 years ago
- Agricultural contaminants
 - Recharge since 1950s
 - Nitrate
 - Pesticides
 - Fertilizers
- Data sources:
 - US government and government-sponsored research databases (Water Quality Portal)
 - New data and literature review
- GIS landscape feature analysis
 - Playas
 - Streambed (including intermittent)

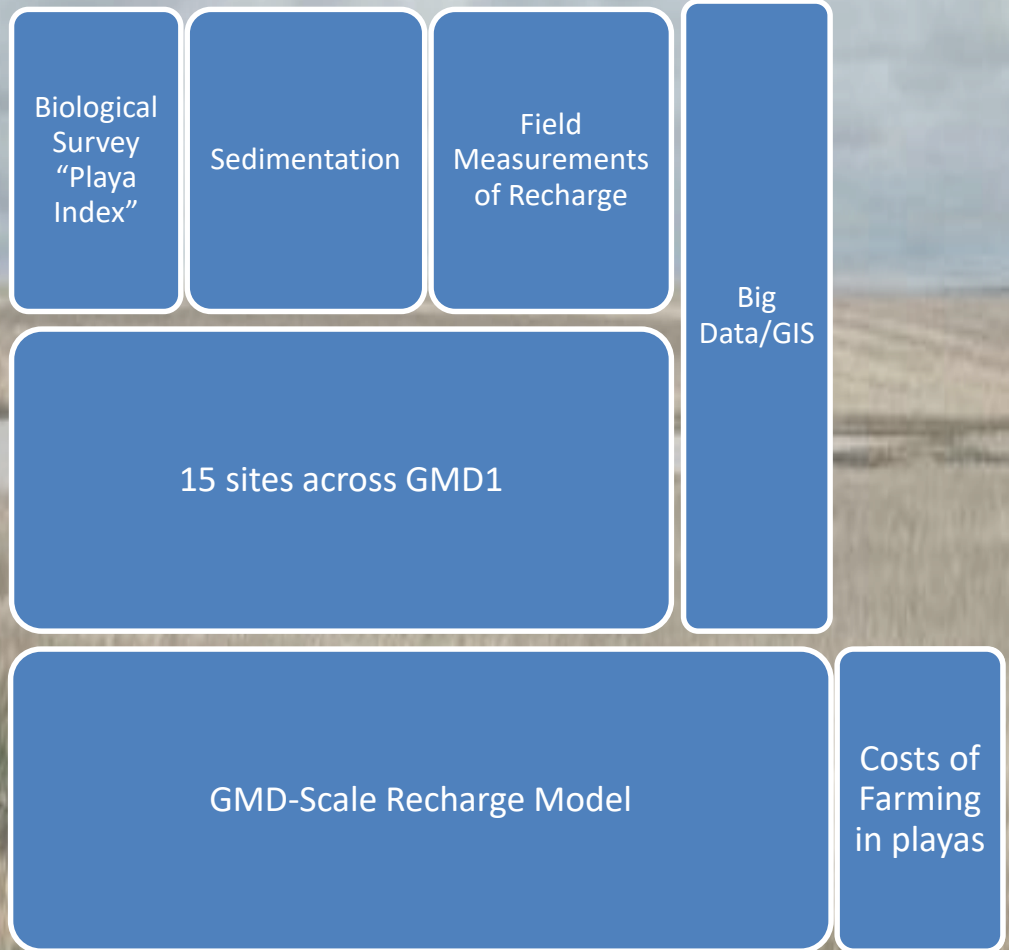
Crop Yield Study



- Yield
- Wet vs. dry years
- Cost-benefit of plant around vs. through

Summary

- Work in Progress!
- Stay tuned for more results in 2023!



Acknowledgements

- US EPA WRDG
- Landowners:
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