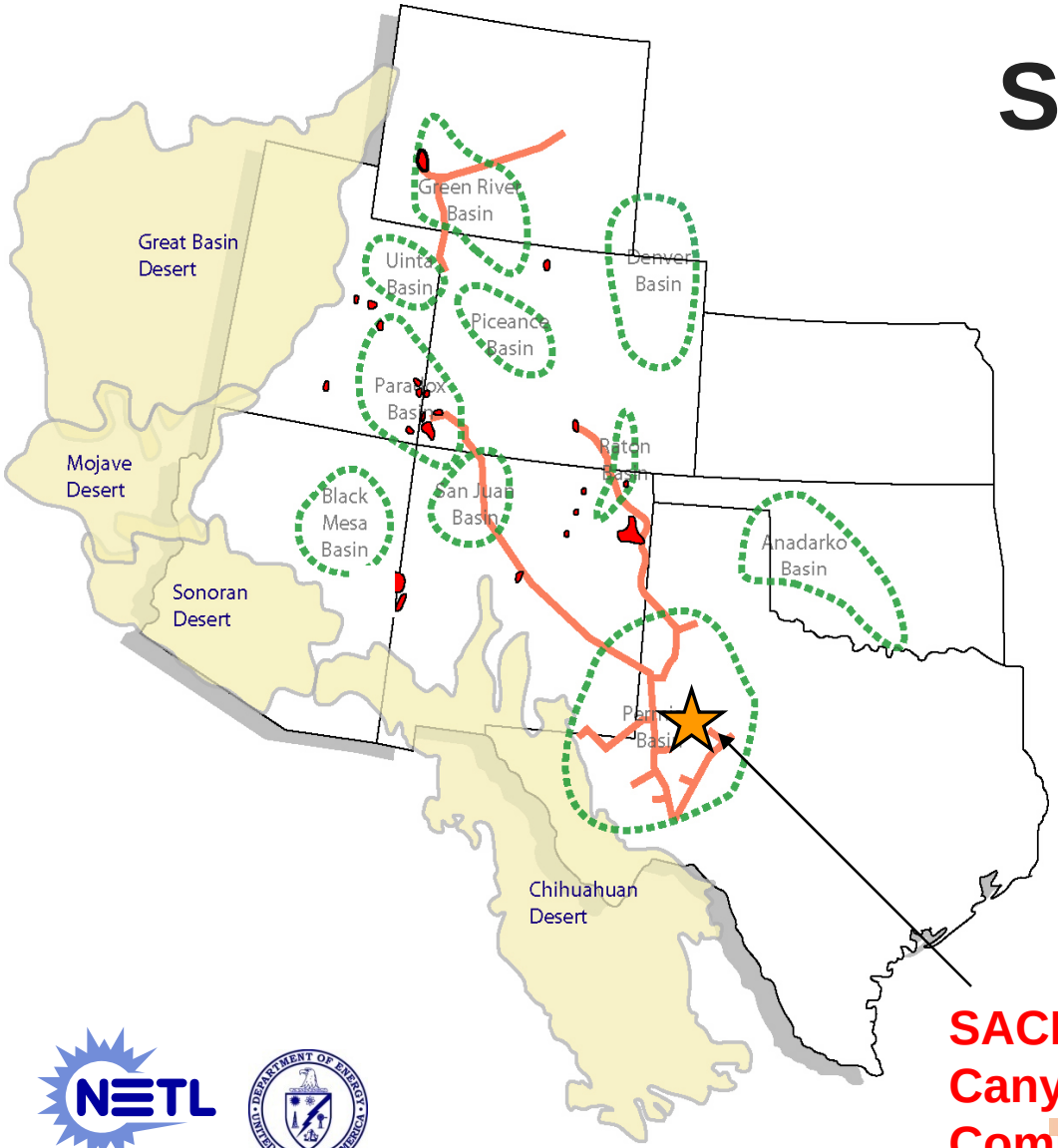
# Southwest Regional Partnership on Carbon Sequestration




# SACROC EOR and Sequestration Demonstration

DE- FC26-05NT42591

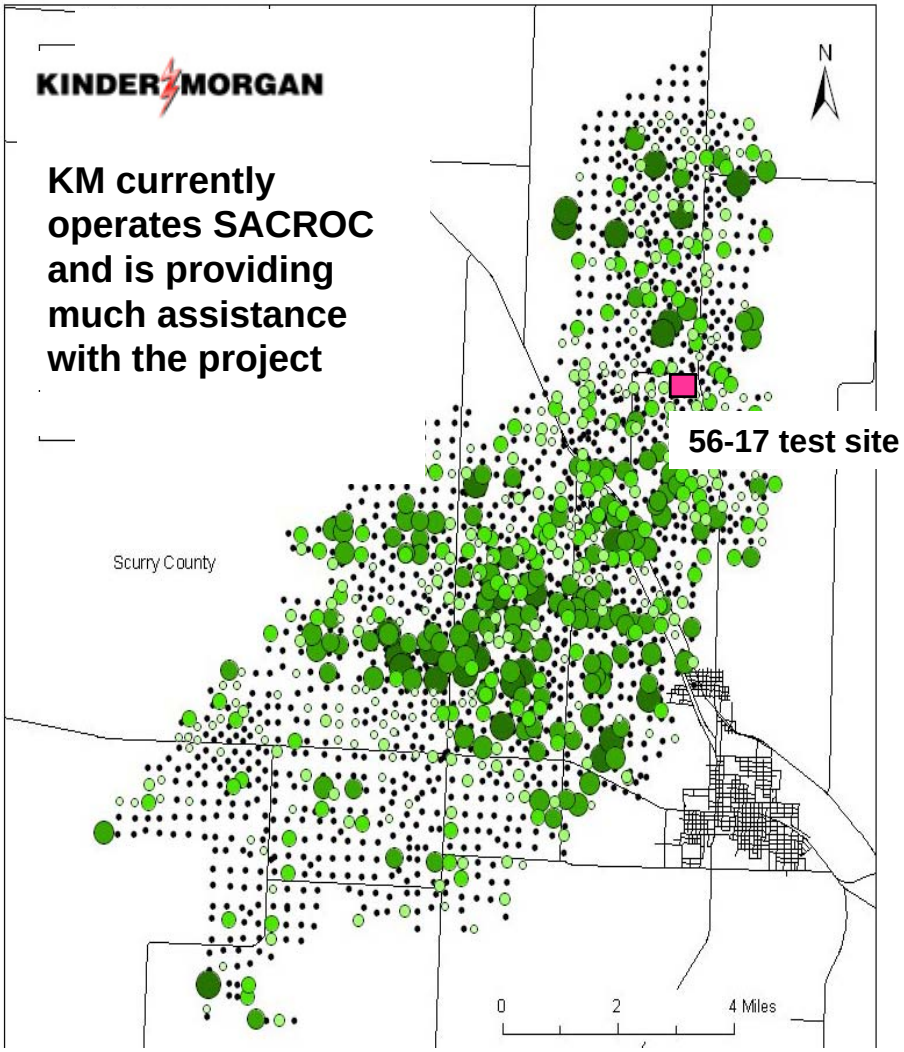
**Rebecca C. Smyth**

**October 23, 2008**

**Albuquerque, New Mexico**

**SACROC – Scurry Area Canyon Reef Operators Committee unitized oilfield**

# SACROC Previous $CO_2$ Injection




- 3 TCF (150 million metric tons (MMt)) $CO_2$ injected for enhanced oil recovery (EOR) since 1972 by multiple operators
- 1.5 TCF (75 MMt) $CO_2$ recovered as of October 1, 2008
- SWP researchers are among first to test if this $CO_2$ is trapped in reservoir zones or if it has leaked into overlying strata
- Previous $CO_2$ injection history provides opportunity for (1) larger scale, inside vs. outside SACROC, and (2) longer time frame soil and groundwater monitoring
- 56-17 reverse 5-spot $CO_2$ EOR injection pattern is location of the SWP injection experiment test site

# BEG Groundwater Sampling

**<u>Geologic Units</u>**

**Qs = Quaternary windblown sand**

**Qu = Quaternary undifferentiated**

**Eo = Eocene Ogallala**

**TRd = Triassic Dockum**

**<u>PERMIAN</u>**

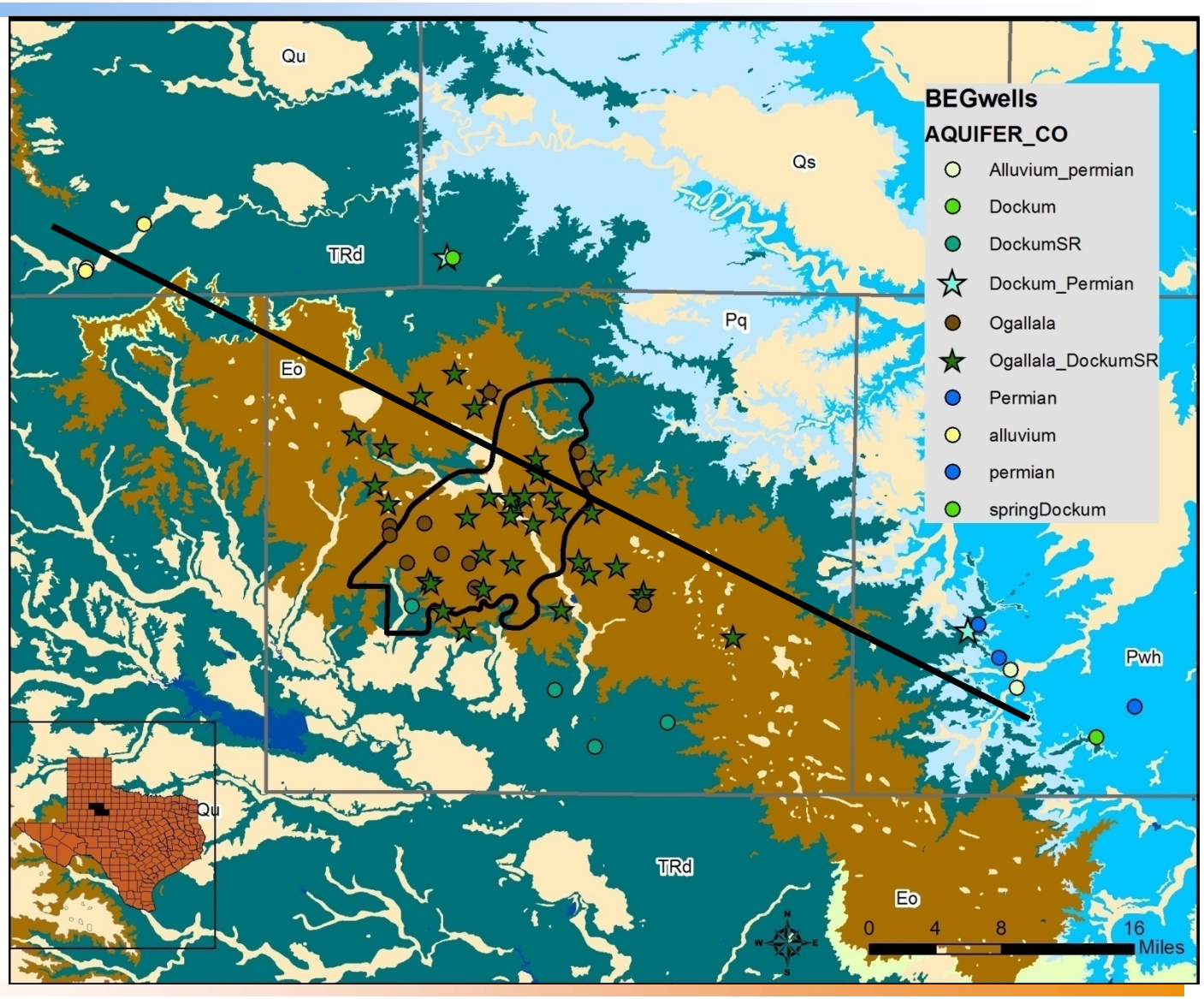
**Pq = Quartermaster**

**Pwh = Whitehorse**

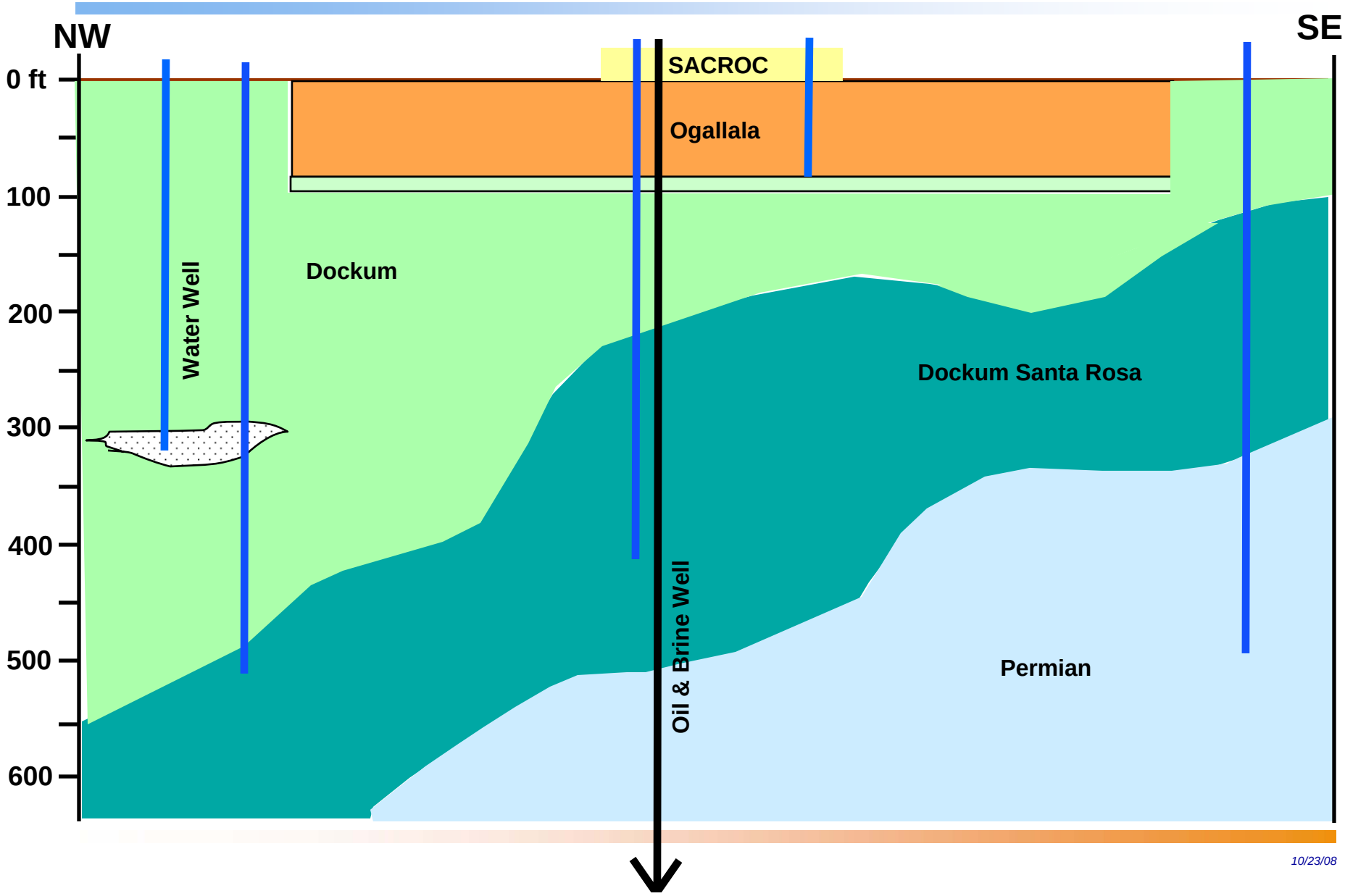
**Pb = Blaine**

**Ps = San Angelo**

**Pc = Clearfork**



# Regional Stratigraphic Schematic



# BEG Water Well Sampling - WQ

- **Six sampling trips – Claytonville in June 2006; SACROC in July 2007, Nov. 2007, March 2008, July 2008, and Nov. 2008**
- **Total wells – 61 wells and 1 spring (+6 SACROC production and brine injection wells sampled 7/07, 11/07, 3/08, and 7/08)**
- **Total samples sets collected – 123**
- **Laboratory analytes (LANL): Al, Ag, As, B, Ba, Be, Br, Ca, Cd, Cl, Co, CO3, Cr, Cs, Cu, d13C, dD, d18O, F, Fe, HCO3, Hg, K, Li, Mg, Mn, Mo, Na, Ni, NO3, Pb, PO4, Rb, Sb, Se, Si, Sn, SO4, Sr, TDS, Th, Ti, Tl, U, V, and Zn**
- **Laboratory analytes (UT DGS): DIC, DOC, headspace gases (pCO2, CH4)**
- **Field parameters: alkalinity, dissolved oxygen, pH, specific conductivity, and temperature**
- **Well information: total depth, water level (where possible), x and y coordinates from GPS, elevation (z) from digital elevation model, stratigraphic unit from BEG-constructed structure contour maps (based on shallow geophysical logs)**

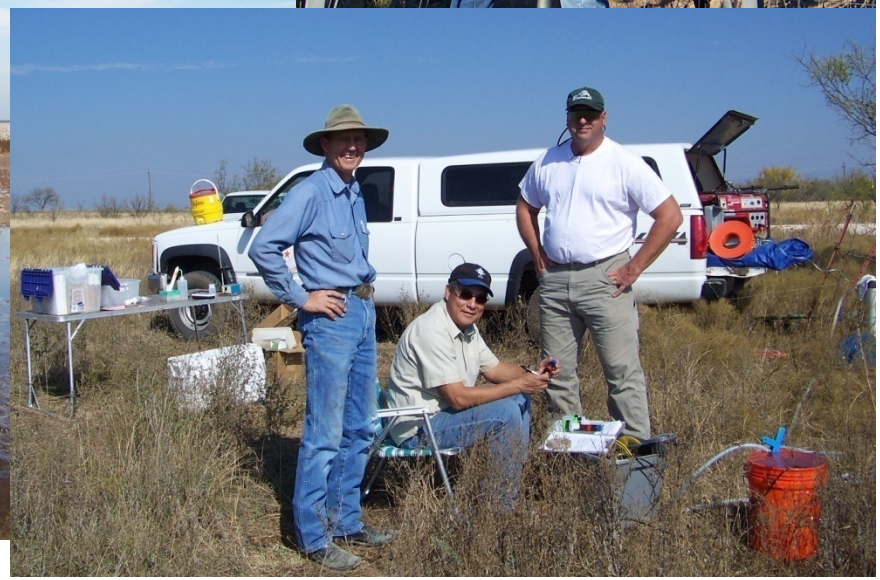
# Types of power for pumping: solar to portable generator

# Low or High Flow Rates from Irrigation Wells

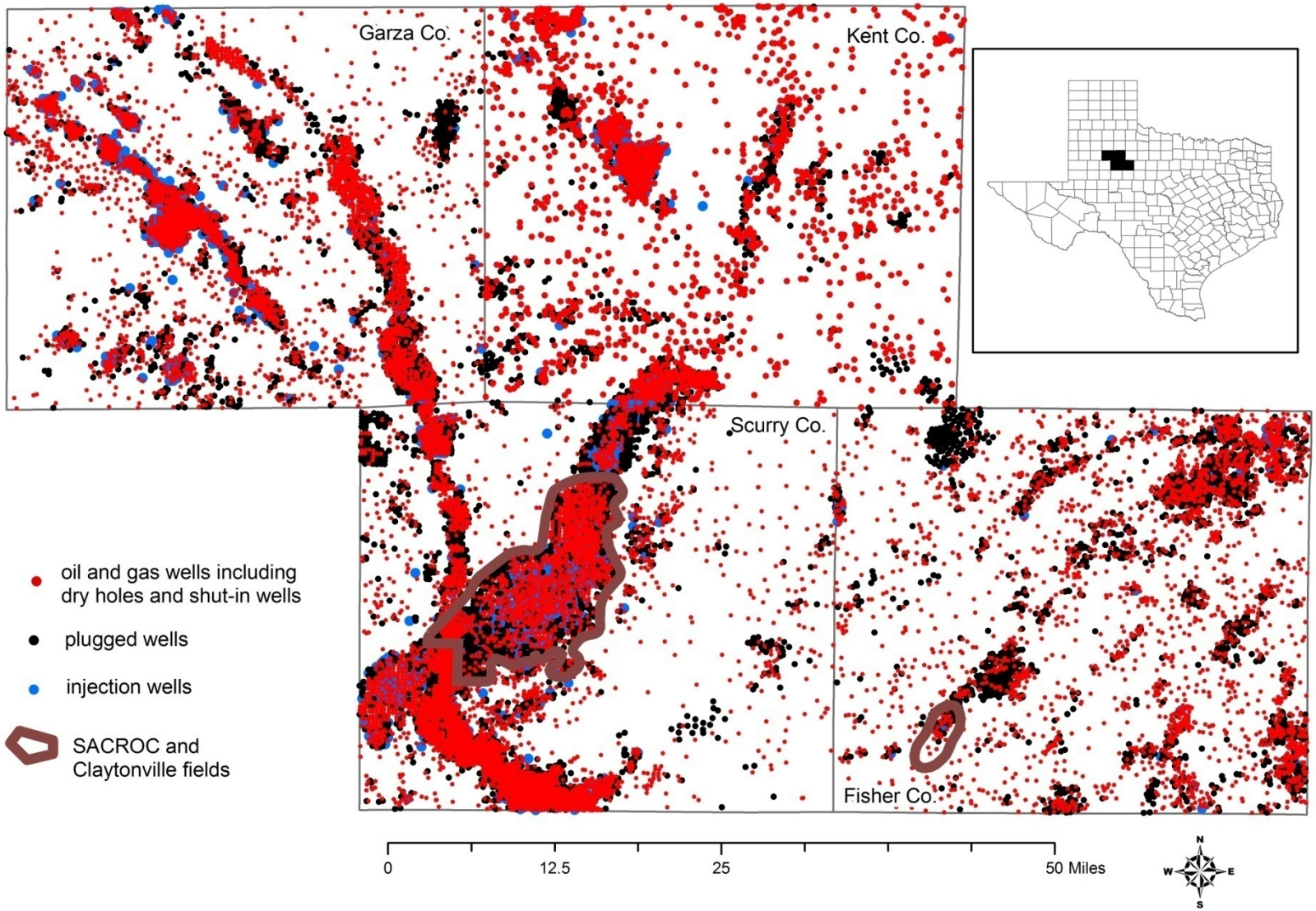
Left: Low discharge rate - less aeration of water hence more accurate *insitu groundwater parameters.*

Right: High discharge rate - more aeration of water hence less accurate *insitu groundwater parameters.*

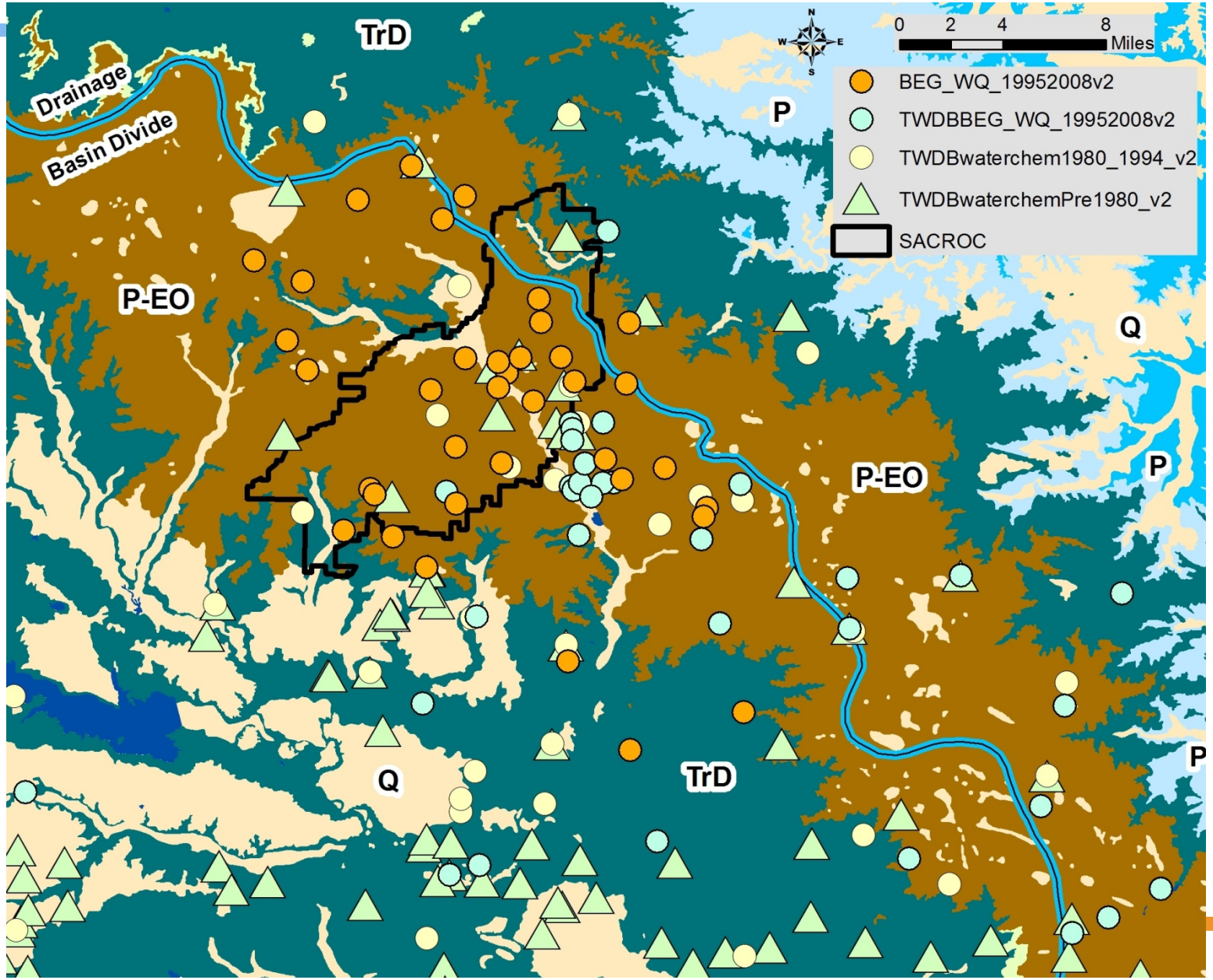
# Water Well Sampling Assistance



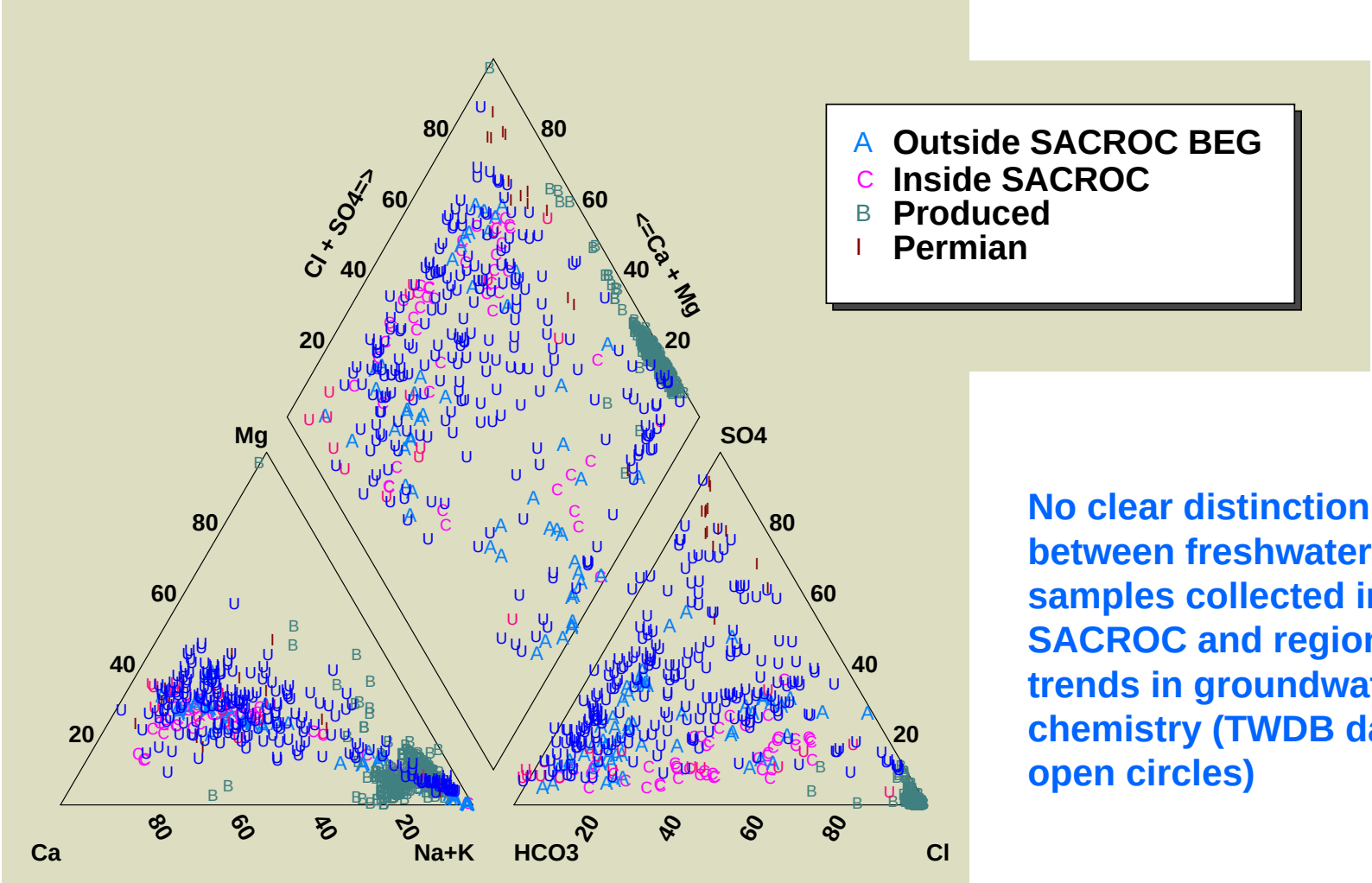
# Previous O&G Well Drilling



# BEG & TWDB Groundwater Sampling



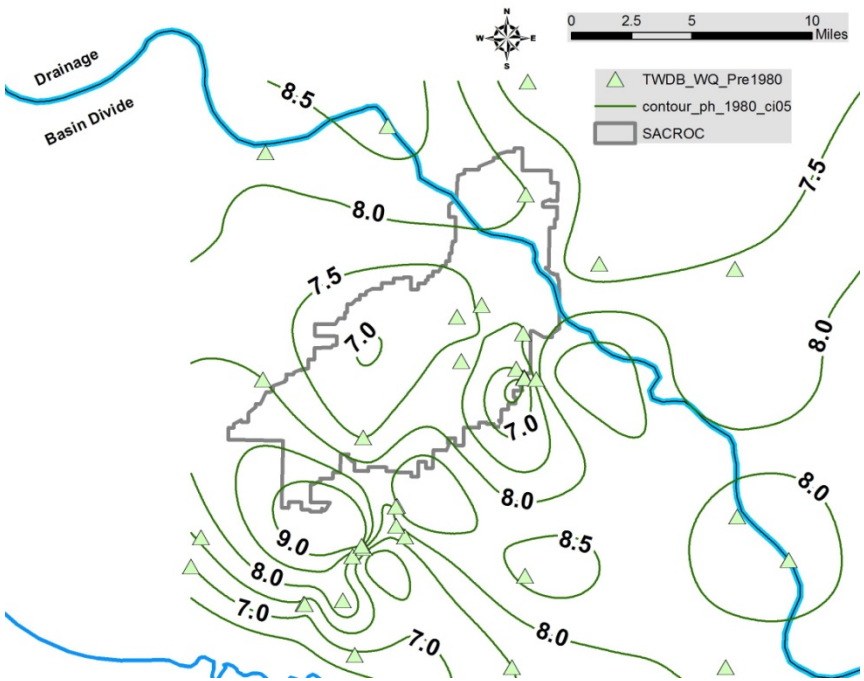
# Geochemical Relationships



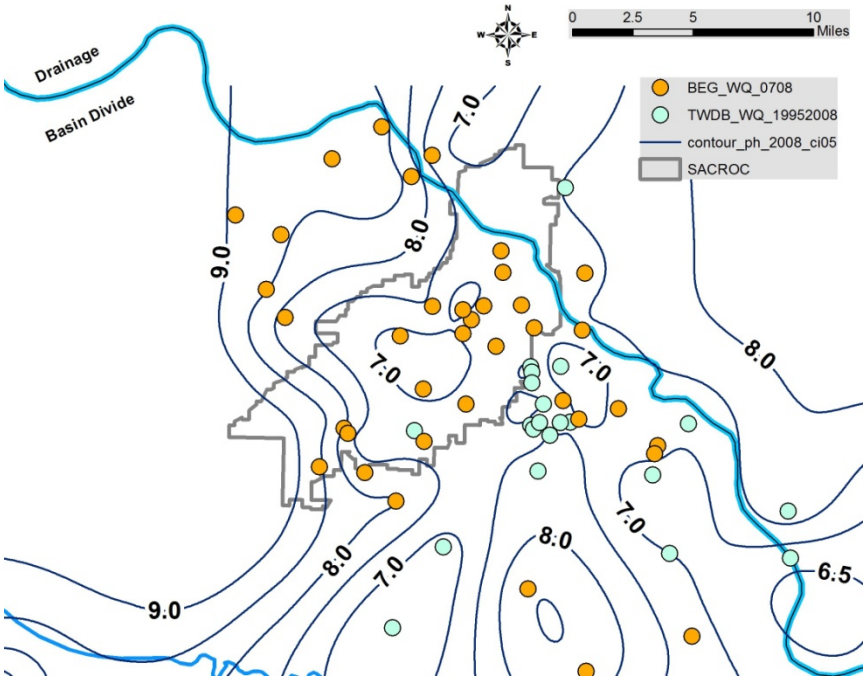

**No clear distinction between freshwater samples collected inside SACROC and regional trends in groundwater chemistry (TWDB data - open circles)**

# BEG Water Chemistry Examples Temporal-Spatial Relationships

Parameter: pH




**Pre-1980 pH values reported in Texas Water Development Board (TWDB) database for water wells completed in Dockum Santa Rosa**

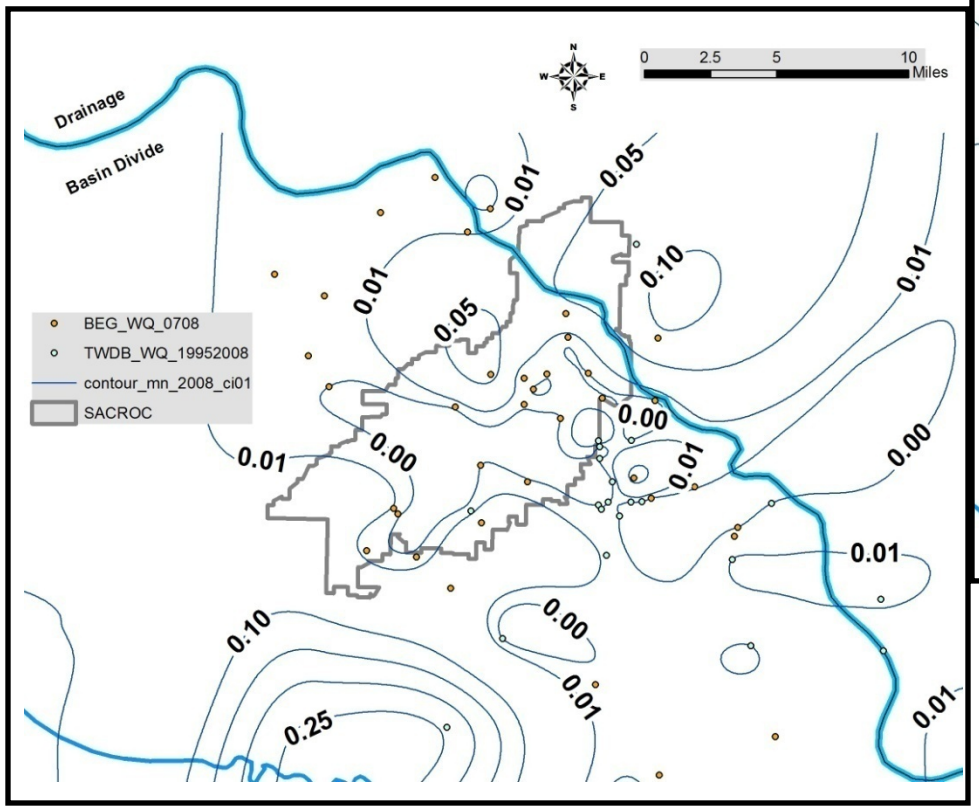


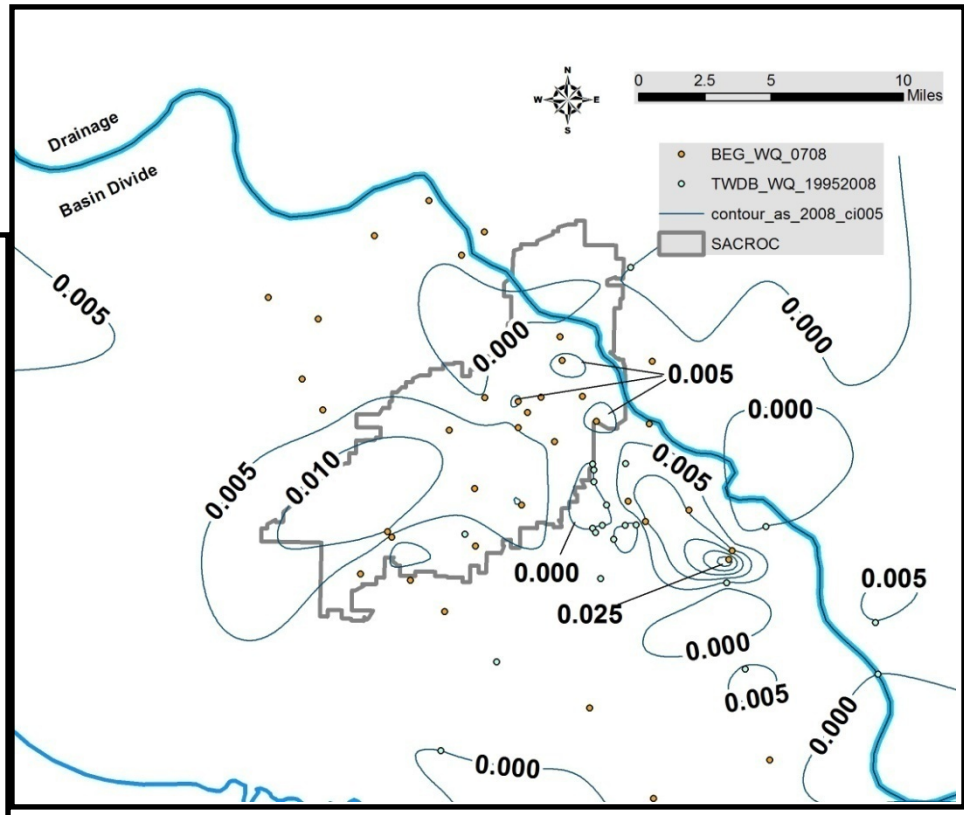

**pH values from TWDB (1995 – 2008 samples) and BEG (2007-2008 samples) for water wells completed in Dockum Santa Rosa**

# BEG Water Chemistry Examples
# Spatial Relationships

## Analyte: Manganese

**EPA 2° drinking water standard - 0.05 mg/L**




## Analyte: Arsenic

**EPA Maximum Contaminant Limit – 0.01 mg/L**

# Water Quality

## 60 wells, 1 spring; Water is filtered

| Analyte | EPA/TCEQ Primary Drinking Water MCL (mg/L) | BEG Wells Exceeding EPA Standards | BEG Wells Exceeding EPA Standards - Inside SACROC | BEG Wells Exceeding EPA Standards - Outside SACROC |
|---|---|---|---|---|
| Primary Maximum Contaminant Level (MCL) | | | | |
| Arsenic (As) | 0.01 | 9.8 % | 1.6 % | 8.2 % |
| Cadmium (Cd) | 0.005 | 1.6 % | 0.0 % | 1.6 % |
| Fluoride ($F^-$) | 0.4 | 4.9 % | 1.6 % | 3.3 % |
| Nitrate ($NO_3$-N) | 10 | 13.1 % | 4.9 % | 8.2 % |
| Selenium (Se) | 0.05 | 4.9 % | 1.6 % | 3.3 % |
| Secondary Drinking Water Standard | | | | |
| Alumnium (Al) | 0.05 | 34.4 % | 13.1 % | 21.3 % |
| Chloride ($Cl^-$) | 250 | 32.8 % | 14.8 % | 18.0 % |
| Fluoride ($F^-$) | 0.2 | 37.7 % | 14.7 % | 23.0 % |
| Manganese (Mn) | 0.05 | 14.7 % | 4.9 % | 9.8 % |
| Sulfate ($SO_4^{2-}$) | 250 | 26.2 % | 1.6 % | 24.6 % |
| Total Dissolved Solids (TDS) | 1000 | 50.8 % | 18.0 % | 32.8 % |

# Gulf Coast Carbon Center (GCCC)

**Mission:** ***Global leadership in research and economic implementation of large scale greenhouse gas sequestration.***

**GCCC Team:**

Ian Duncan, Susan Hovorka, Tip Meckel, Becky Smyth, J. P. Nicot, Katherine Romanak, Jeff Paine, Changbing Yang + *3 new post-docs, MA and undergraduate research assistants*

Steve Bryant & Gary Rochelle (UT- Chem. Eng.)

## Sponsors