Geochemistry of the Northern Segment of the Edwards Aquifer in Relation to Salado Springs and Baseline Assessment of Trinity Aquifer Water Quality

November 16, 2016

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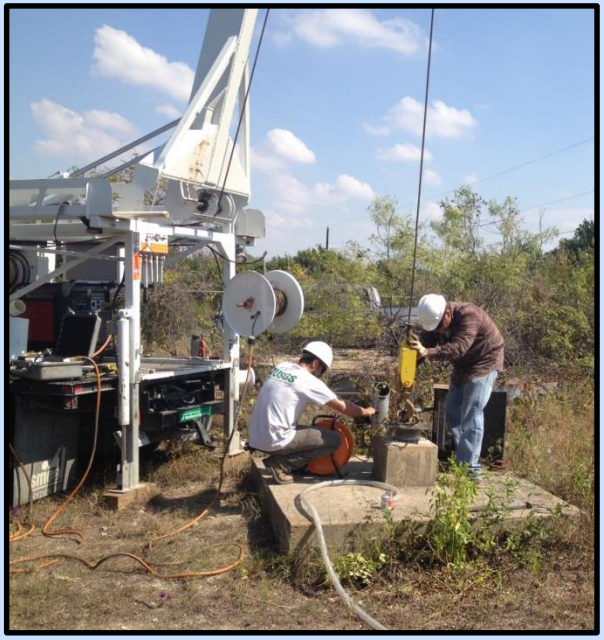
Bell County Adaptive Management Coalition (BCAMC)



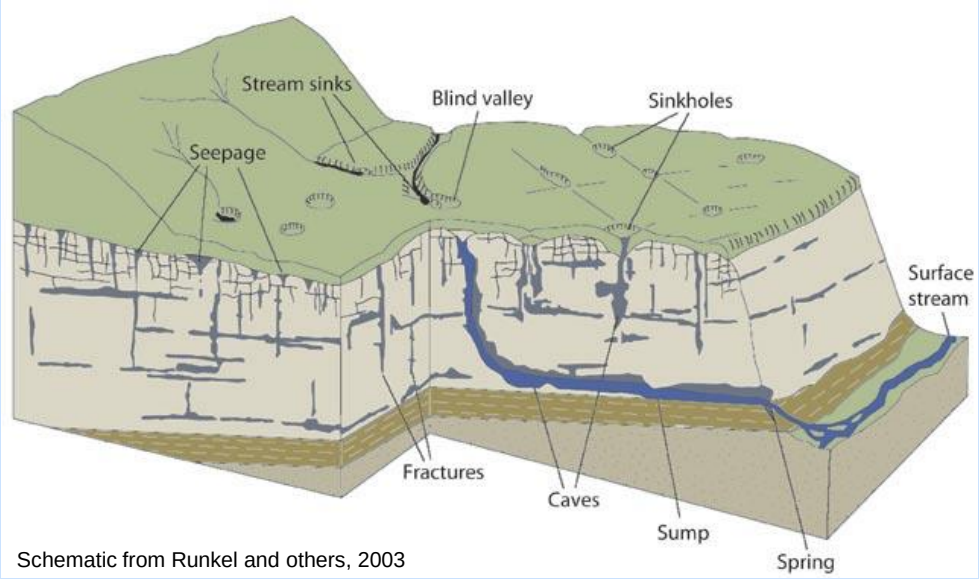
Outline

- Karst, geochemistry, and the Edwards aquifer
- USGS studies in the Edwards aquifer
- USGS baseline assessment of Trinity aquifer water quality

What is Karst?

Landforms and hydrology created by the dissolution of soluble rocks (such as limestone and dolomite)

Photo from David A. Johns, City of Austin



Schematic from Runkel and others, 2003

Characterized by sinkholes, caves, and springs

What is Karst?

Often productive…

but highly vulnerable to contamination

What can groundwater geochemistry tell us?

- Sources of recharge
- Contaminant information
- Sources of contamination
- Residence time
- Vulnerability
- Flow paths

What's in the water → tools for resource management in terms of suitability and availability for multiple purposes and end users

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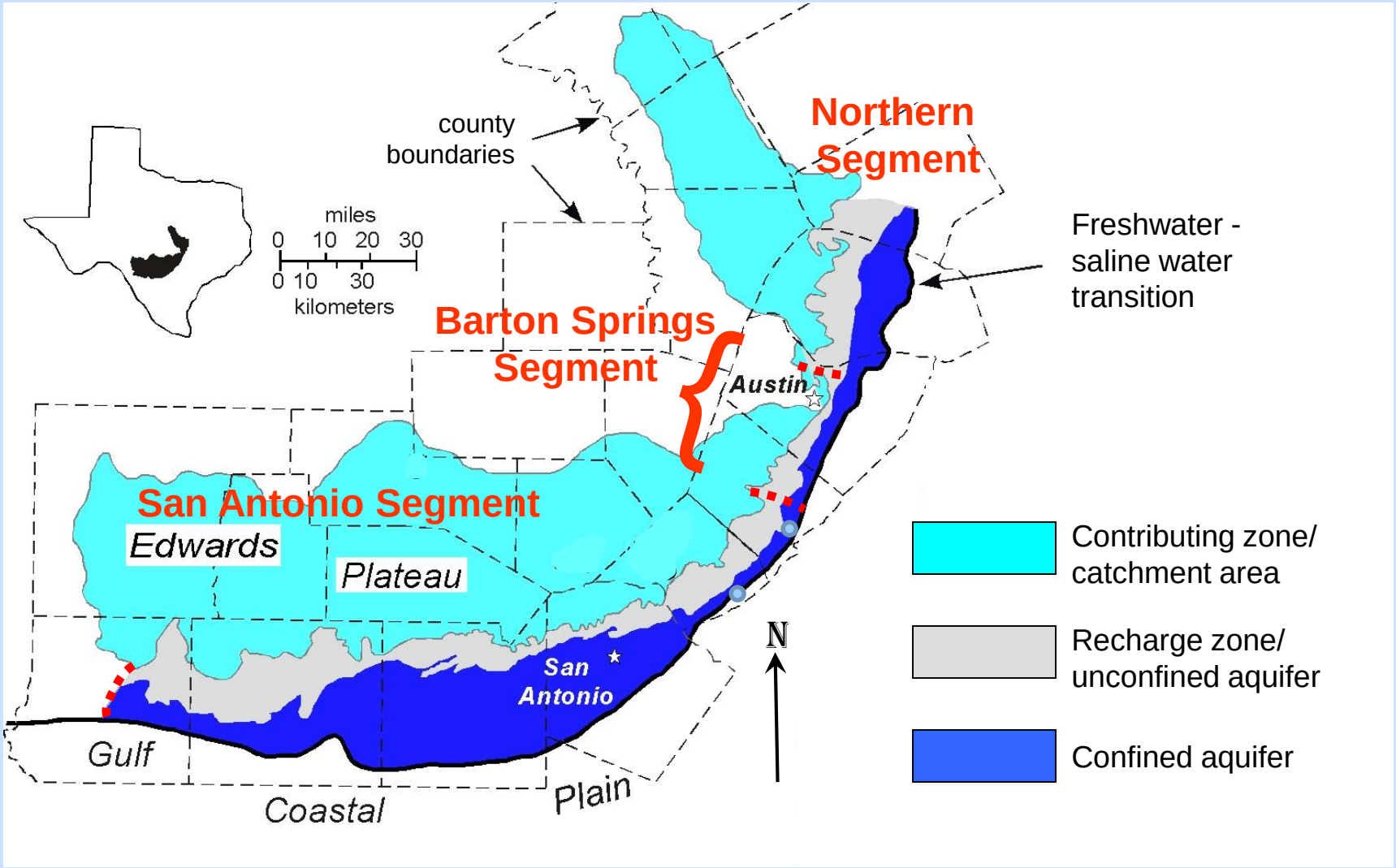
Edwards Aquifer in Central Texas



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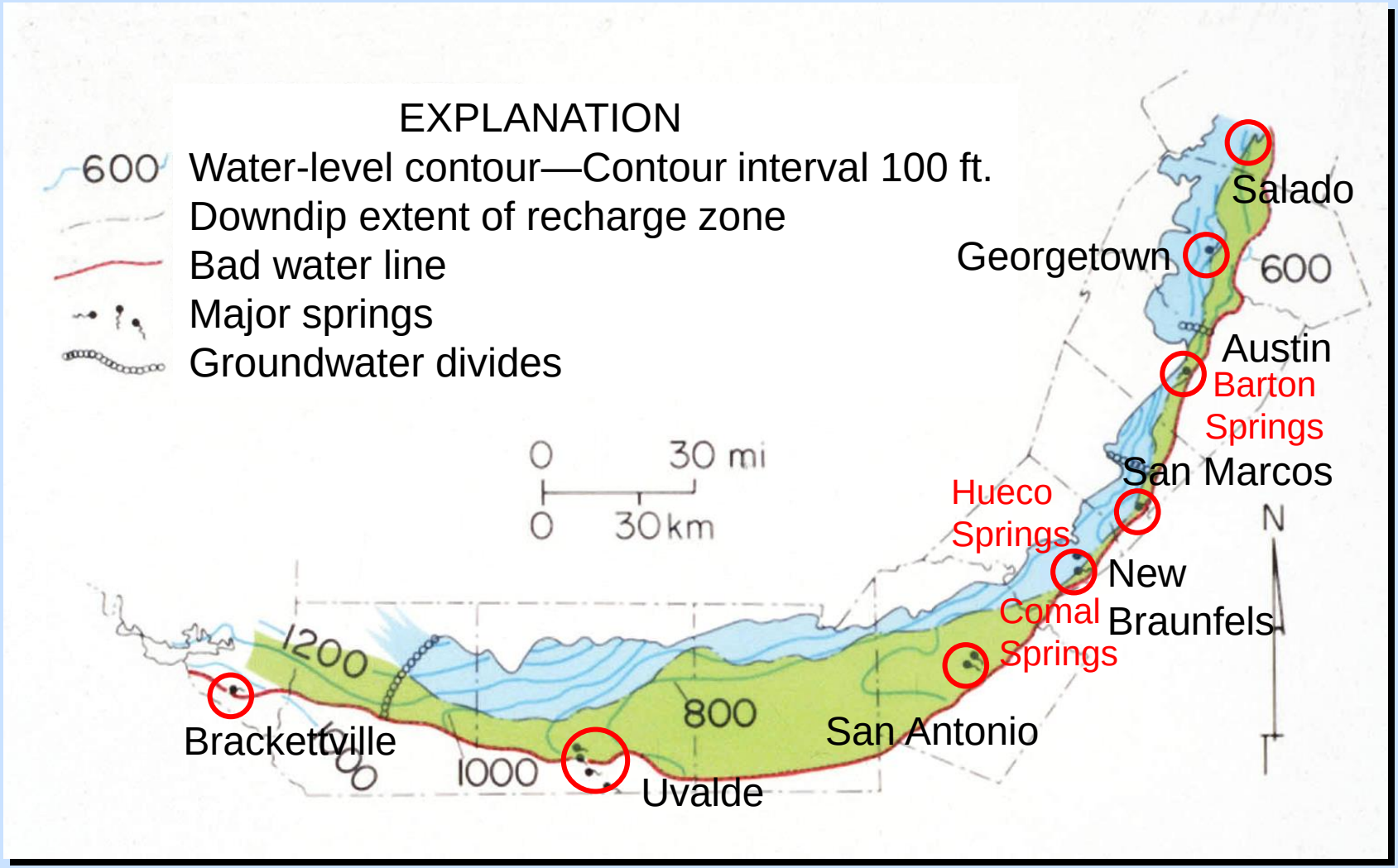
Springs of the Edwards Aquifer



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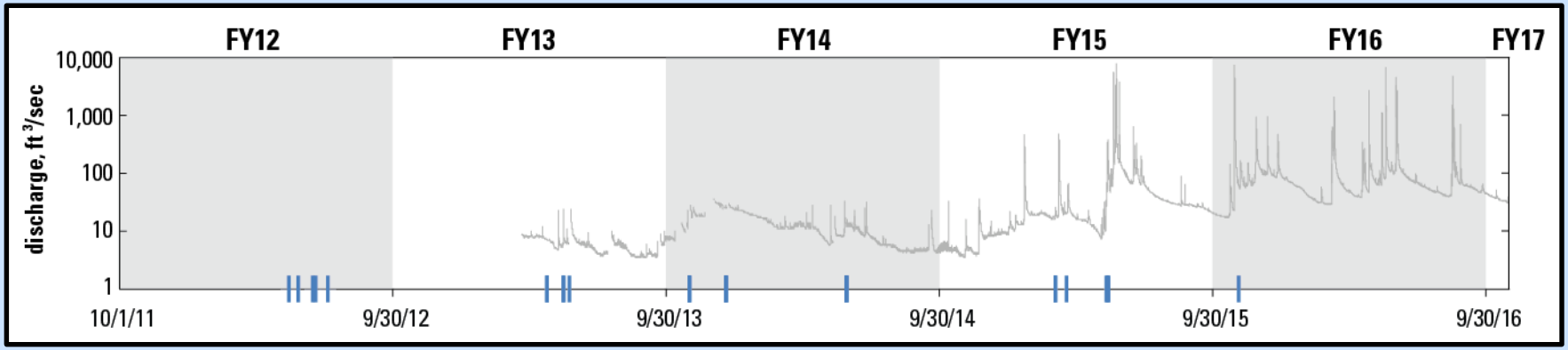
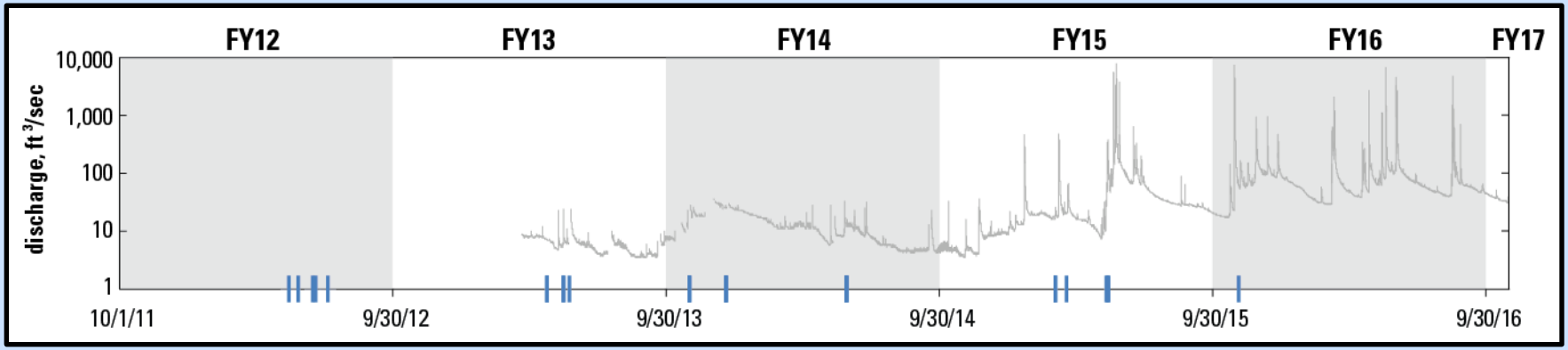
Timeline
Edwards Aquifer Spring-Related Sampling



FY12

- 5/15-5/18 – collected synoptic samples at six spring orifices (Big Boiling, Little Boiling, Robertson, Anderson, Critchfield, Benedict)
- 5/24 – sampled Salado Creek Below downstream from confluence of N. and S. Salado Creeks
- 6/15 – sampled unconfined Edwards well on FM 2843
- 6/19 – sampled confined Edwards well at Salado Cemetery
- 7/5 – sampled middle/lower Trinity well at Micheaux Ranch

Timeline
Edwards Aquifer Spring-Related Sampling

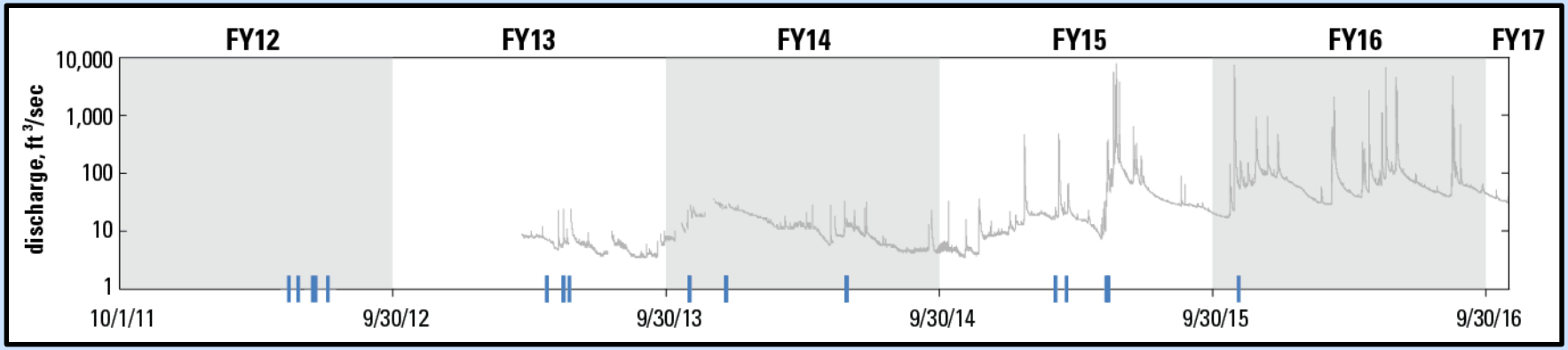


FY13

- 3/21 – installed low-flow streamflow gage on Salado Creek
- 4/24 – collected paired samples at Big Boiling Spring and Stagecoach Inn "cave" well under baseline conditions
- 5/16 – collected paired samples at Big Boiling Spring and Stagecoach Inn "cave" well following light rain
- 5/24 – collected sample at Big Boiling Spring following moderate rain

Timeline

Edwards Aquifer Spring-Related Sampling

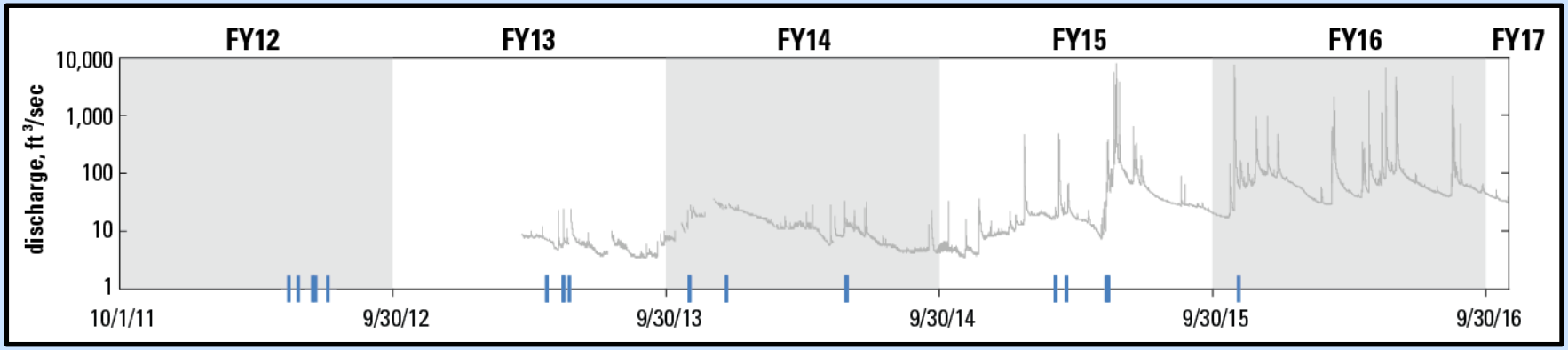


FY14

- 10/31 – collected paired samples at Big Boiling Spring and Stagecoach Inn "cave" well following heavy rain along with grab sample from Salado Creek for major ions, nutrients, and trace elements (Strontium and Boron only)
- 12/19 – collected samples from same locations following light precipitation event
- 5/29 – collected samples from same locations following light precipitation event
- Early FY14 – expanded streamgage range to full range

Timeline

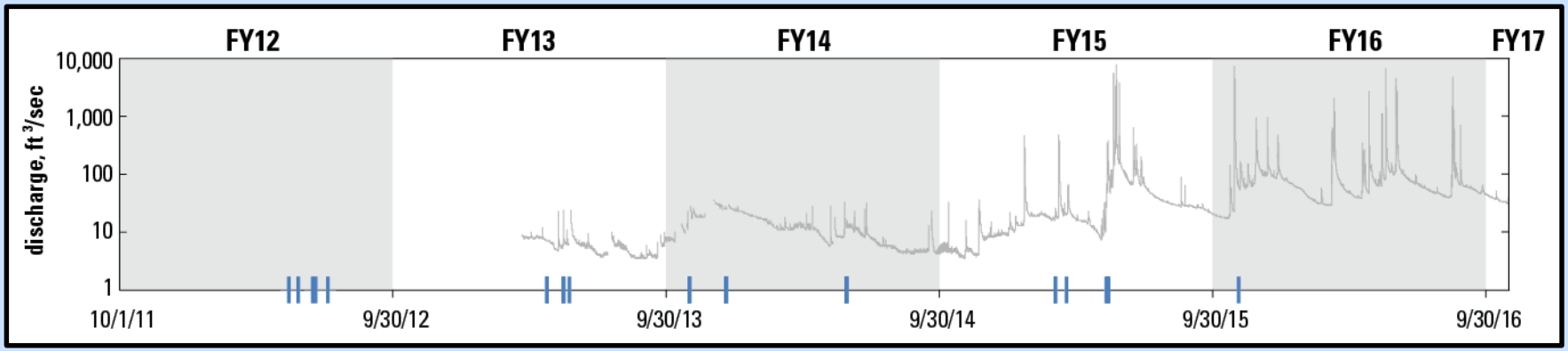
Edwards Aquifer Spring-Related Sampling



FY15

- 3/4 – collected paired samples at Robertson Spring and Robertson well
- 3/19 – collected sample from Big Boiling Spring following light precipitation event
- 5/11, 5/13, and 5/14 – collected three samples from Big Boiling Spring during multi-day precipitation event
- mid-May to late-July – weekly monitoring of geochemical properties at 4 Northern Edwards springs

Timeline
Edwards Aquifer Spring-Related Sampling



FY16

- 11/4 – collected synoptic samples at six spring orifices (Big Boiling, Little Boiling, Robertson, Anderson, Critchfield, Benedict) at different flow regime than samples collected during first phase of the investigation (May 2012)

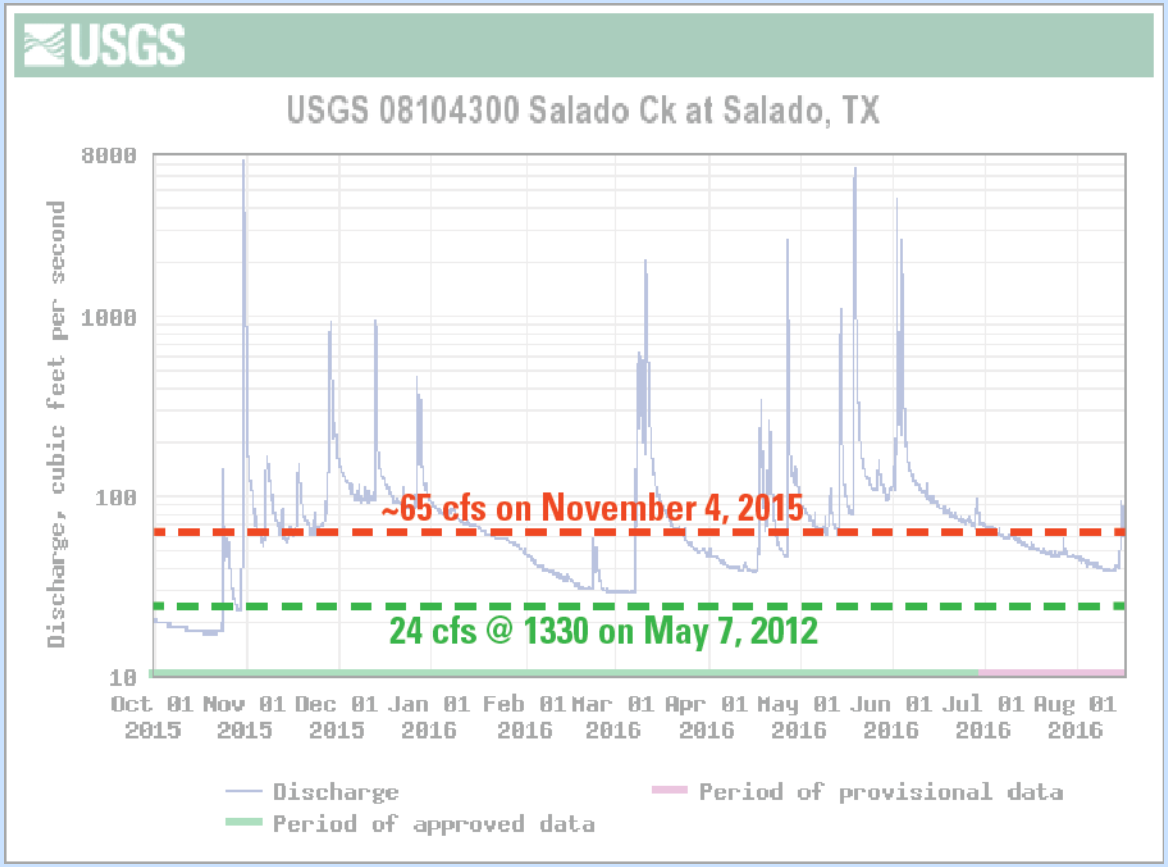
Edwards Aquifer Spring-Related Sampling in FY16

- Discharge Comparison
- Water Quality Comparison
  - Cations/Anions
  - Pesticides
  - Nitrate
  - Isotopes

Little Boiling sampling location on 7/2/12

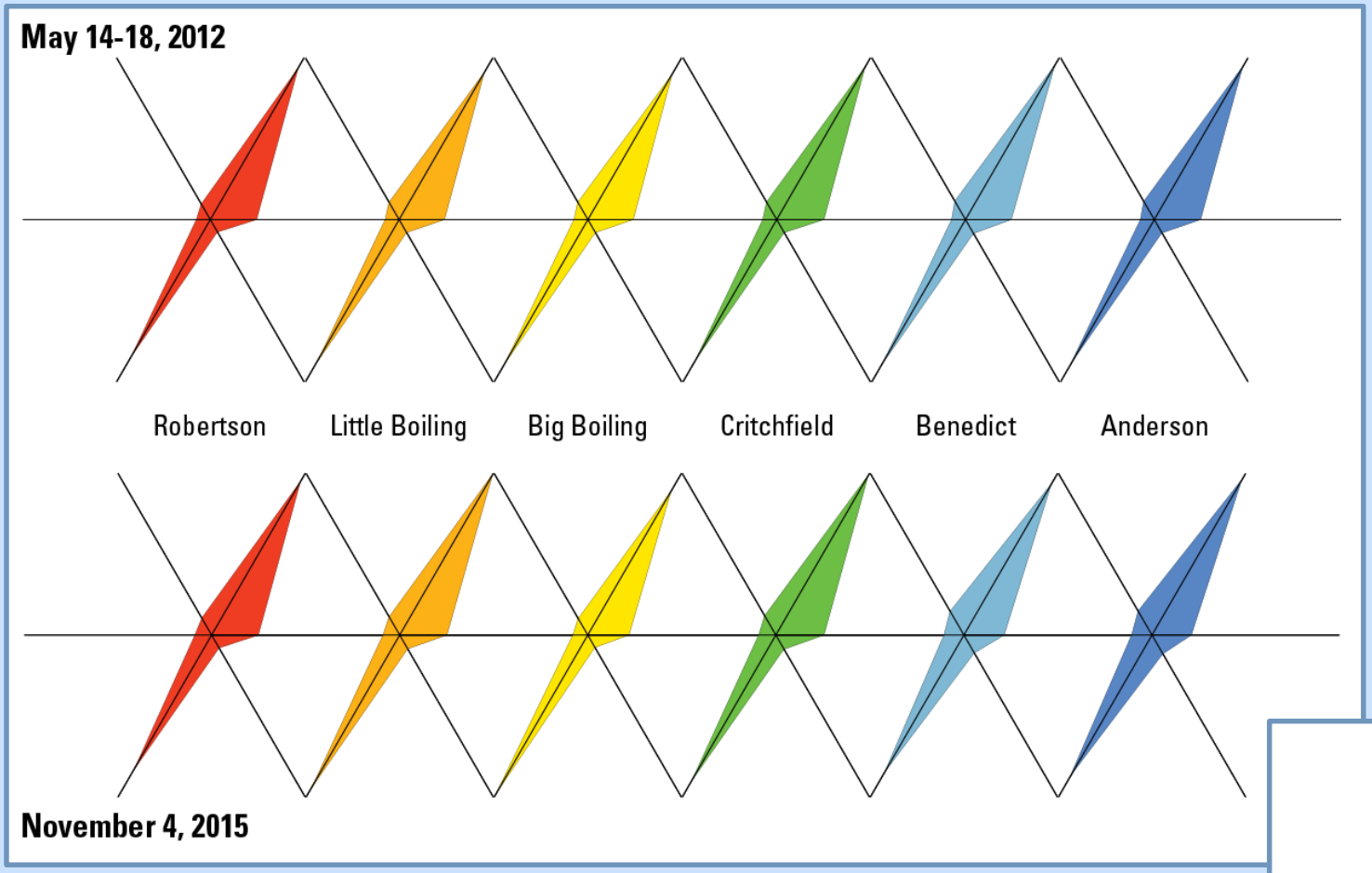
Little Boiling sampling location on 11/4/15

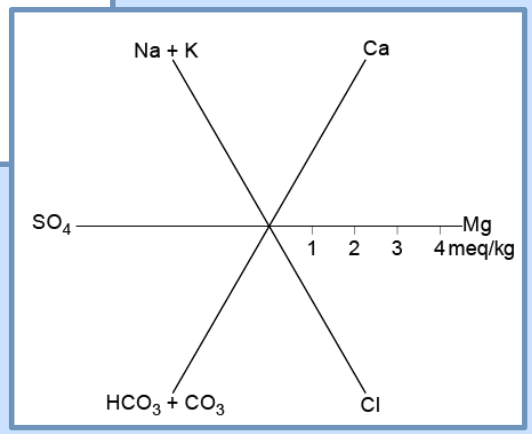
Discharge Comparison
Between Synoptic Spring Sampling Efforts



General Chemistry Comparison

Cations/Anions





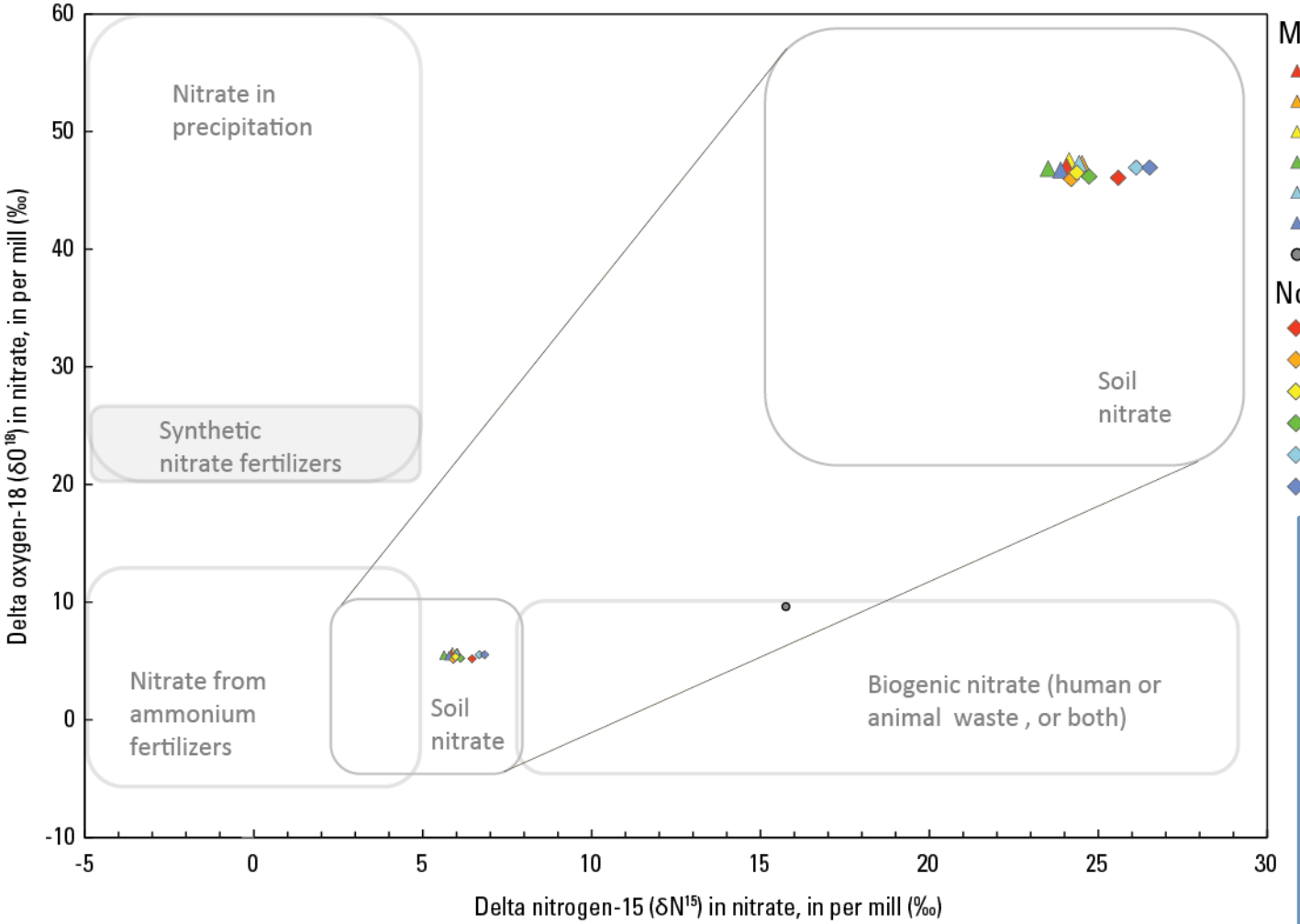
Pesticide Concentrations (in µg/L)

Comparison Between Synoptic Spring Sampling Efforts

Nitrate Concentrations (in mg/L)

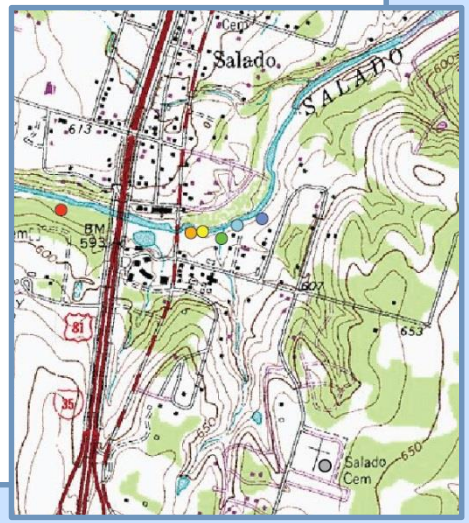
Comparison Between Synoptic Spring Sampling Efforts

Isotopic Chemistry Comparison
Nitrogen-15/Oxygen-18 in Nitrate



May/June 2012
- Robertson
- Little Boiling
- Big Boiling
- Critchfield
- Benedict
- Anderson
- Salado Cemetery

November 2015
- Robertson
- Little Boiling
- Big Boiling
- Critchfield
- Benedict
- Anderson



Insights about Edwards Aquifer and Salado Springs Complex

- Multiple lines of evidence to indicate alternate flowpath contributions to Benedict and Anderson Springs are likely under moderate to wet conditions

- Benedict and Anderson springs have an isotopic chemistry signature more similar to the isotopic signature observed at the Salado Cemetery well relative to the four remaining Salado Springs

- Evidence for anthropogenic effects on water quality
  - Nitrate (NO_3), pesticides

- Spring discharge varies in response to rainfall and aquifer recharge

- Building a long-term and valuable dataset

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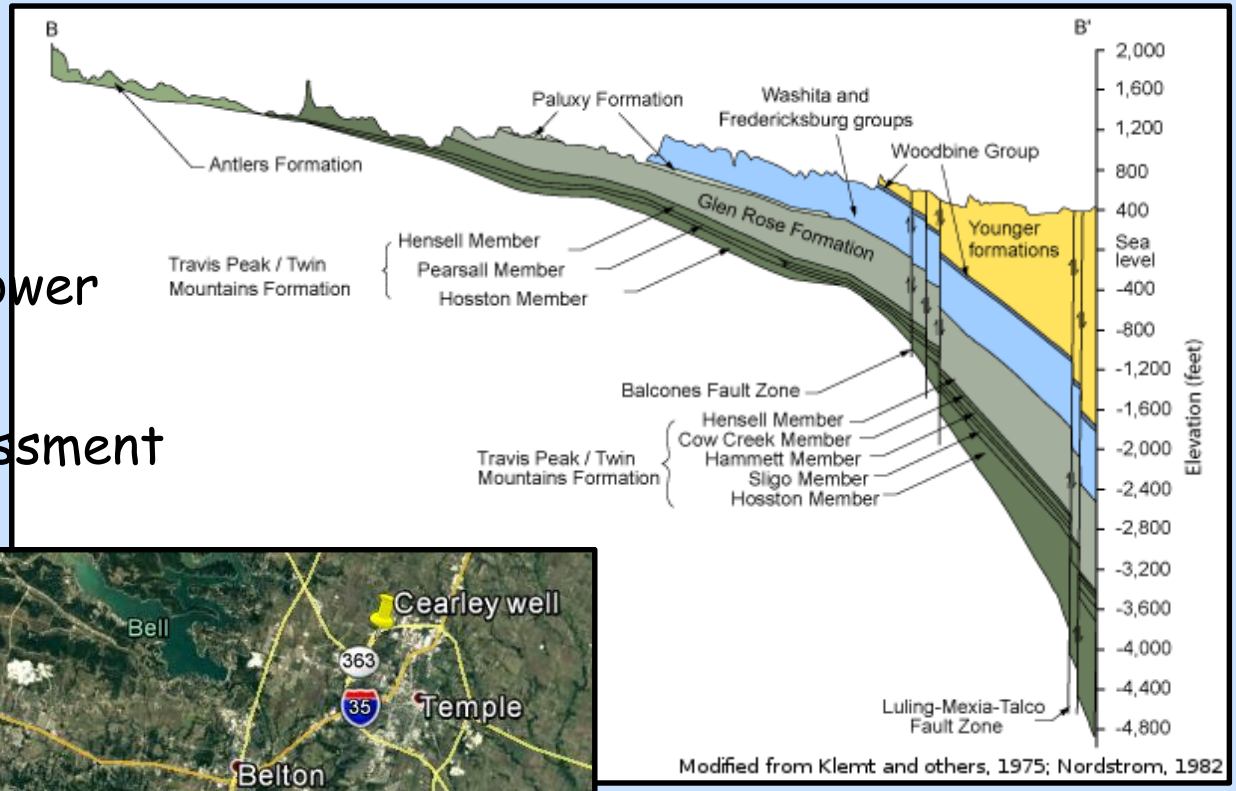
Trinity Aquifer Sampling

- Three wells
- September 2015
- Upper, Middle, and Lower Trinity aquifers
- Baseline aquifer assessment



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Upper Trinity
Central Texas College (CTC) Well
September 8-9 & 21-22

- High TDS
- Depth of 450′
- Static water level of 85.95′ on 9/8/15; 4.5″ casing

Middle Trinity
Stillman Valley Monitor Well
September 28

- Depth of 605'
- Static water level of 477.7' on 9/28/15
- 4" casing

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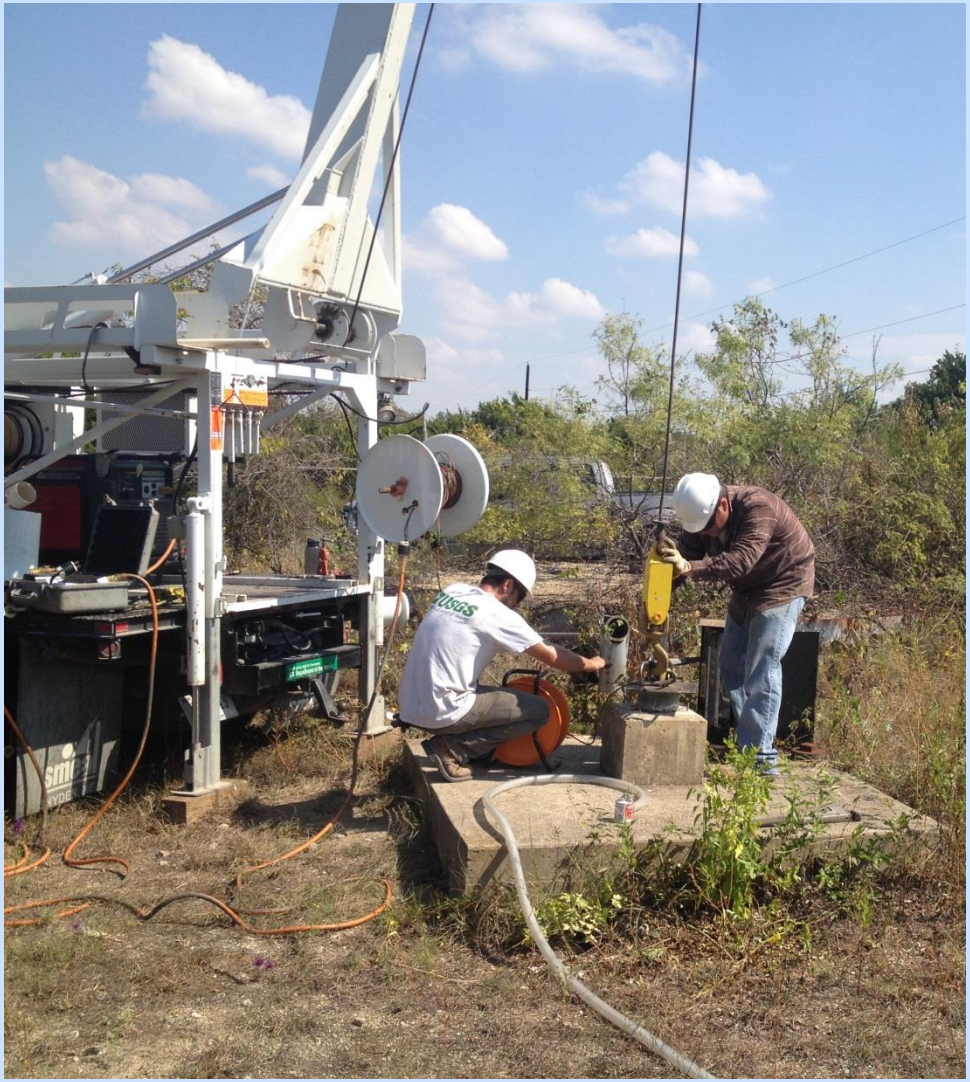
Lower Trinity
Cearley Well (City of Temple #2)
September 22-24

- Used to be Peppers Creek WSC
- No longer used
- Depth of 1669'
- Static WL of 469.26' on 9/22/15
- 7" casing



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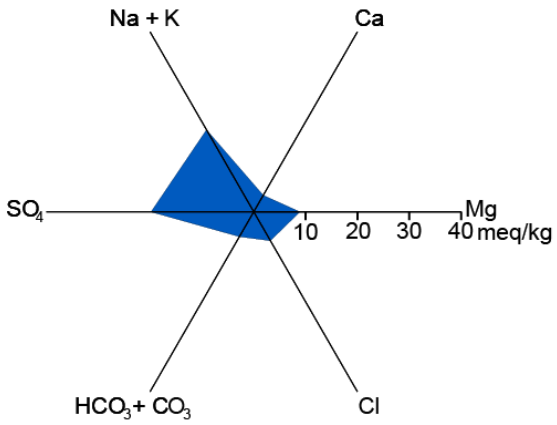
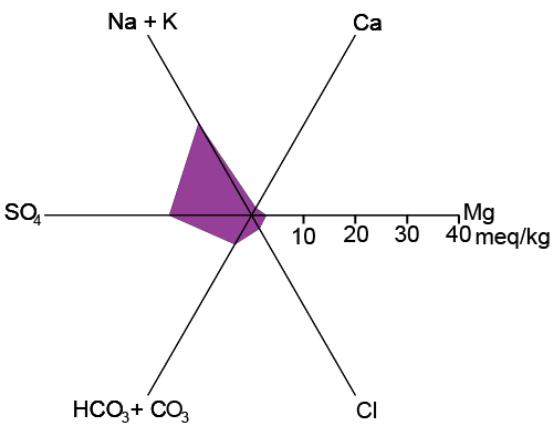
Major Ions

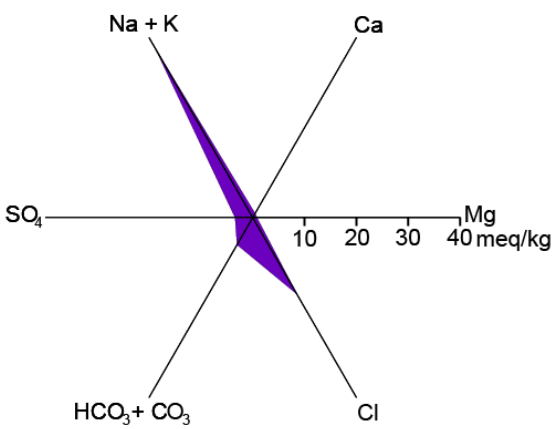
Upper Trinity
CTC
9/22/15



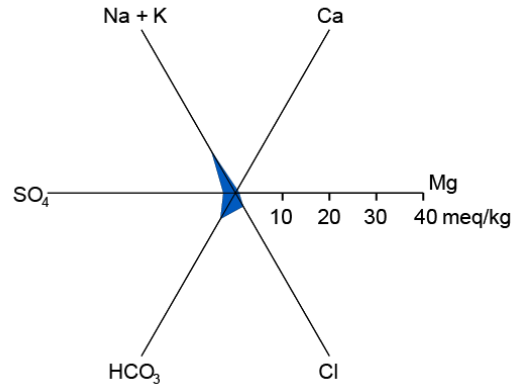
Middle
Stillman Valley
9/28/15



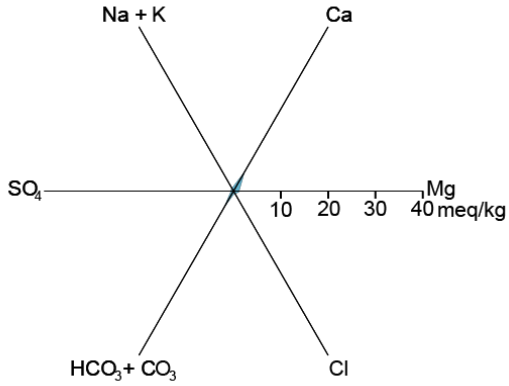
Lower Trinity
Cearley
9/24/15



Middle/Lower Trinity (Travis Peak Fm.)
Micheaux well
7/5/12



Edwards
Big Boiling
5/14/15



Major Ions
Sodium

- Upper – 412 mg/L
- Middle – 458 mg/L
- Lower – 858 mg/L

Drinking Water Advisory Table (from EPA Drinking Water Standards and Health Advisories Spring 2012)

- Health-based Value – 20 mg/L (for individuals on a 500 mg/day restricted sodium diet)
- Taste Threshold – 30-60 mg/L

Major Ions
Sulfate

- Upper – 949 mg/L
- Middle – 762 mg/L
- Lower – 164 mg/L

Secondary Drinking Water Regulations (from EPA Drinking Water Standards and Health Advisories Spring 2012)

- SDWR – 250 mg/L

Drinking Water Advisory Table

-Health-based Value – 500 mg/L

- Taste Threshold – 250 mg/L

Trace Elements
Boron

- Upper – 4.5 mg/L
- Middle – 5.6 mg/L
- Lower – 1.4 mg/L

Health Advisories (from EPA Drinking Water Standards and Health Advisories Spring 2012)

- RfD (reference dose) – 0.2 mg/kg/day
- DWEL (Drinking Water Equivalent Level) – 7 mg/L
- Lifetime Health Advisory – 6 mg/L
- 1-day for 10 kg child – 3 mg/L
- 10-day for 10 kg child – 3 mg/L

Trace Elements
Strontium

- Upper – 11.4 mg/L
- Middle – 13.5 mg/L
- Lower – 4.9 mg/L

Health Advisories (from EPA Drinking Water Standards and Health Advisories Spring 2012)

- RfD (reference dose) – 0.6 mg/kg/day
- DWEL (Drinking Water Equivalent Level) – 20 mg/L
- Lifetime Health Advisory – 4 mg/L
- 1-day for 10 kg child – 25 mg/L
- 10-day for 10 kg child – 25 mg/L

Pesticides

- No pesticides were detected in samples collected from wells completed in upper or lower zones of the Trinity aquifer

Low-level detections were measured in samples collected from the Stillman Valley well (middle zone of the Trinity aquifer)

- Desulfinyl fiprinol amide – 0.003 µg/L (E)
- Desulfinyl fiprinol – 0.0042 µg/L

Age-Dating

- Upper: 0.97 TU
- Middle: 0.40 TU
- Lower: -0.09 TU

Where 1 TU = 1 atom of ^{3}H per 10^{18} atoms of hydrogen

Tritium values less than about 0.5 TU usually* indicate groundwater recharged before 1952

- upper zone of the Trinity aquifer – recharged after 1952
- middle zone of the Trinity aquifer – recharged before 1952, but likely not much before
- lower zone of the Trinity aquifer – recharged before 1952

* Provided that extensive dilution by older groundwater has not occurred

Insights about Trinity Aquifer in Bell County

Preliminary observations based on an extremely limited dataset:

- Water chemistry is substantially different between the upper, middle, and lower zones of the Trinity aquifer

- As drinking water resources, there may be concerns with respect to
  - Sodium – upper, middle, and lower
  - Sulfate – upper and middle
  - Boron and Strontium – primarily upper and middle

Questions ?

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