Quantitative, Qualitative, and Spatial Evaluation of Groundwater Recharge in the Salt Basin, NM/TX

Beth Ann Eberle and Dr. Daniel Cadol

NEW MEXICO TECH
SCIENCE • ENGINEERING • RESEARCH UNIVERSITY

Salt Basin

- SE New Mexico + W Texas
- Semi-arid climate
- 13,034 km^2
- Partially within Basin and Range
- Mostly carbonate aquifers

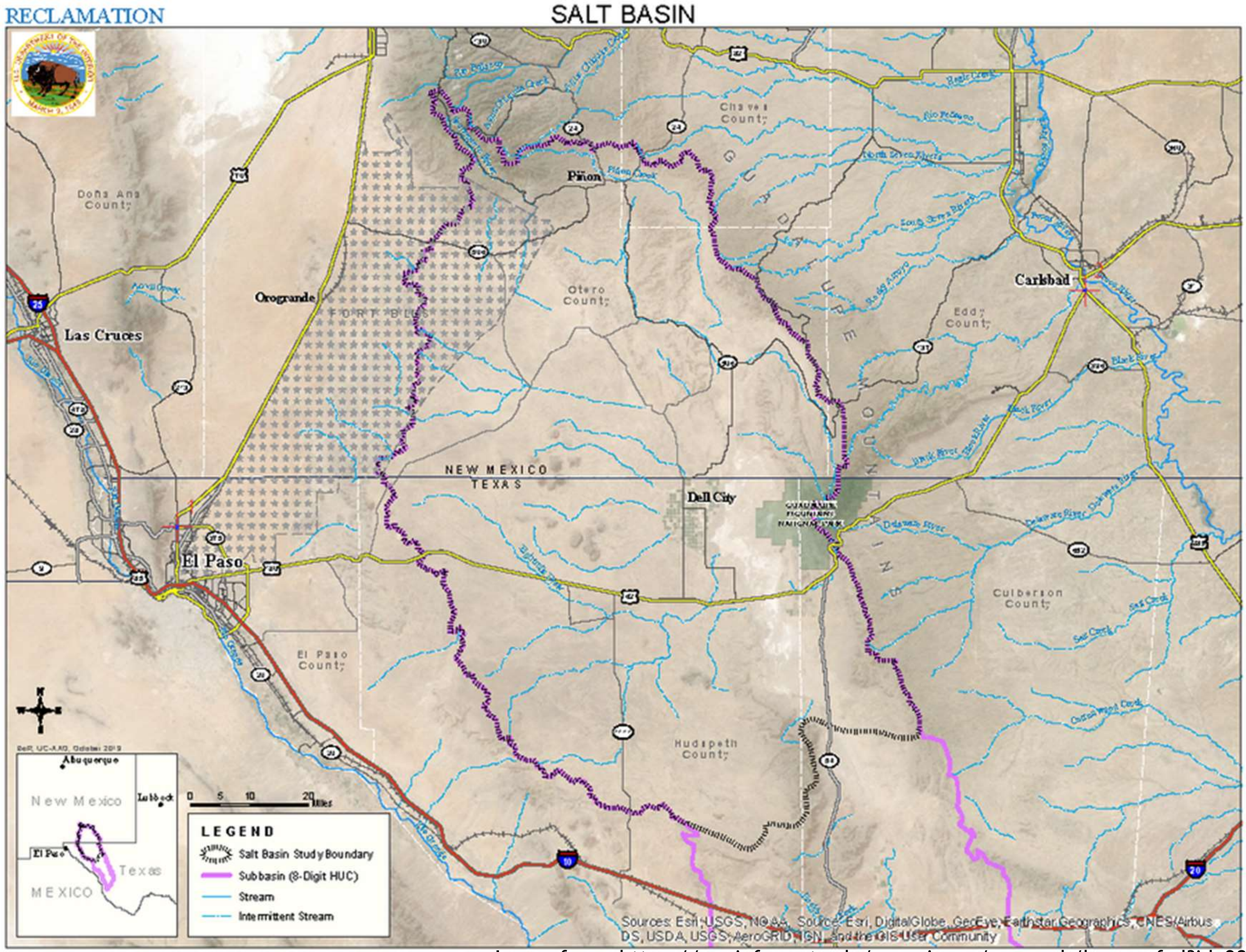


Image from: https://geoinfo.nmt.edu/geoscience/research/home.cfml?id=98

Project Background

- *Sub-project components*:
  - Geophysical analysis
  - Groundwater modeling
  - Groundwater recharge evaluation

- *Purpose*:
  - Evaluate groundwater availability and overall water budget in the Salt Basin
  - Assess local sustainability of current groundwater usage
  - Implications for future basin development

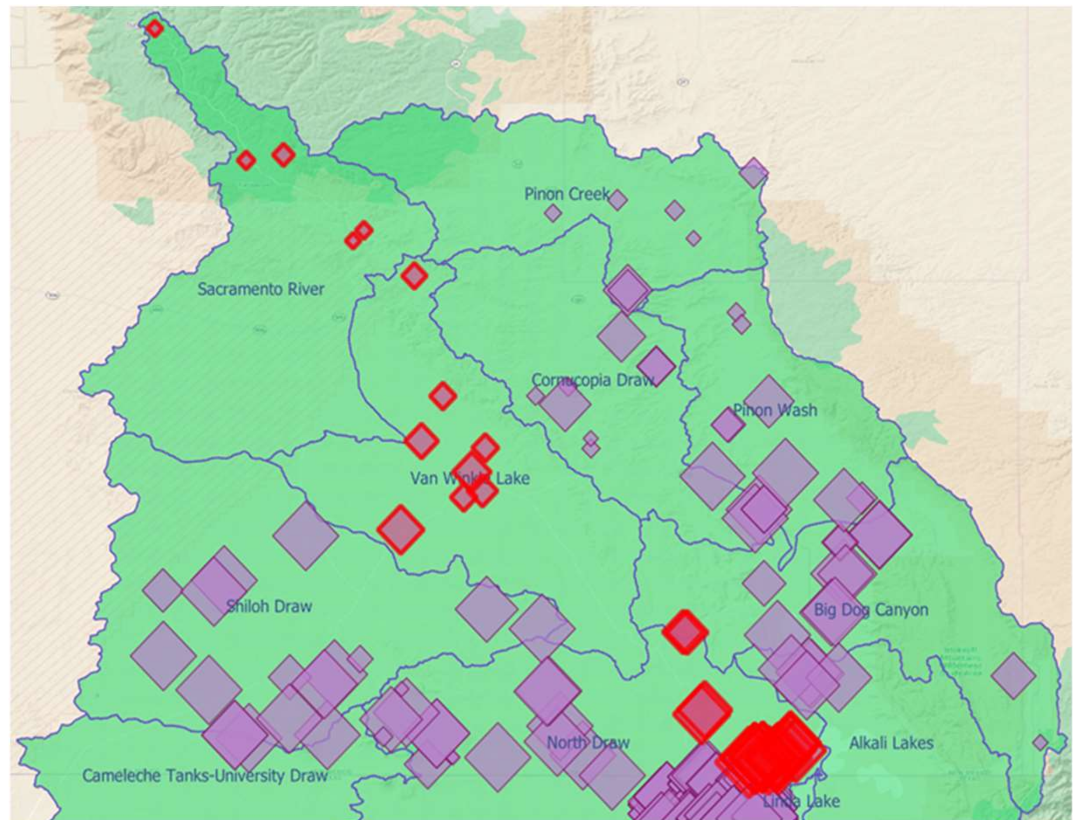
Previous recharge estimates

Author, Year	Recharge Estimate (acre-feet per year)
Chace and Roberts, 2004	100,000 to 240,000 (entire basin)
Bjorklund, 1957	<100,000 (entire basin)
Ashworth, 1995	90,000 to 100,000 (entire basin)
Hutchison, 2008	71,531 (entire basin)
Shomaker, 2010	61,723 (entire basin + Peñasco inflow)
Tillery, 2011	60,414 (northern basin)
DBS&A, 2010a	37,000 to 82,000 (entire basin)
Mayer, 1995	58,370 (entire basin)
Finch, 2002	54,943 (entire basin + Peñasco inflow)
Gates, 1980	48,000 (entire basin)
DBS&A, 2010b	26,710 (entire basin)
Sigstedt, 2016	6,000 to 12,000 (entire basin)

Recharge from Chemistry

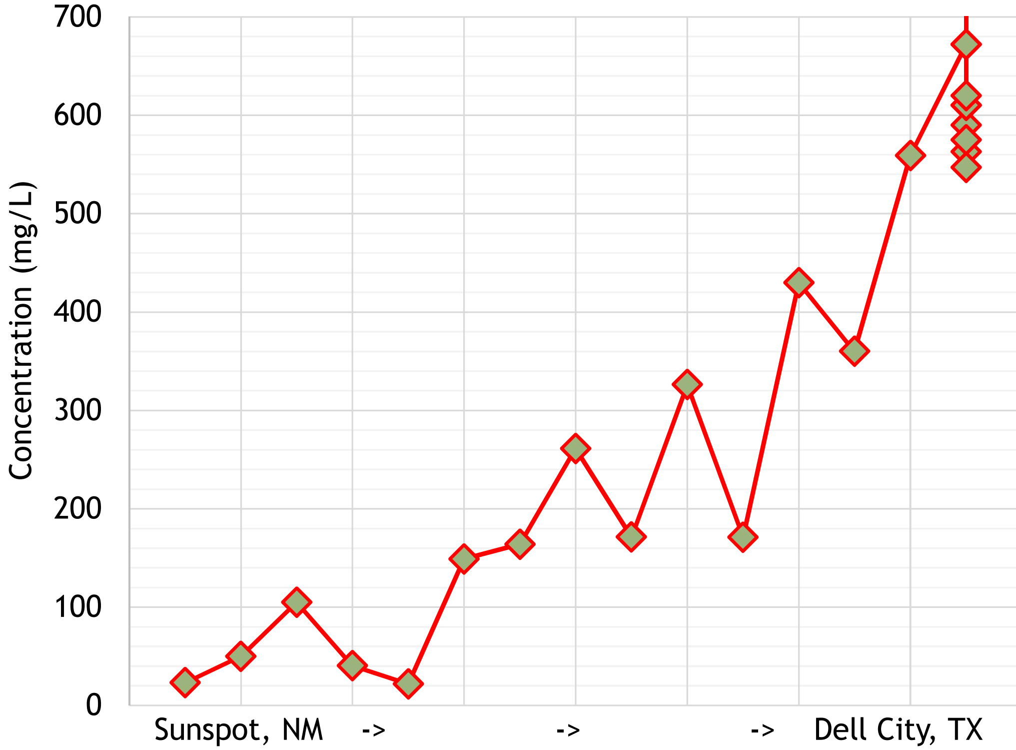
Abundances of environmental tracers throughout water wells of basin:

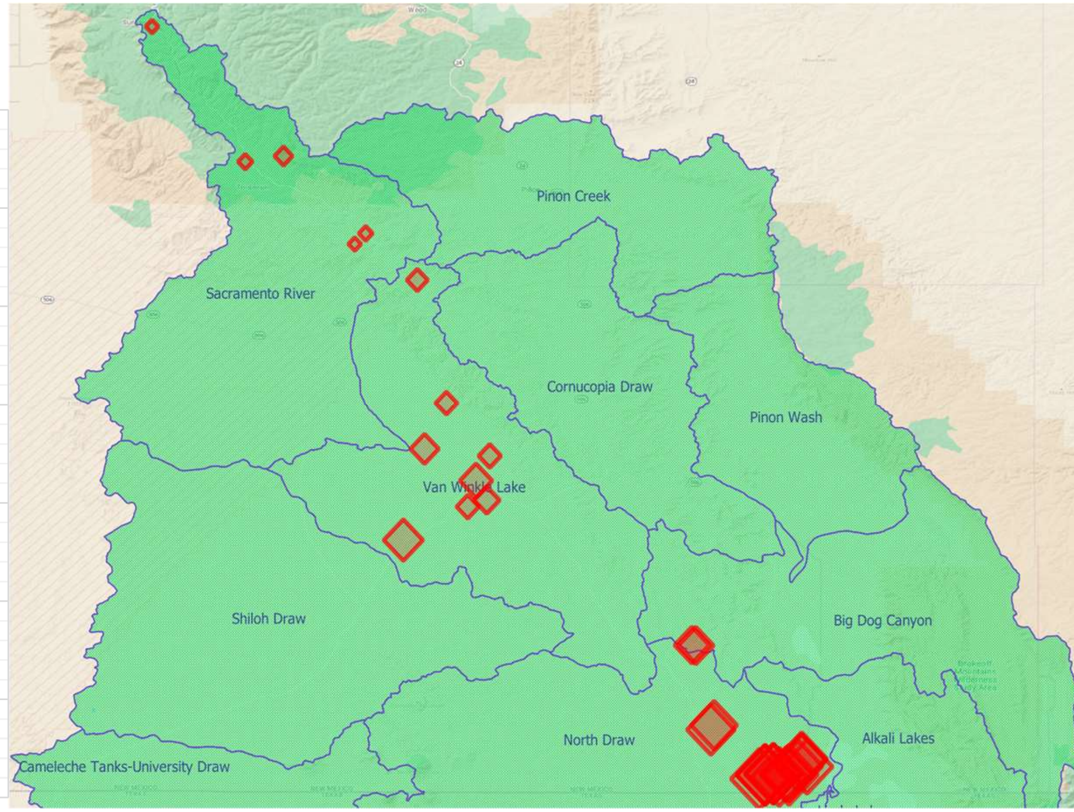
- Flow paths of groundwater
- Chemical evolution
- Velocities of groundwater movement



Sulfate Concentrations (mg/L) Along Sacramento River Flow Path

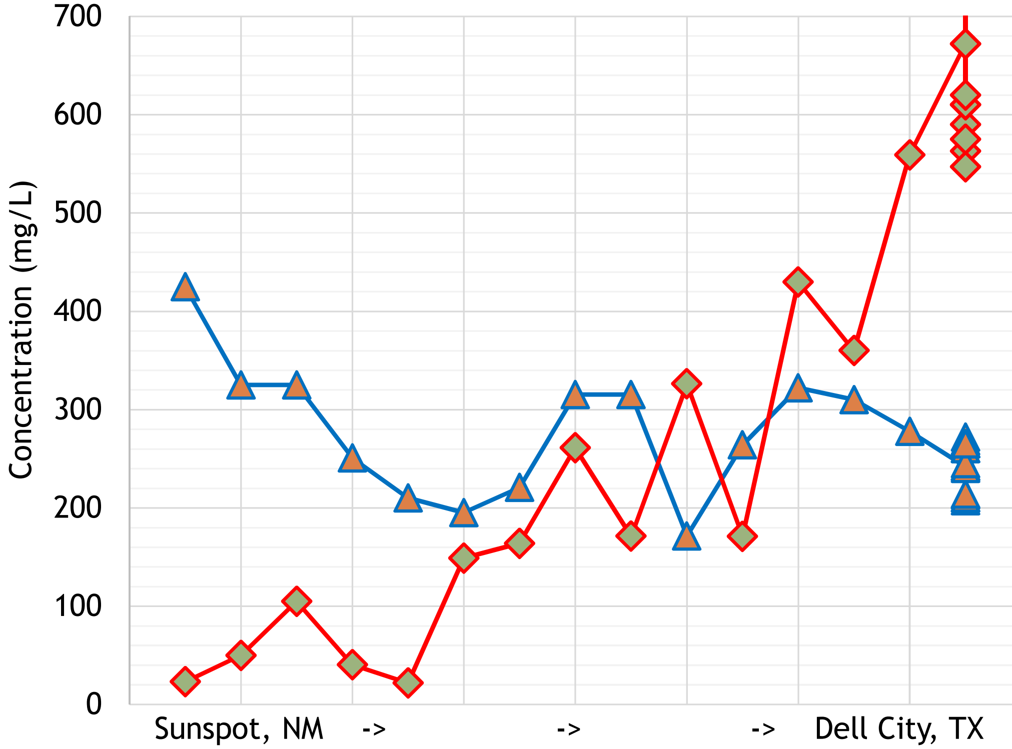
Flow Paths

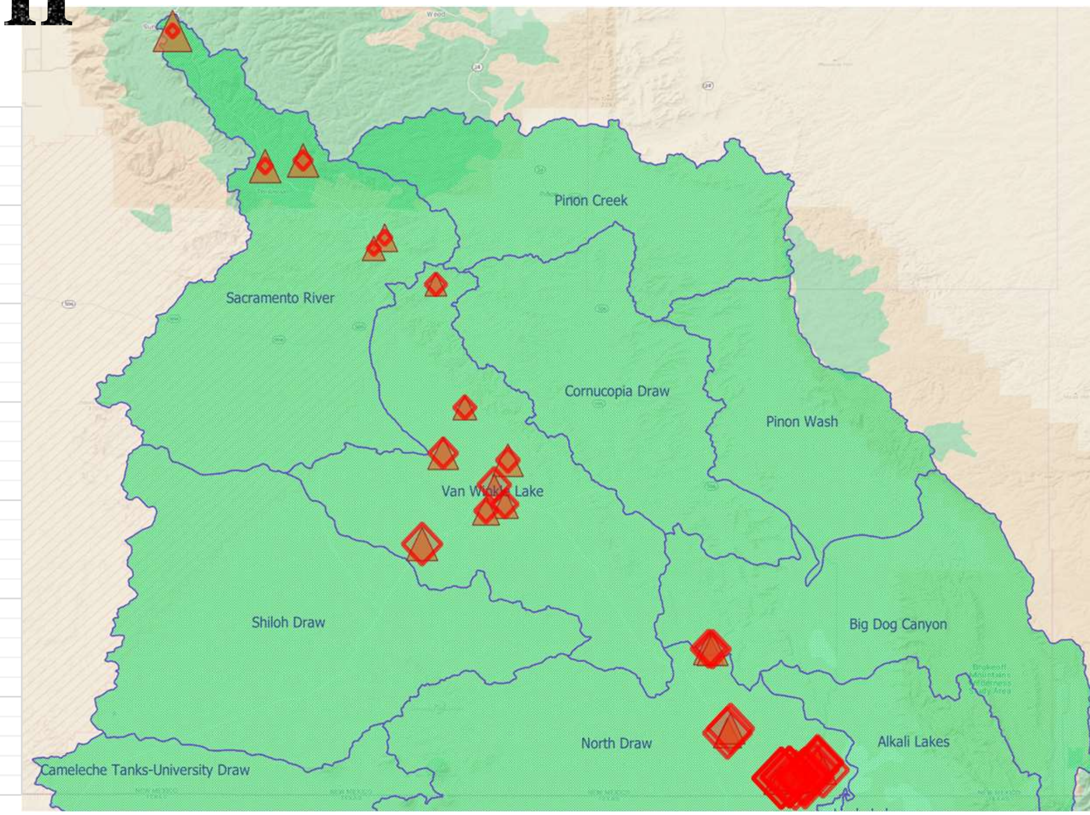




Sulfate Concentrations (mg/L) Along Sacramento River Flow Path

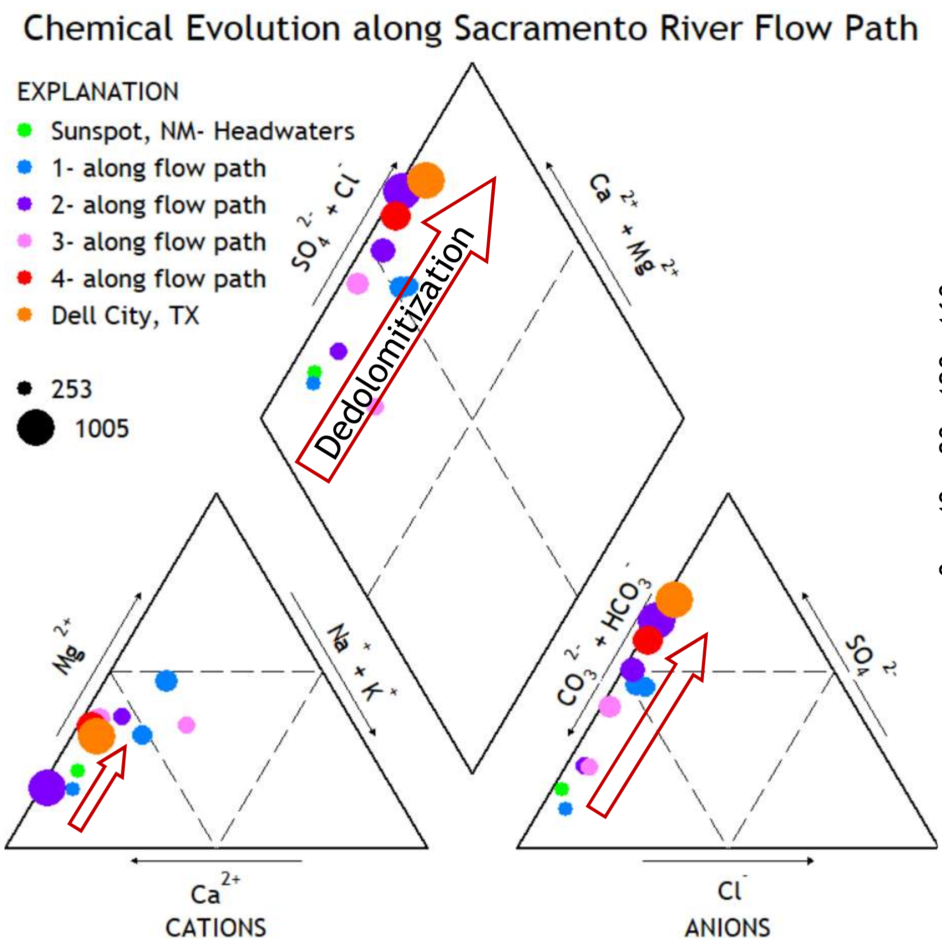
Chemical Evolution

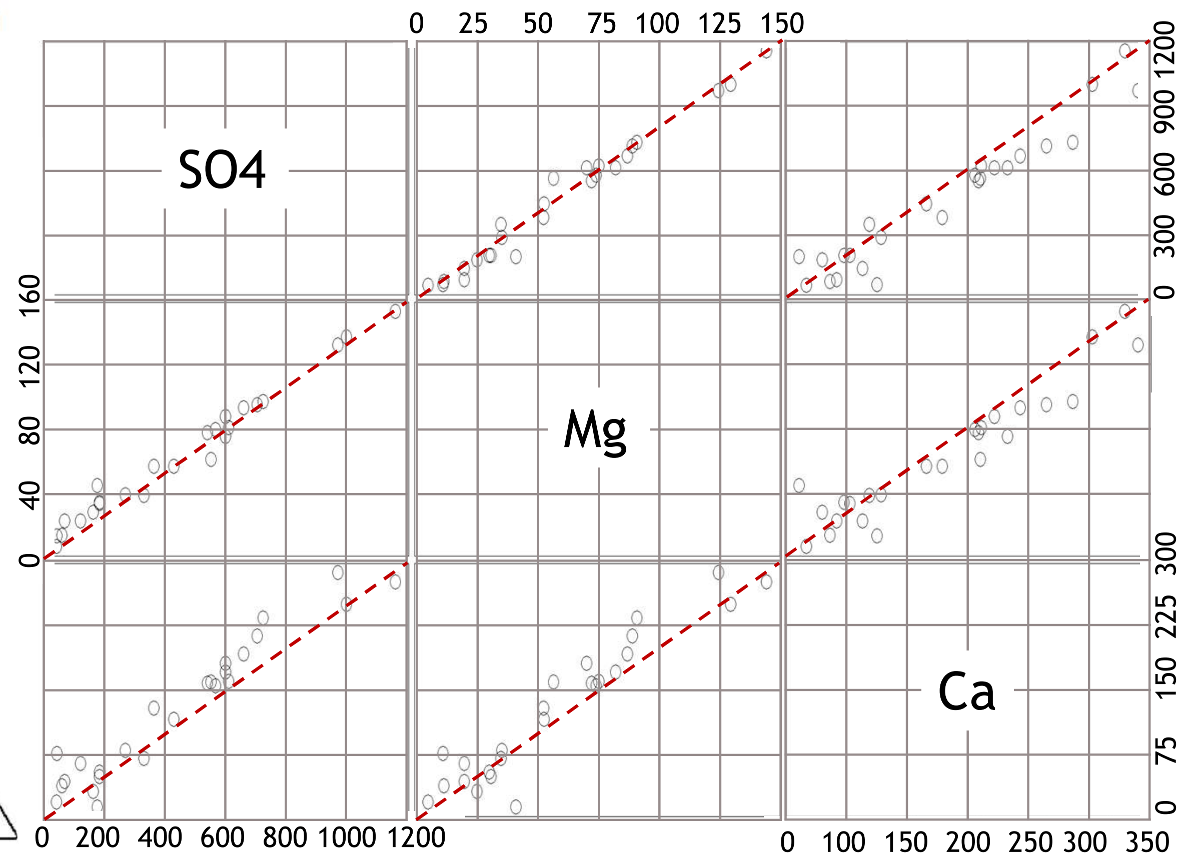




Sulfate and Carbonate Concentrations (mg/L) Along Sacramento River Flow Path

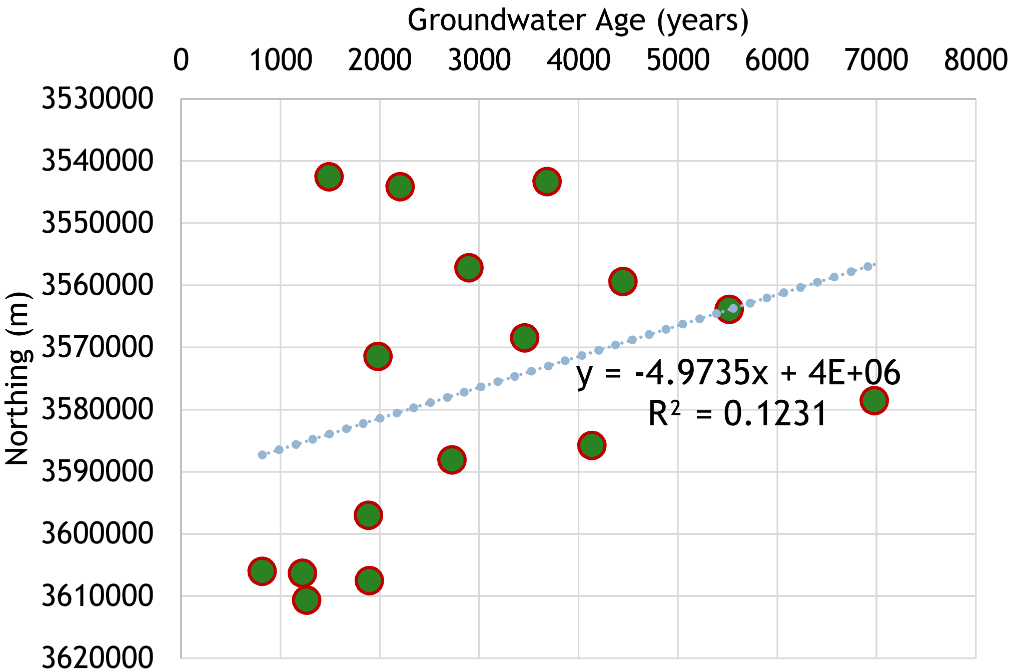
Chemical Evolution

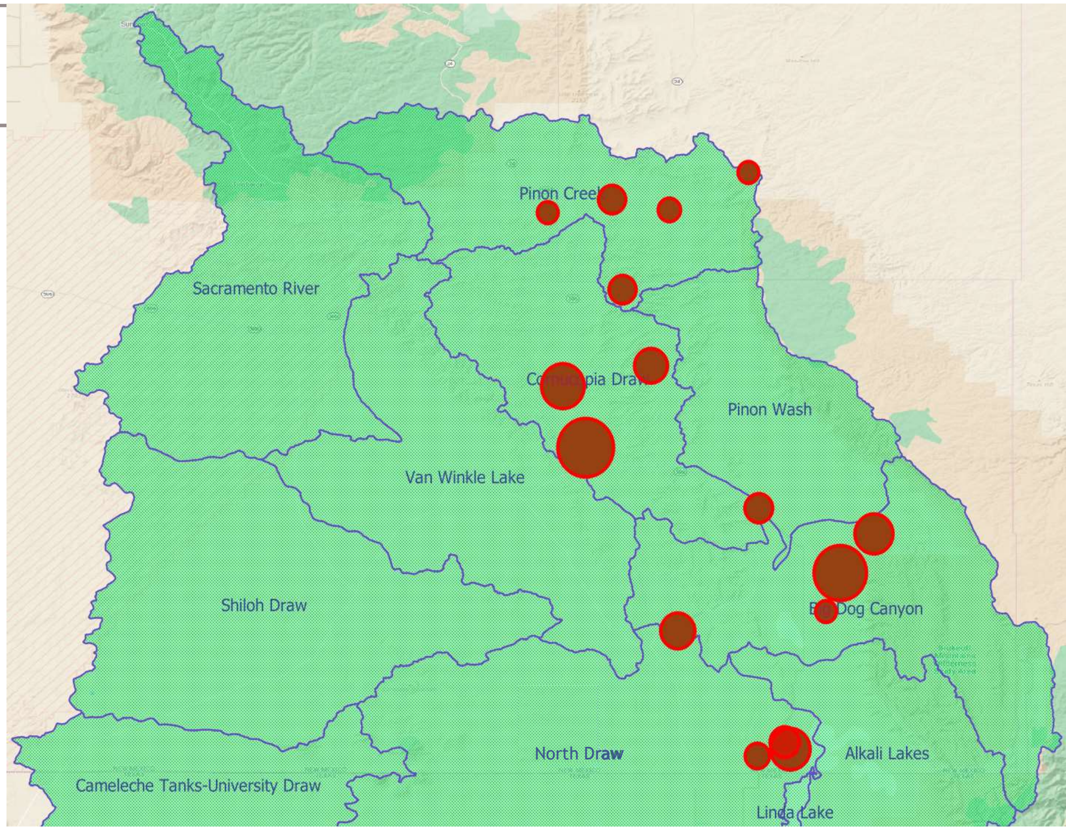




Groundwater Velocities

$$\frac{distance\ from\ source\ (m)}{corrected\ age\ (C^{14}\ years)} \approx \text{velocity of water} \left(\frac{m}{yrs}\right)$$

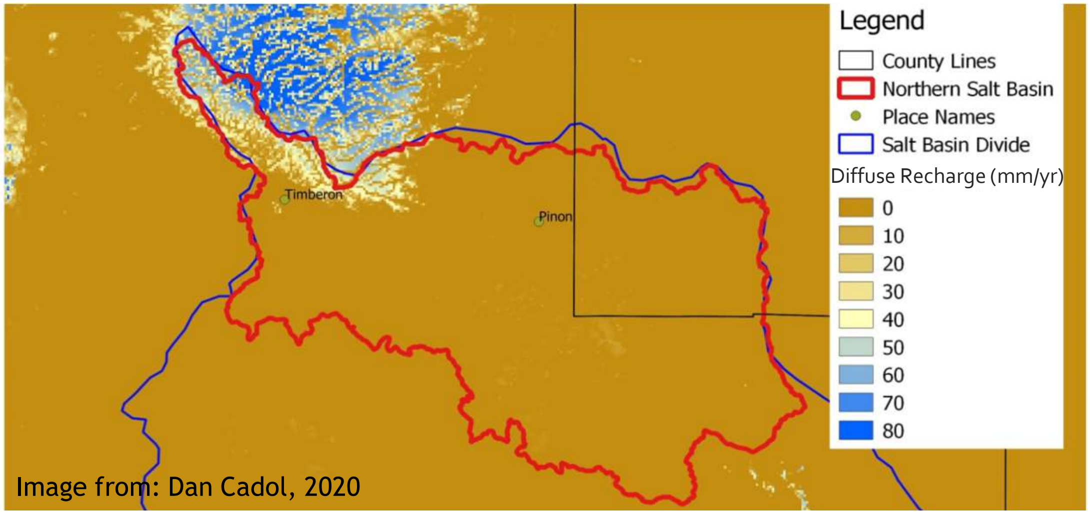




Radiocarbon Groundwater Age (yrs) Along Pinon Creek Flow Path

PyRANA Estimate

- Python Recharge Assessment for New Mexico Aquifers
- Developed by David Ketchum, Peter ReVelle, Esther Xu, Jake Ross, and Talon Newton starting in 2016
- Soil water balance model to constrain recharge estimates
- Estimates evapotranspiration and runoff from input parameters



Future Estimates

Chloride mass balance:

- Atmospheric chloride as groundwater tracer
- Cl/Br ratio to distinguish source of chloride

Groundwater flow model:

- Finite-element, steady-state model
- Can use radiocarbon ages to calibrate
- Can use Blaney-Criddle to estimate ET

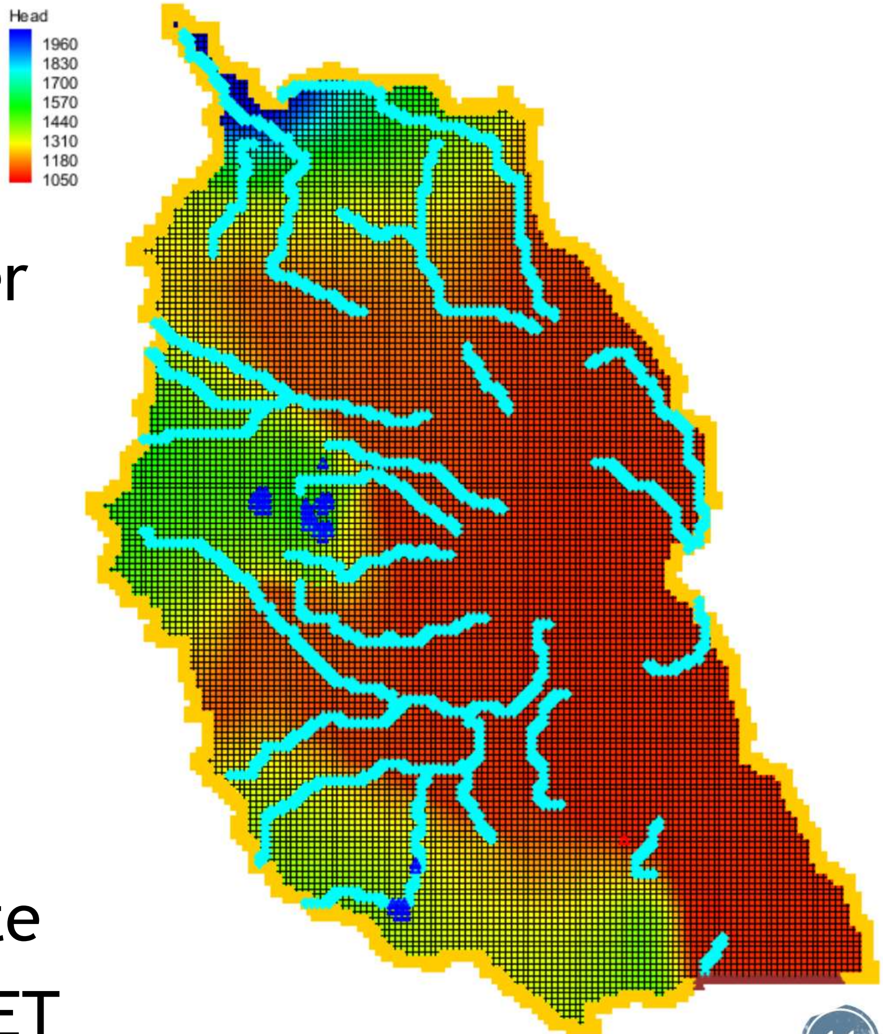


Image from: Elizabeth Evenocheck, 2021

Thank you

Any questions?

Blaney-Criddle

- Used by the New Mexico Office of the State Engineer (NM OSE)
- Estimates consumptive pumping use from Dell City irrigation district using NDVI active cells and local climate data
- Utilized in groundwater flow model