# DRAFT CONCEPTUAL MODEL

## Update of the Groundwater Availability Model for Northern Portion of Queen City, Sparta, and Carrizo-Wilcox Aquifers

## Stakeholder Advisory Forum #2

August 9, 2018

Staffan Schorr

MONTGOMERY & ASSOCIATES
Water Resource Consultants

GSI ENVIRONMENTAL

esi Environmental Simulations Inc.

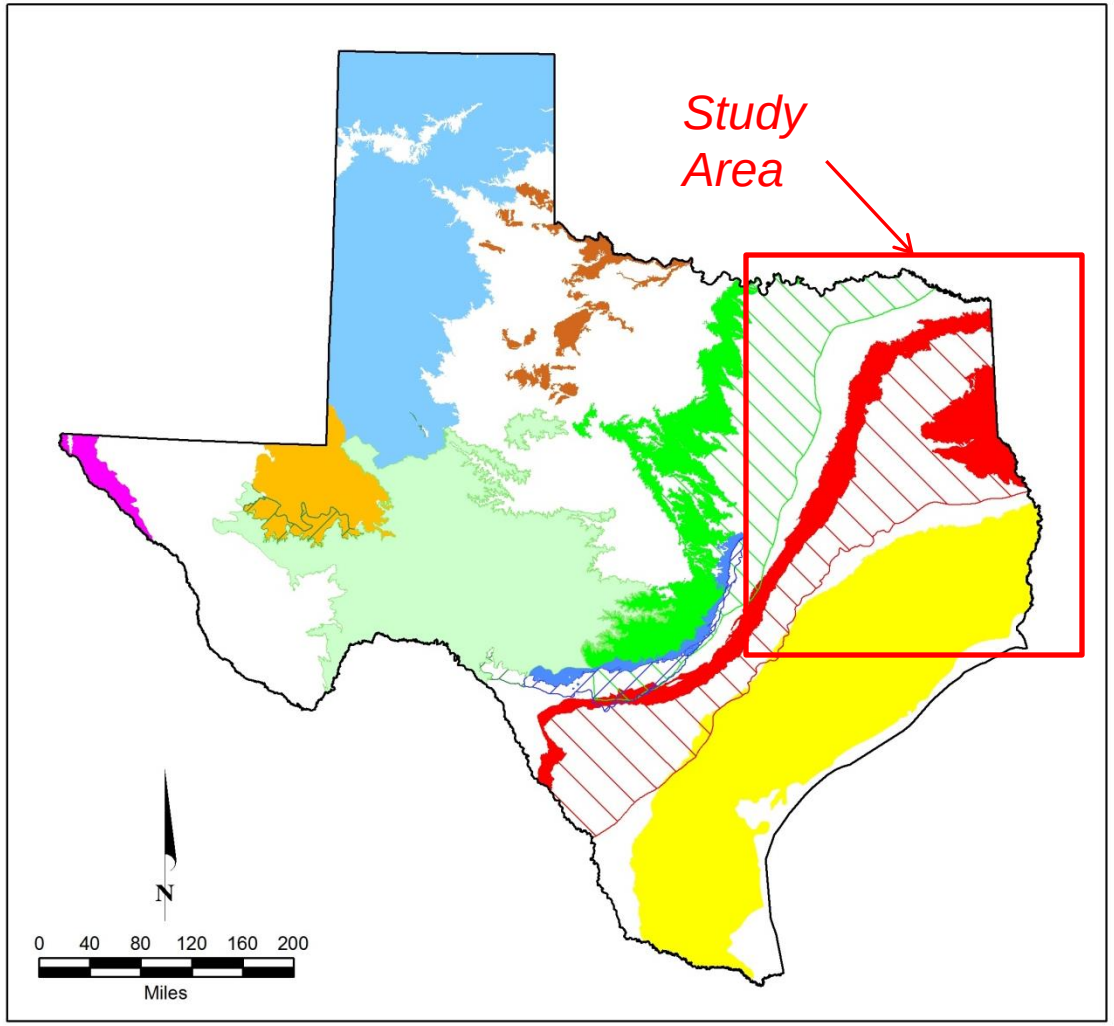
# Topics

- Brief Overview of Project
- Overview of Conceptual Model
  - Aquifer Framework
  - Inflows and Outflows
  - Groundwater Salinity
- Next Steps
  - Numerical Model
  - Schedule

# Background

- Carrizo-Wilcox aquifer is a major aquifer
- Sparta and Queen City aquifers are minor aquifers
- These aquifers extend from south Texas to northeast Texas and continue into Louisiana and Arkansas
- For modeling purposes, TWDB divided the aquifers into three areas:  southern portion, central portion, and northern portion.

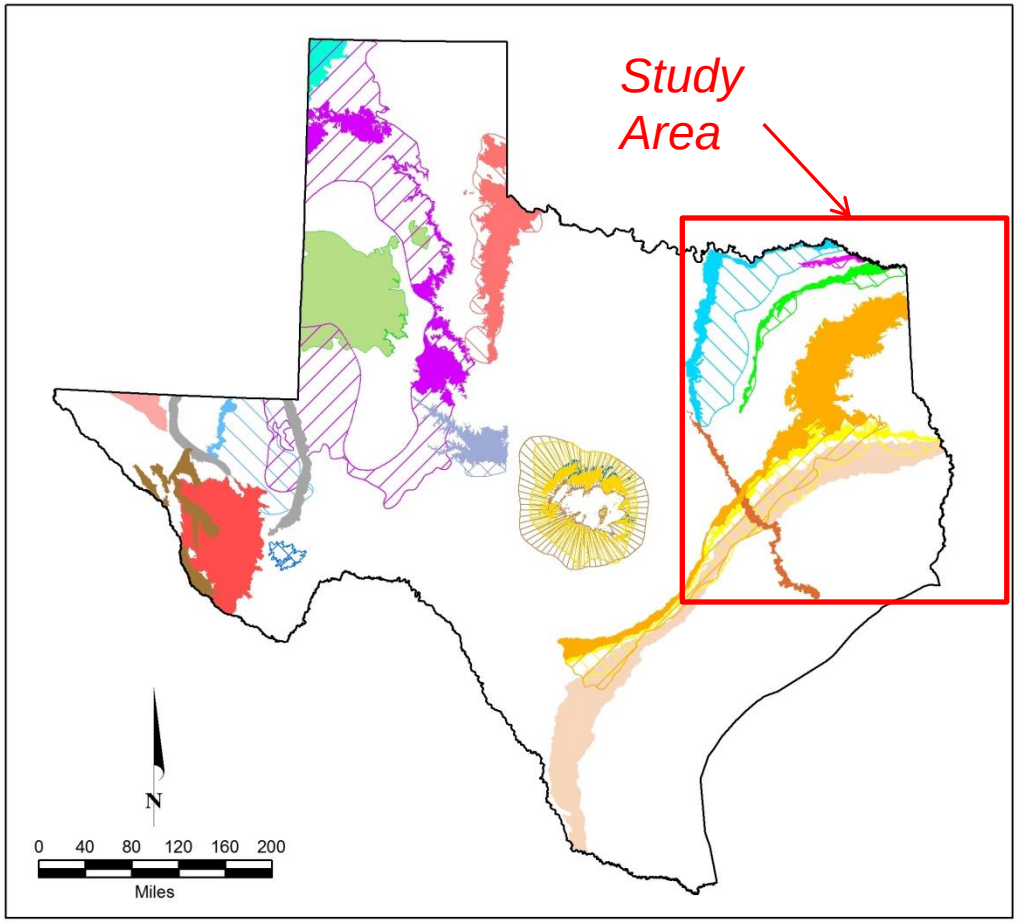
# Major Aquifers




EXPLANATION

- Pecos Valley
- Seymour
- Gulf Coast
- Carrizo - Wilcox (outcrop)
- Carrizo - Wilcox (subcrop)
- Hueco - Mesilla Bolson
- Ogallala
- Edwards - Trinity Plateau (outcrop)
- Edwards - Trinity Plateau (subcrop)
- Edwards BFZ (outcrop)
- Edwards BFZ (subcrop)
- Trinity (outcrop)
- Trinity (subcrop)

# Minor Aquifers




EXPLANATION

- Brazos River Alluvium
- West Texas Bolsons
- Lipan (outcrop)
- Lipan (subcrop)
- Yegua Jackson
- Igneous
- Sparta (outcrop)
- Sparta (subcrop)
- Queen City (outcrop)
- Queen City (subcrop)
- Nacatoch (outcrop)
- Nacatoch (subcrop)
- Blossom (outcrop)
- Blossom (subcrop)
- Woodbine (outcrop)
- Woodbine (subcrop)
- Rita Blanca
- Edwards -Trinity (High Plains)
- Dockum (outcrop)
- Dockum (subcrop)
- Rustler (outcrop)
- Rustler (subcrop)
- Capitan Reef Complex
- Blaine (outcrop)
- Blaine (subcrop)
- Bone Spring - Victorio Peak
- Marble Falls
- Marathon
- Ellenburger - San Saba (outcrop)
- Ellenburger - San Saba (subcrop)
- Hickory (outcrop)
- Hickory (subcrop)

# Existing GAM

- GAM for northern portion of Carrizo-Wilcox aquifer completed in 2003
- Updated in 2004 when Queen City and Sparta aquifers were added to Carrizo-Wilcox GAM
- Transient model calibration period: 1980-1989
- Model verification period: 1990-1999
- Grid cell dimensions: 1 sq. mi.

# Existing GAM

- Concerns:
  - In 2016, attempt to update calibration through 2013 failed due to erroneous rising water levels
    - Overestimated recharge?
    - Inability of model to move water from outcrop areas to subcrop areas?
  - Discontinuous outcrops of Sparta and Queen City aquifers in outcrop area not correctly represented in model, which results in misrepresentation of confined/unconfined aquifer conditions in the outcrop areas

# Objective

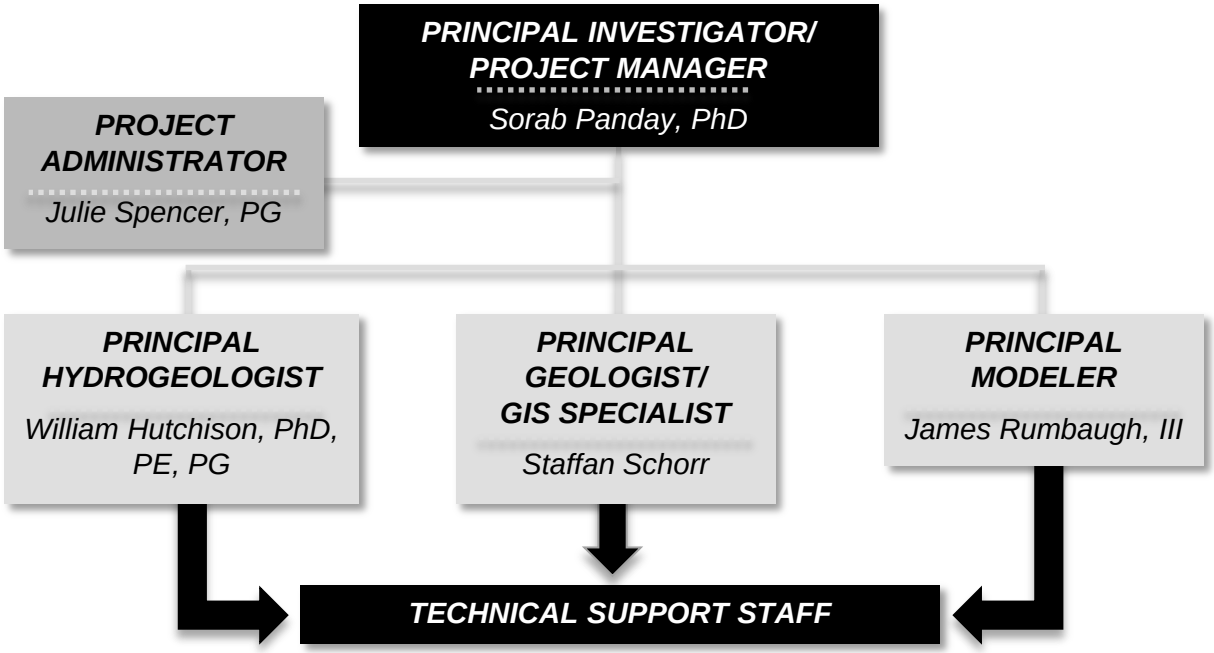
- The primary objective of this project is to update the existing Groundwater Availability Model (GAM) for the northern portion of the Queen City, Sparta, and Carrizo-Wilcox Aquifers.
  - Upgrade model code
  - Update model components with data through 2015 (ie, pumping, recharge, ET)
  - Update calibration with data through 2015 (ie, water levels, streamflows)
  - Verify and update aquifer framework (layers), particularly the Sparta and Queen City aquifers

# History

- July 2016
  - TWDB Published Request for Statement of Qualifications
- August 11, 2016
  - Due date for Statement of Qualifications
- November 2, 2016
  - TWDB Awarded Project to GSI Environmental team
- March 28, 2017
  - Contract signed by TWDB
- May 8, 2017
  - Kick-off Meeting with TWDB and GSI Environmental Team
- May 9, 2017
  - Stakeholder Advisory Forum No. 1
- November 11, 2017 and June 27, 2018
  - Informal progress updates at GMA 11 metings
- June 28, 2018
  - Draft Conceptual Model Report Submitted to TWDB

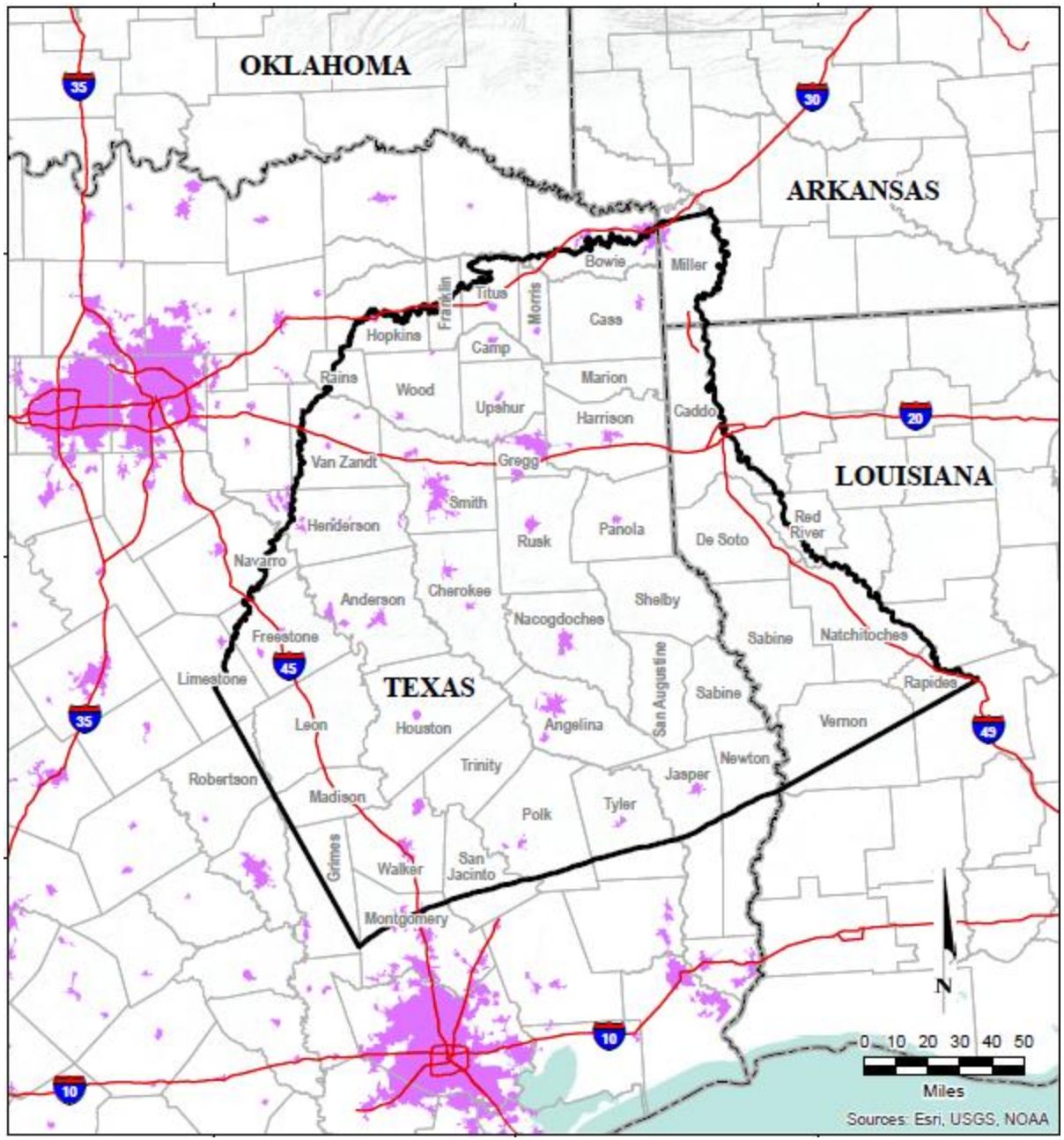
# GSI Environmental Team

- Sorab Panday
- Julie Spencer
- Jim Rumbaugh
- Bill Hutchison
- Staffan Schorr



# Overview of Conceptual Model

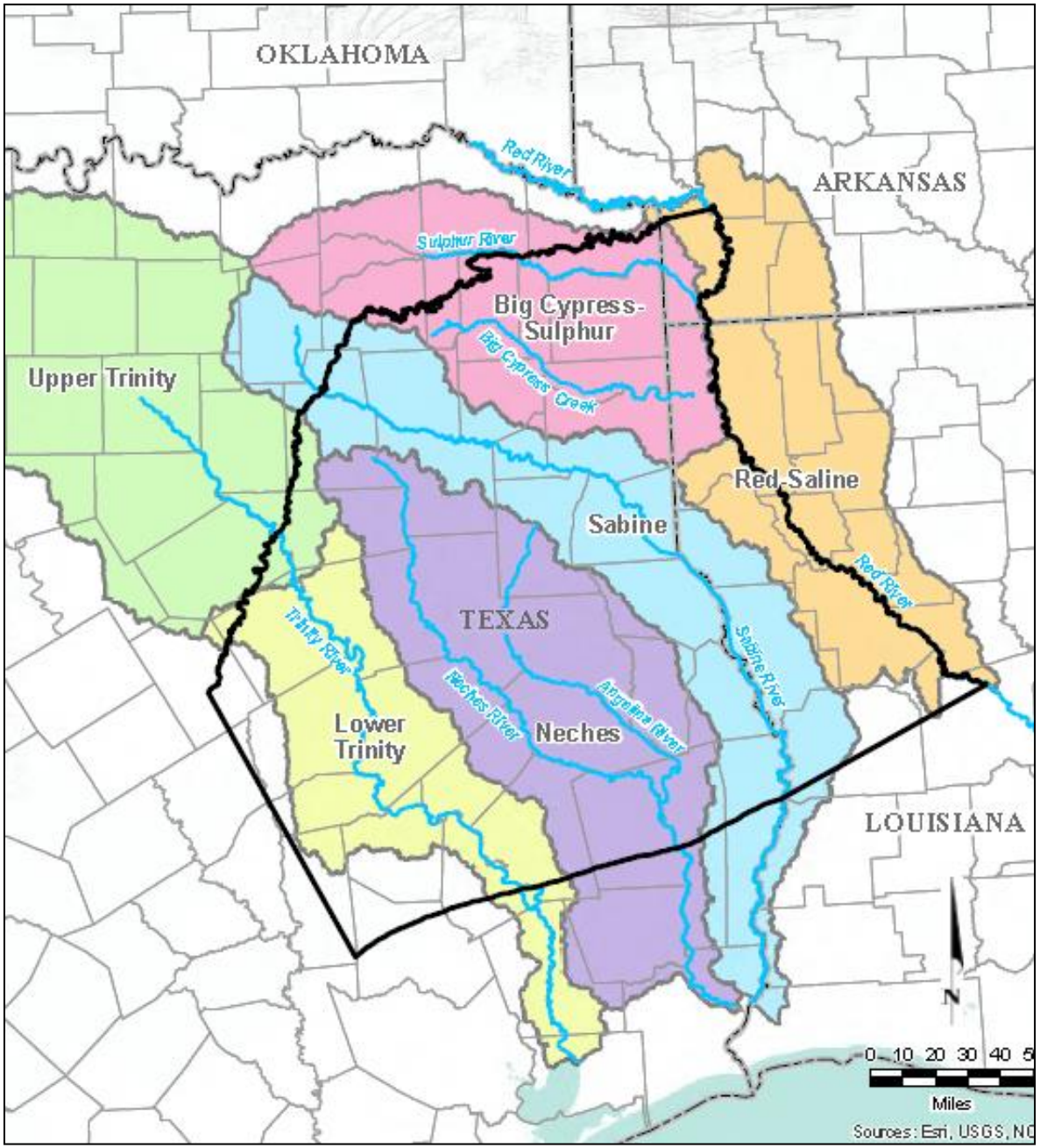
# Study Area




EXPLANATION

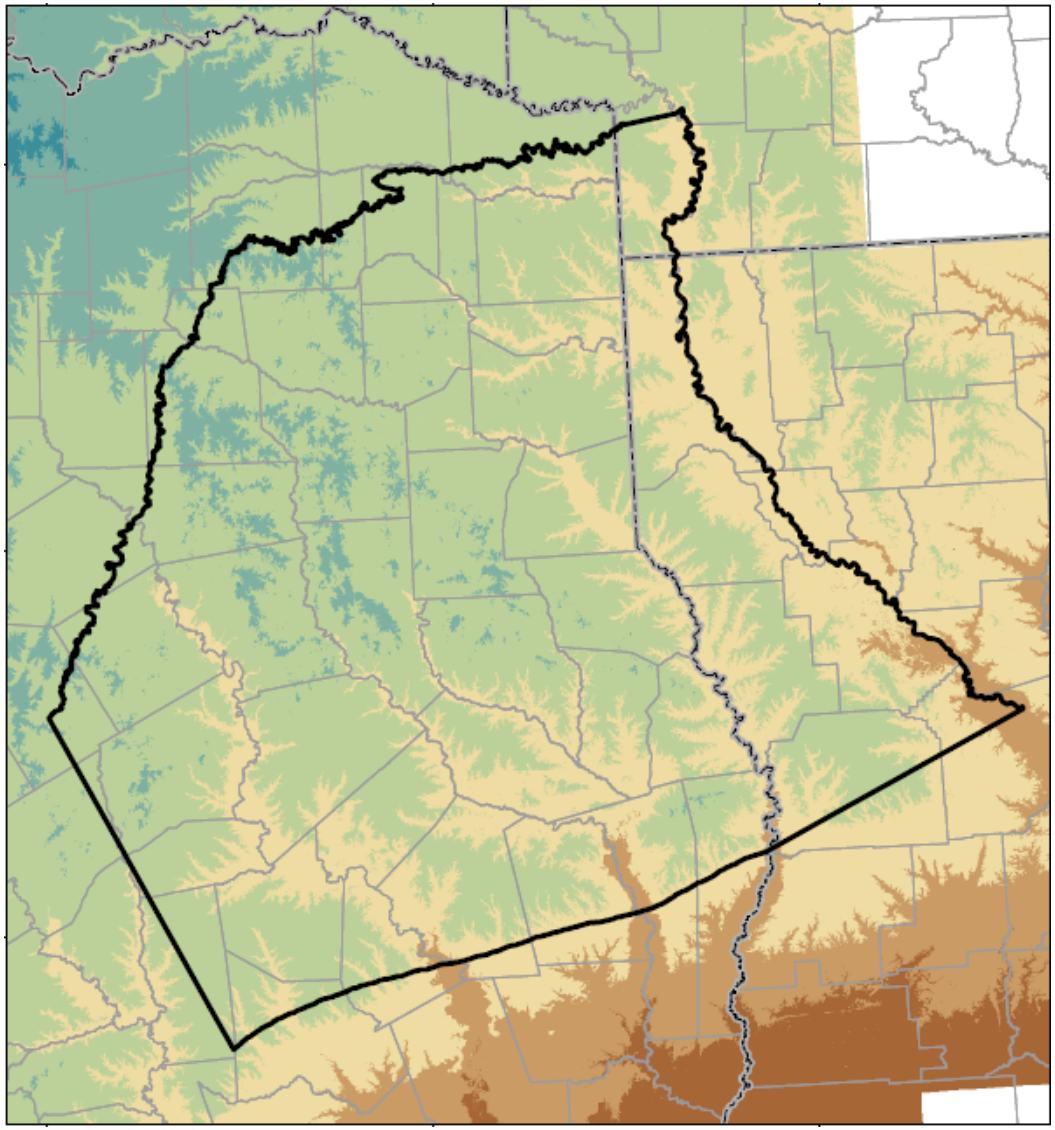
- Roadway
- Urban Area, Texas (TNRIS, dated 2015)
- Study Area
- Polk — County/Parish and Identifier
- State

# River Basins

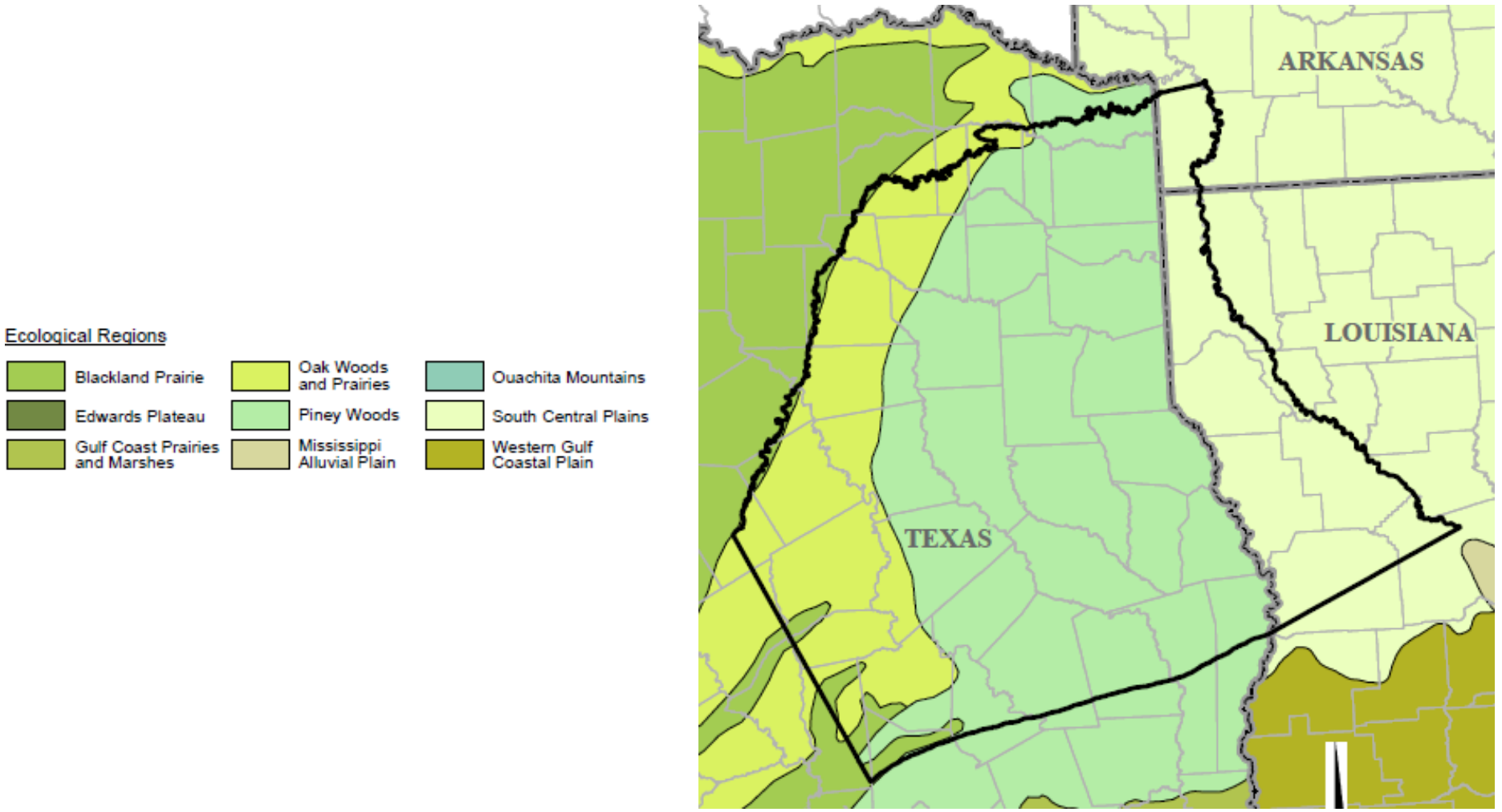


# Land Surface Elevation

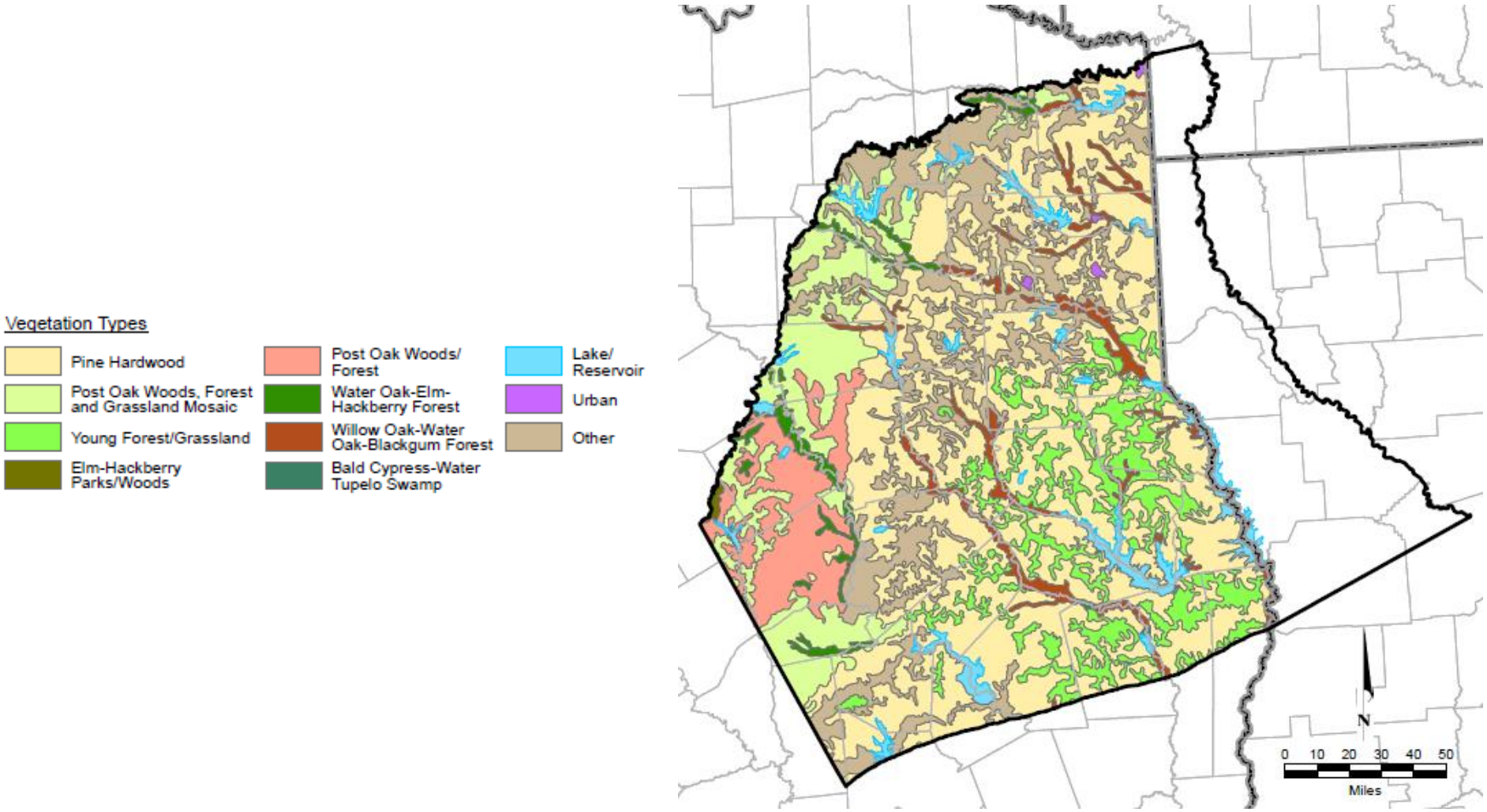
# Land Surface Elevation



# Ecological Regions

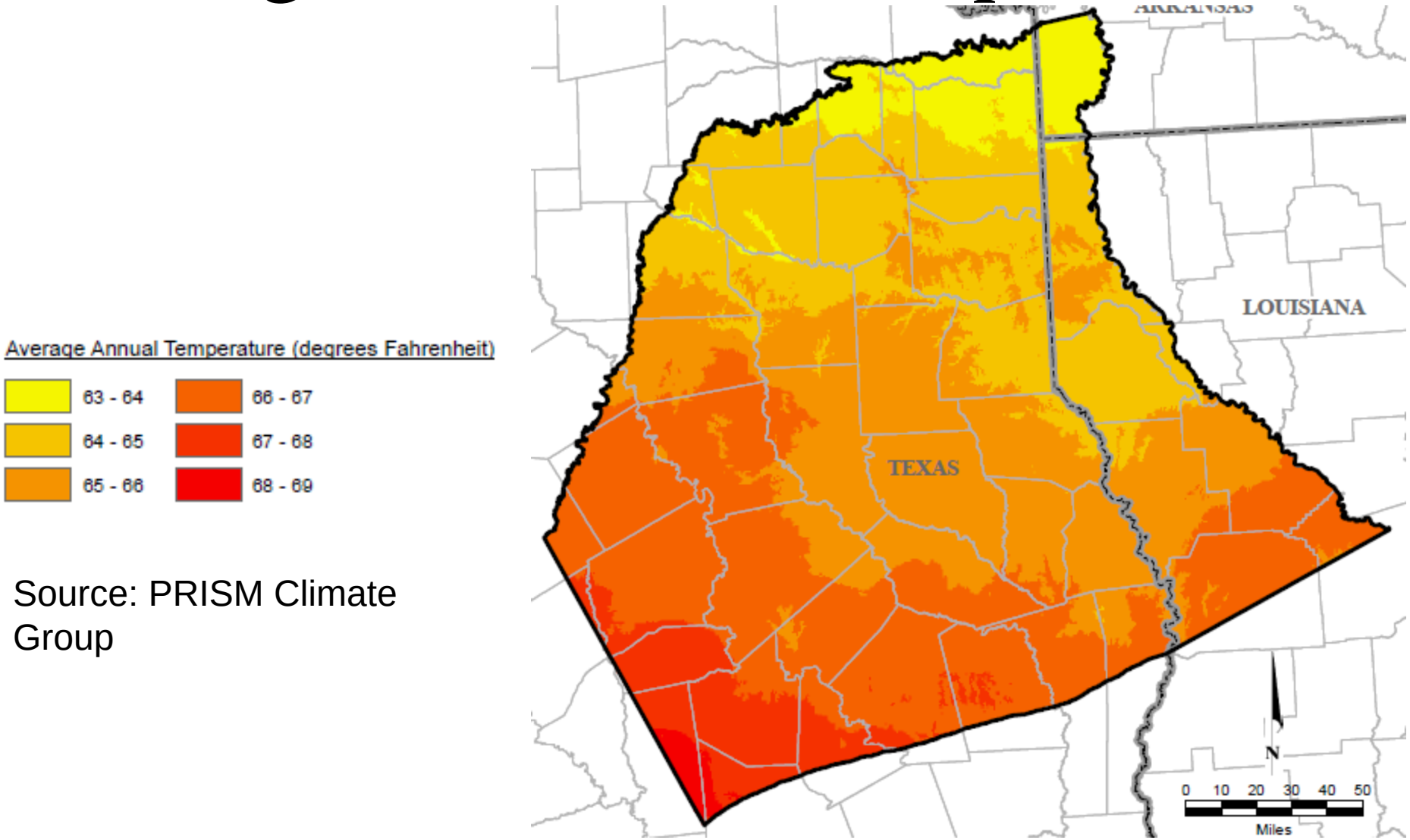


# Vegetation Types



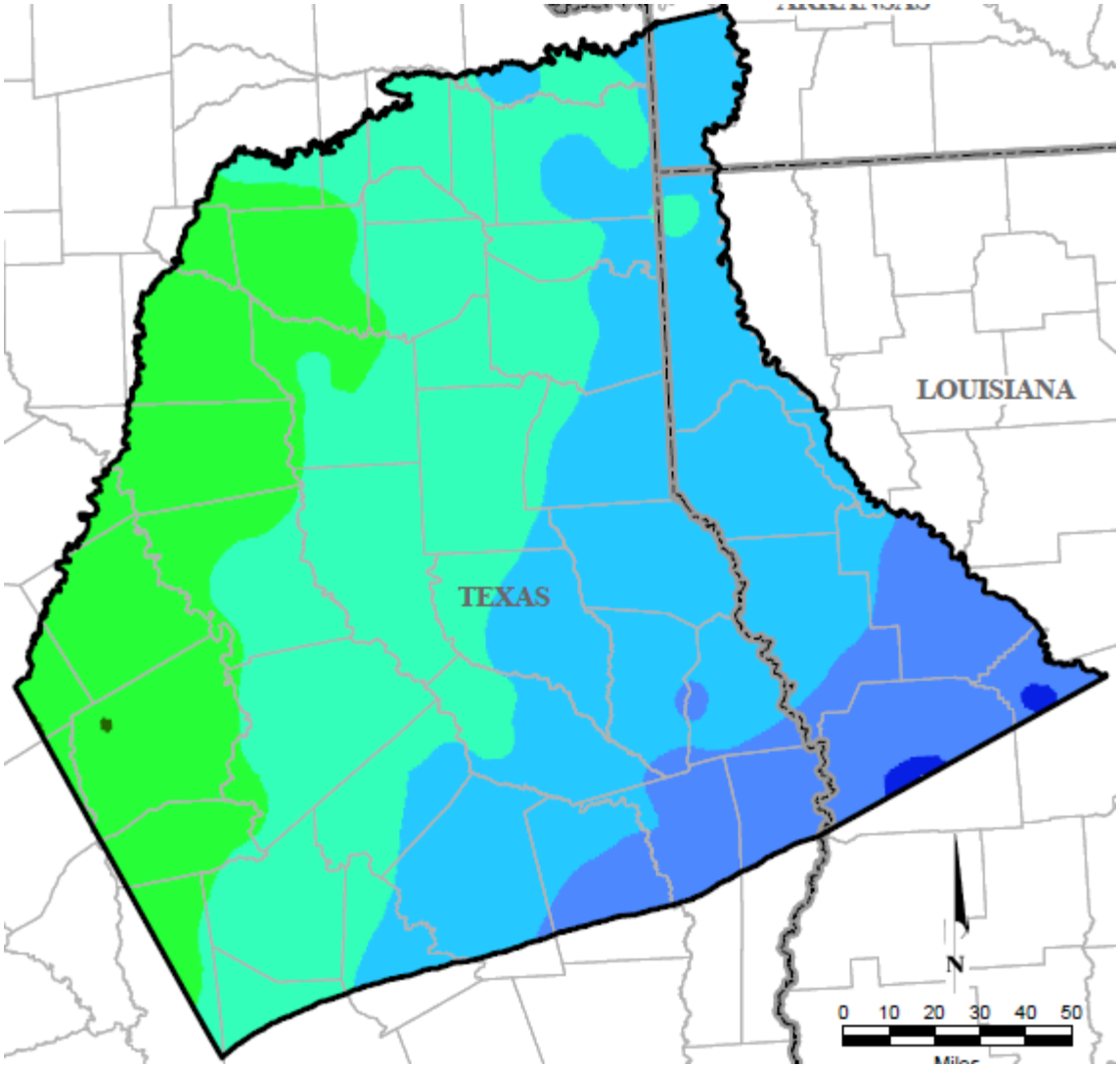
# Climate

# Average Annual Air Temperature



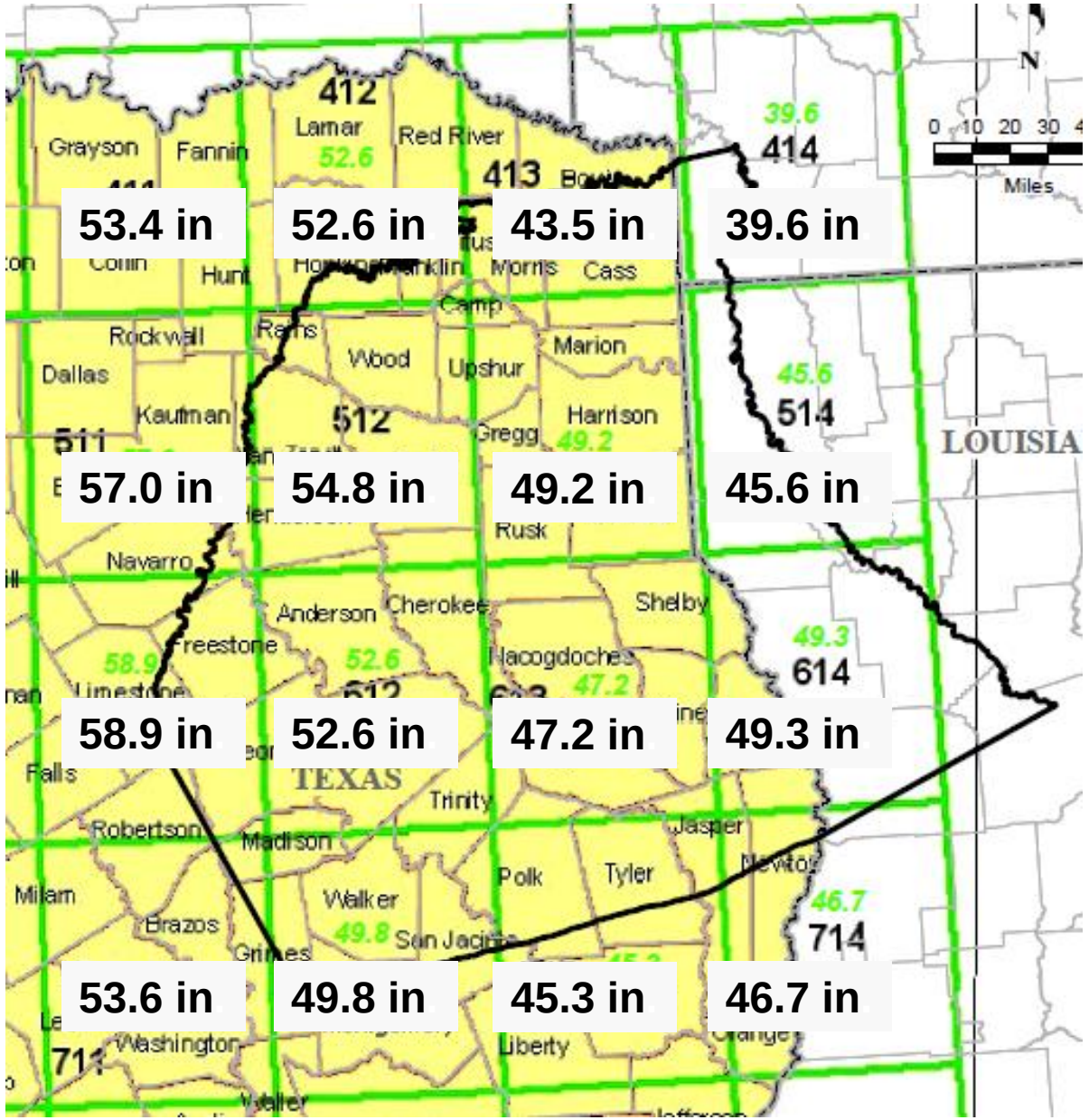

Source: PRISM Climate Group

# Average Annual Precipitation




Source: PRISM Climate Group

# Average Annual Lake Evaporation

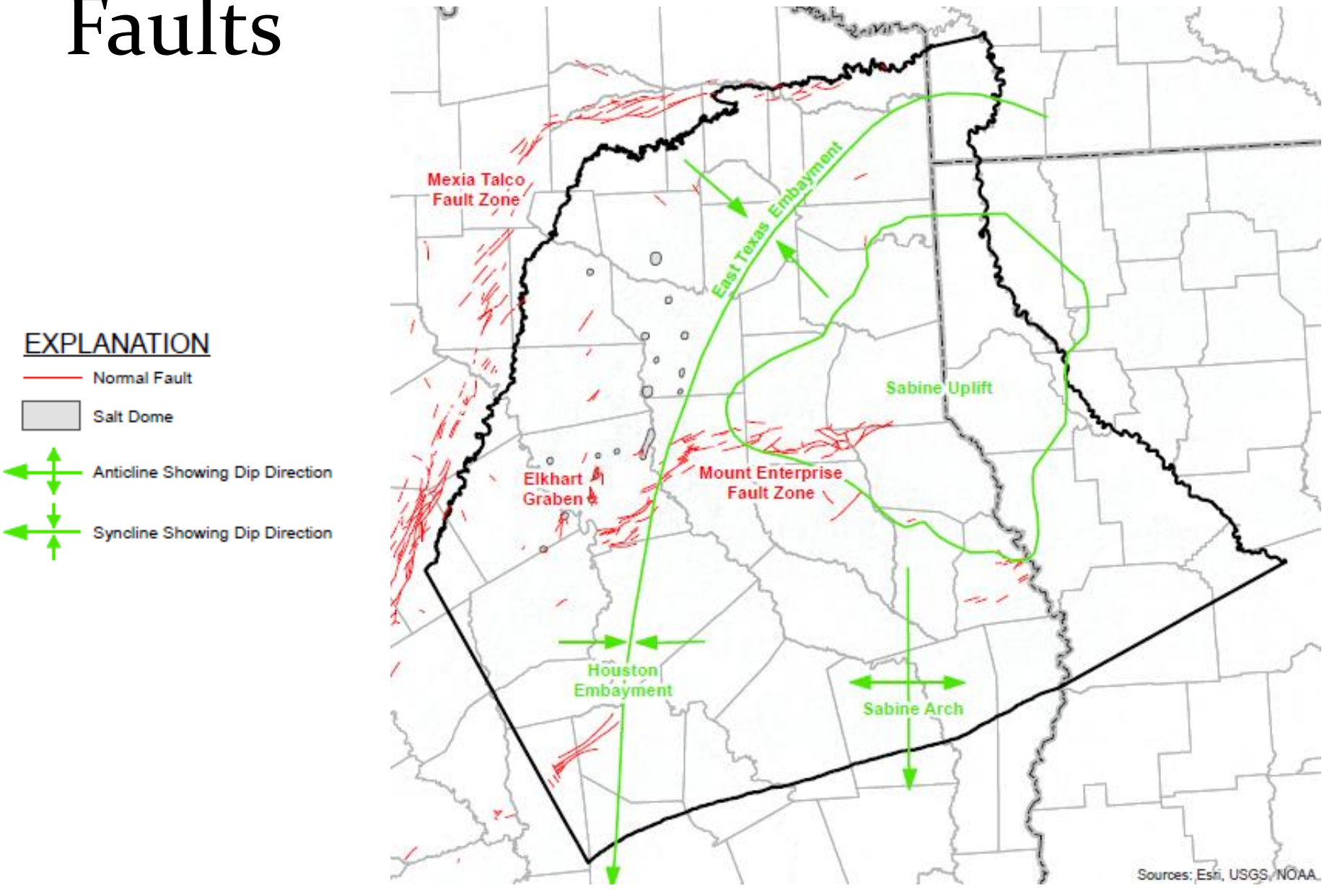



EXPLANATION

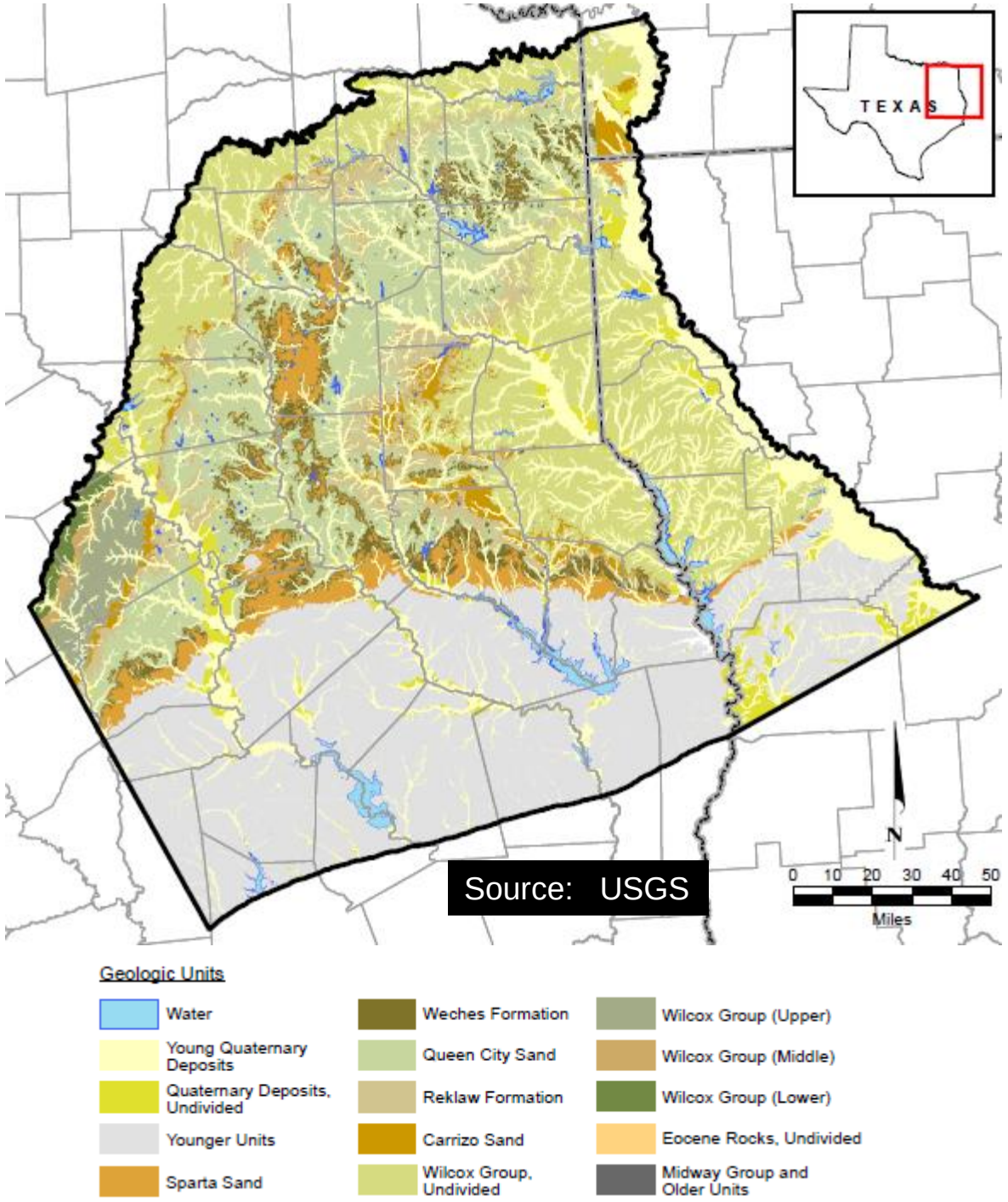
- 52.5 — Quadrangle and Average Evaporation Rate (inches/year)
- Study Area
- County/Parish
- State

# Geology

# Faults

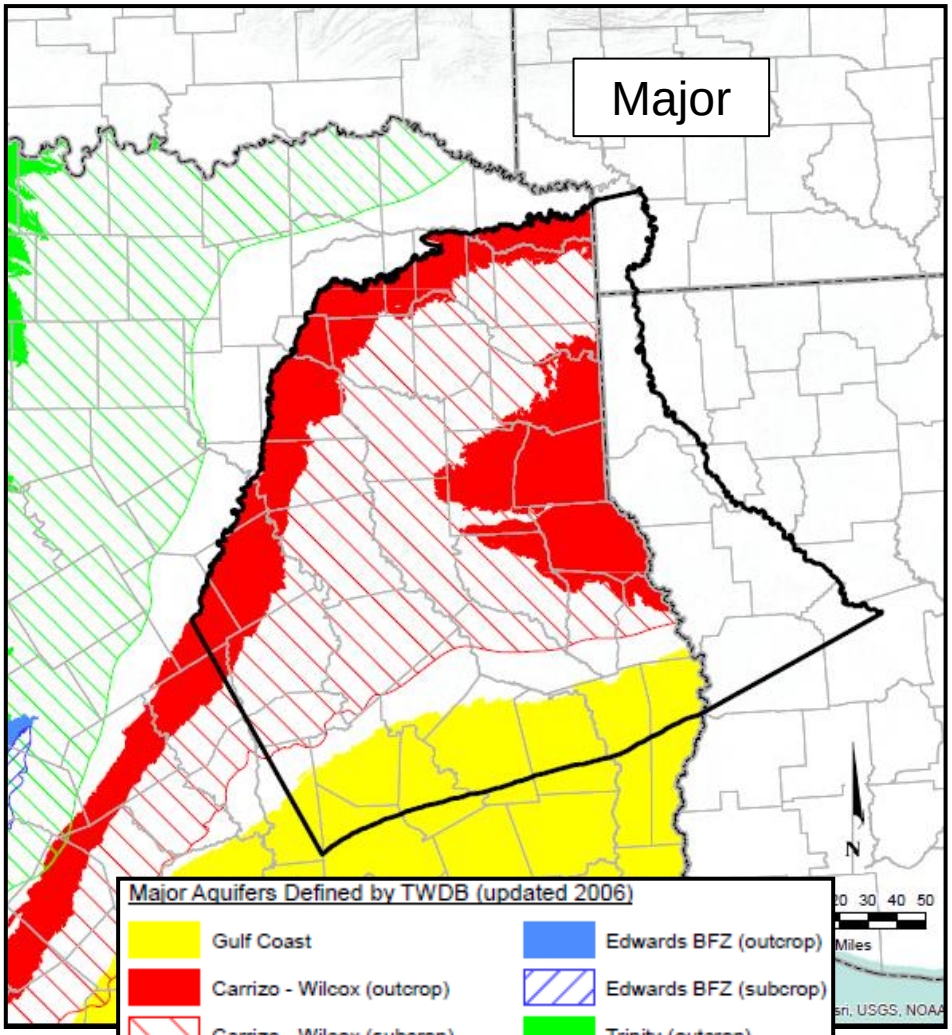

EXPLANATION
Normal Fault
Salt Dome
Anticline Showing Dip Direction
Syncline Showing Dip Direction
Mexia Talco Fault Zone
East Texas Embayment
Sabine Uplift
Elkhart Graben
Mount Enterprise Fault Zone
Houston Embayment
Sabine Arch
Sources: Esri, USGS, NOAA

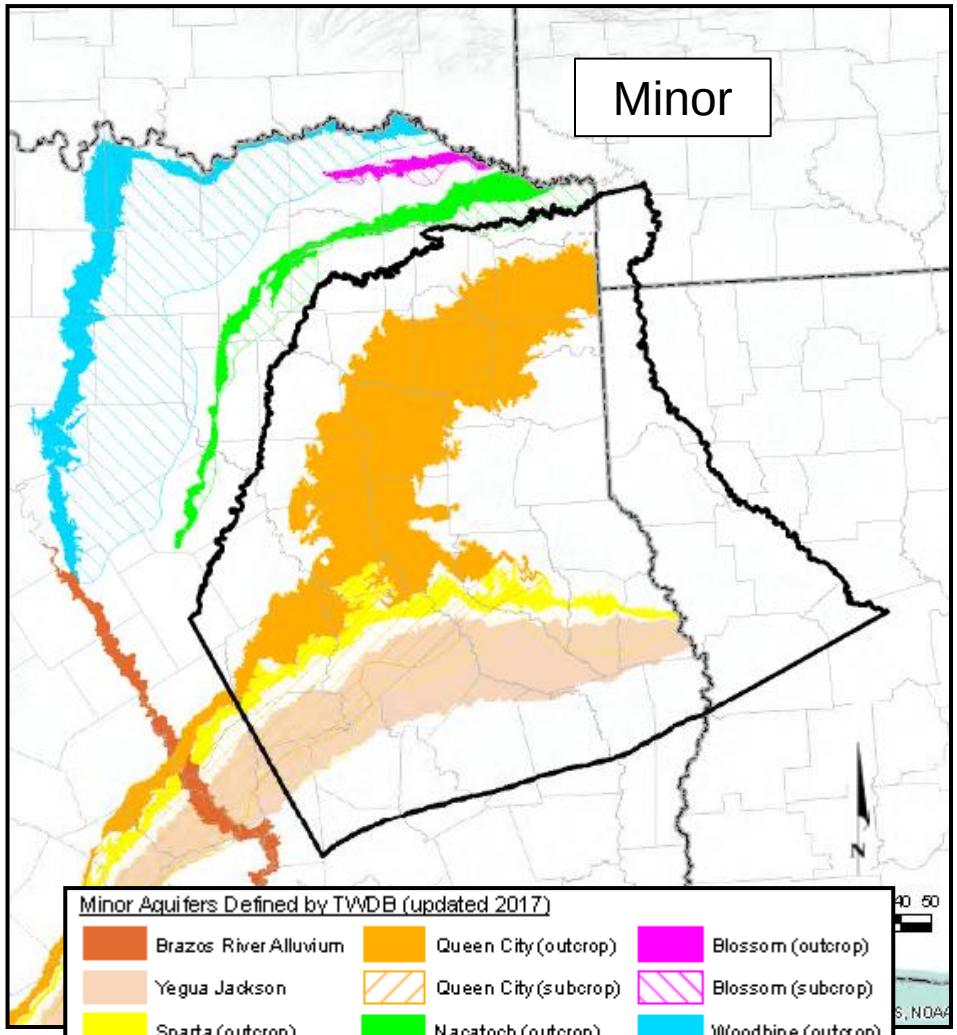
# Surface Geology



# Hydrostratigraphy and Framework

# TWDB-Designated Aquifers in Study Area



# Hydrostratigraphy

- Previous GAM has 8 aquifer layers
  - Sparta
  - Weches
  - Queen City
  - Reklaw
  - Carrizo
  - Upper Wilcox
  - Middle Wilcox
  - Lower Wilcox
- Updated GAM has same layers plus a new River Alluvium layer that overlies all others

# Objectives for framework update

- Update HSU surfaces with new information, including geophysical well logs and historical geologic studies
- Honor discontinuous outcrops ("islands")
- Improve representation of Enterprise Fault
- Identify geophysical logs (e-logs) verifying the surfaces in the model
    - Determine the e-log characteristics for each unit throughout the model domain
    - Review e-logs for contacts and compile list of elogs from BRACS supporting the model
- Improve representation of river alluvium deposits

# Framework Construction

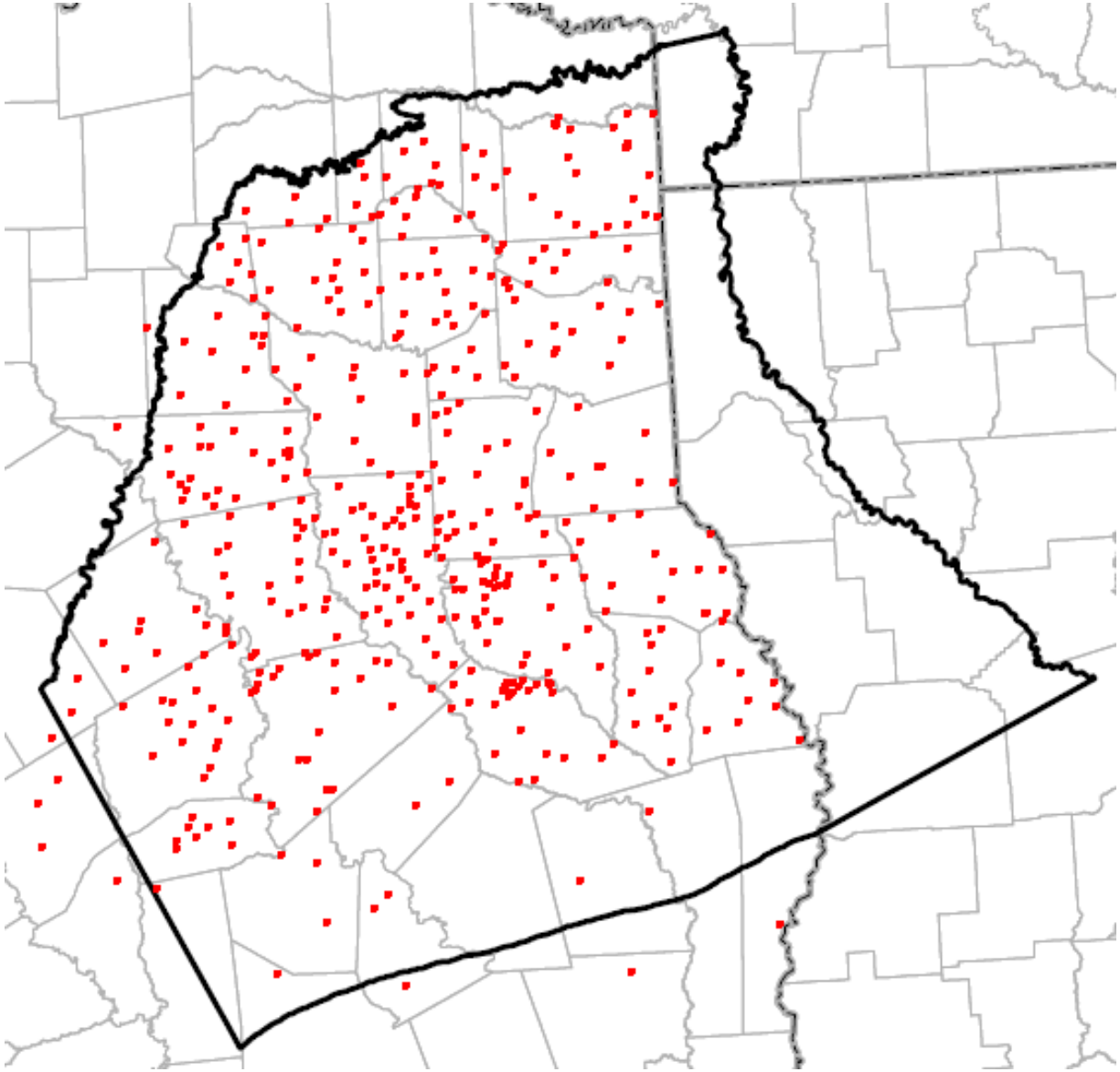
- Constructed 3D geologic model using Leapfrog Geo software based on:
  - Surficial geologic maps (outcrops)
  - Aquifer layer contacts
    - Numerous geologic reports with maps, contact summary tables, and cross sections
    - Geospatial datasets for TWDB GAMs
    - BRACS geophysical logs (e-logs)
  - Verified aquifer layer contacts from previous GAM with e-logs provided by TWDB BRACS

# Layer Verification

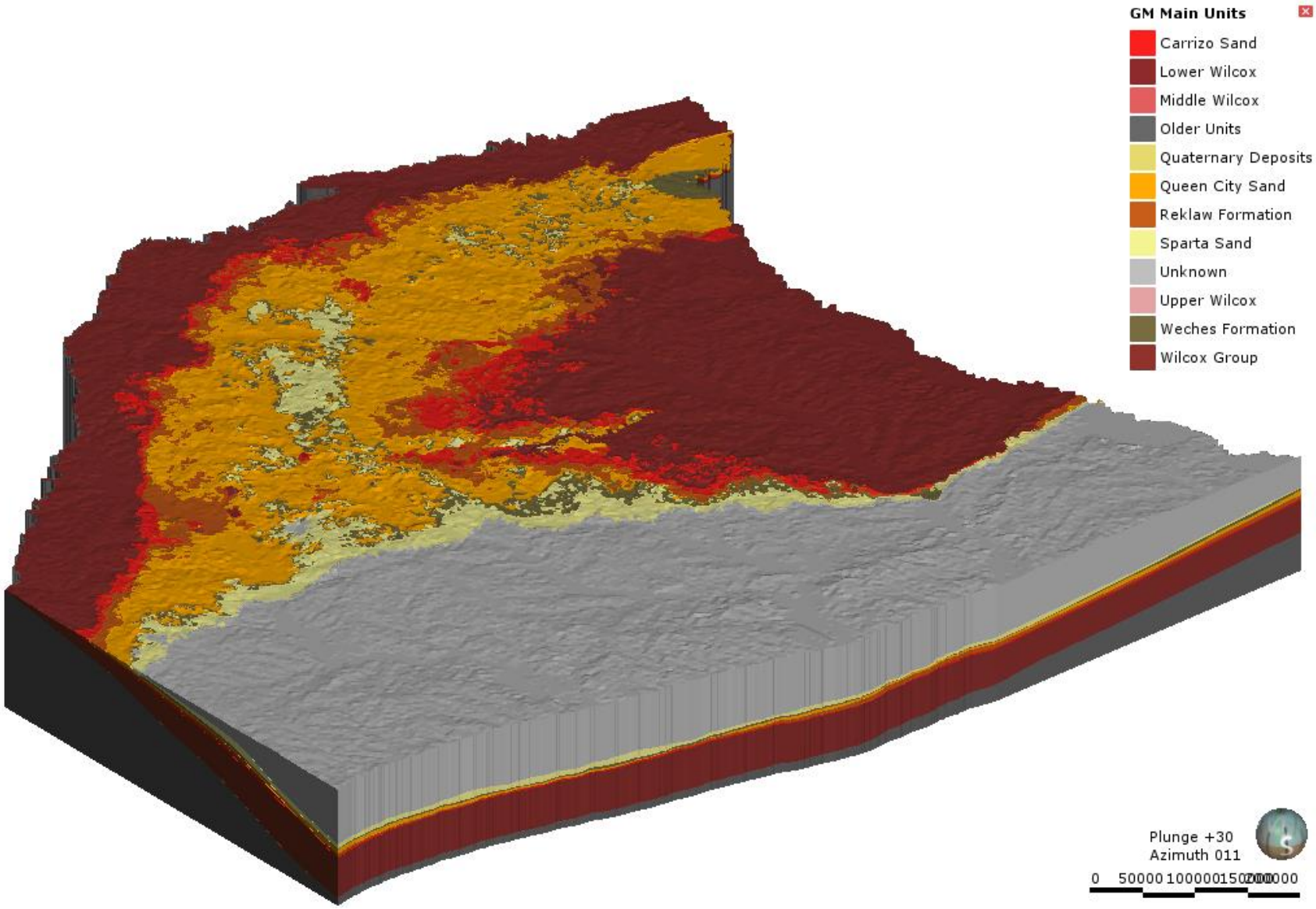
- 3,700 locations with elevations of aquifer contacts used for previous GAM
- BRACS e-logs located in close proximity to contact locations were selected to verify contact elevations
- 714 e-logs were reviewed for this update
- Of these 714 e-logs, 453 were verified to match contacts from previous GAM
- Remaining 261 e-logs did not match a nearby contact location used in the previous GAM. Suggests source other than a BRACS e-log was used for those locations.
- 107 new contact locations were added for this update to fill spatial gaps in contact locations
- E-log contacts will be submitted to BRACS

# Layer Verification

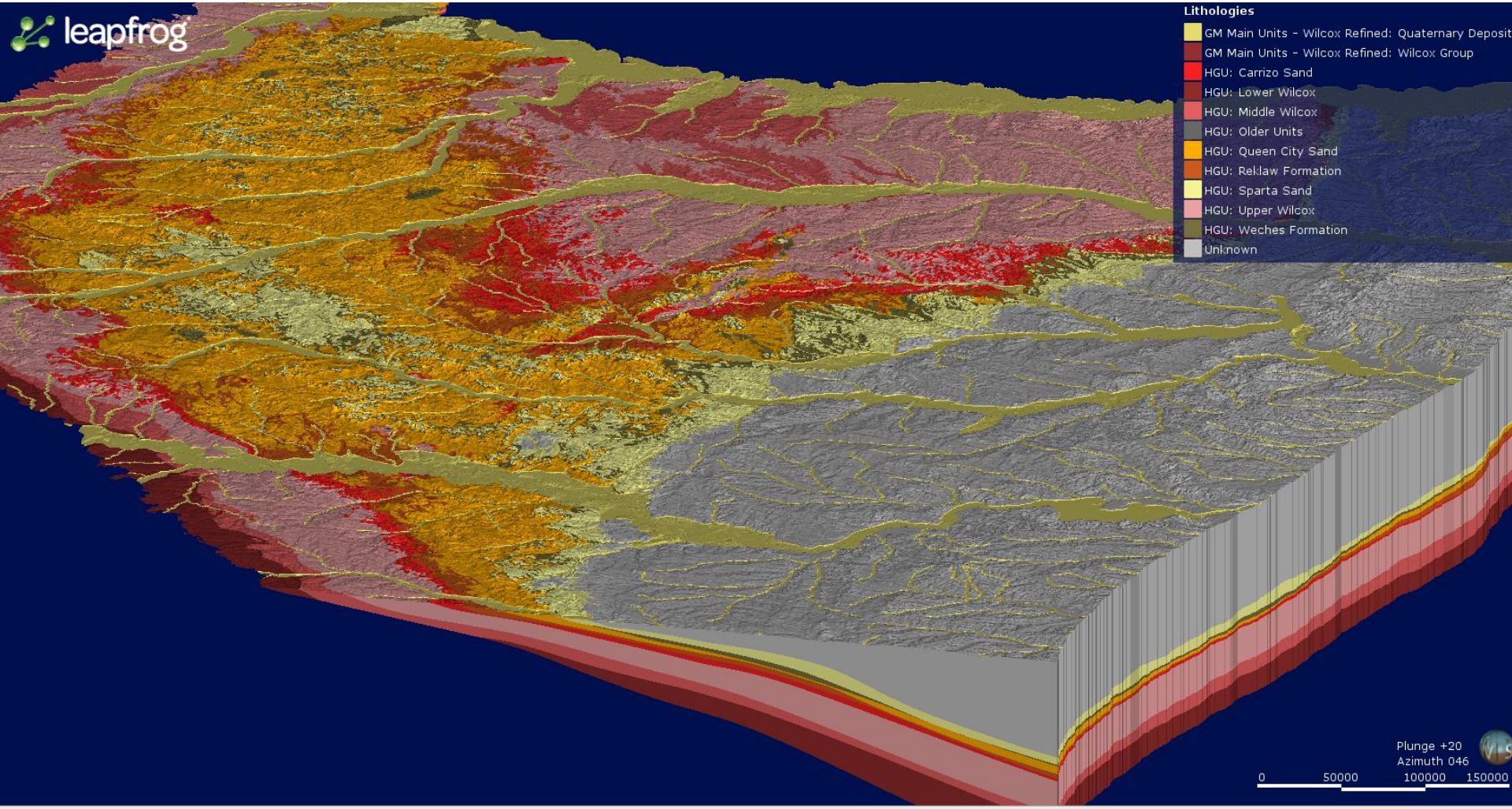
Locations of verified e-log locations



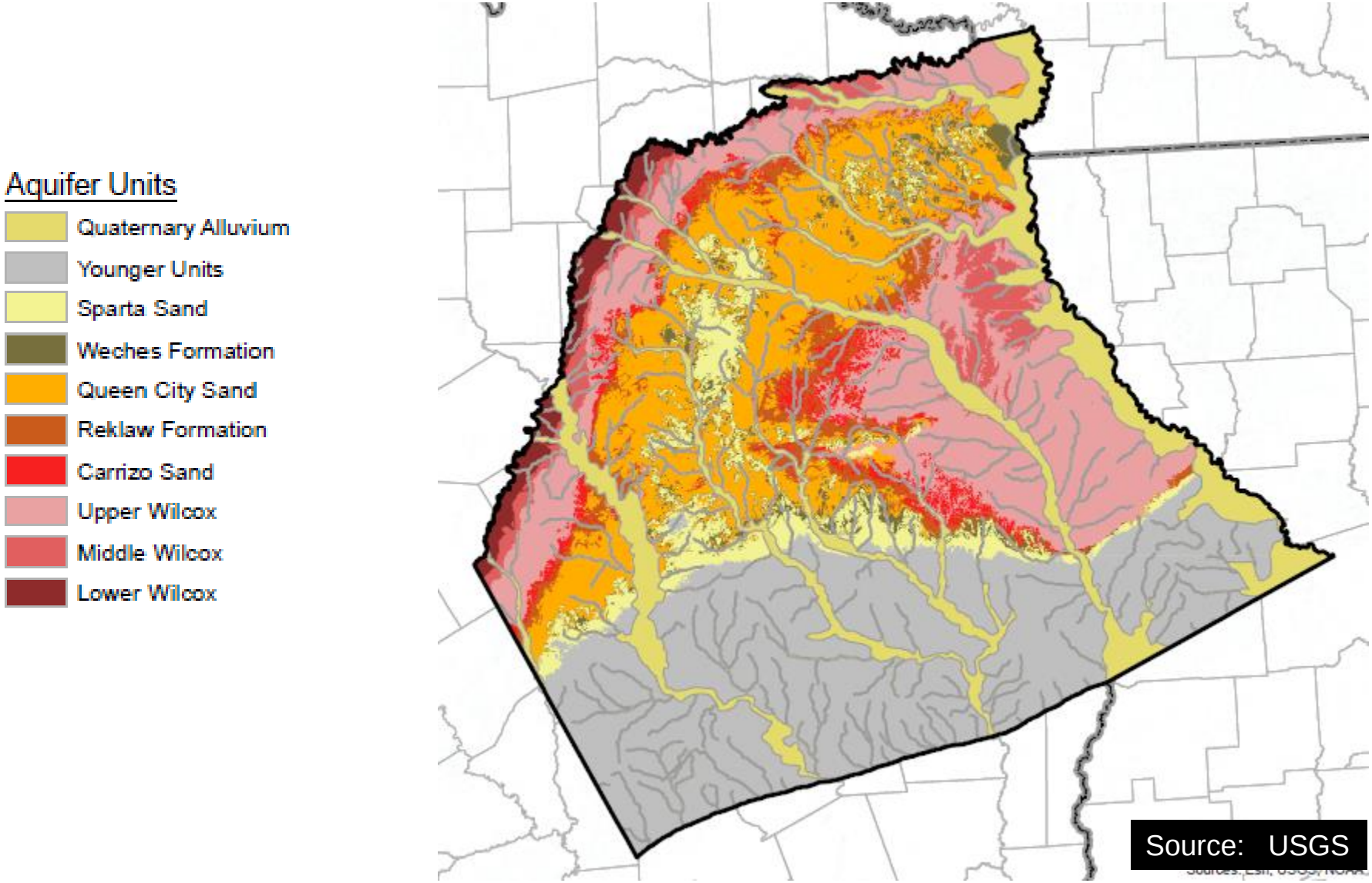
# Geologic Model (main aquifers)



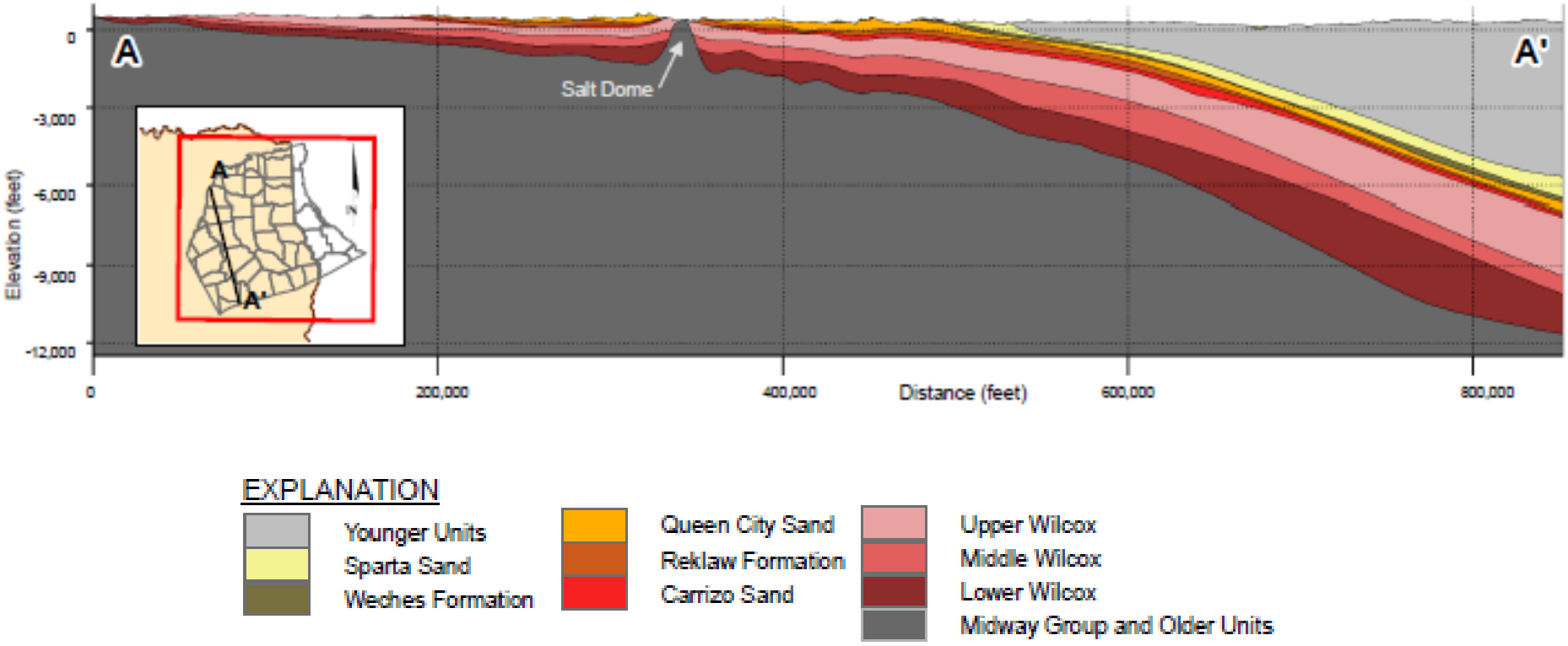
# Geologic Model (with river alluvium)



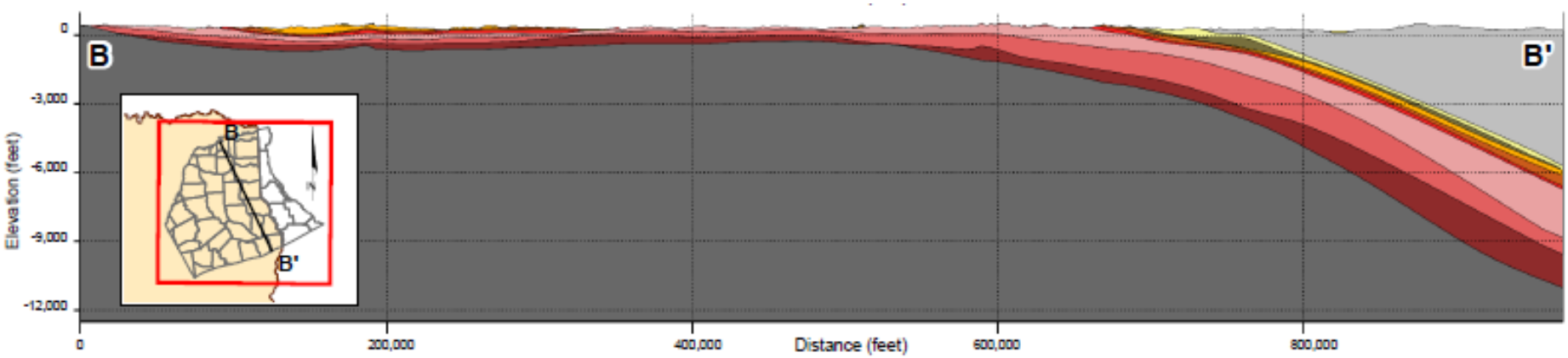
# Aquifer Outcrop Areas



# Cross-Section A-A’



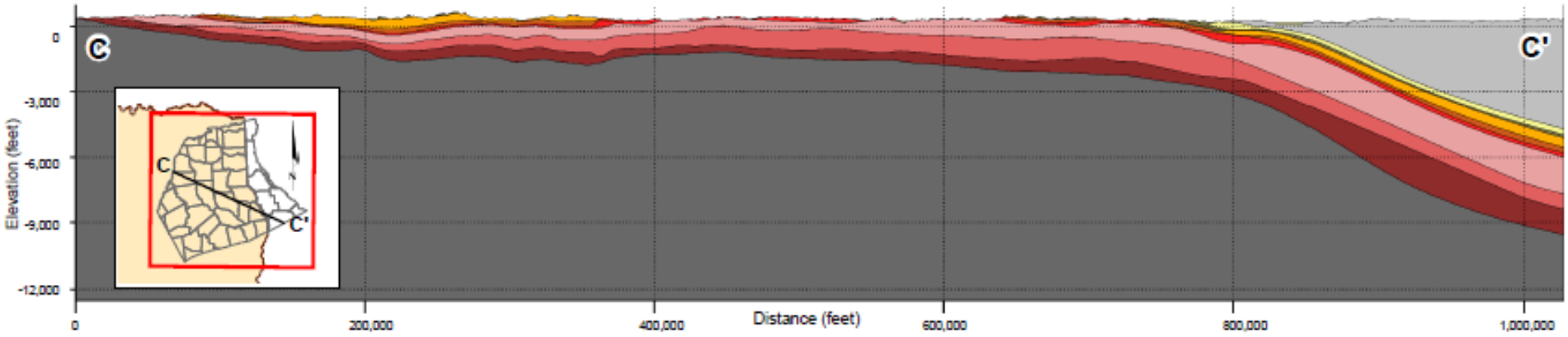
# Cross-Section B-B’




EXPLANATION

- Younger Units
- Sparta Sand
- Weches Formation
- Queen City Sand
- Reklaw Formation
- Carrizo Sand
- Upper Wilcox
- Middle Wilcox
- Lower Wilcox
- Midway Group and Older Units

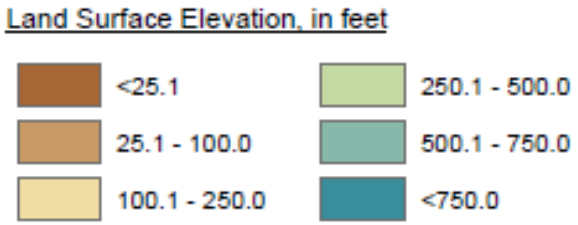
# Cross-Section C-C’

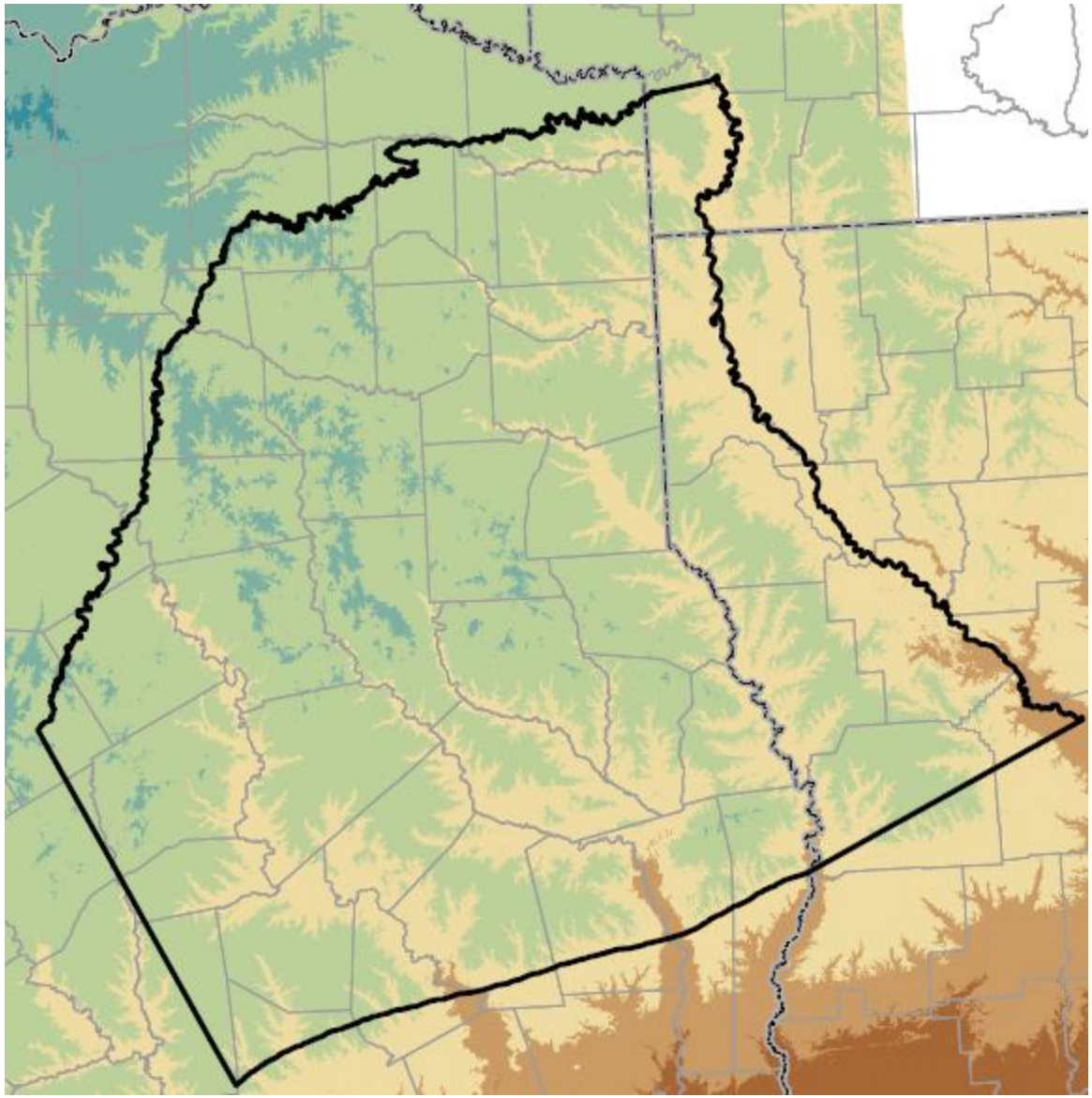



EXPLANATION

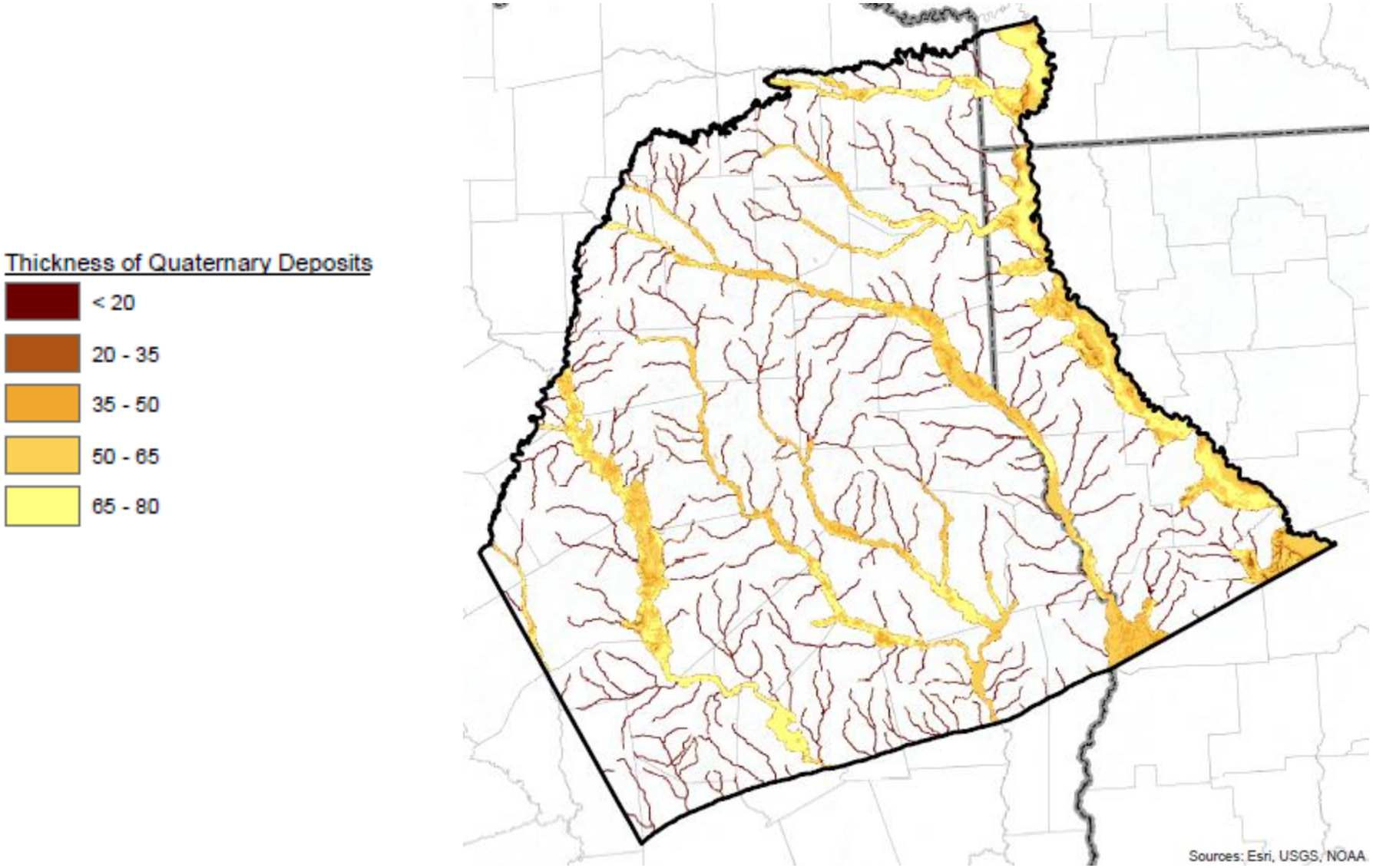
- Younger Units
- Sparta Sand
- Weches Formation
- Queen City Sand
- Reklaw Formation
- Carrizo Sand
- Upper Wilcox
- Middle Wilcox
- Lower Wilcox
- Midway Group and Older Units

# Land Surface Elevation

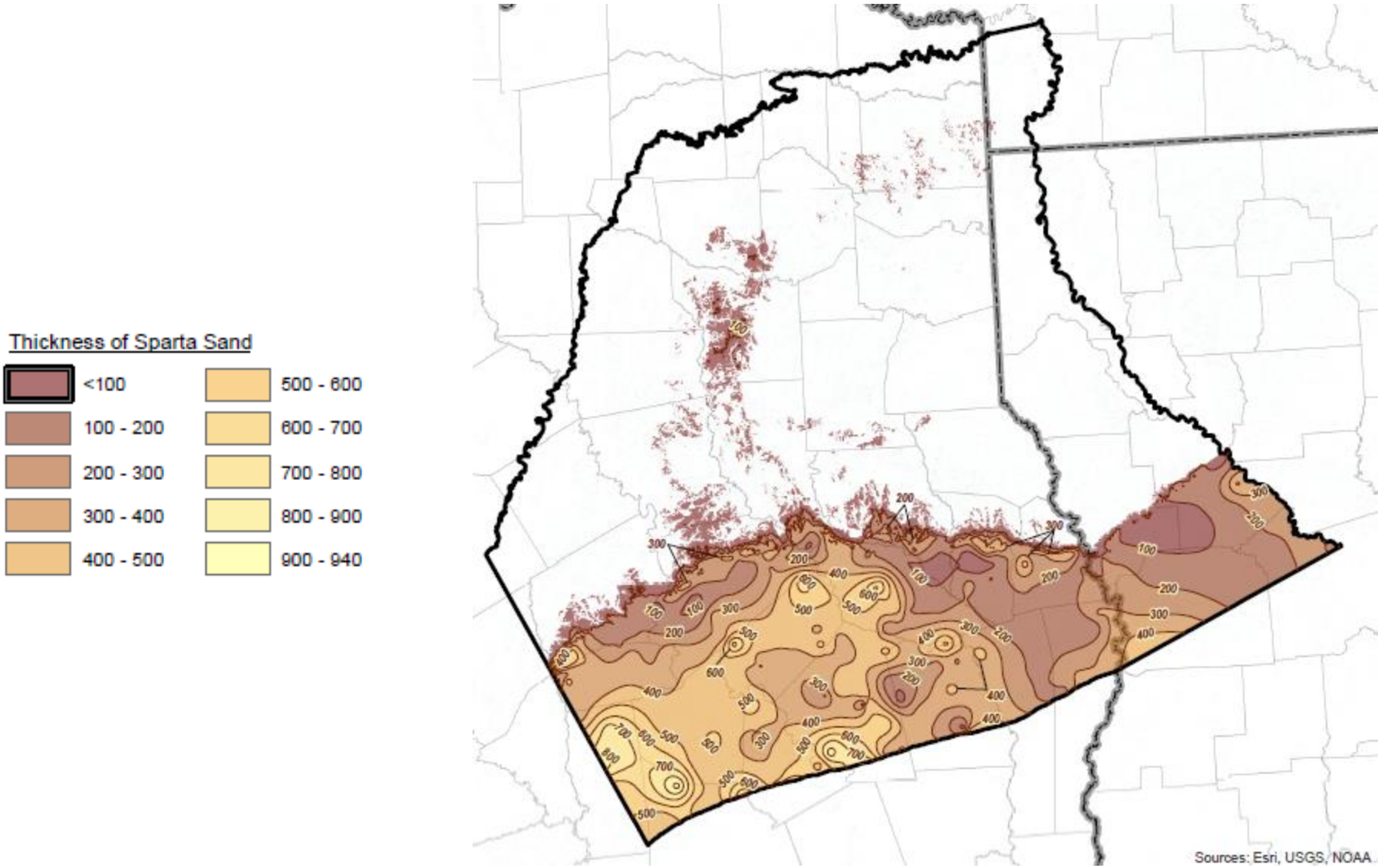


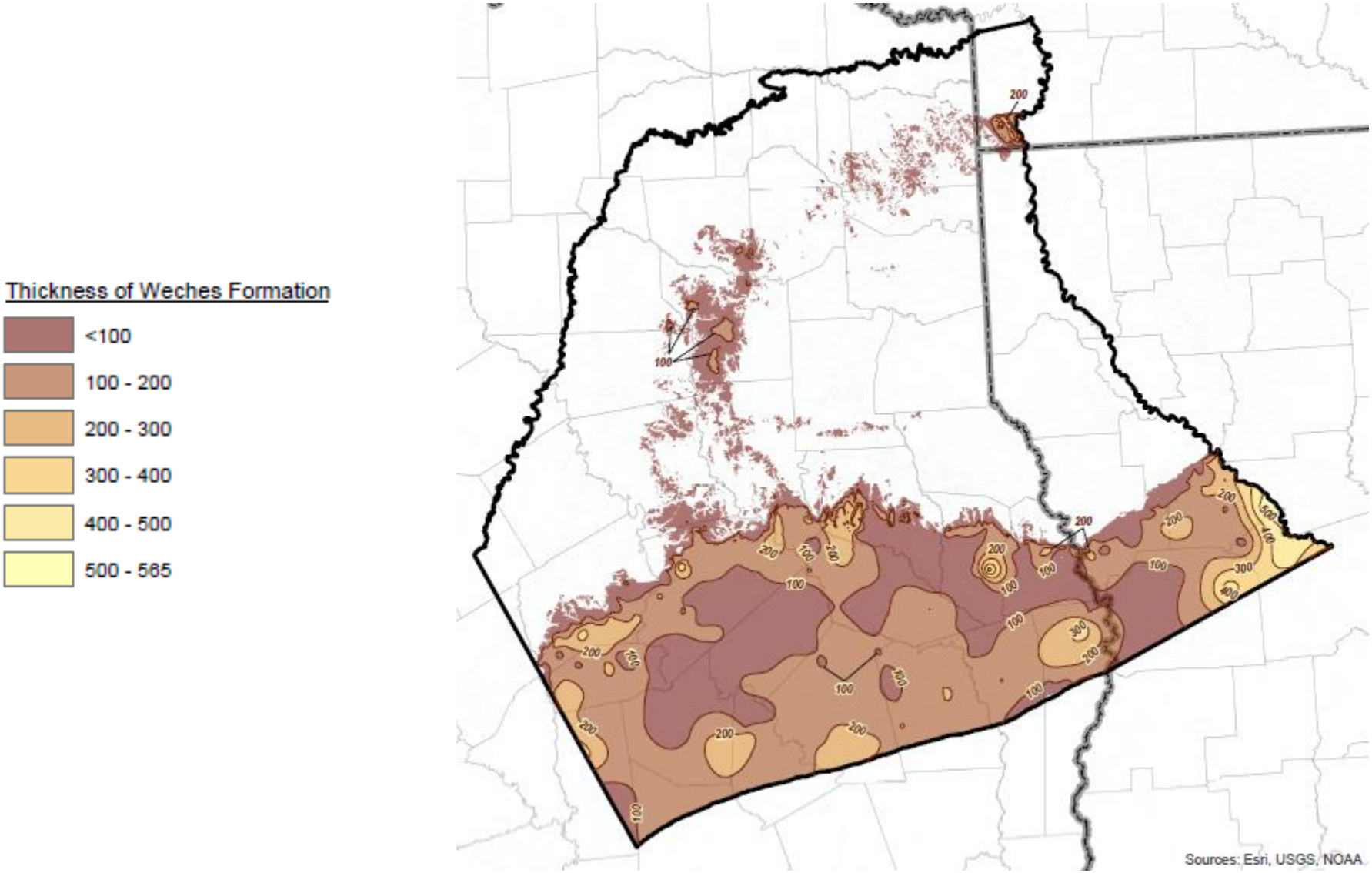
# Thickness of Quaternary Units



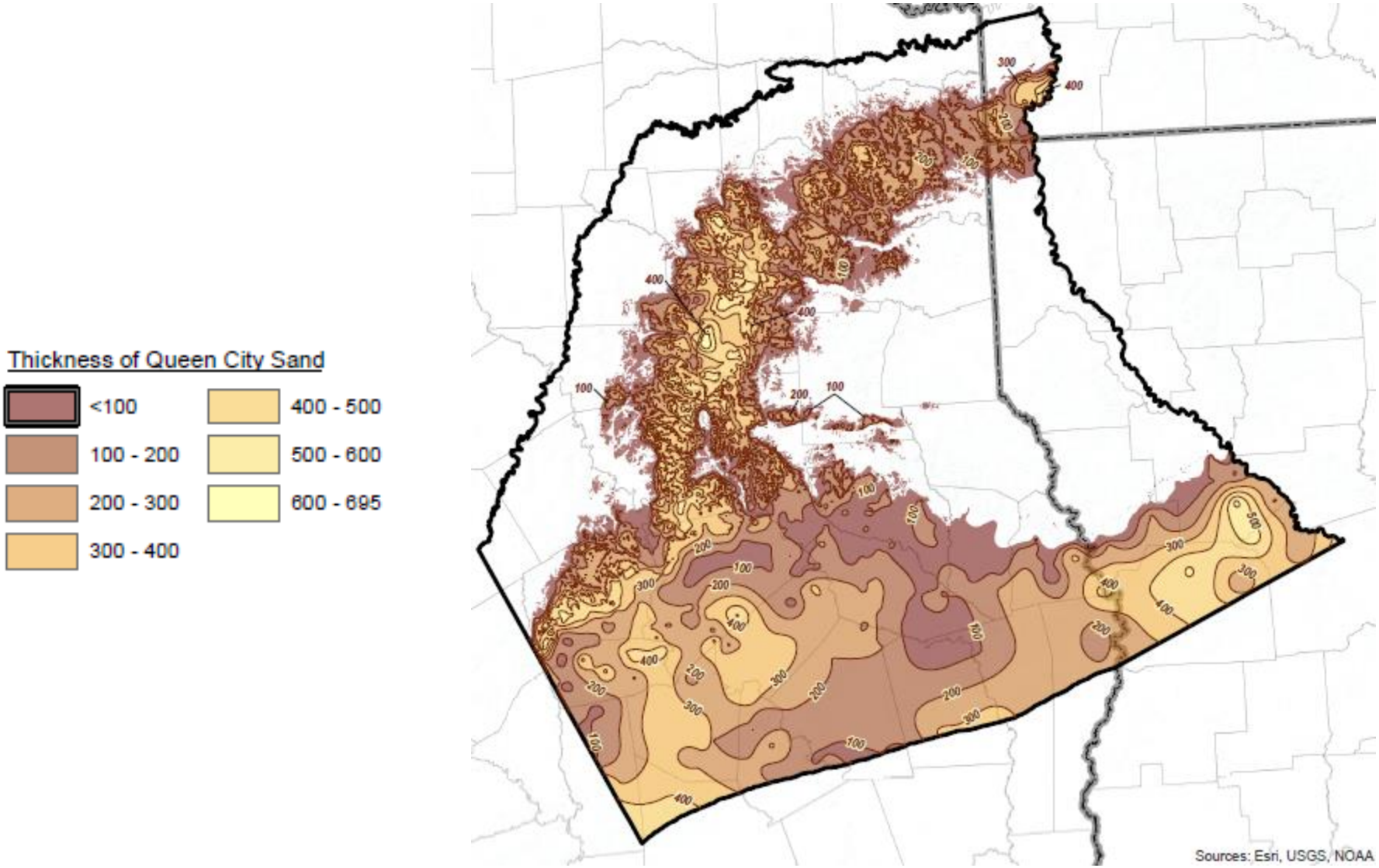
# Thickness of Sparta Sand



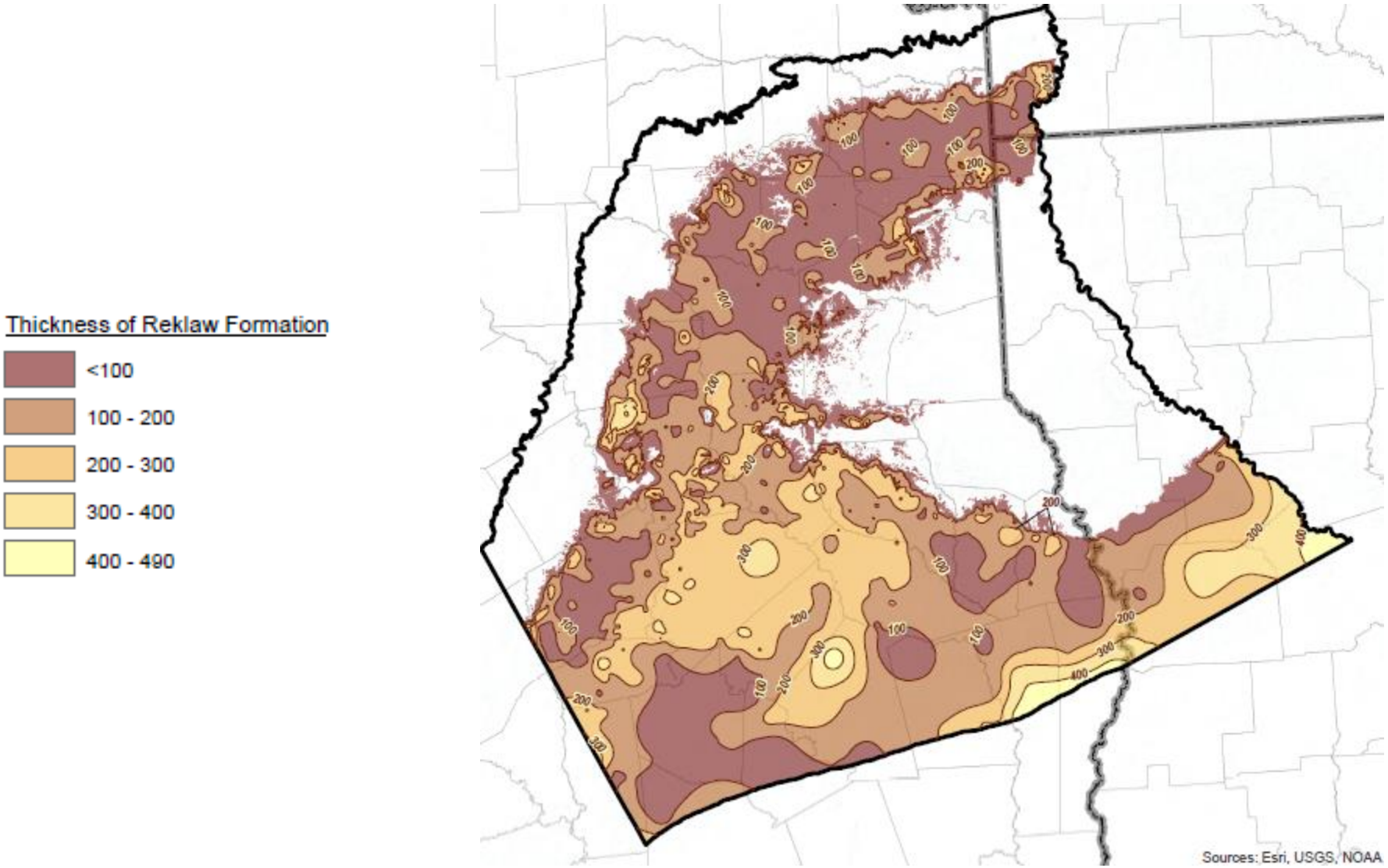
# Thickness of Weches Formation



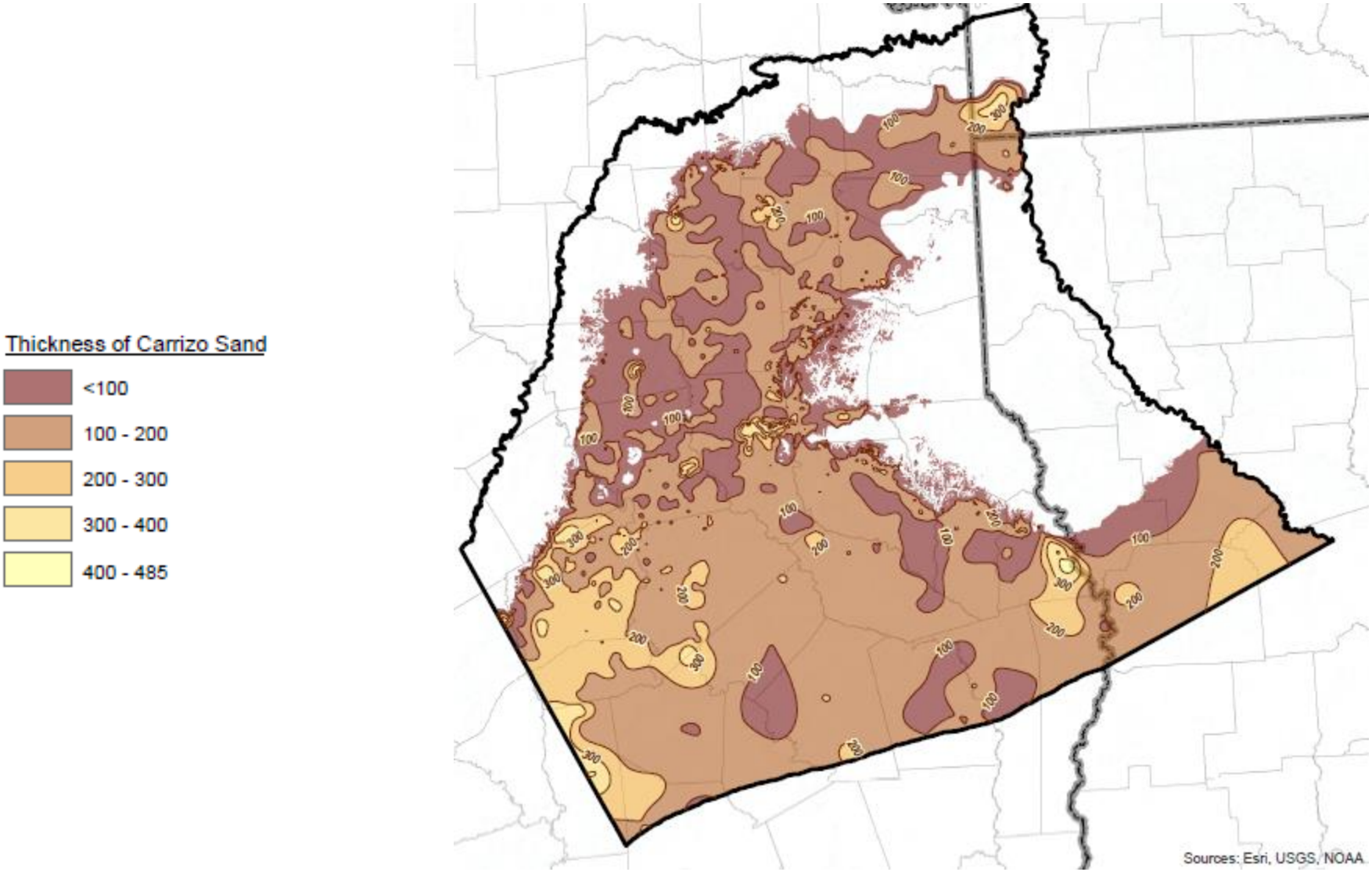
# Thickness of Queen City Sand



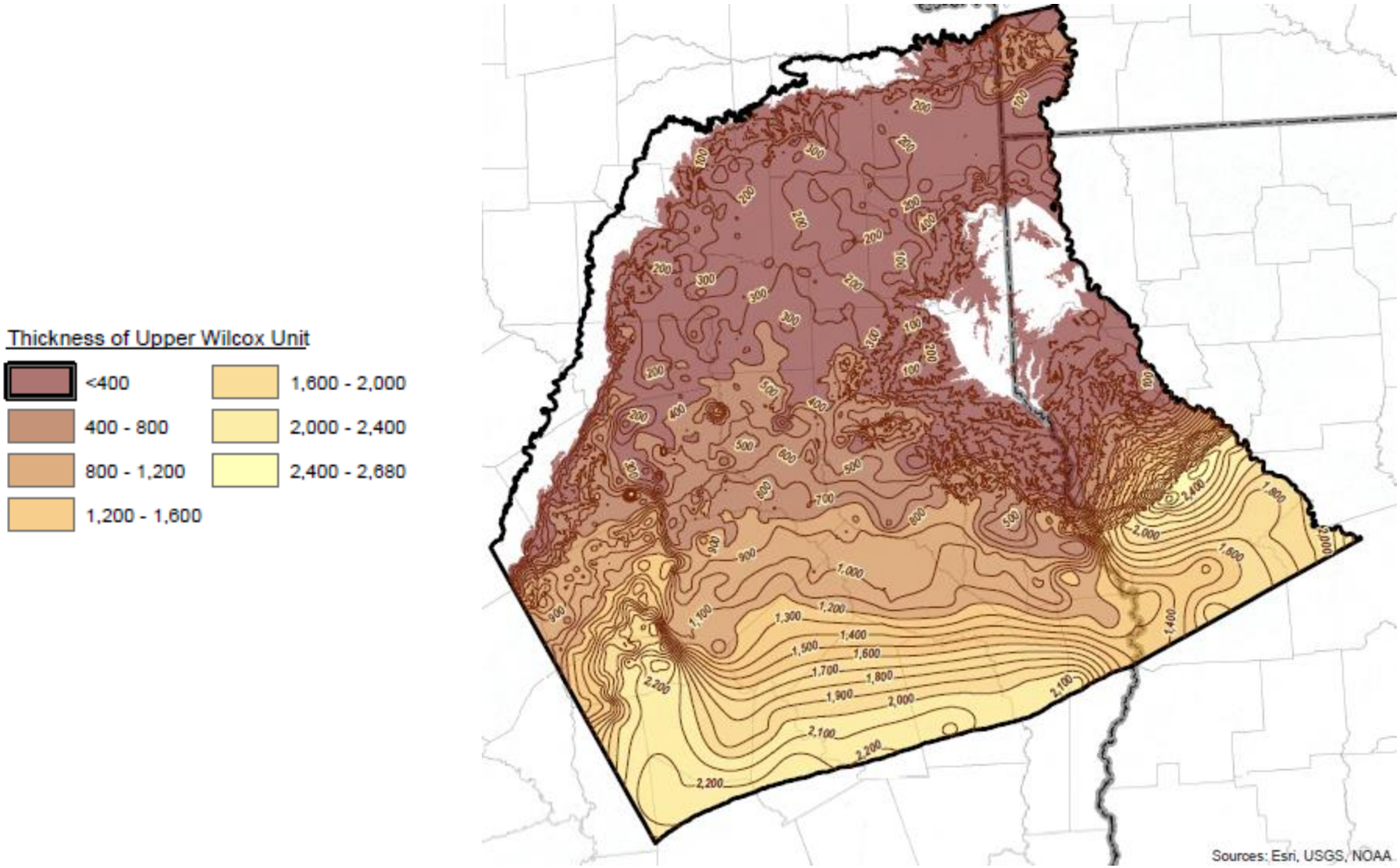
# Thickness of Reklaw Formation



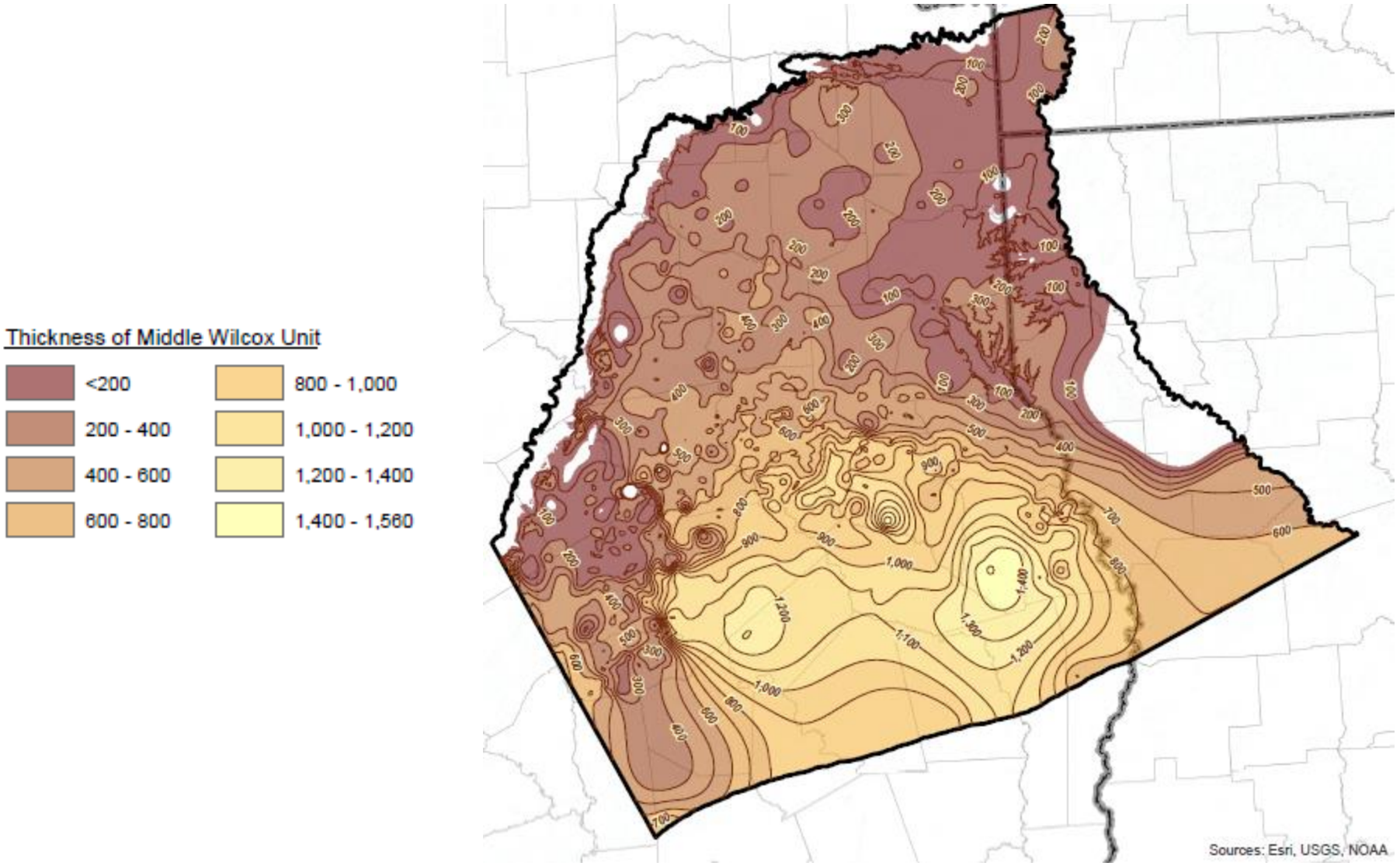
# Thickness of Carrizo Sand



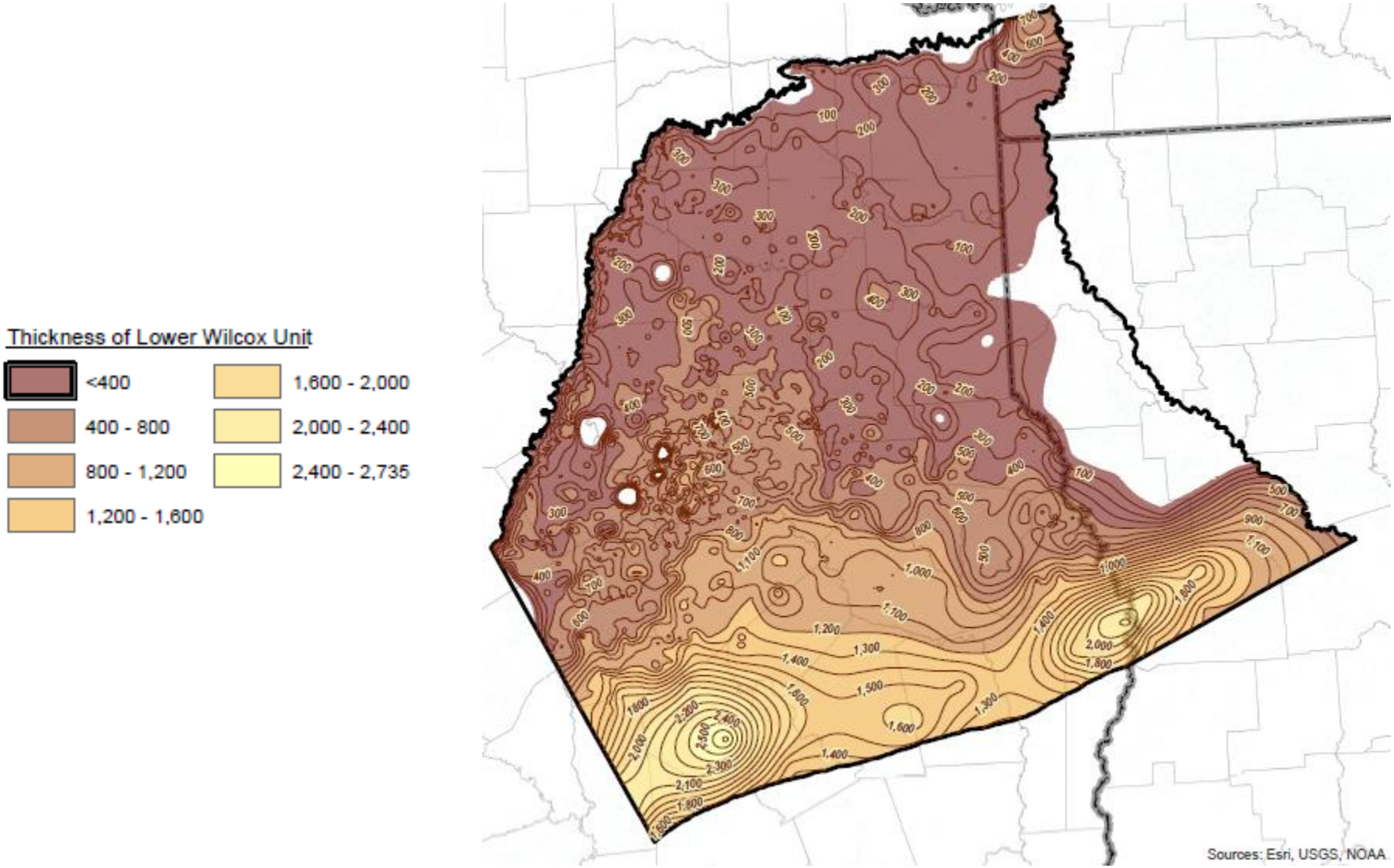
# Thickness of Upper Wilcox



# Thickness of Middle Wilcox



# Thickness of Lower Wilcox



# Updated GAM Framework

- Nine-layer aquifer system
- Top and bottom elevation surfaces exported from Leapfrog geologic model for input to numerical model

# Groundwater Levels and Regional Groundwater Flow

# Queen City Sands: Water Level Contours

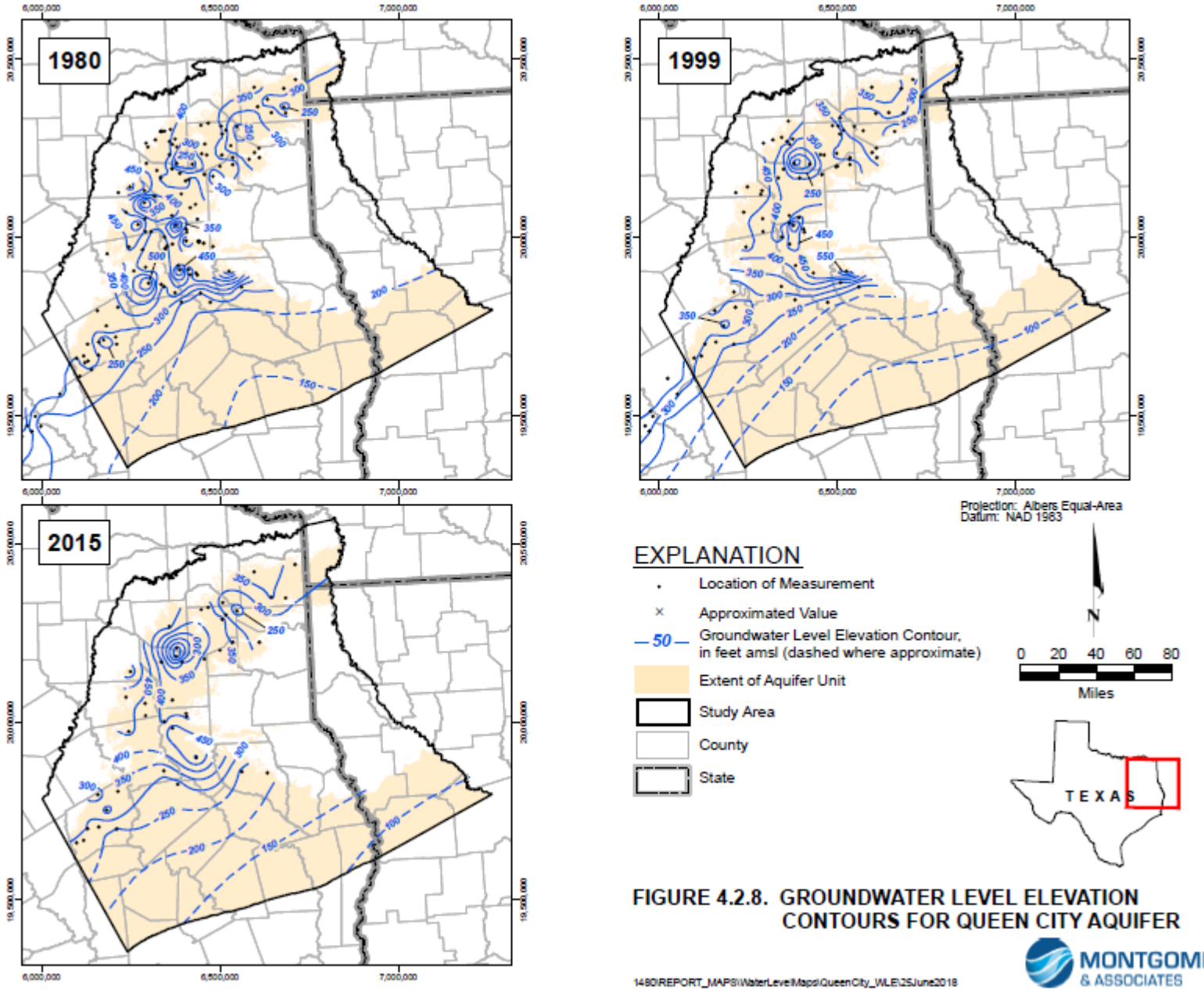



FIGURE 4.2.8. GROUNDWATER LEVEL ELEVATION CONTOURS FOR QUEEN CITY AQUIFER

1480\REPORT_MAPS\\WaterLevelMaps\QueenCity_WLE\25June2018

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# Carrizo Sands: Water Level Contours

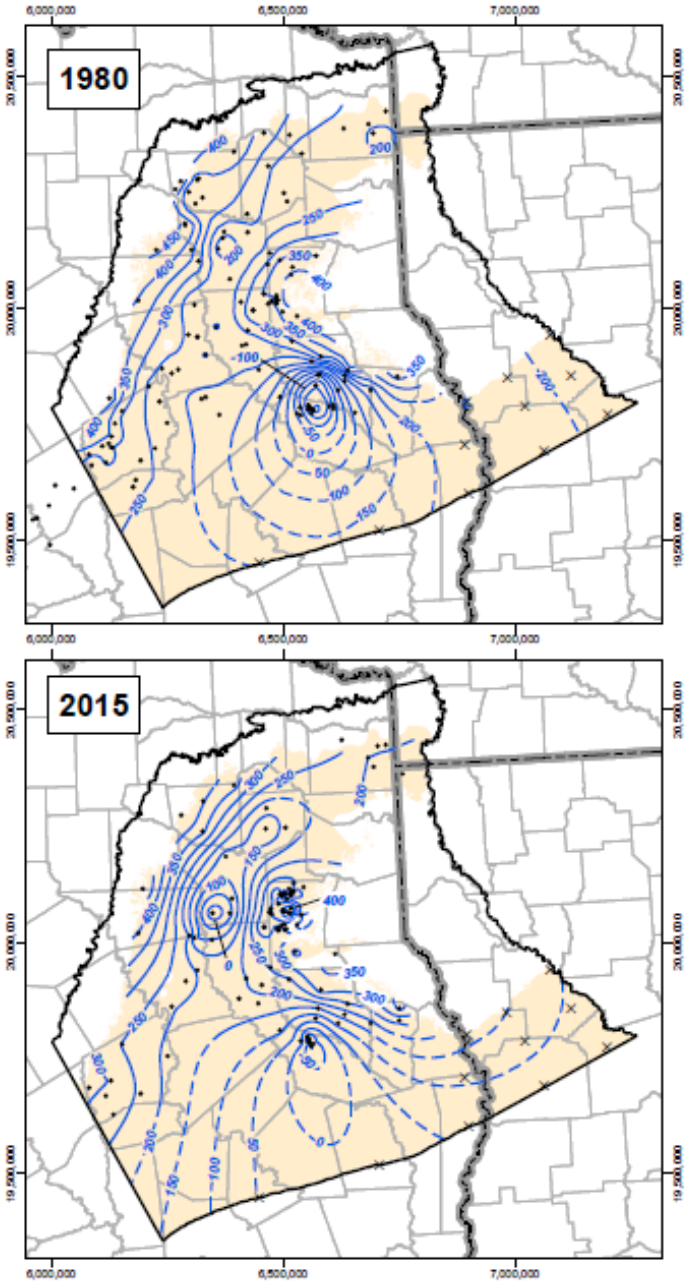


FIGURE 4.2.9. GROUNDWATER LEVEL ELEVATION CONTOURS FOR CARRIZO AQUIFER

1480\REPORT_MAPS\Carrizo_WLE\26June2018

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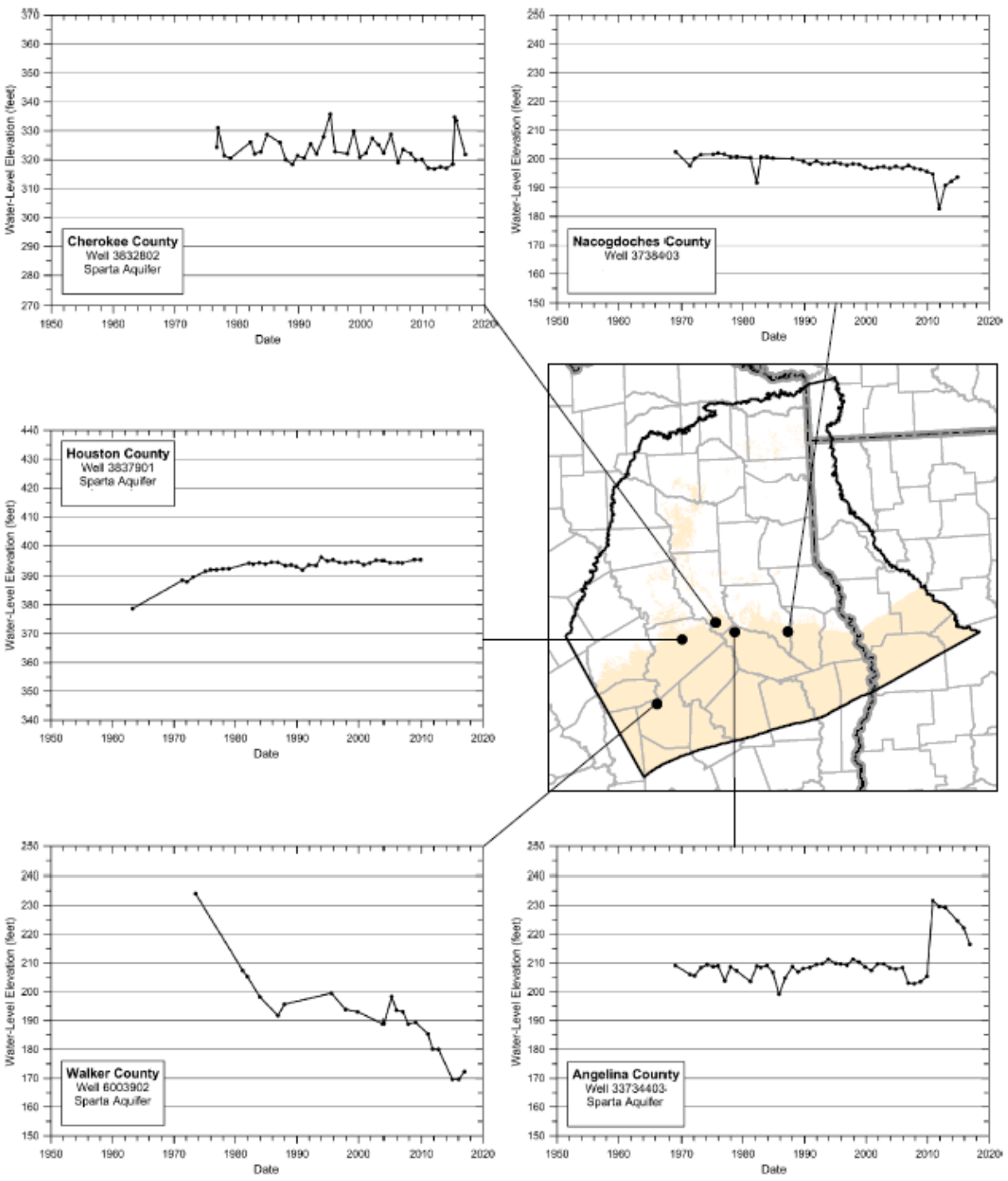
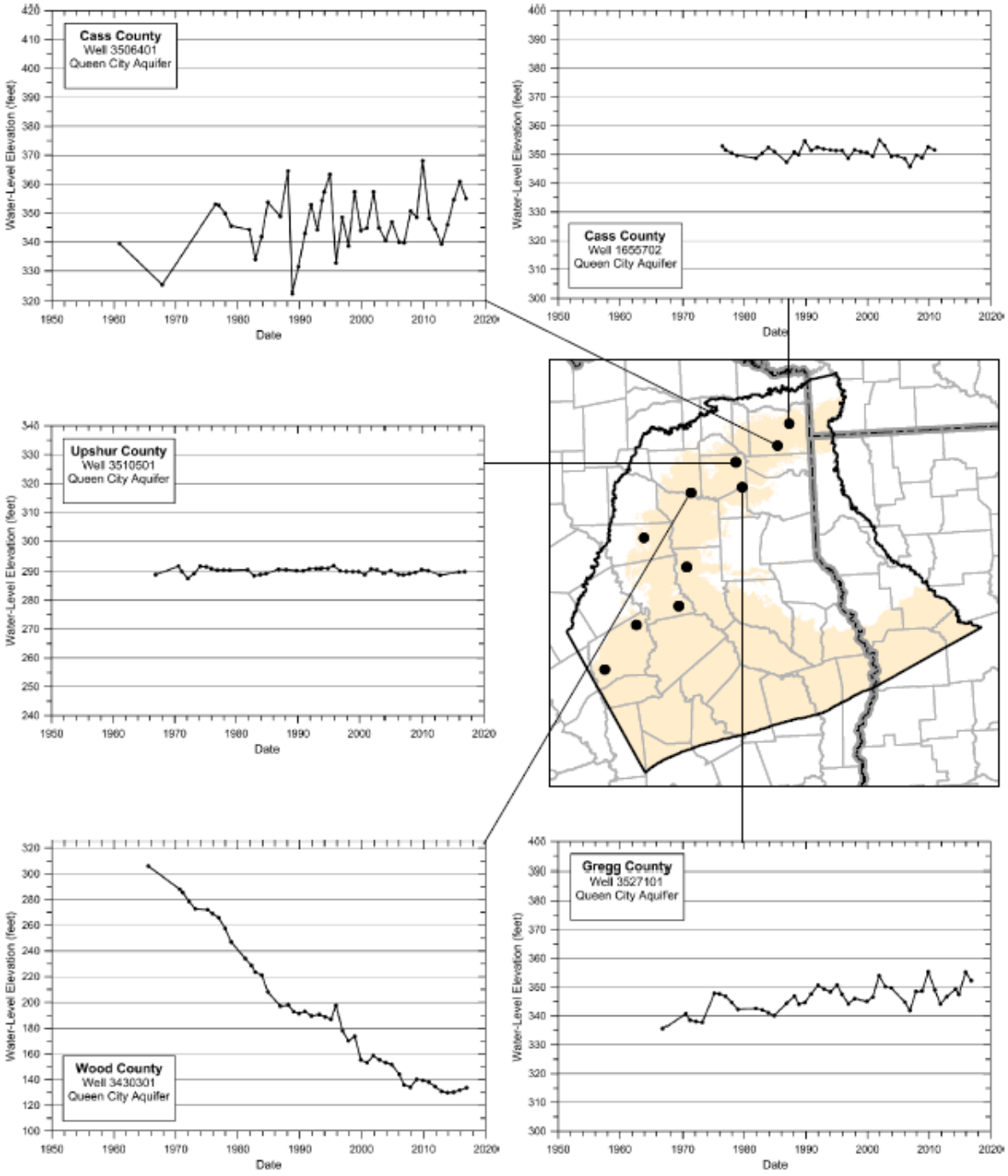
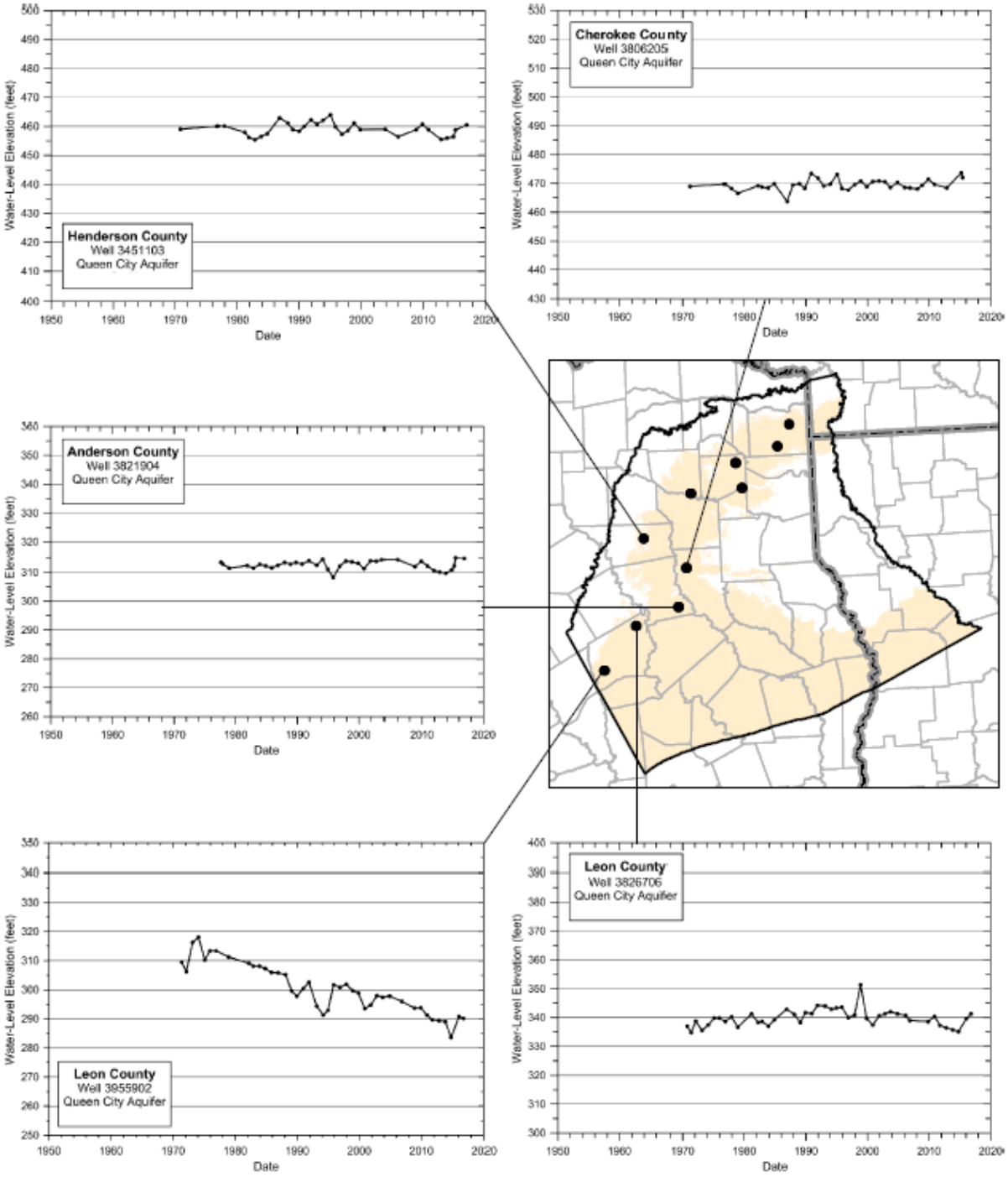
# Sparta Sands: Water Level Time Series



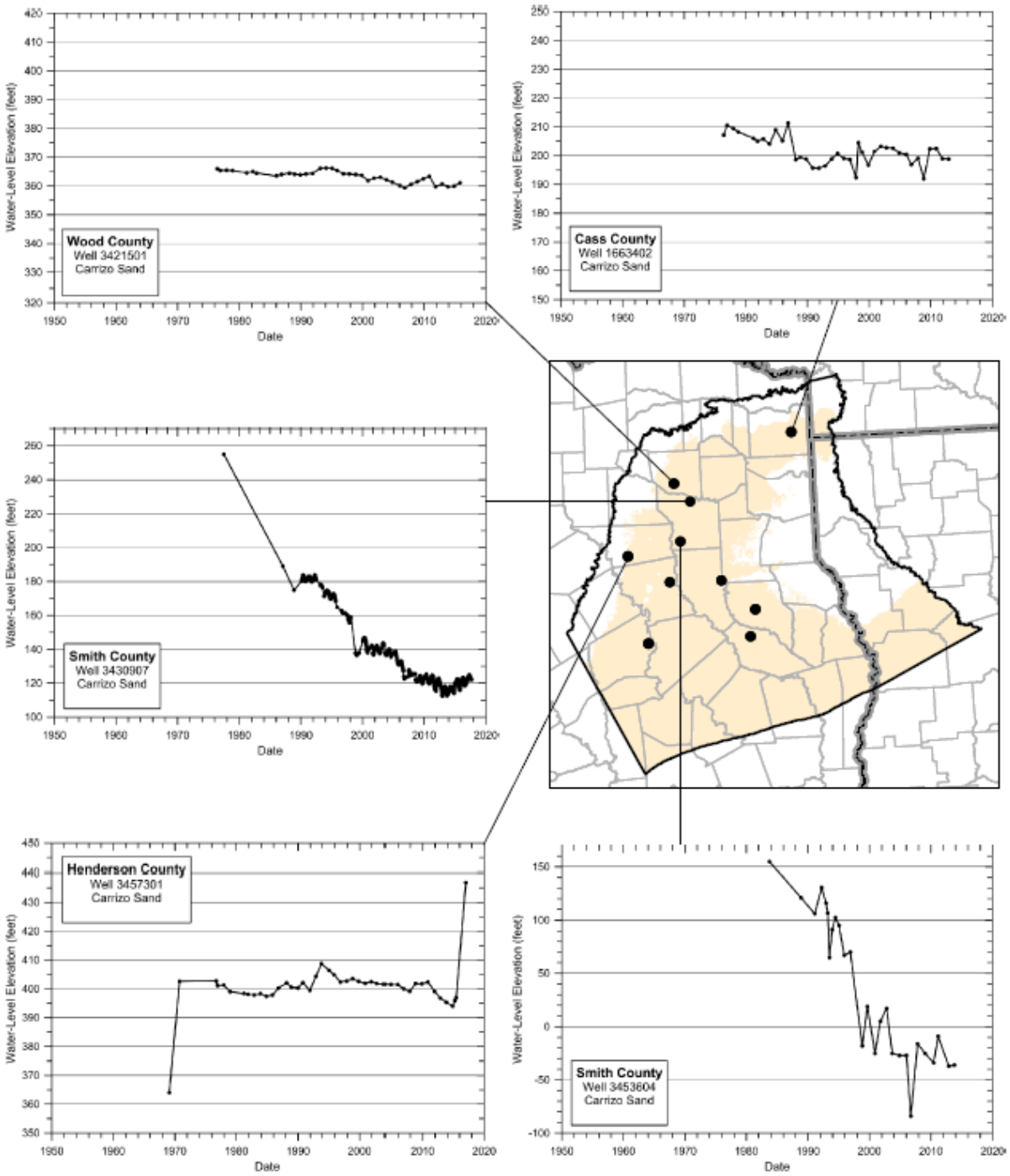
# Queen City Sands: Water Level Time Series (North)



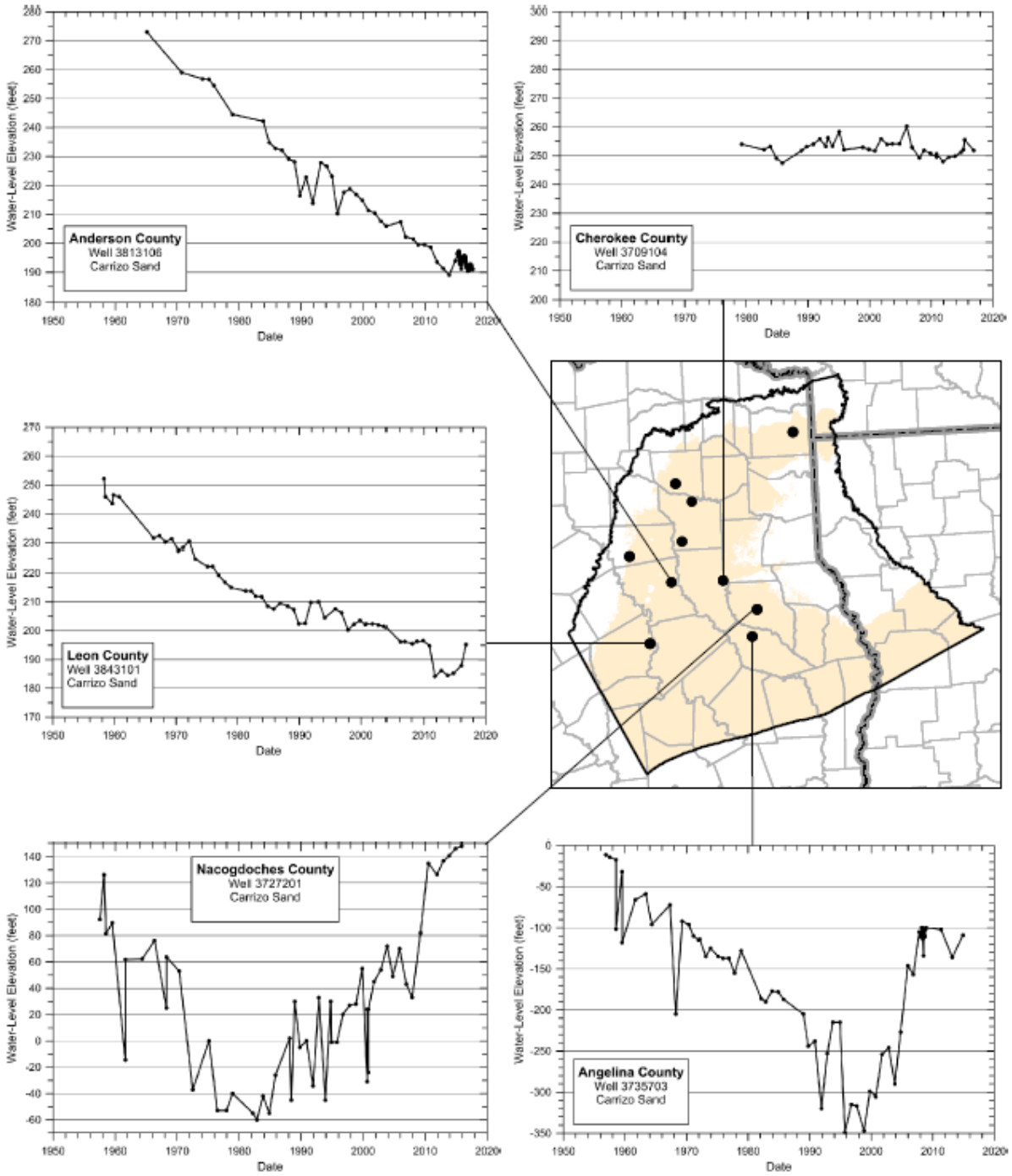
# Queen City Sands: Water Level Time Series (South)



# Carrizo Sands: Water Level Time Series (North)



# Carrizo Sands: Water Level Time Series (South)



# Recharge

# Recharge Distributions

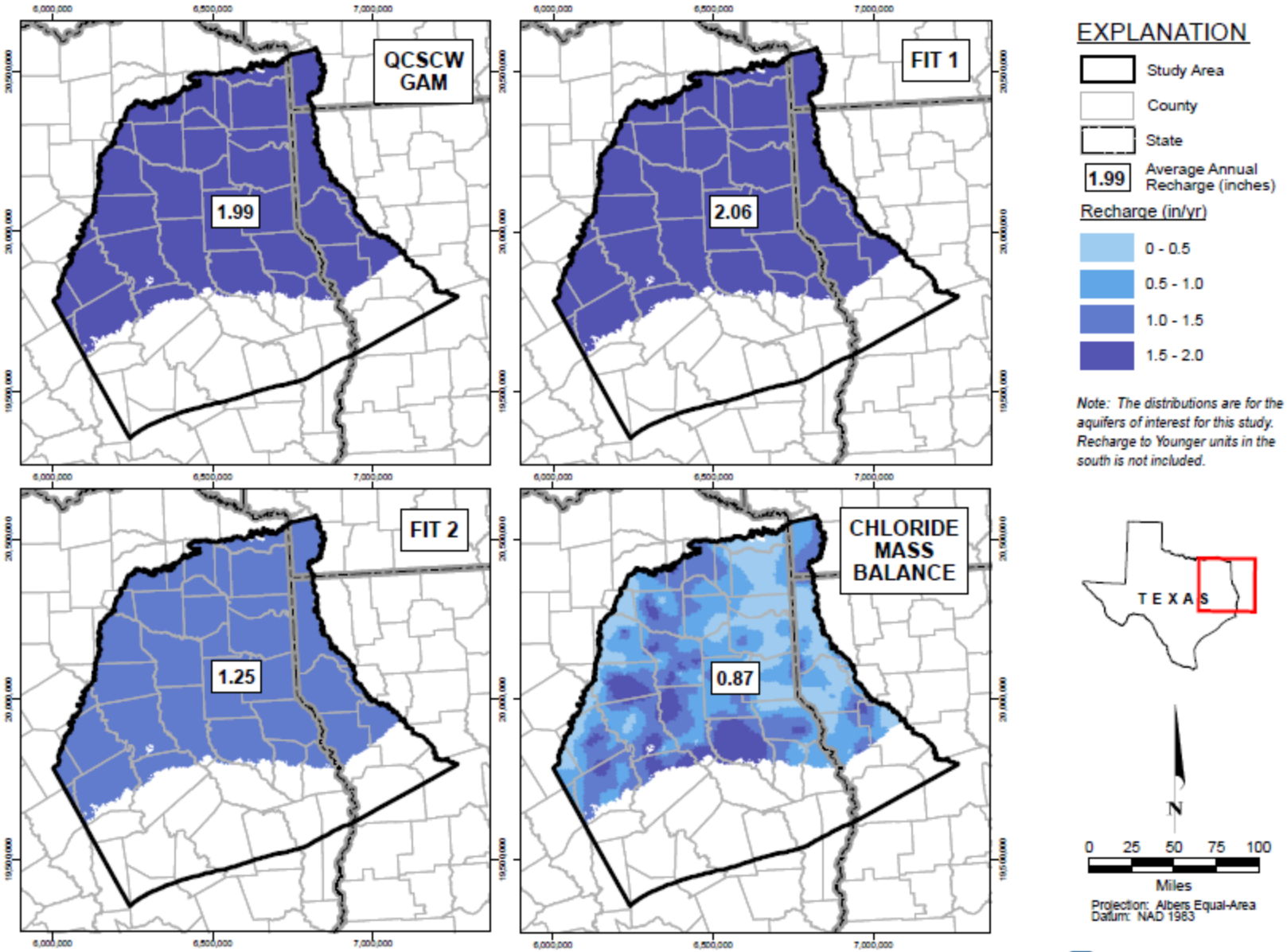



FIGURE 4.3.2. RECHARGE DISTRIBUTIONS FROM VARIOUS METHODS BASED ON 30-YEAR AVERAGE PRECIPITATION

1480\REPORT_MAPS\Recharge_Distribution_30yrAvPrecip.mxd\27June2018

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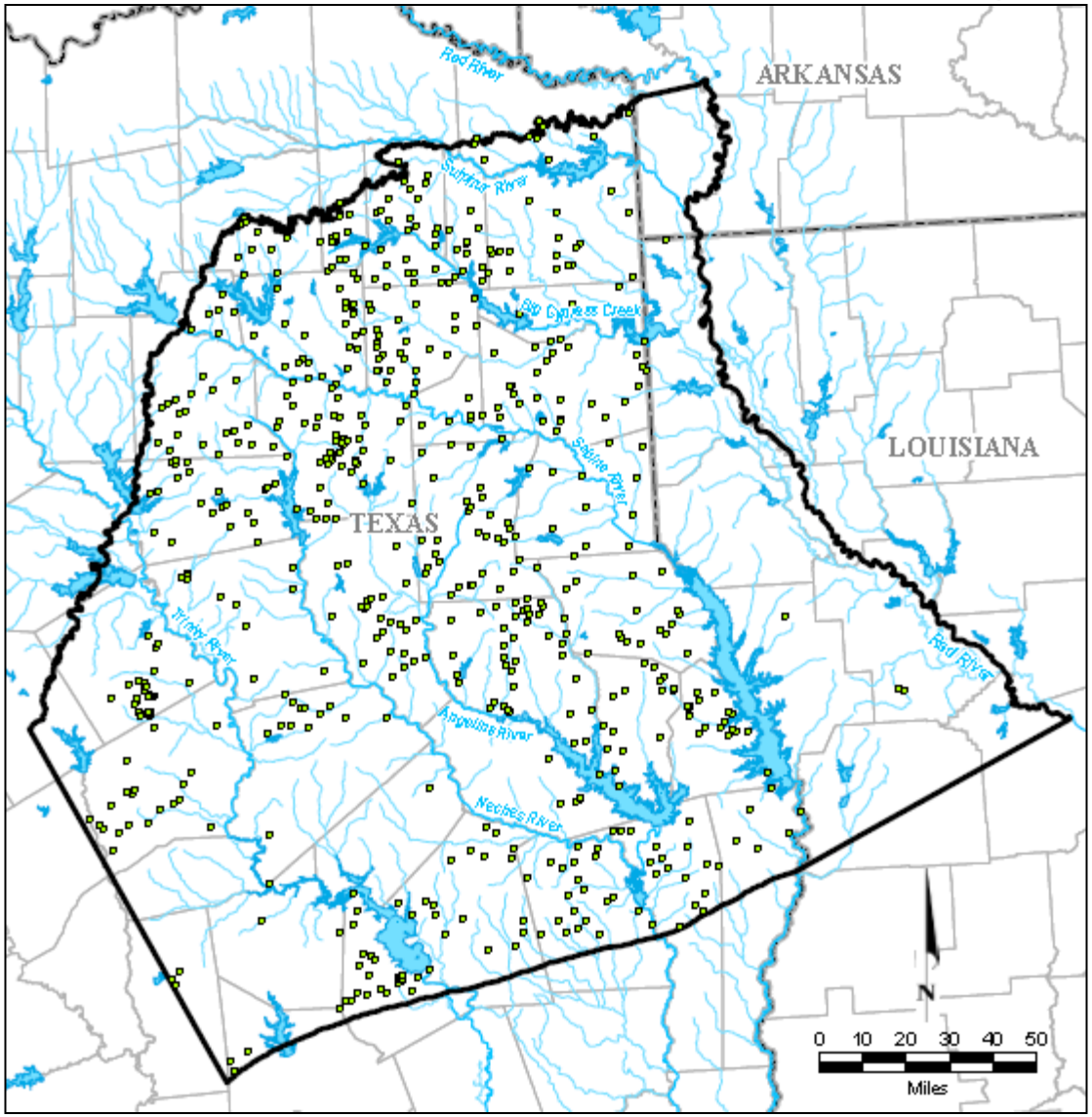
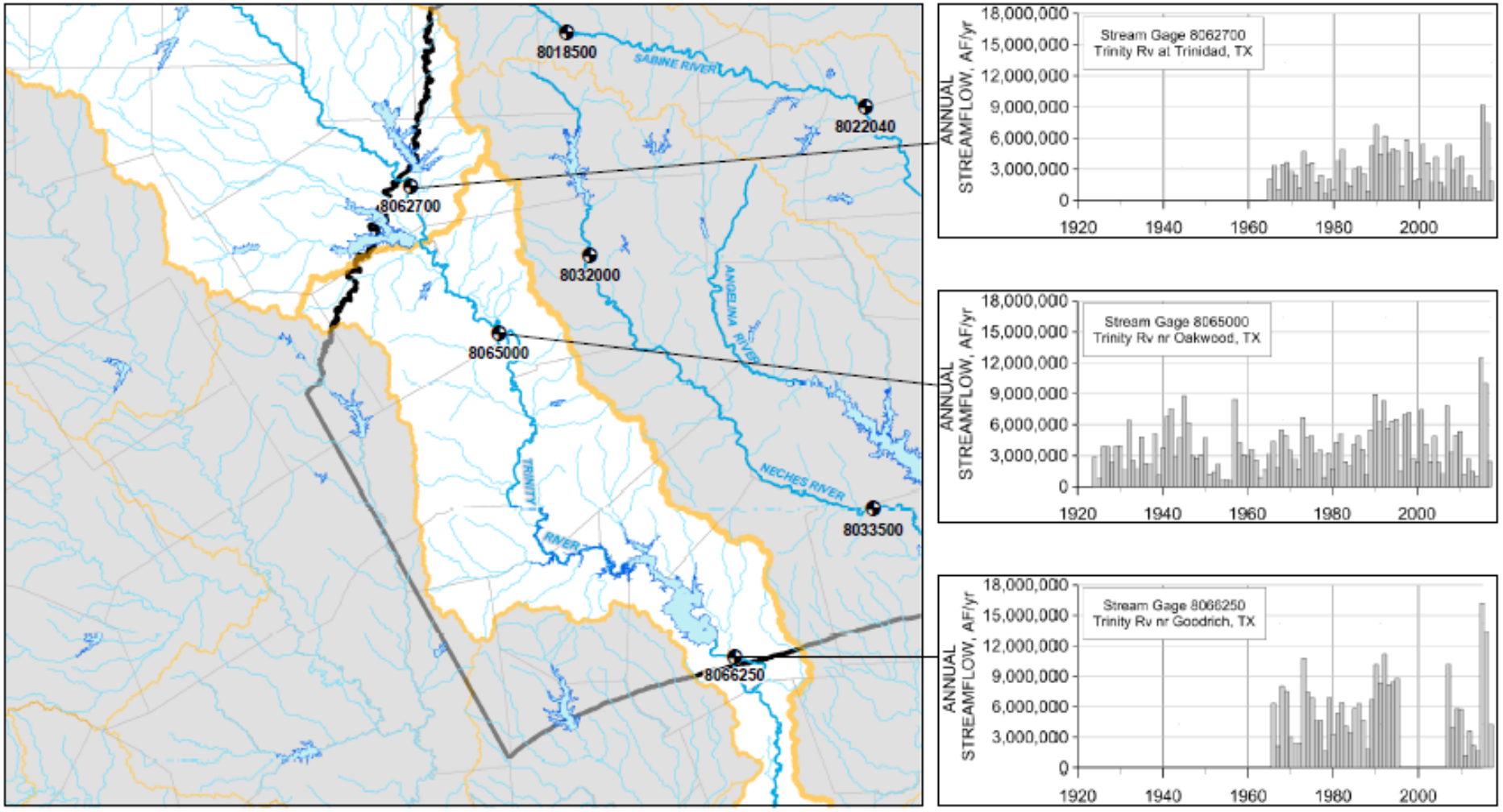
# Surface Water

# Rivers, Reservoirs, and Springs

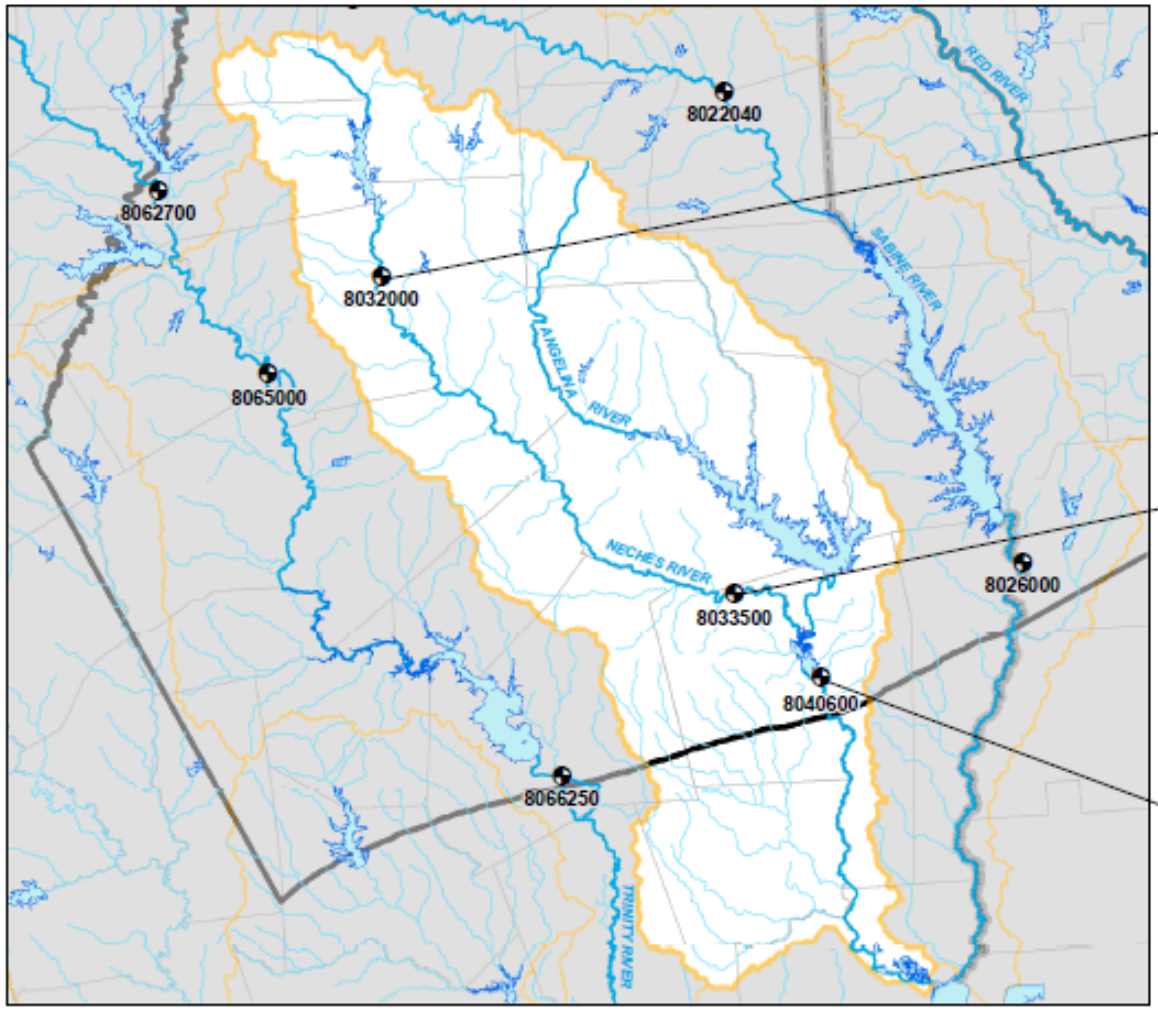


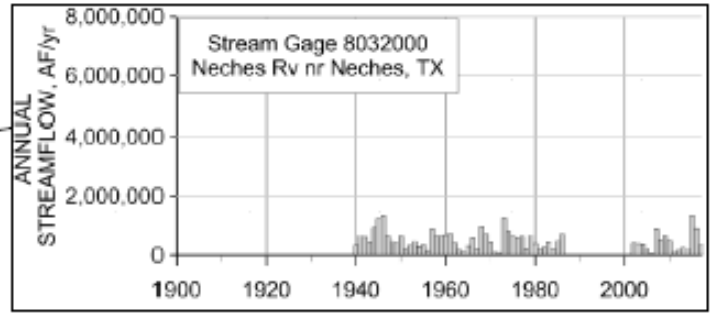
# Streamflow Trinity

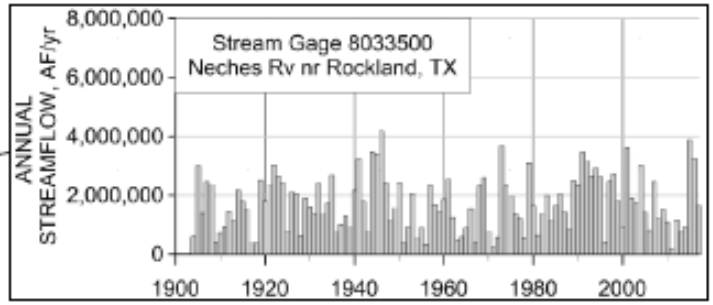


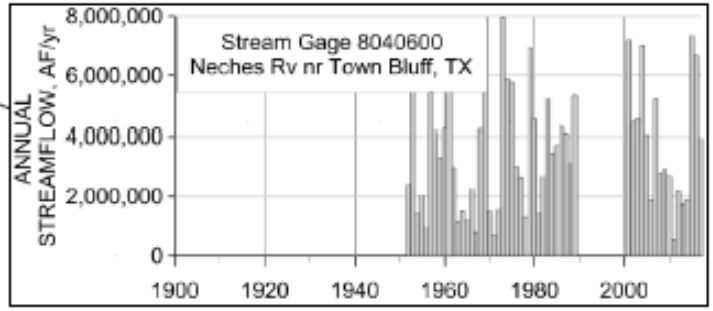

*Source: USGS, daily mean streamflow summarized to annual streamflow*

# Streamflow Neches



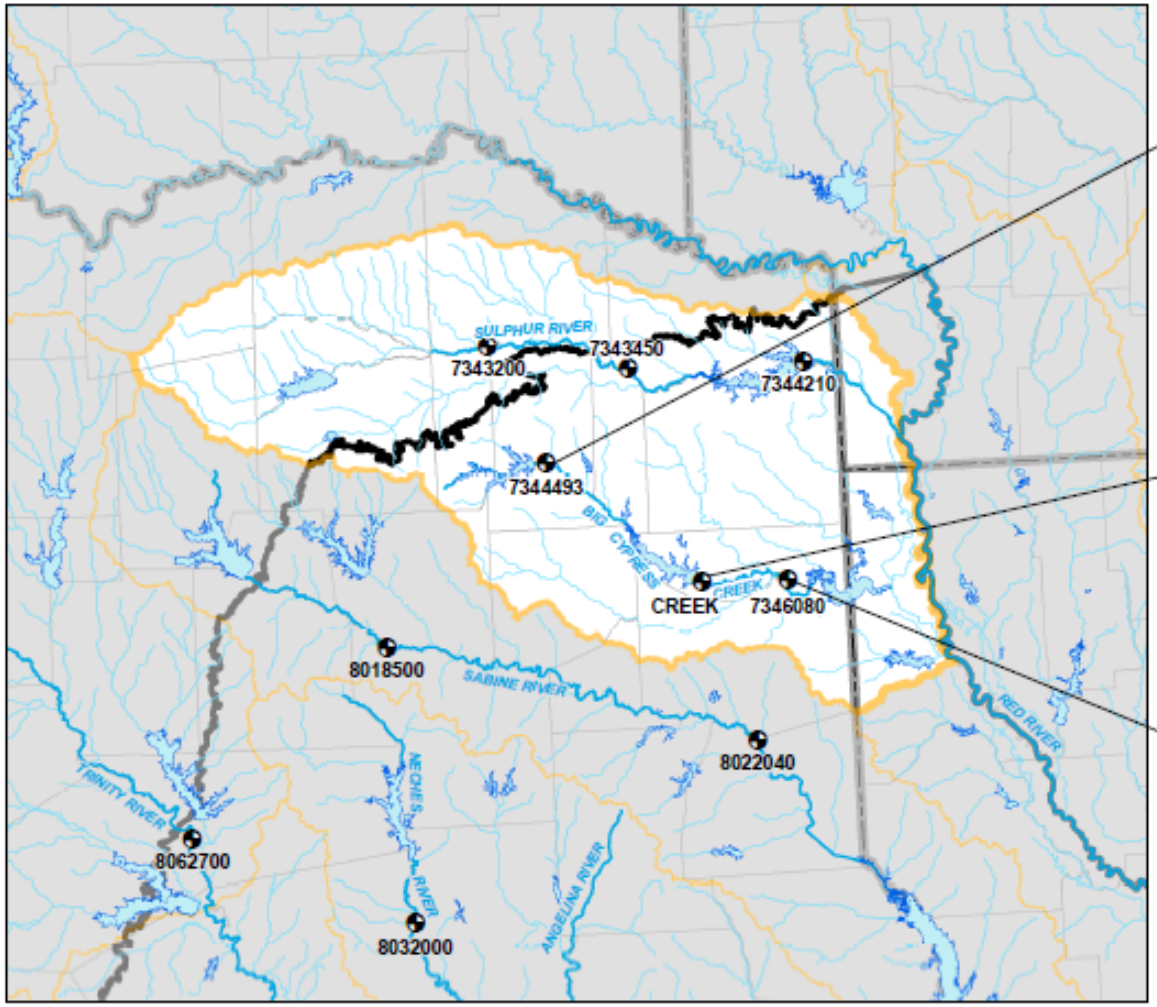



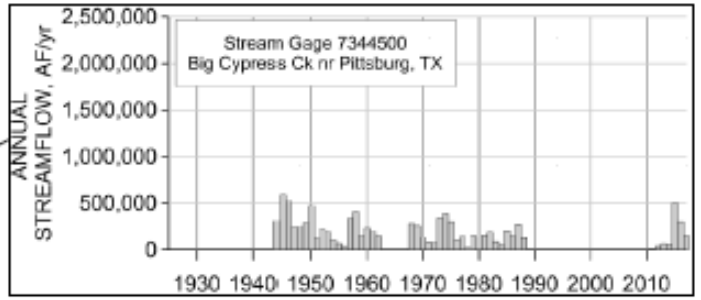



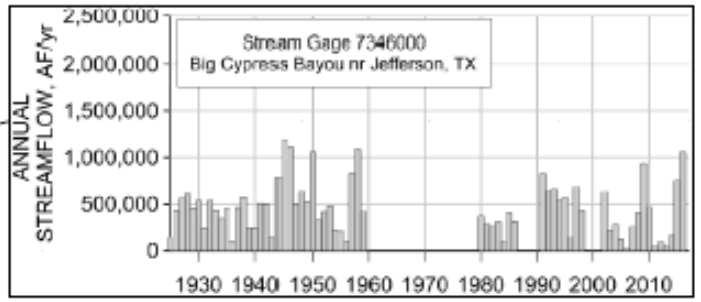



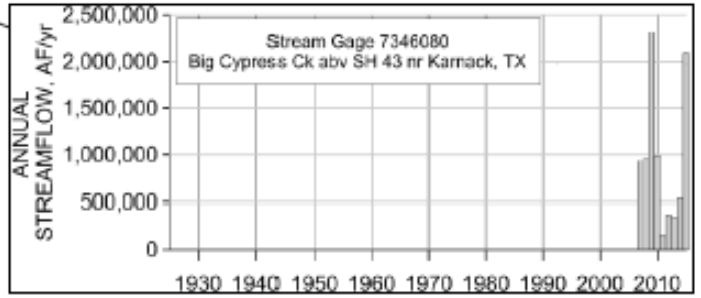

*Source: USGS, daily mean streamflow summarized to annual streamflow*

# Streamflow Big Cypress



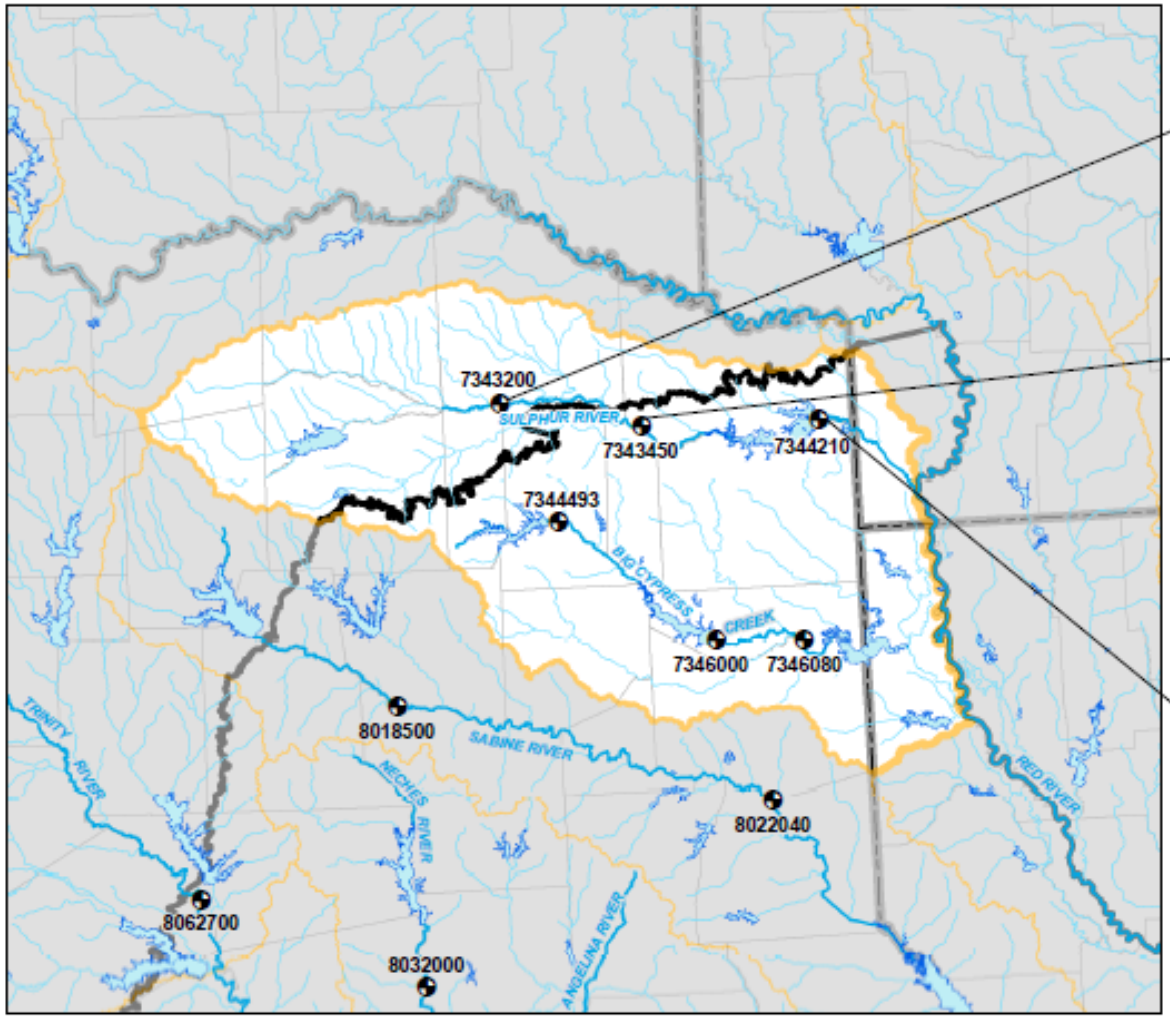



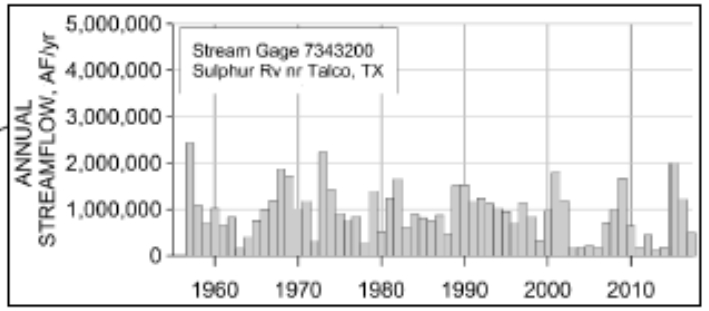



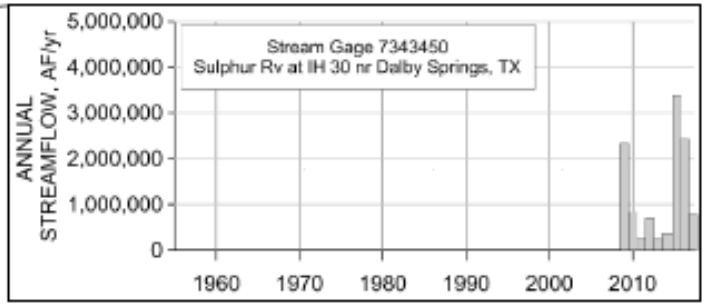



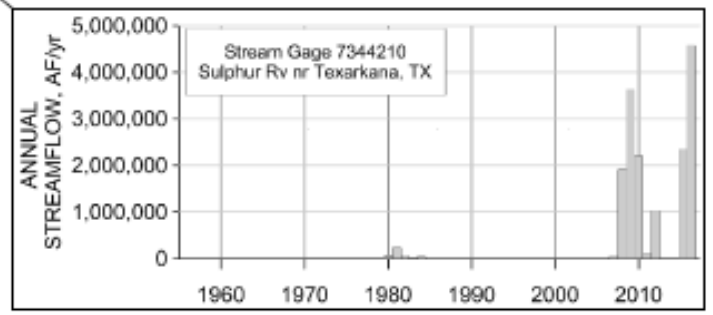

*Source: USGS, daily mean streamflow summarized to annual streamflow*

# Streamflow Sulfur



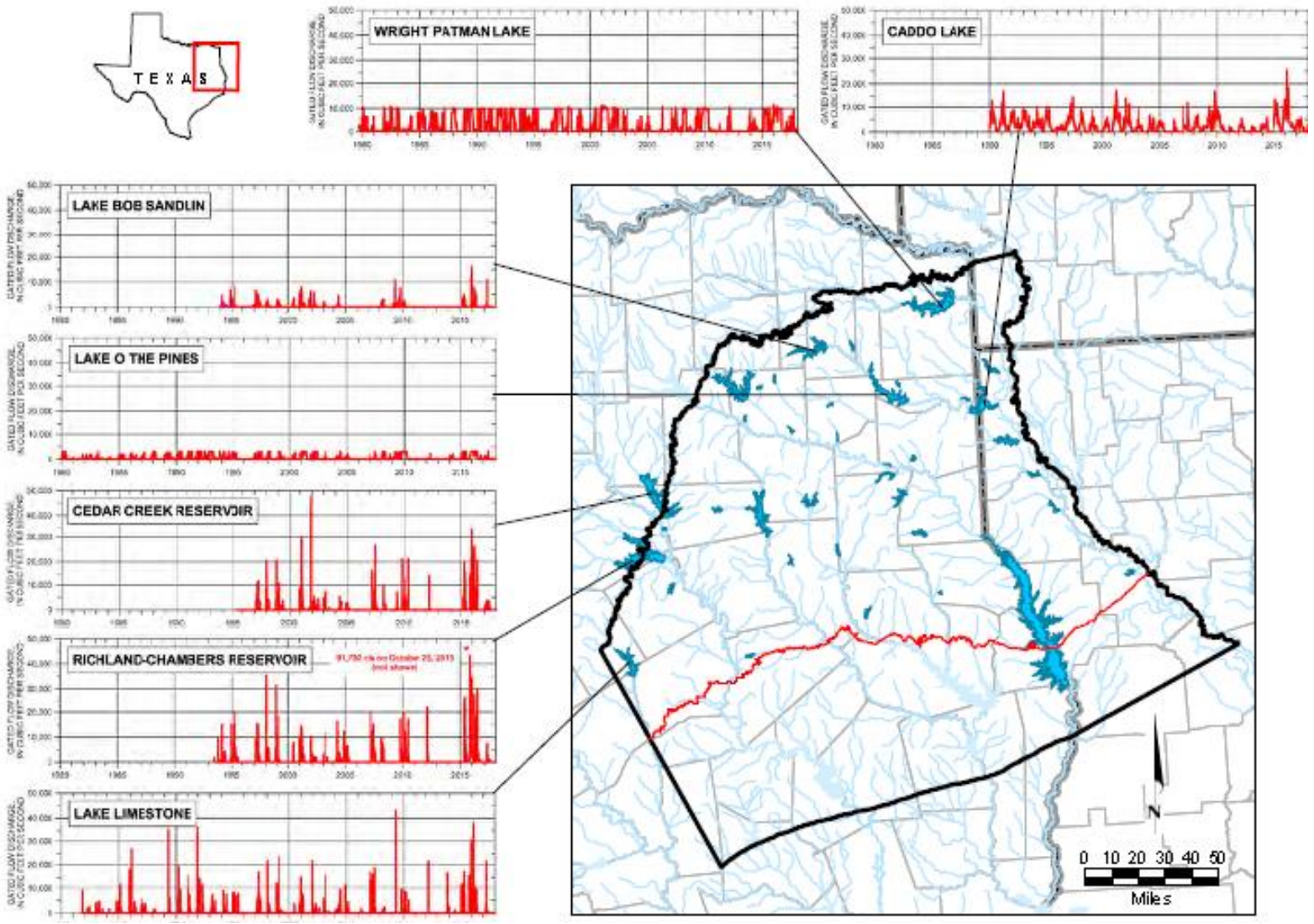



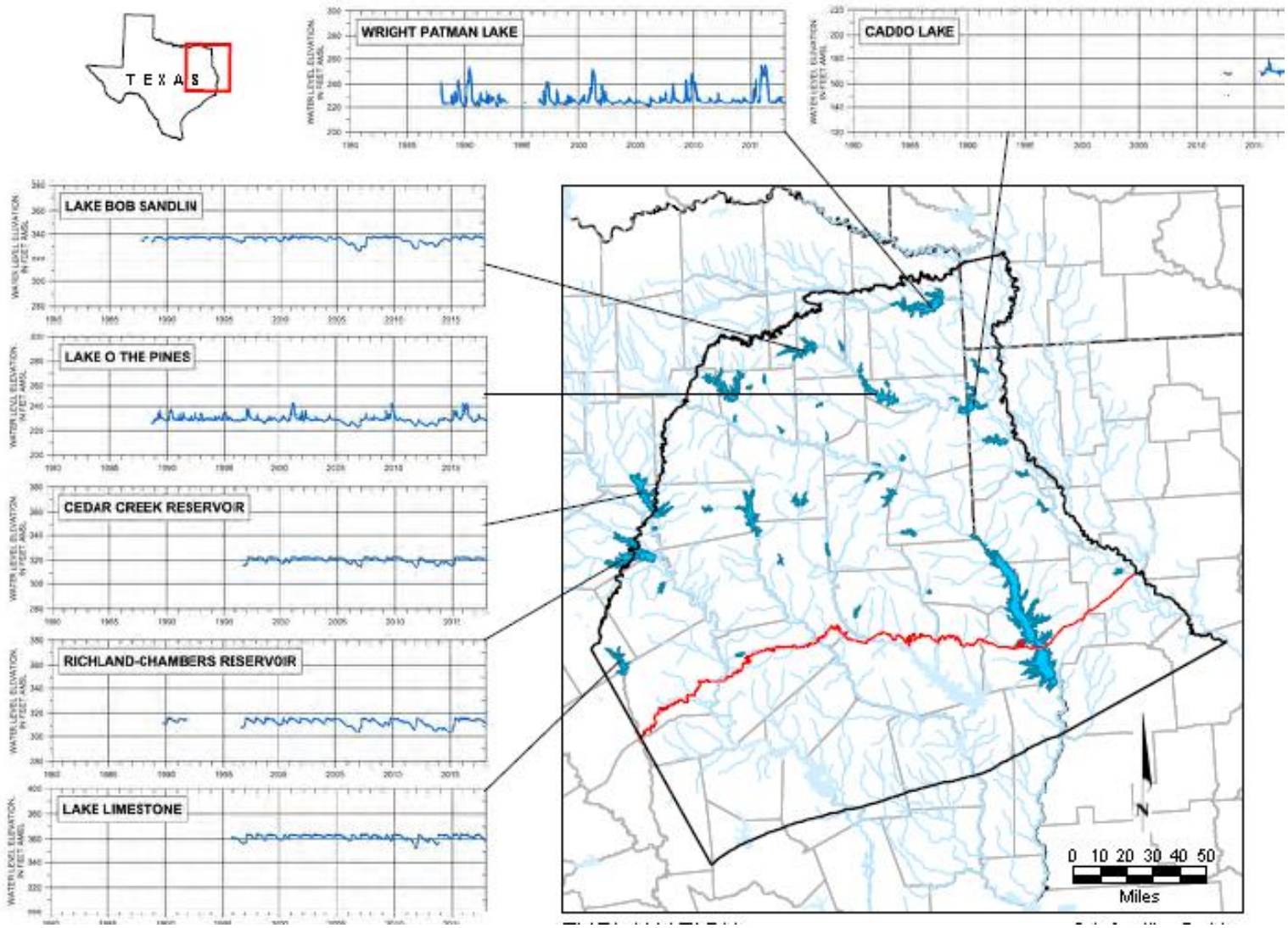




*Source: USGS, daily mean streamflow summarized to annual streamflow*

# Reservoir Discharge Hydrographs

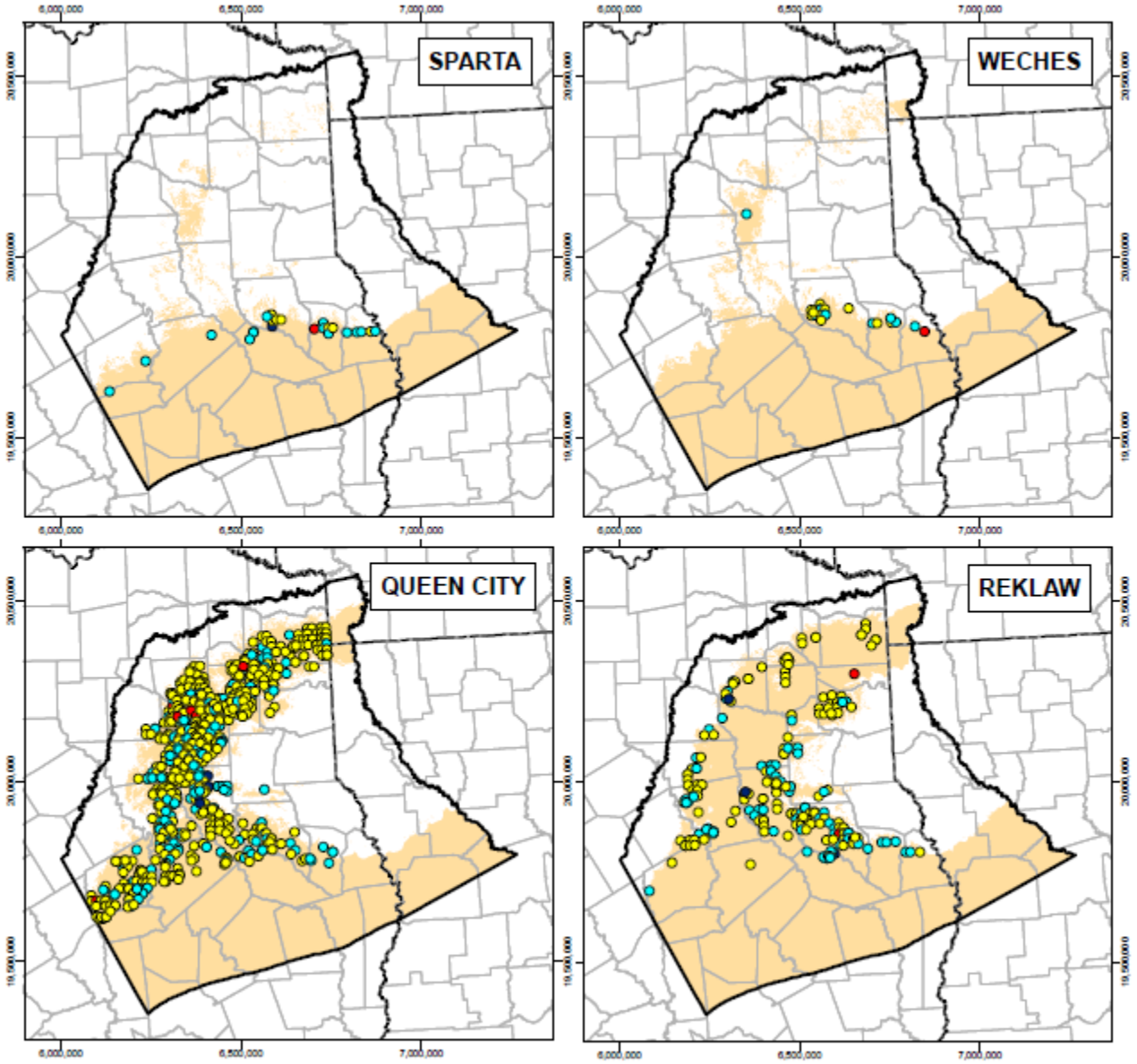


# Reservoir Water Level Hydrographs



# Aquifer Hydraulic Properties

# Hydraulic Conductivity




EXPLANATION

- Study Area
- County
- State

Hydraulic Conductivity, in feet per day

- 0 - 1
- 1 - 10
- 10 - 100
- 100 - 1,000



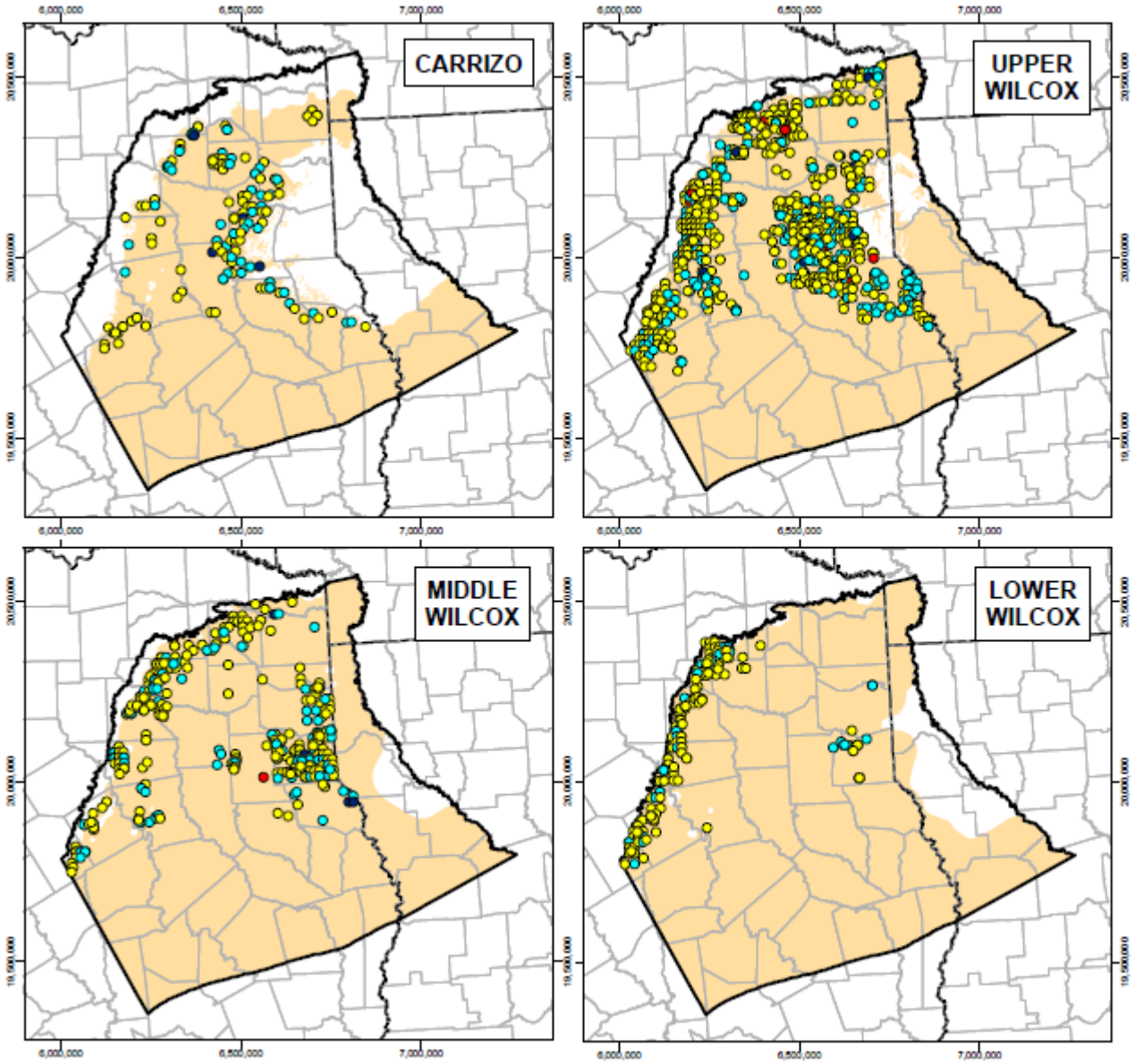
Projection: Albers Equal-Area
Datum: NAD 1983

FIGURE 4.5.2. HYDRAULIC CONDUCTIVITY FOR UPPER AQUIFER UNITS

1480\REPORT_MAPS\HydraulicParameters\BaseMap_K-1_4.mxd\07June2018

MONTGOMERY & ASSOCIATES

# Hydraulic Conductivity




EXPLANATION

- Study Area
- County
- State

Hydraulic Conductivity, in feet per day

- 0 - 1
- 1 - 10
- 10 - 100
- 100 - 1,000



Projection: Albers Equal-Area
Datum: NAD 1983

FIGURE 4.5.3. HYDRAULIC CONDUCTIVITY FOR LOWER AQUIFER UNITS

1480\REPORT_MAPS\HydraulicParameters\BaseMap_K-5_8.mxd\07June2018

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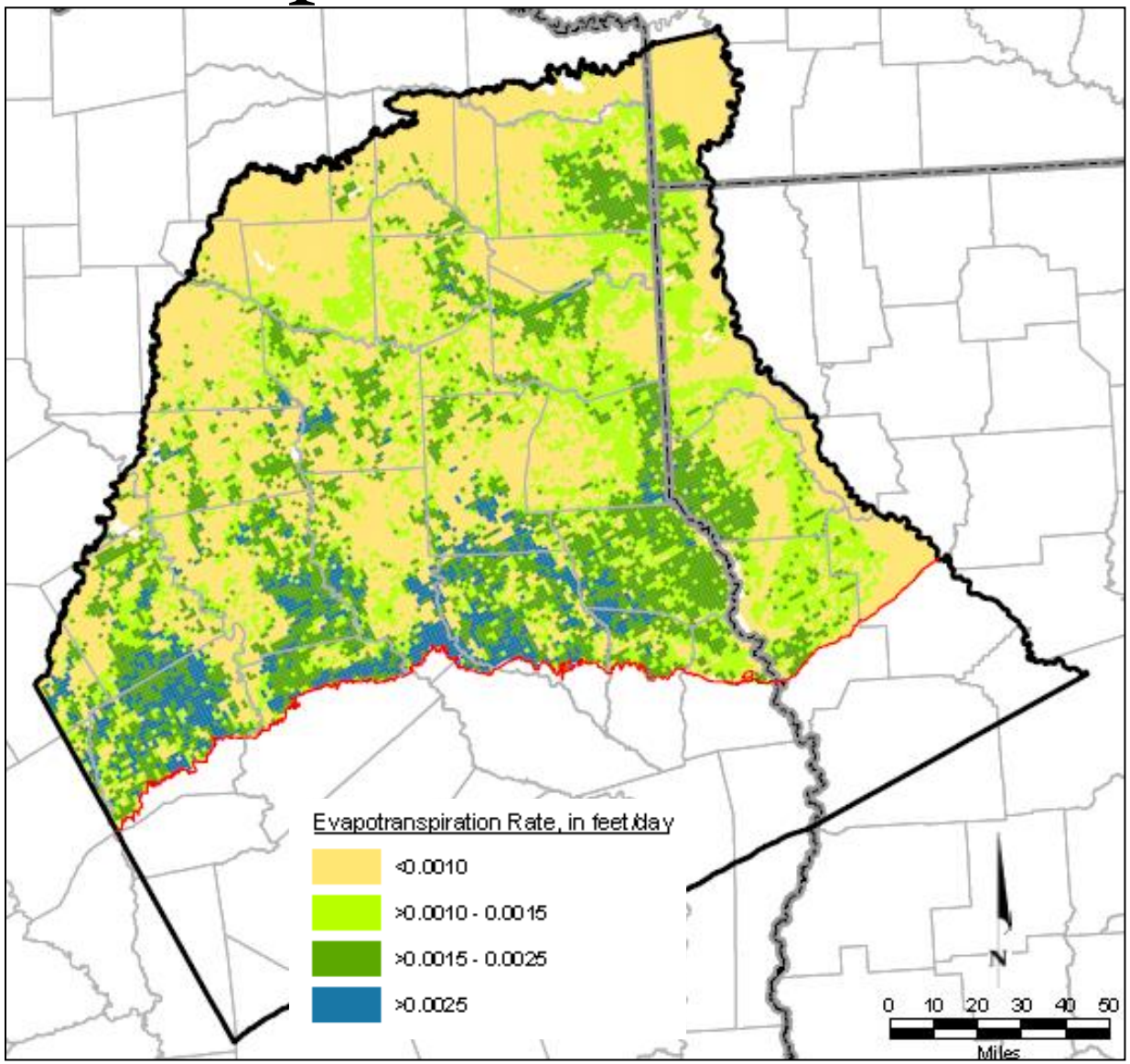
# Groundwater Discharge

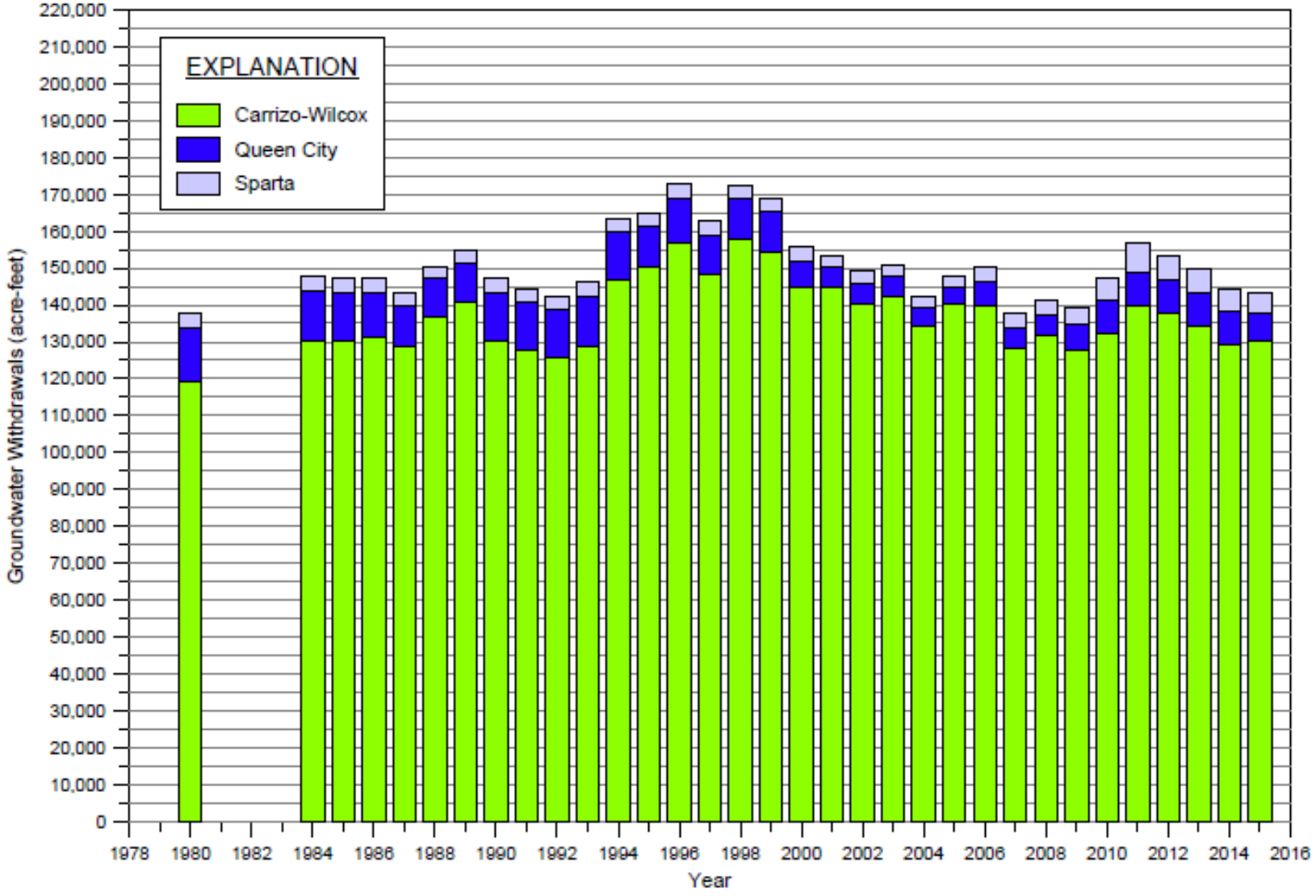
# Evapotranspiration (ET)



# Groundwater Pumping

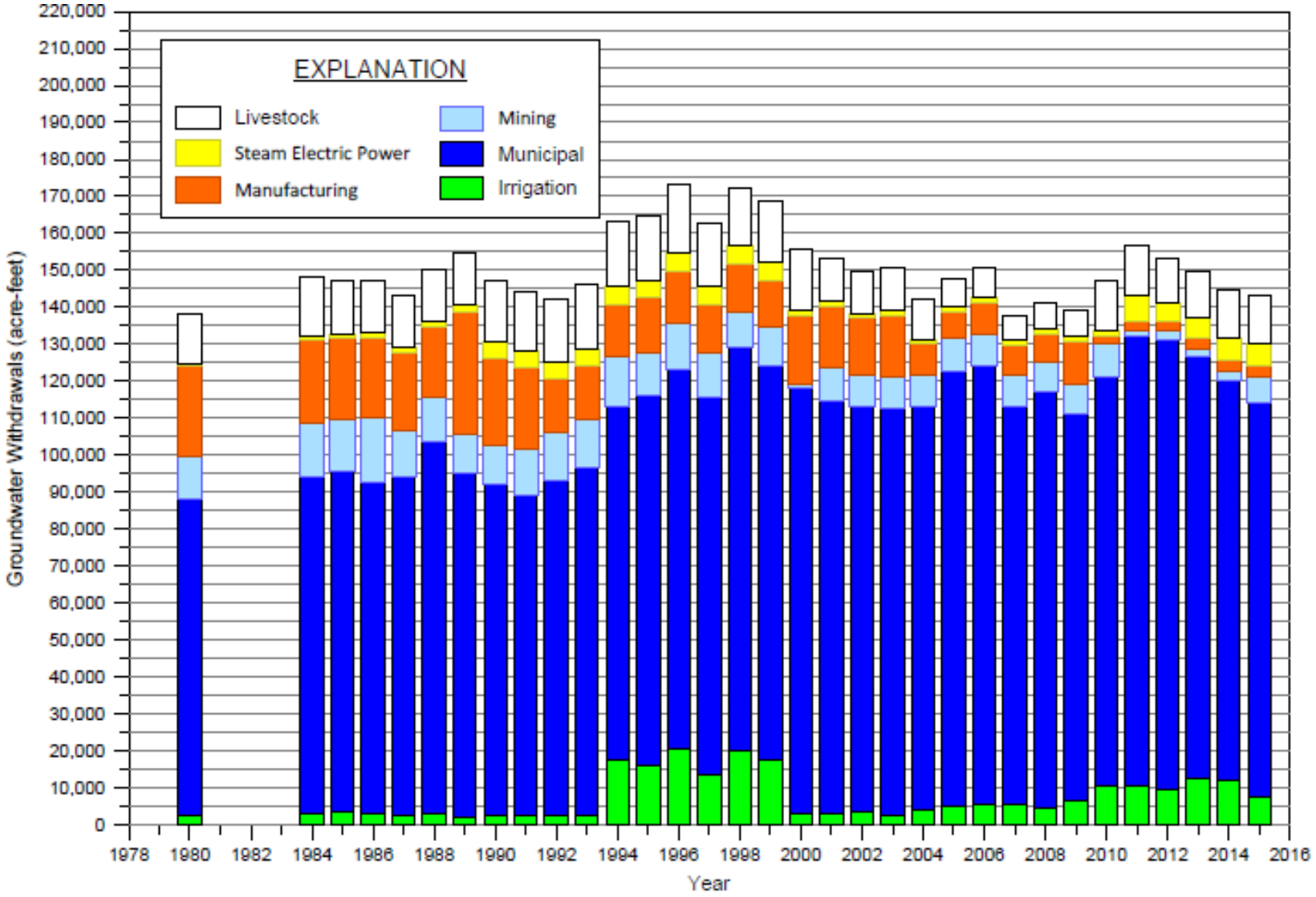
- Data sources:
  - TWDB annual water use surveys
  - USGS 5-year water use reports
  - Texas Railroad Commission (mining only)
  - Data requests submitted to GCDs
    - Received data from Rusk County and Mid-East Texas

# Groundwater Pumping in Texas by Aquifer



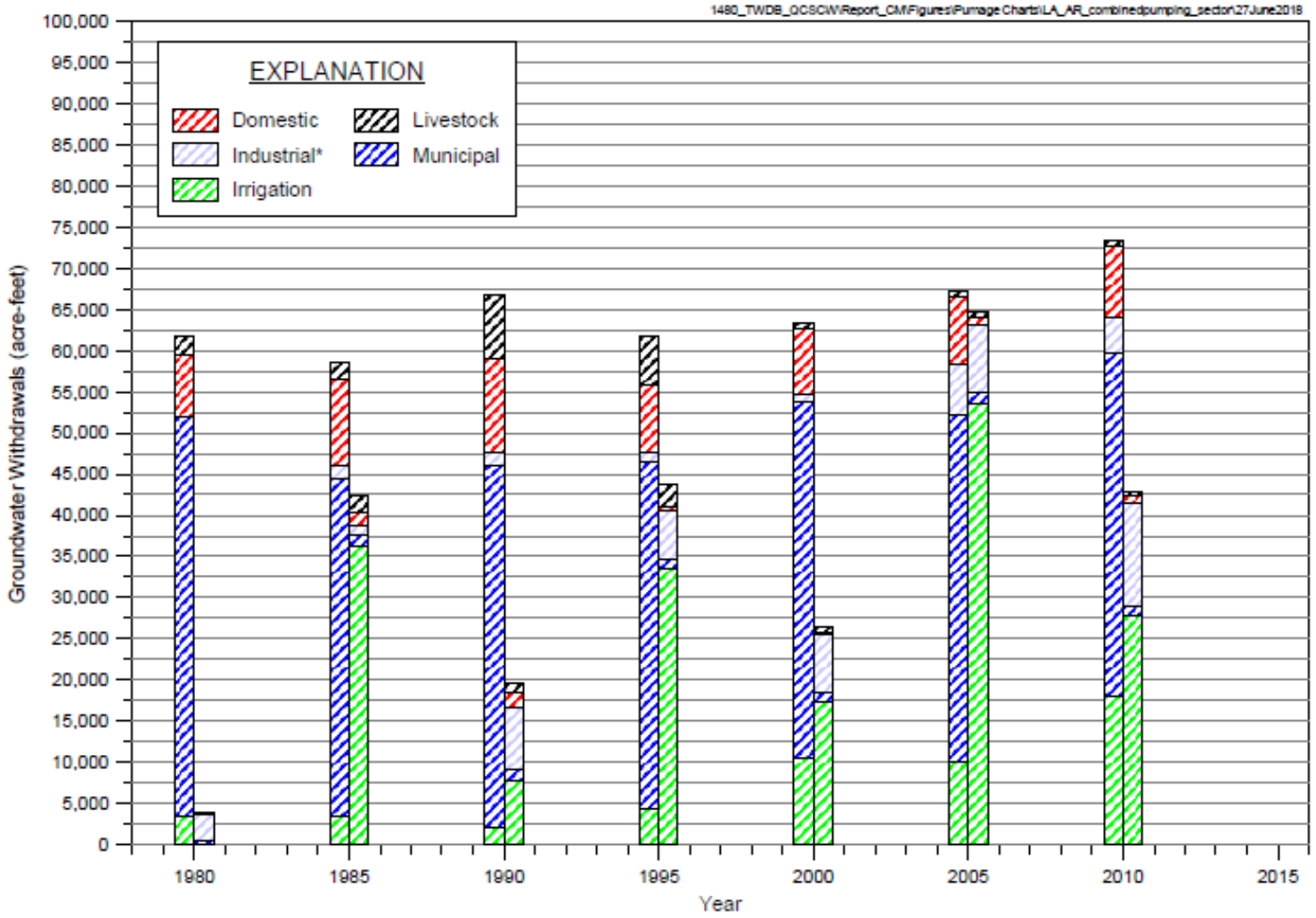

*Source: TWDB annual water use surveys; does not include domestic pumping estimates*

# Groundwater Pumping in Texas by Water Use Sector




*Source: TWDB annual water use surveys; totals include estimated pumpage from Queen City, Sparta, and Carrizo-Wilcox aquifers*

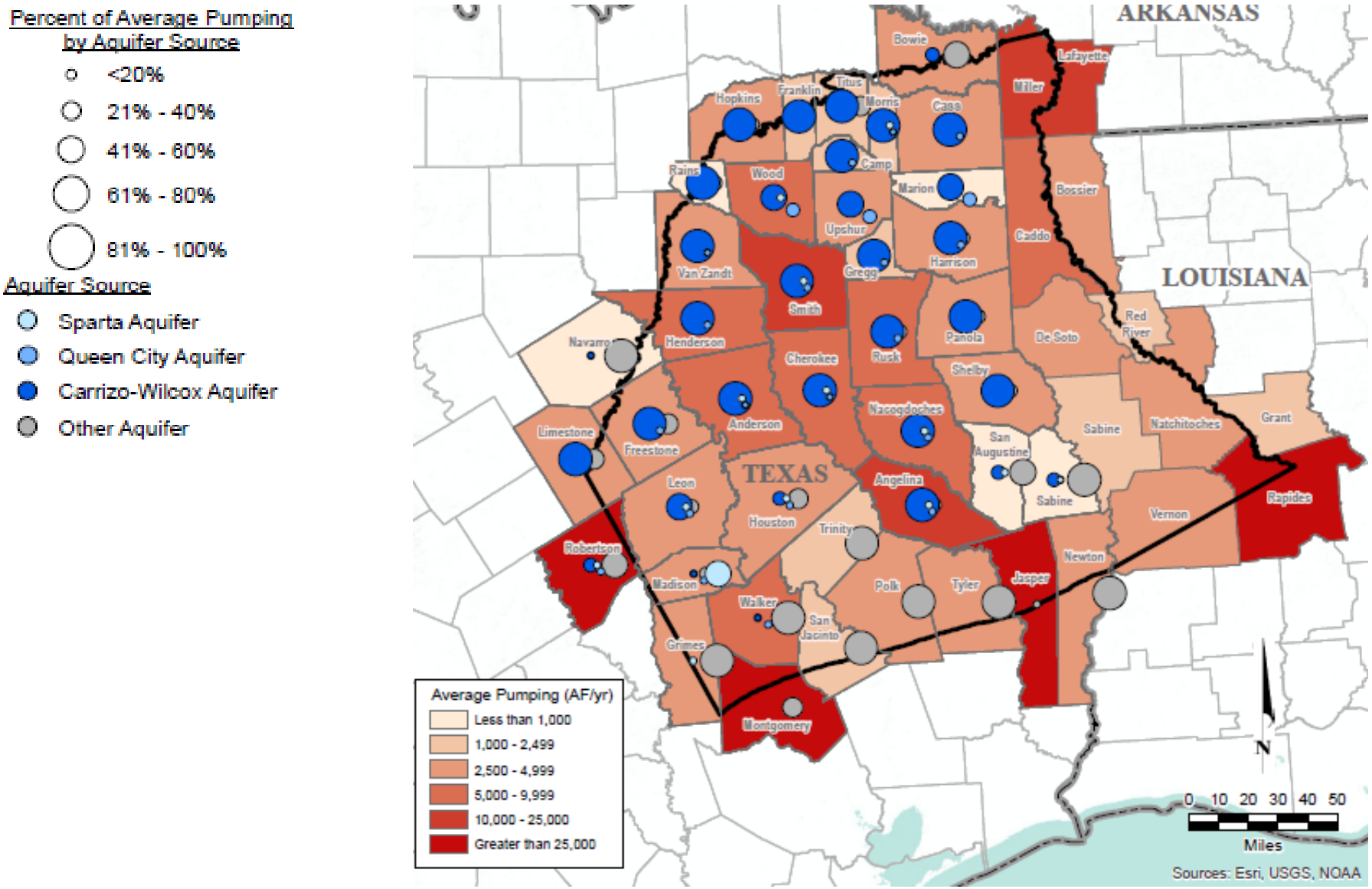
# Groundwater Pumping in Louisiana and Arkansas by Water Use Sector



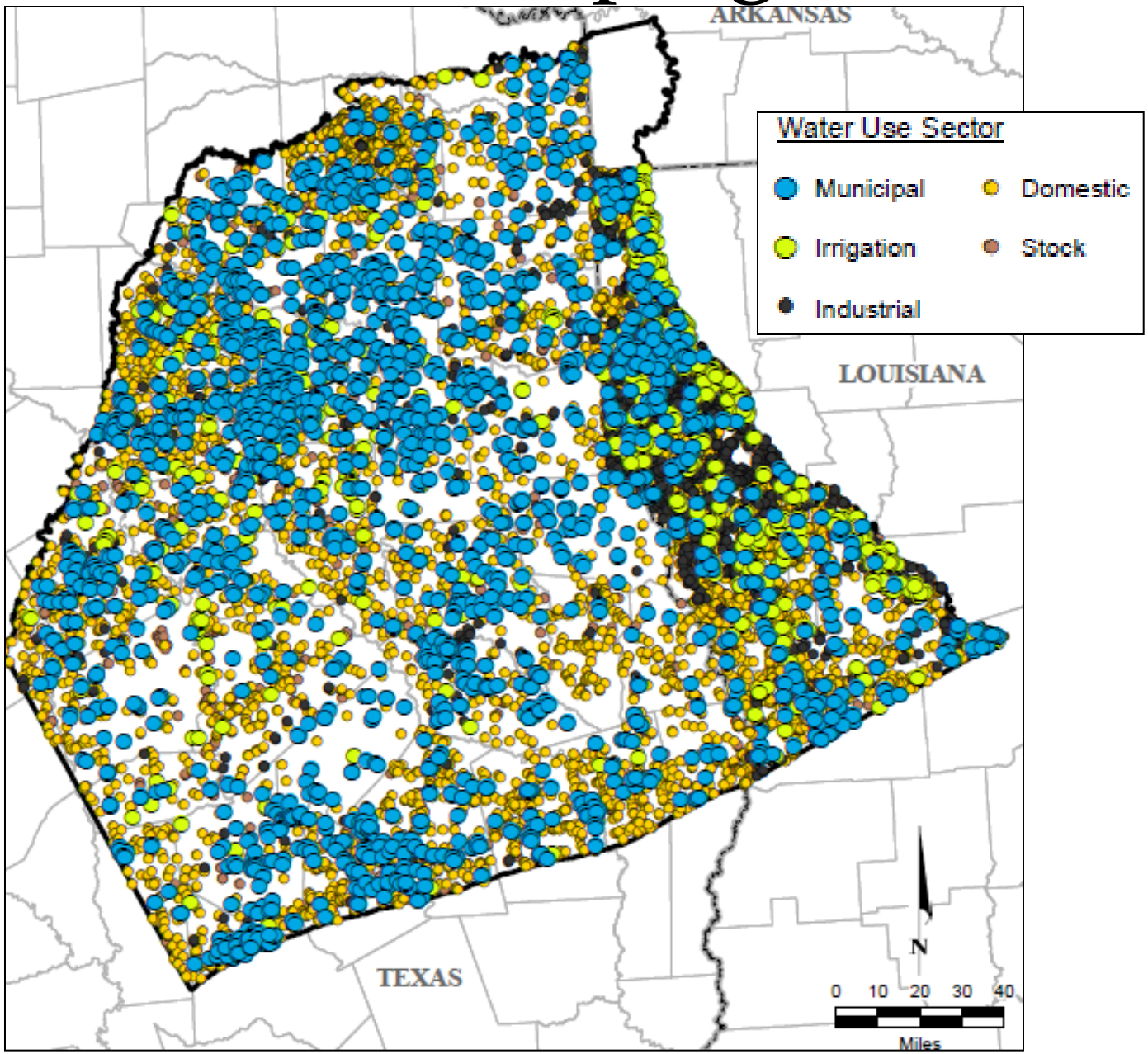

*Source: USGS 5-year water use survey pumping estimates (Totals include pumping from all aquifer sources in a county or parish); bar totals on the left side of each pair are for Louisiana, and on the right are for Arkansas*

*[1]Industrial category includes the sum of the reported estimates for industrial, mining, electric power, and aquaculture sectors*

# Groundwater Pumping by County

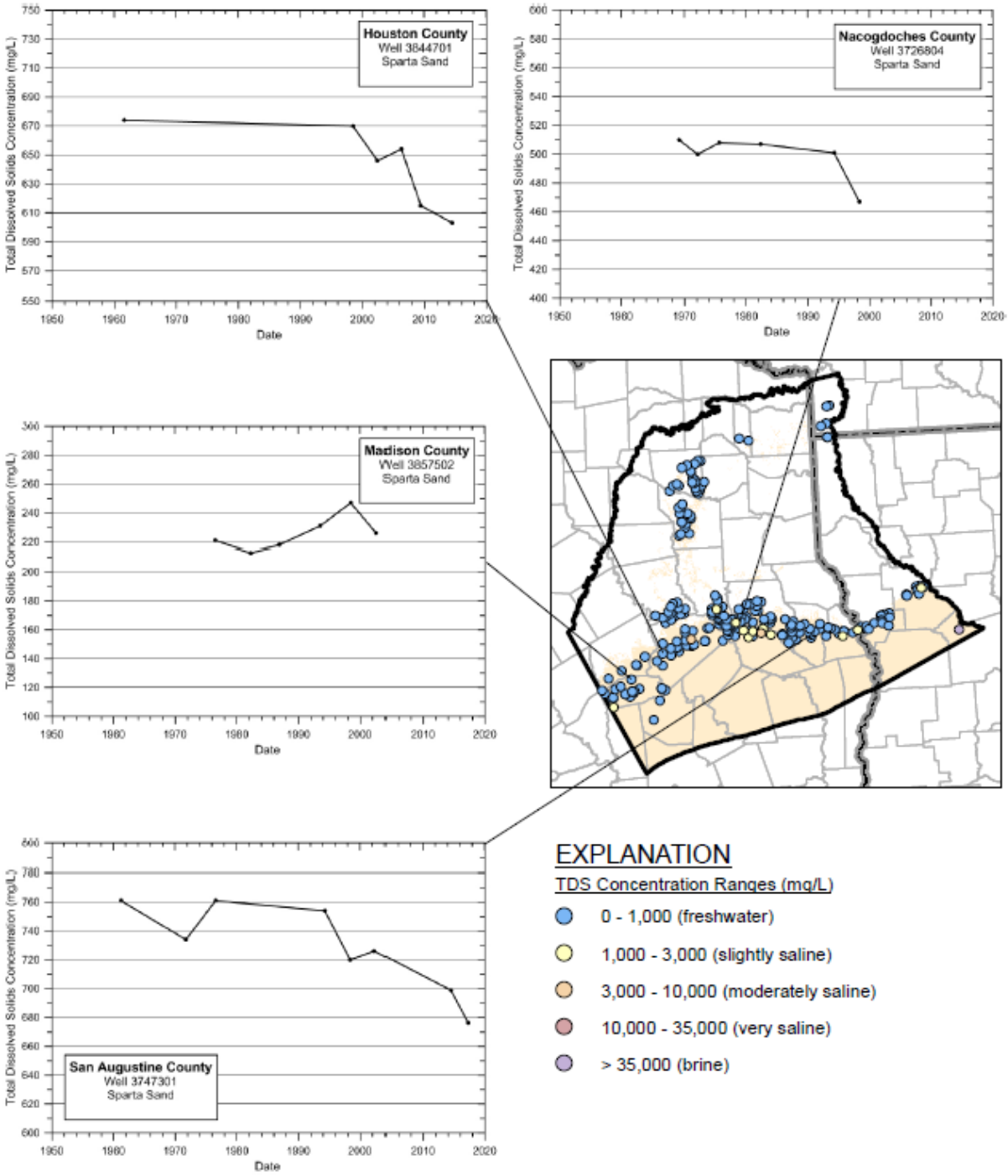


# Groundwater Pumping Wells

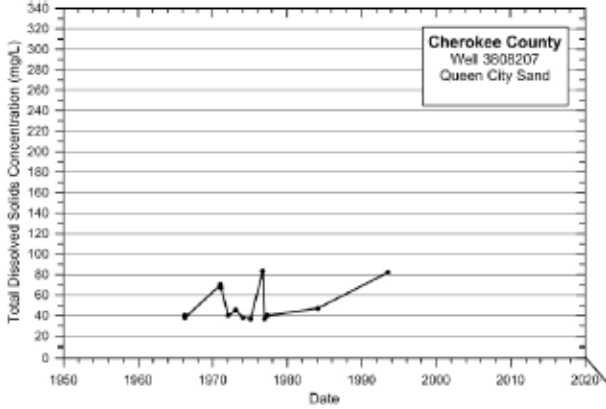


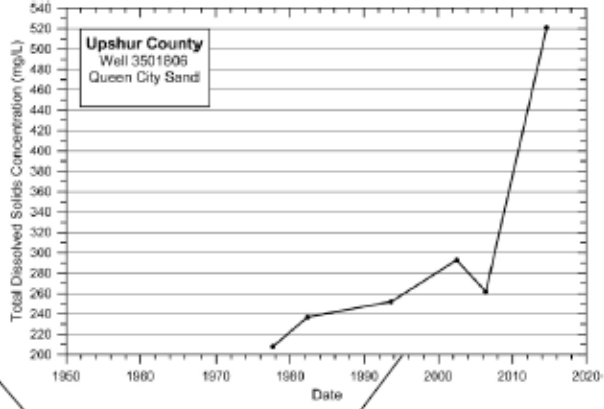
# Water Quality

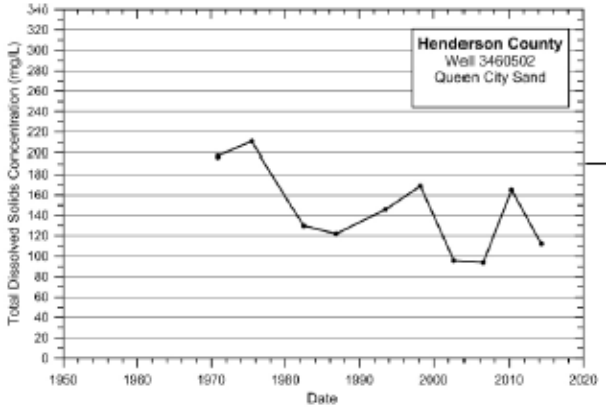
# Total Dissolved Solids: Sparta

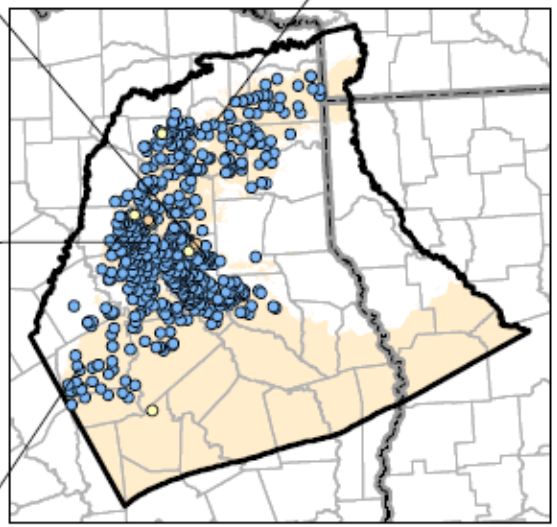


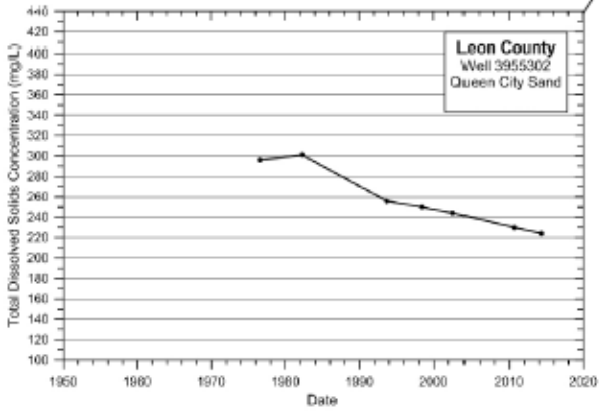
# Total Dissolved Solids: Queen City



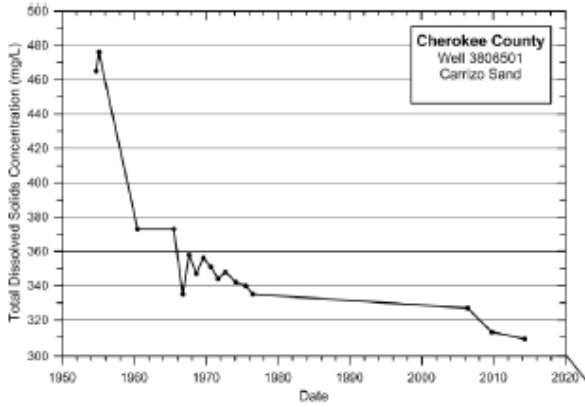


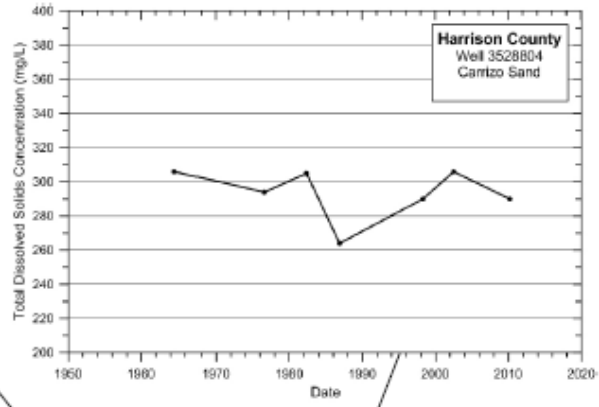

## EXPLANATION

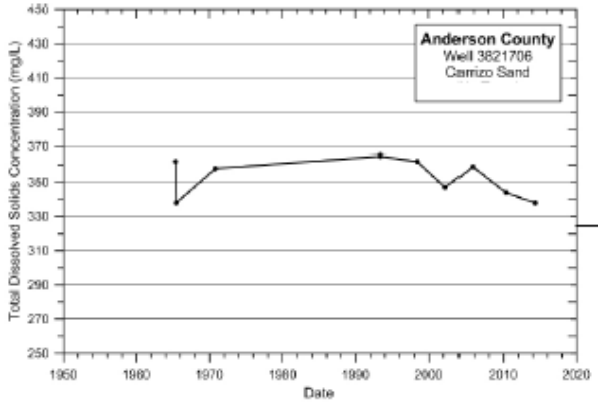
TDS Concentration Ranges (mg/L)

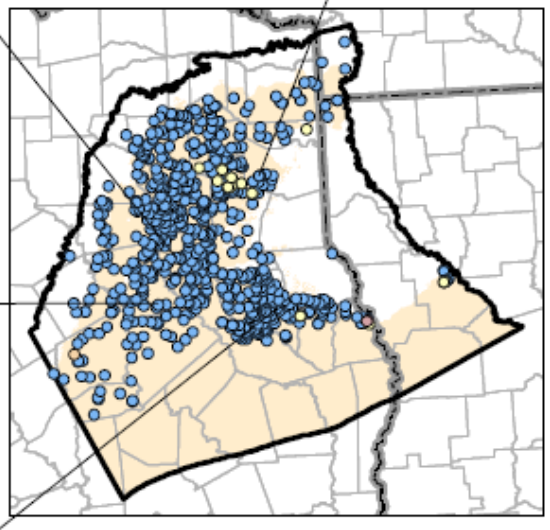
- 0 - 1,000 (freshwater)
- 1,000 - 3,000 (slightly saline)
- 3,000 - 10,000 (moderately saline)
- 10,000 - 35,000 (very saline)
- > 35,000 (brine)

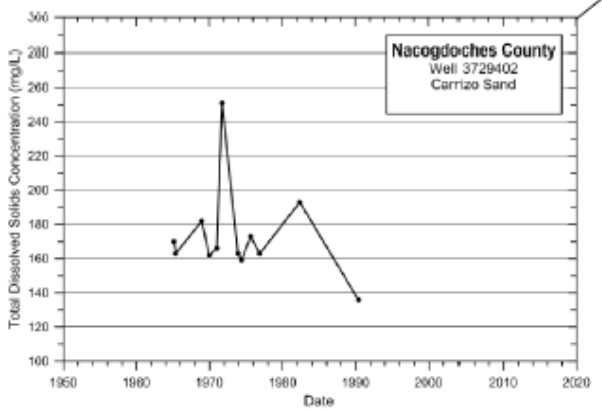
# Total Dissolved Solids: Carrizo






EXPLANATION

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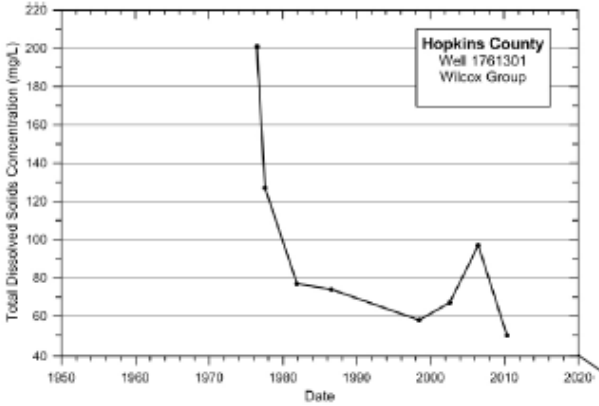
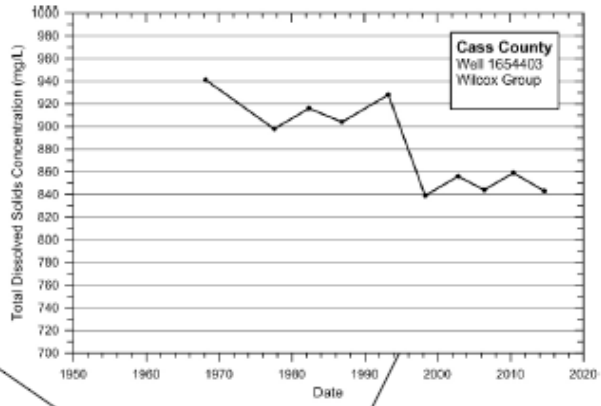
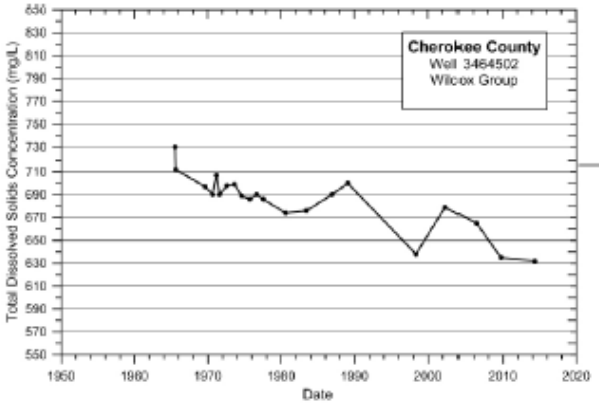
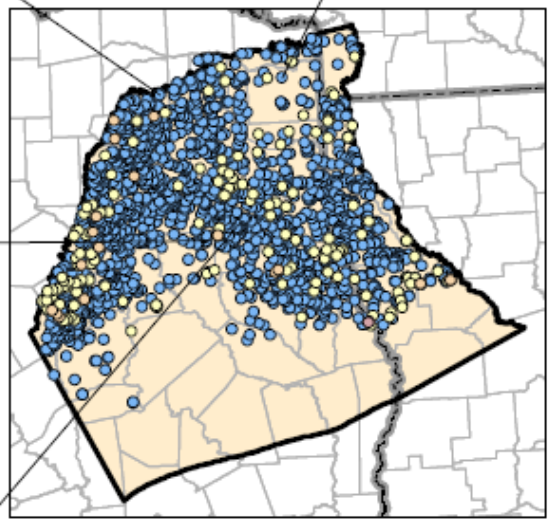
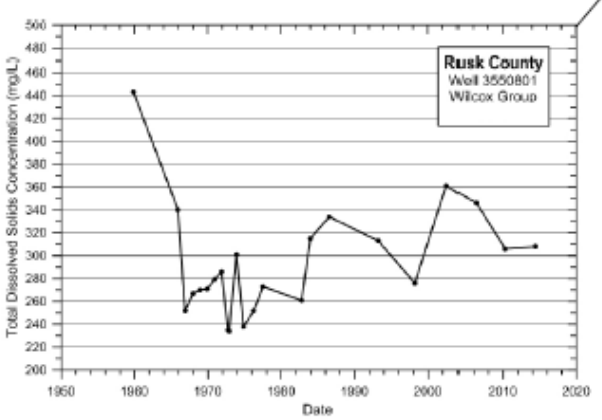
# Total Dissolved Solids: Wilcox






## EXPLANATION

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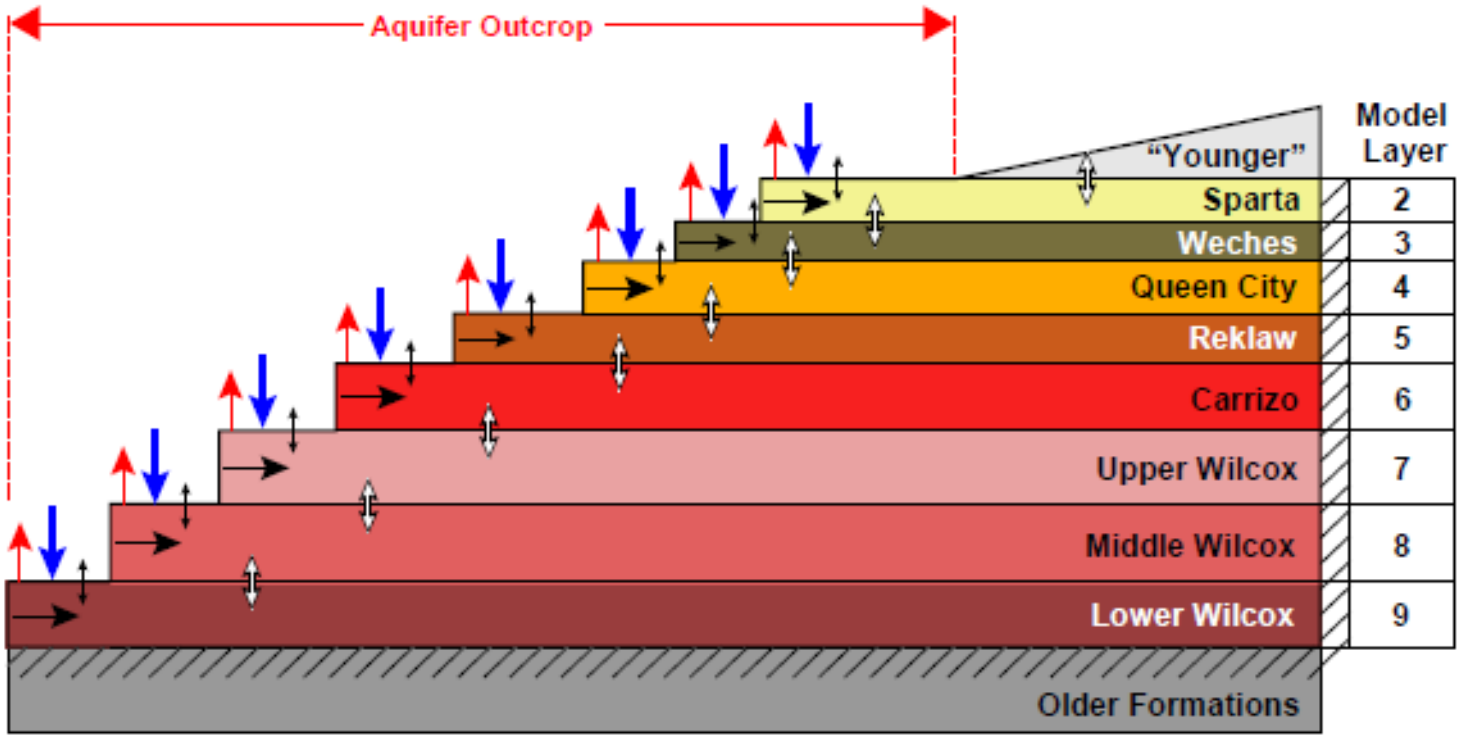
- > 35,000 (brine)

# Conceptual Model

# Generalized Conceptual Model




*Note: Model layer 1 is river channel alluvium that extends across all other layers. "Younger" sediments are not included in this model.*

EXPLANATION

- Recharge
- Discharge (Pumping, ET, Springs)
- River-Aquifer Interaction
- Cross-Formational Flow
- Downdip Groundwater Flow
- No Flow Boundary

# Project Schedule

- Public Comment Deadline for draft Conceptual Model Report:  August 15, 2018
- Currently developing the groundwater flow model
- Calibrated Model Deadline:  June 27, 2019
- Study Completion Date:  October 31, 2019
- Final Report Deadline :  October 31, 2019

# Future Improvements

- Pumping estimates would improve by incorporating additional data from GCDs
- Pumping distributions would improve by using well location coordinates from GCDs
- Additional studies for recharge and ET
- Additional information for deep, down-dip portions of the aquifer layers
  (e-logs, water levels, aquifer properties)

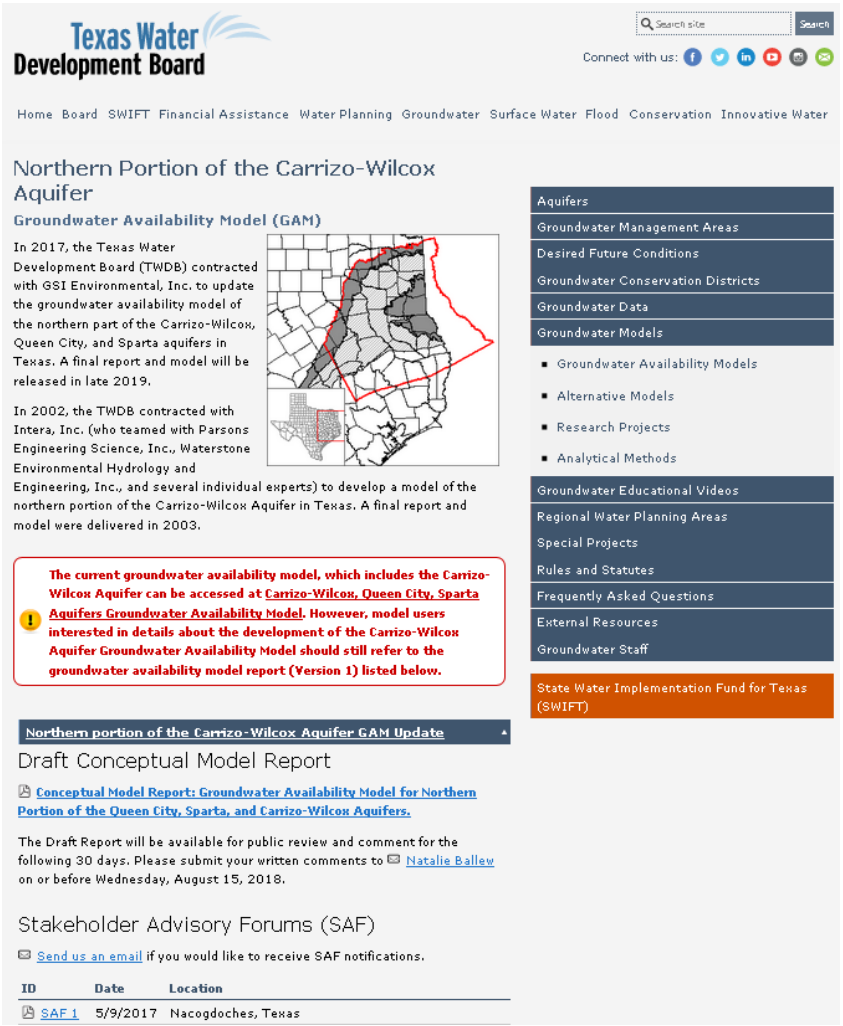
# Draft Conceptual Model Report

- Available online:

http://www.twdb.texas.gov/groundwater/models/gam/czwx_n/czwx_n.asp

- Submit comments on the report and presentation to:

Natalie Ballew
1700 N. Congress Ave.
PO Box 13231
Austin, TX 78711-3231
Natalie.Ballew@twdb.texas.gov



# Next Steps

- Develop numerical groundwater model
- Update conceptual model with new information, if received

# Remaining Project Schedule

- Calibrated Model Deadline
  - June 27, 2019
- Final Report Deadline
  - October 31, 2019

# Questions and Discussion

*sschorr@elmontgomery.com*

MONTGOMERY & ASSOCIATES

GSI ENVIRONMENTAL

**MEMORANDUM**

**TO:** Natalie Ballew, TWDB

**CC:** Cindy Ridgeway, TWDB

**FROM:** Julie Spencer, GSI Environmental Inc.

**RE:** Notes from the Stakeholder Advisory Forum for the Update to the Existing Groundwater Availability Model for the Northern Portion of the Queen City, Sparta, and Carrizo-Wilcox Aquifers project

A Stakeholder Advisory Forum (SAF) for the Update to the Existing Groundwater Availability Model (GAM) for the Northern Portion of the Queen City, Sparta, and Carrizo-Wilcox Aquifers project was held at Nacogdoches City Hall located at 202 E. Pilar Street in Nacogdoches, Texas at 2:00 PM CDT on August 9, 2018. The purpose of the SAF was to present findings of the Draft Conceptual Model Report, which is currently under Texas Water Development Board (TWDB) and Stakeholder review. A summary of the meeting, questions asked and answers provided, and a list of attendees is provided below.

Due to car trouble on the way to Nacogdoches, the TWDB team was unable to attend the SAF. With TWDB's authorization, Mr. Staffan Schorr with Montgomery & Associates, gave a presentation summarizing the findings of the Conceptual Model Report. During the presentation, several questions were received from the audience. These questions and answers are summarized below:

Q1: Are the main rivers added in the river Alluvium layer of the model, particularly the Trinity and Sabine?

A1: Yes. Alluvium associated with the main tributaries and rivers are added to the new model.

Q2: There are people in Panola County that indicate they hit groundwater at 10 feet below ground surface. Are they in the Alluvium rather than the Wilcox?

A2: Yes, they are likely in the Alluvium.

Q3: We have 10 artesian wells in Panola County. Are those wells also completed in the Alluvium?

A3: The current model shows that deeper wells are completed in the unconfined Wilcox in Panola County, which is not accurate. The new model will more accurately show that those wells are in the confined Wilcox.

Q4: What impact with the river Alluvium have on the groundwater model?

A4: It will be a better representation of how groundwater from the Wilcox interacts with surface water, as well as give better information as related to TERS (total estimated recoverable storage) and specific yield. In general, it will give a better representation of how water moves from the rivers, to/from the alluvium and the other aquifers.

Q5: Will Leapfrog Geo work for any code that is selected to prepare the groundwater model?

A5: Yes.

Q6: Will the inflows and outflows of the Alluvium be represented in the model?

A6: Yes.

Q7: How will salt domes be represented in the model?

A7: Salt domes will be part of the no-flow base of the model, but they will be represented.

Q8: What is the vertical exaggeration on the cross-sections you are showing?

A8: 15 times.

Q9: Is there going to be delineation between the middle and lower Wilcox aquifers in the model? In many areas they seem to act the same and be connected.

A9: This is may be true as they seem connected in many areas. If you feel it is important to combine layers and make this something other than a 9-layer model, make a suggestion as part of the current Conceptual Model Report review that the same layers seem to be connected. This will then be addressed when we respond to comments that are received.

Q10: Can you look at the potential middle and lower Wilcox connectivity on a county by county basis?

A10: No, the model can only assess these units in the model area as a whole. However, if you feel that it is important that they be addressed as one unit, please make a comment on the Draft Conceptual Model report and we will have an opportunity to address this issue with the TWDB.

Q11: Panola County is completely within the Sabine Uplift. In the current model, it shows that we have upper and lower Wilcox, but no middle Wilcox. We do not see an obvious delineation between these units.

A11: In your area, the Wilcox units are on the surface. With the new model accounting for river Alluvium, you should get more realistic model outputs in your area.

Q12: When putting the Conceptual Model Report together, did you see water level fluctuation and recovery issues in the Groundwater Management Area (GMA)?

A12: Yes, the groundwater levels went down and came back up.

Q13: Were you able to match this up with our production data and see if it is related to a former paper mill near Nacogdoches and Lufkin that is no longer in operation?

A13: Yes, we did see a fast recovery of groundwater that appeared to correspond with the timing of the paper mill closure.

Q14: Will this information be represented in the new GAM?

A14: Yes, this model will have the ability to track these changes over time.

Q15: Will the water level graphs you are showing be available?

A15: Yes, the model will reflect what is being shown in the water level graphs [and they will be located in the geodatabase].

Q16: Our biggest drought was in 2012. Will that be reflected in the data?

A16: Yes, the model will reflect that.

Q17: How will recharge be applied in the model?

A17: It will be an inflow to the model using the recharge package of MODFLOW.

Q18: How is the temporal variability handled?

A18: During the next phase of the project, the development of the groundwater model itself, this will be determined. The former model applied recharge without temporal variation. We will be looking at that when developing this model. An annual time scale will be used in the model to evaluate temporal variability.

Q19: The former model did not show the differences between recharge across the model study area.

A19: That was a limitation of the previous study and the current study will include spatial variability of recharge. Also, addition of the Alluvium to the new model will help with that issue.

Q20: What is the range of data used in the Conceptual Model?

A20: All available historic data through 2015 were compiled for the Conceptual Model. A 30-year average was used for general summary of precipitation and temperature. The groundwater model period will be 1980 through 2015.

Q21: I notice that the Gulf Coast Aquifer will not be included in the new model. On future updates to the GAM will other units within the GMA be considered?

A21: Prior to 2005, TWDB used an aquifer-based concept to develop models. However, they are moving toward incorporation of all units within a GMA when developing projects.

Q22: Does an aquifer need to be considered a Major Aquifer to be considered for a groundwater model?

A22: Not necessarily. It may make hydrologic sense to combine all aquifers within a GMA in a single groundwater model. Meaning there would be no exclusions such as the Gulf Coast Aquifer in this model. [The TWDB is directed by statute to develop models fo all major and minor aquifers in the state.]

Q23: We are thinking about doing pump tests on our high volume wells. Would you be interested in that data?

A23: Yes, that data would be good to know. Even a simple specific capacity test gives valuable data.

Q24: Sands in Panola County are highly variable. We think that contributes to the wide range of hydraulic conductivity and storage numbers in our area. How will this be addressed?

A24: In the 2003 groundwater model, storage was not that important. However, with TERS it has become important. Relying on old storage data is not good. We will be looking at these relationships during calibration of the model. Also, the source data includes percent sand and that has been preserved in our database, which will further help with determining parameter ranges.

Q25: Water marketers are using the current storage numbers as fact, but they are not accurate. They are only estimates with no real data to back them up.

A25: Any additional information that you can provide to support development of the Conceptual Model will be assessed. The report is currently in draft form. If that data is made available, it can be incorporated in the report before it is finalized.

Q26: I believe information was provided from Panola and Rusk Counties. Can you check to see that you received it?

A26: Yes. If there is additional data, we would need to receive it within the month to be able to include it in the final report. We will provide information on an .FTP site where you can upload information that you have.

Q27: Does TWDB track oil and gas pumping?

A27: No, they make an estimate based on Texas Railroad Commission (RRC) data. The RRC would have actual oil and gas pumping information.

Q28: We report groundwater pumping information to TWDB. Do you have access to that information?

A28: We will look for the TWDB database where that information is housed, and verify that spatial information is captured.

Q29: Mining and oil and gas wells do not appear to be represented on the groundwater pumping totals you are showing. This is an important factor in Panola County. Do you have that information accounted for in your database?

A29: If you have a list of those wells and their location, please send it to us. Groundwater withdrawals for mining and oil and gas wells are included in the "mining" water use category in the TWDB water use surveys. TWDB estimates for mining are likely underestimated based on monitoring data from the RRC.

Q30: Is well depth and production volume data valuable to you?

A30: Yes.

Q31: On the slides you are showing, the total dissolved solids concentrations appear to be dropping over time.

A31: Yes, this occurs at some wells and is likely caused by recharge (dilution). Data for other wells show rising or variable TDS concentrations.

Q32: What water quality parameters are you monitoring?

A32: We looked at total dissolved solids (TDS), pH and drinking water standard exceedances in data since 2010.

Q33: What is considered deep with respect to down-dip portions of the model aquifer layers?

A33: About 2,000 or more feet. It is in the southern portion of the study area.

Q34: The TWDB has significant underestimates of groundwater pumping with regard to oil and gas wells. How will this be addressed?

A34: Oil and gas use is going to continue to be a challenge because it goes and up and down so much. Planning for other uses is easier to calculate and model.

Q35: Did you get recent groundwater pumping numbers from Smith and/or Rusk counties? There are several chicken processing plants and farms are going in and it will affect groundwater usage numbers.

A35: In the completed groundwater model, you will have the ability to change pumping rates to account for these increased uses.

Q36: Smith County, with the City of Tyler, is the largest pumper in the GMA, but they don't have a groundwater district. How is this information captured in the model?

A36: We are relying on TWDB data. Since the City of Tyler is rather large, it is likely that TWDB has accounted for it in their database.

Q37: We are holding a Region I meeting in November. Can you come to that meeting and give us an update on this project?

A37: Yes, but more importantly, it would be more advantageous to give another update after we have prepared the Groundwater Model. We can do these presentations at GMA meetings in advance of our next SAF, if you would like.

The audience was reminded that the presentations given today would be available for download from the TWDB website in about 1 week. The meeting was adjourned at approximately 3:45 PM. A list of attendees is provided below:

| **Name** | **Affiliation** |
|---|---|
| Sorab Panday | GSI Environmental Inc. |
| Julie Spencer | GSI Environmental Inc. |
| Bill Hutchison | Independent Consultant |
| Staffan Schorr | Montgomery & Associates |
| David Alford | Neches & Trinity Valley Groundwater Conservation District |
| Amanda Maloukis | Rusk County Groundwater Conservation District |
| Leah Adams | Panola County Groundwater Conservation District |
| David Waldrop | Panola County Groundwater Conservation District |
| True Scarborough | Hydrex Environmental |
| Kelly Holcomb | Angelina and Neches River Authority - Region I Water Planning Group Area |

To provide information for use in updating the Existing Groundwater Availability Model for the Northern Portion of the Queen City, Sparta, and Carrizo-Wilcox Aquifers project, please contact any of the following:

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