Mapping Fresh, Brackish, and Saline Groundwater in the Queen City, Sparta, and Carrizo-Wilcox Aquifers mainly in Groundwater Management Area 13

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Meeting at Evergreen Underground Water Conservation District, April 15, 2016

Relationship between current TWDB Project and House Bill 30

- Our current project contract is being amended to incorporate House Bill 30 requirements for suggesting potential brackish groundwater production areas and scheduling
- We will estimate potential production areas in the Carrizo-Wilcox Aquifer in 2016 and the Queen City and Sparta aquifers in 2017
- After TWDB staff evaluates the potential areas and recommends the final areas, we will calculate water volumes in those areas.

Background

- Definition of water types:
  - Fresh: ≤1,000 mg/L Total Dissolved Solids (TDS)
  - Brackish: 1,000 – 10,000 mg/L TDS
    - Slightly saline: 1,000 – 3,000 mg/L;
    - moderately saline, 3,000 – 10,000 mg/L TDS
  - Saline: ≥ 10,000 mg/L TDS
  - Seawater: 35,000 mg/L TDS

Tasks
GMA 13 Brackish Groundwater Mapping

- Task 1: Project management
- Task 2: Groundwater quality
- Task 3: Use of geophysical log interpretation to map fresh, brackish, and saline groundwater
- Task 4. GIS-based application to calculate volumes of fresh, brackish, and saline groundwater
- Task 5. Visualization and groundwater quality

Additional Tasks
Studies to Support House Bill 30

- Task 6: Aquifer hydraulic properties
- Task 7: Mapping brackish groundwater production areas

Task 3: Use of Geophysical Log Interpretation to Map Fresh, Brackish, and Saline Groundwater

- 3.1: Evaluation of geophysical well logs, including availability, log quality, and data management (5,200 wells in BRACs database, 3,300 geophysical well logs)
- 3.2: Interpreting groundwater salinity from geophysical logs – 500 to 600 selected logs
- 3.3: Groundwater salinity and lithology mapping

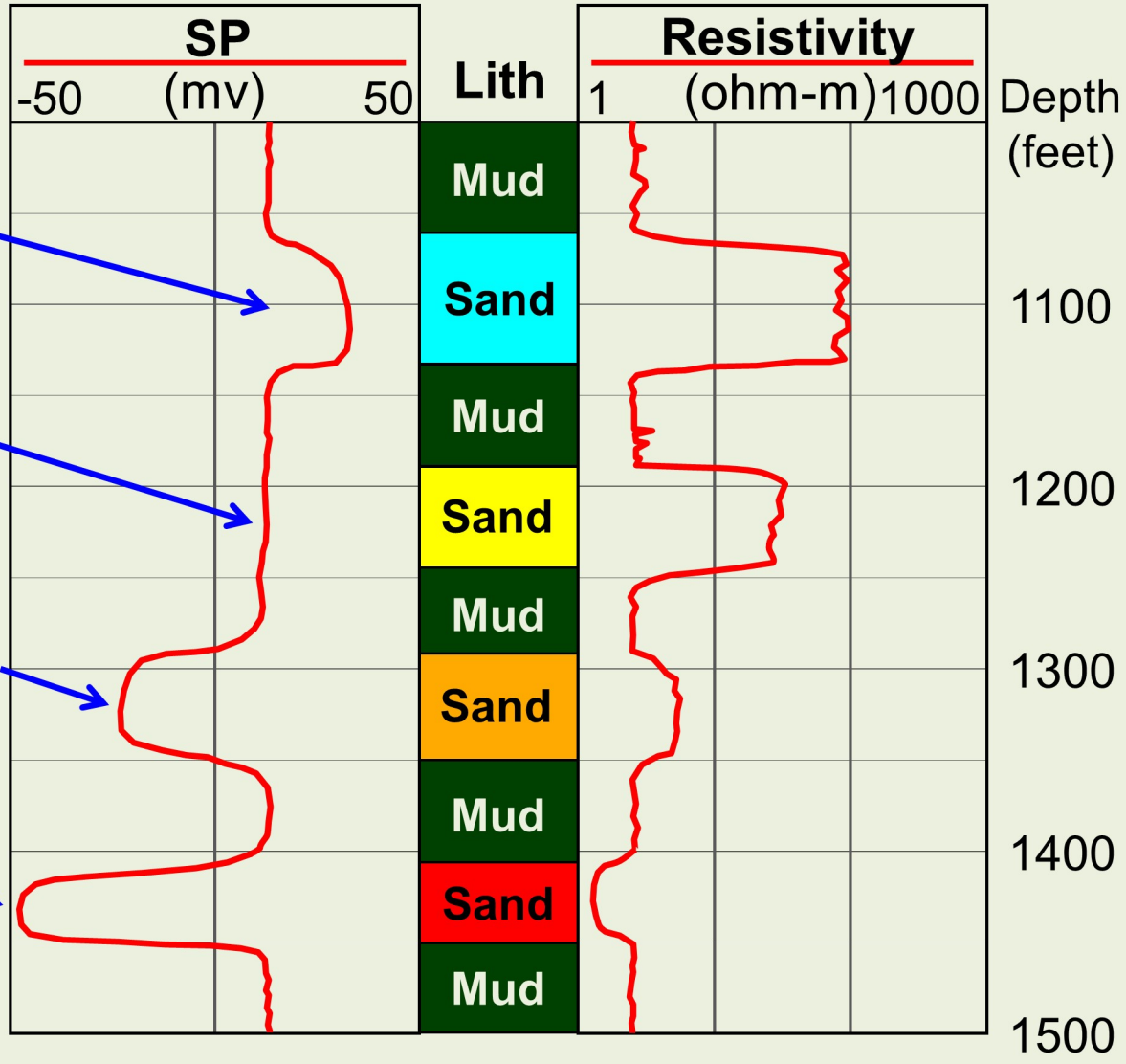
Electric Log Response to Groundwater Salinity

Freshwater sand
- SP positive
- Res very high

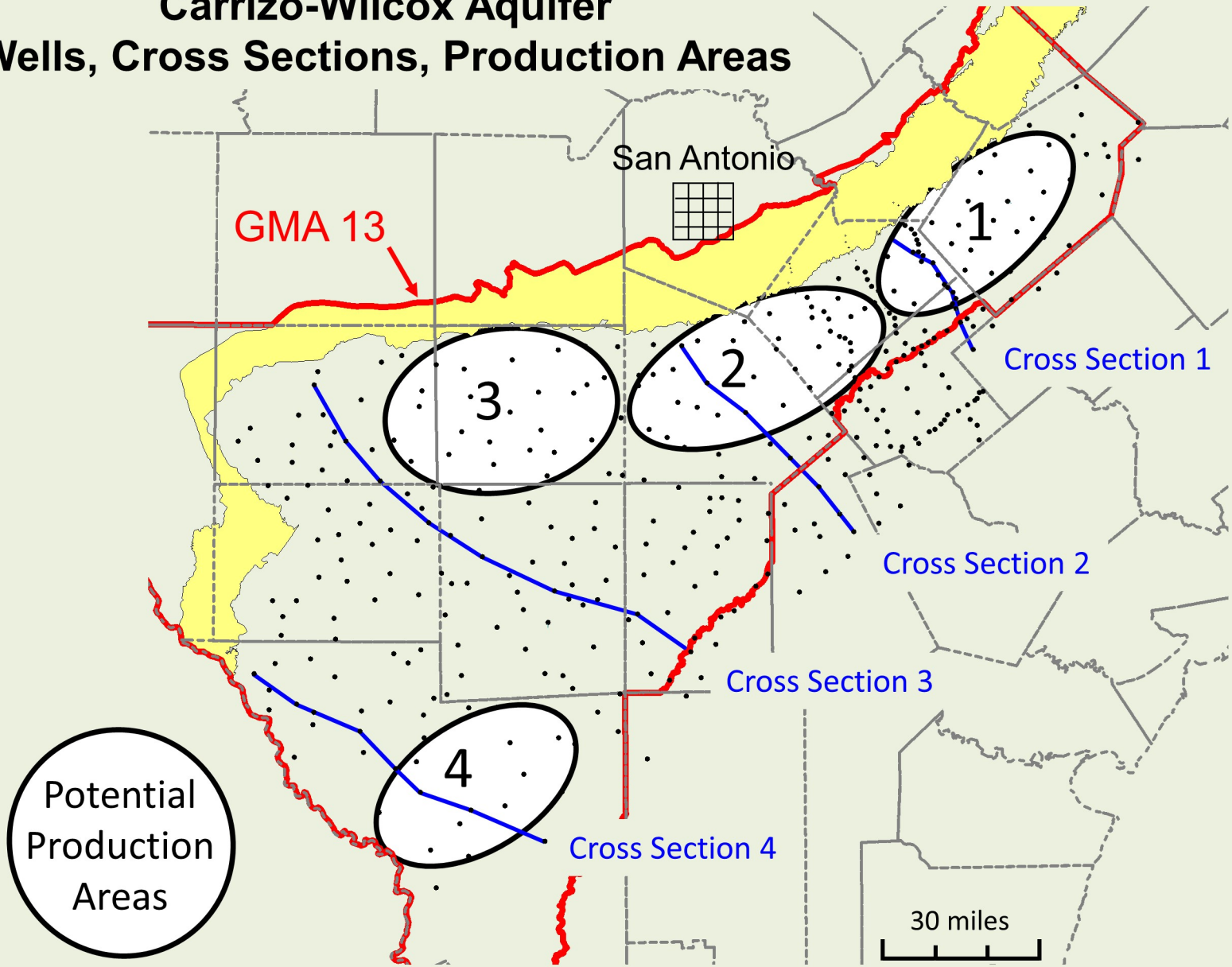
Slightly saline water sand
- SP neutral
- Res high

Moderately saline water sand
- SP negative
- Res low

Very saline water sand
- SP very negative
- Res very low



Carrizo-Wilcox Aquifer
Wells, Cross Sections, Production Areas



Brackish Groundwater Production Areas

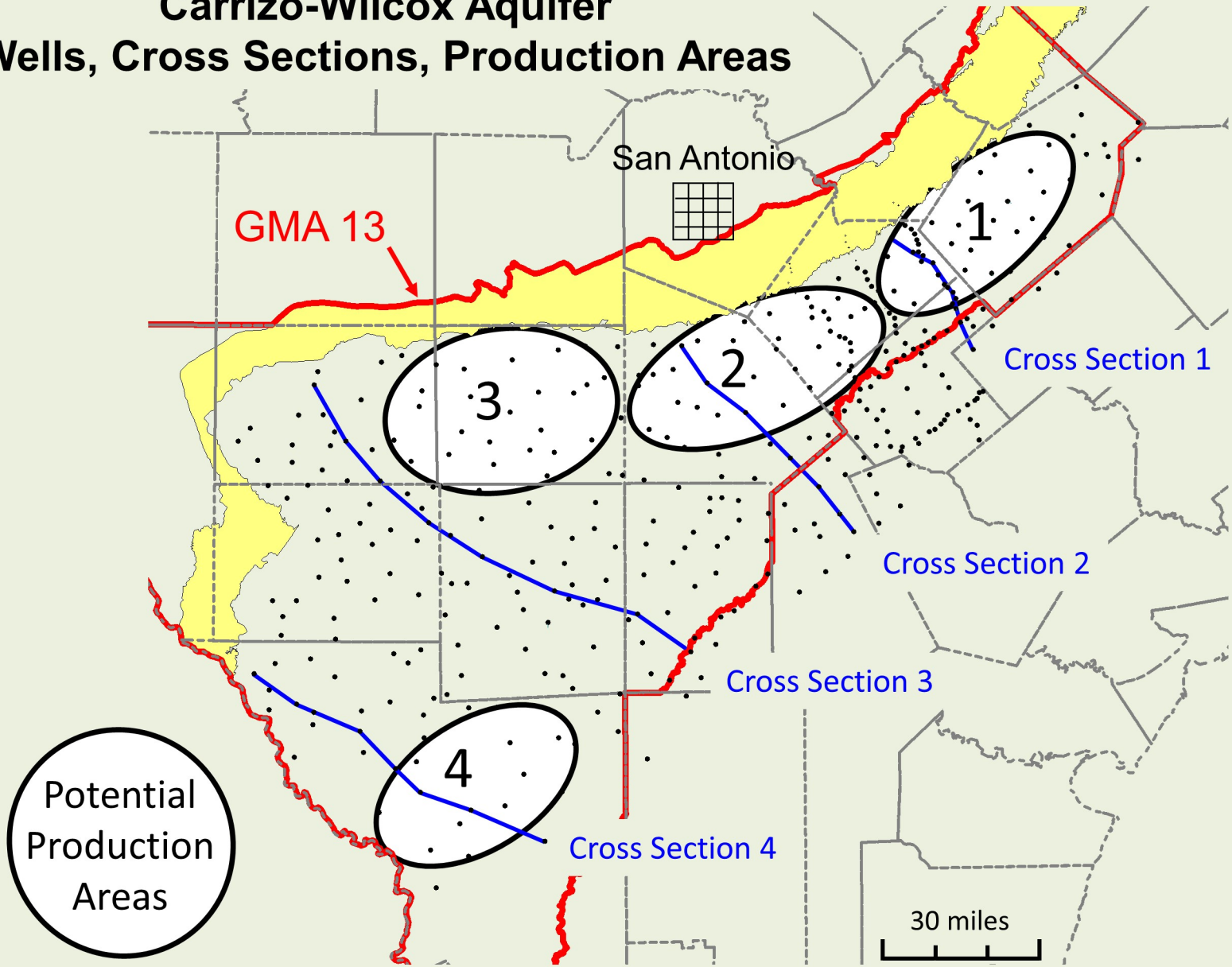
1. Lower Wilcox in Gonzales County and northeastern Wilson County
    a) mostly moderately saline groundwater 1,500 to 5,500 feet deep
    b) very high sand area
    c) Middle Wilcox shale hydrogeologic barrier

2. Lower Wilcox in southwestern Wilson County and Atascosa County
    a) mostly moderately saline groundwater 1,500 to 5,500 feet deep
    b) less sandy than area 1
    c) Middle Wilcox shale hydrogeologic barrier

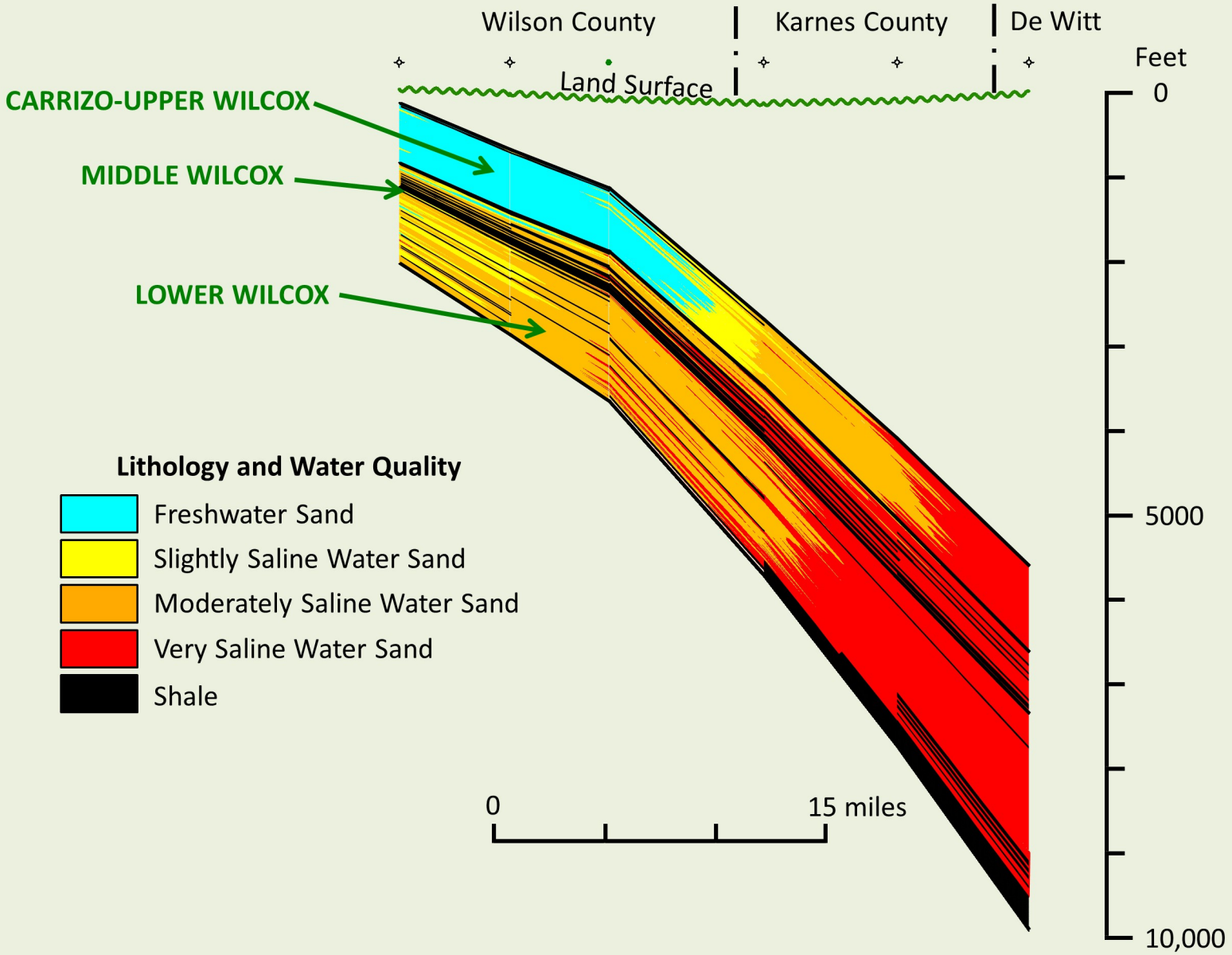
3. Lower Wilcox in Frio County and eastern Zavala County
    a) mostly slightly saline groundwater 1,500 to 4,500 feet deep
    b) mixed sand and shale
    c) Middle Wilcox shale hydrogeologic barrier

4. Carrizo-Upper Wilcox in Webb County
    a) mixed slightly and moderately saline gw 2,500 to 4,500 feet deep
    b) downdip from fresh groundwater
    c) hydrogeologic barrier provided by distance

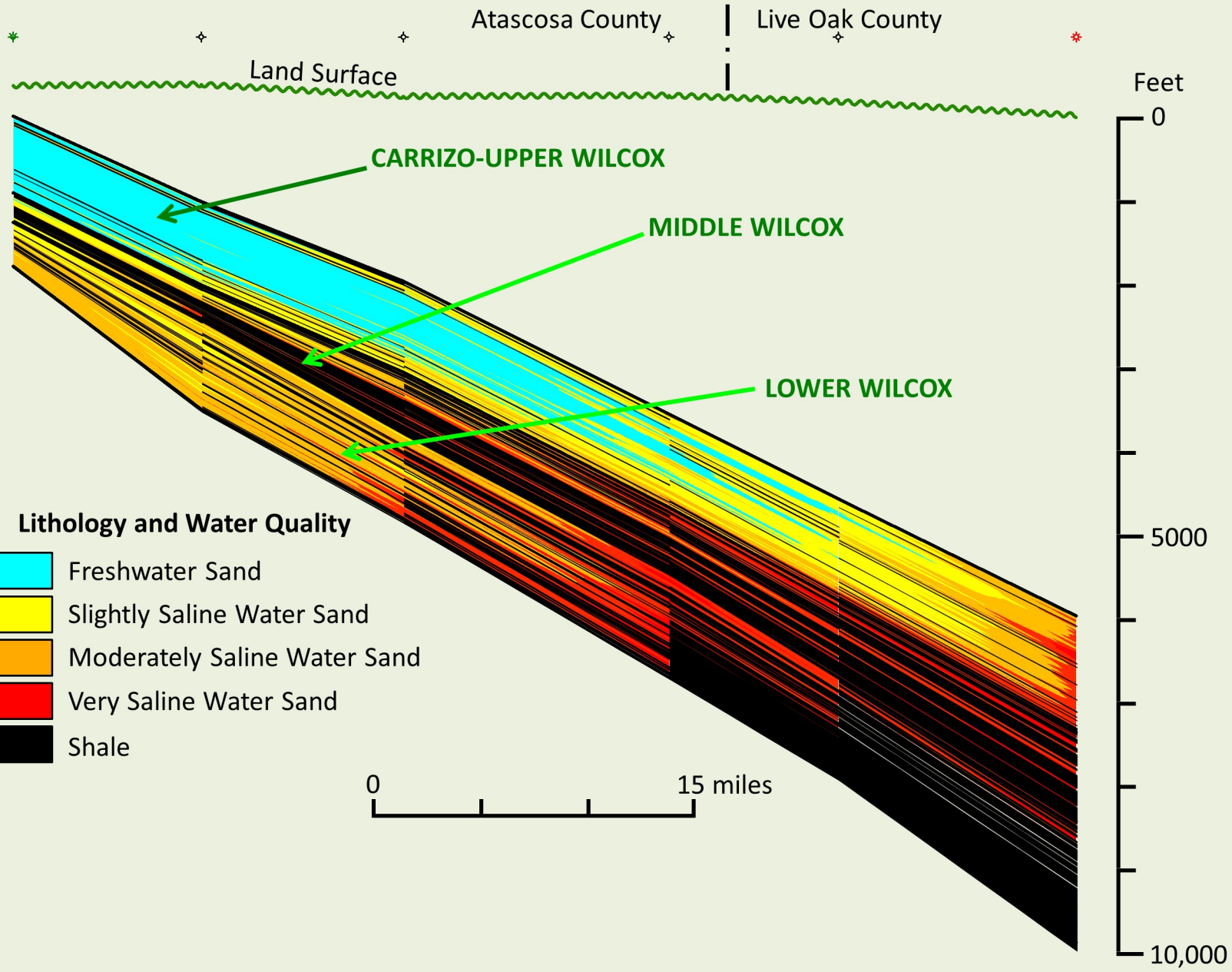
Carrizo-Wilcox Aquifer
Wells, Cross Sections, Production Areas



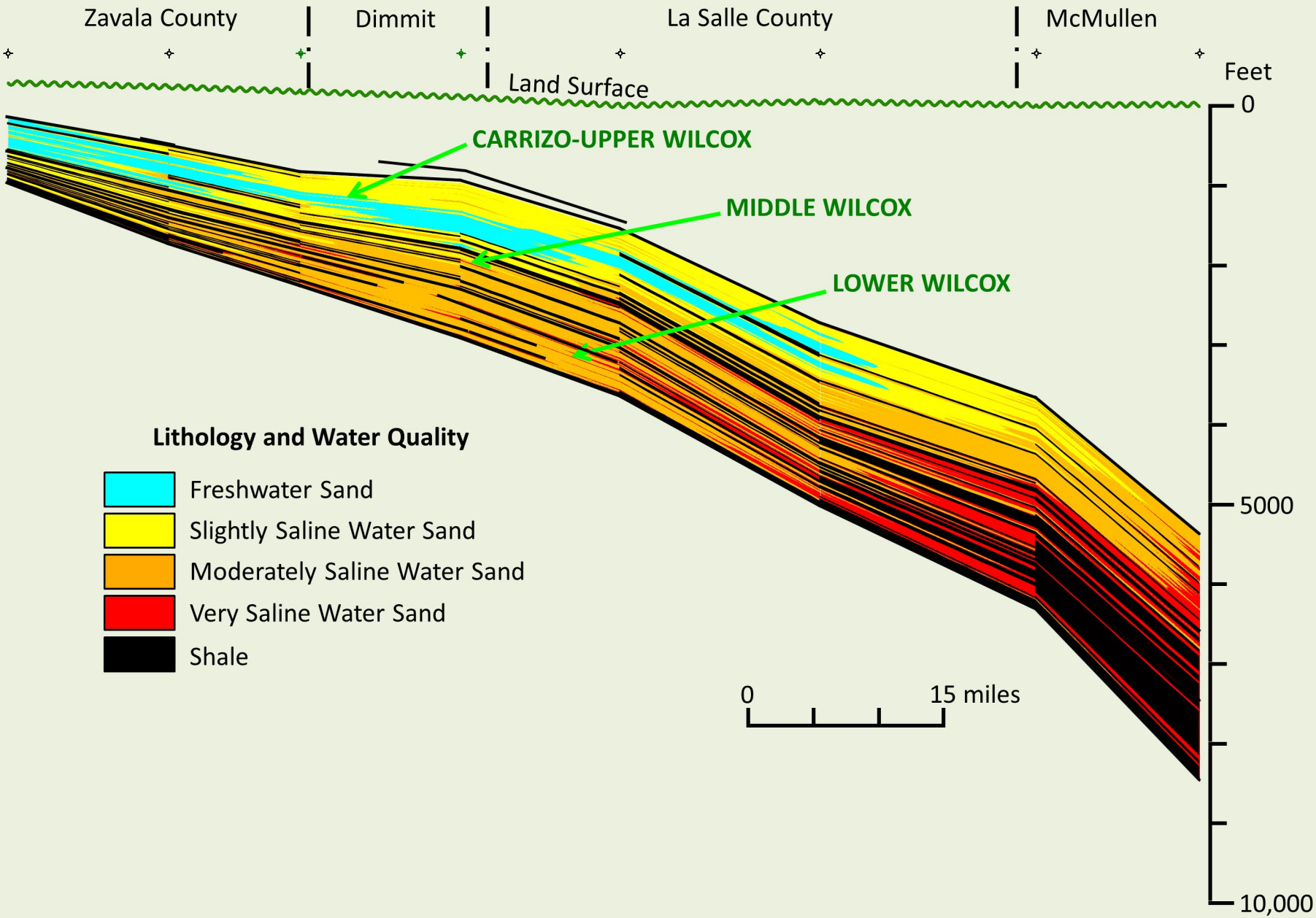
CARRIZO-WILCOX AQUIFER CROSS SECTION 1



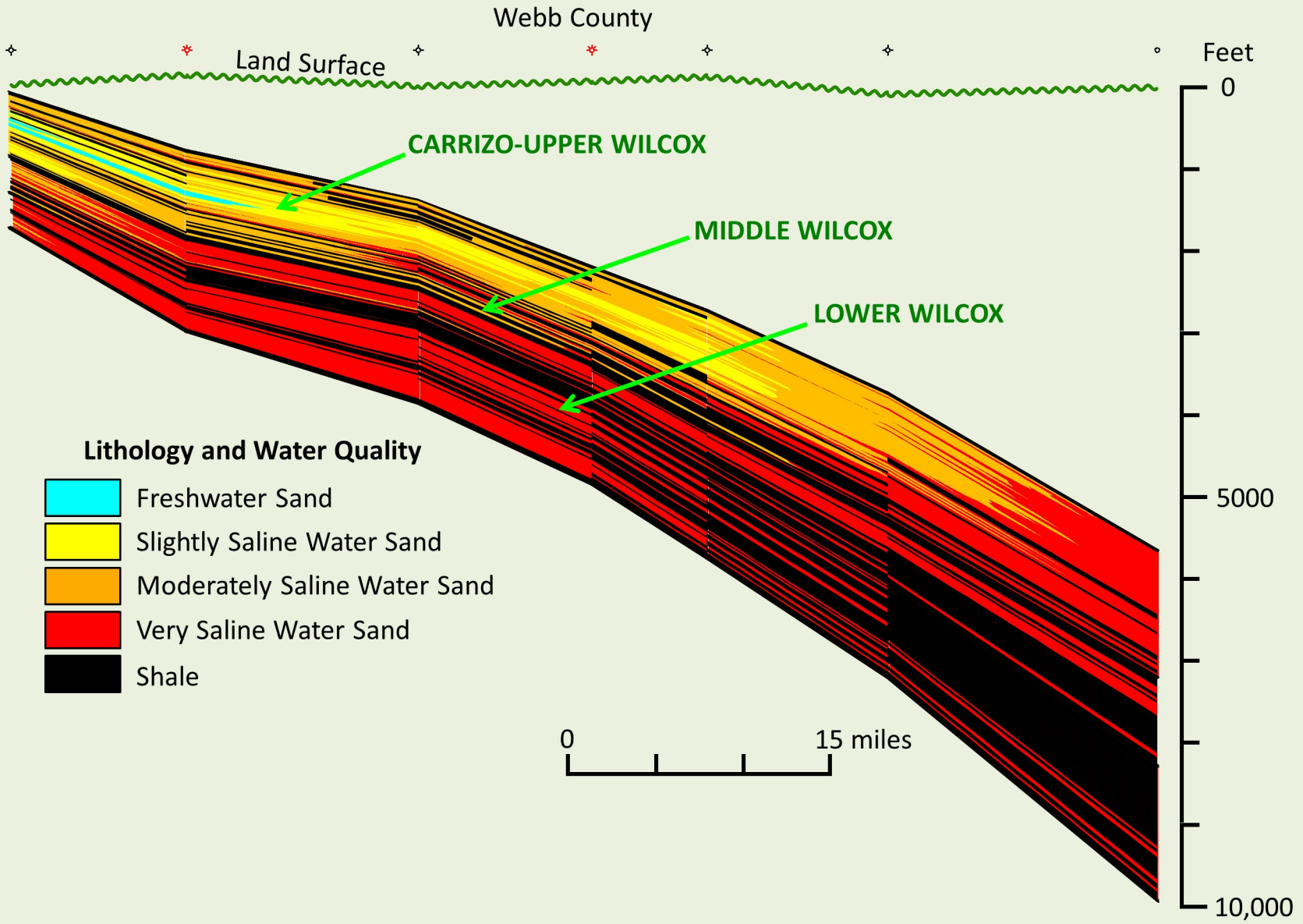
CARRIZO-WILCOX AQUIFER CROSS SECTION 2

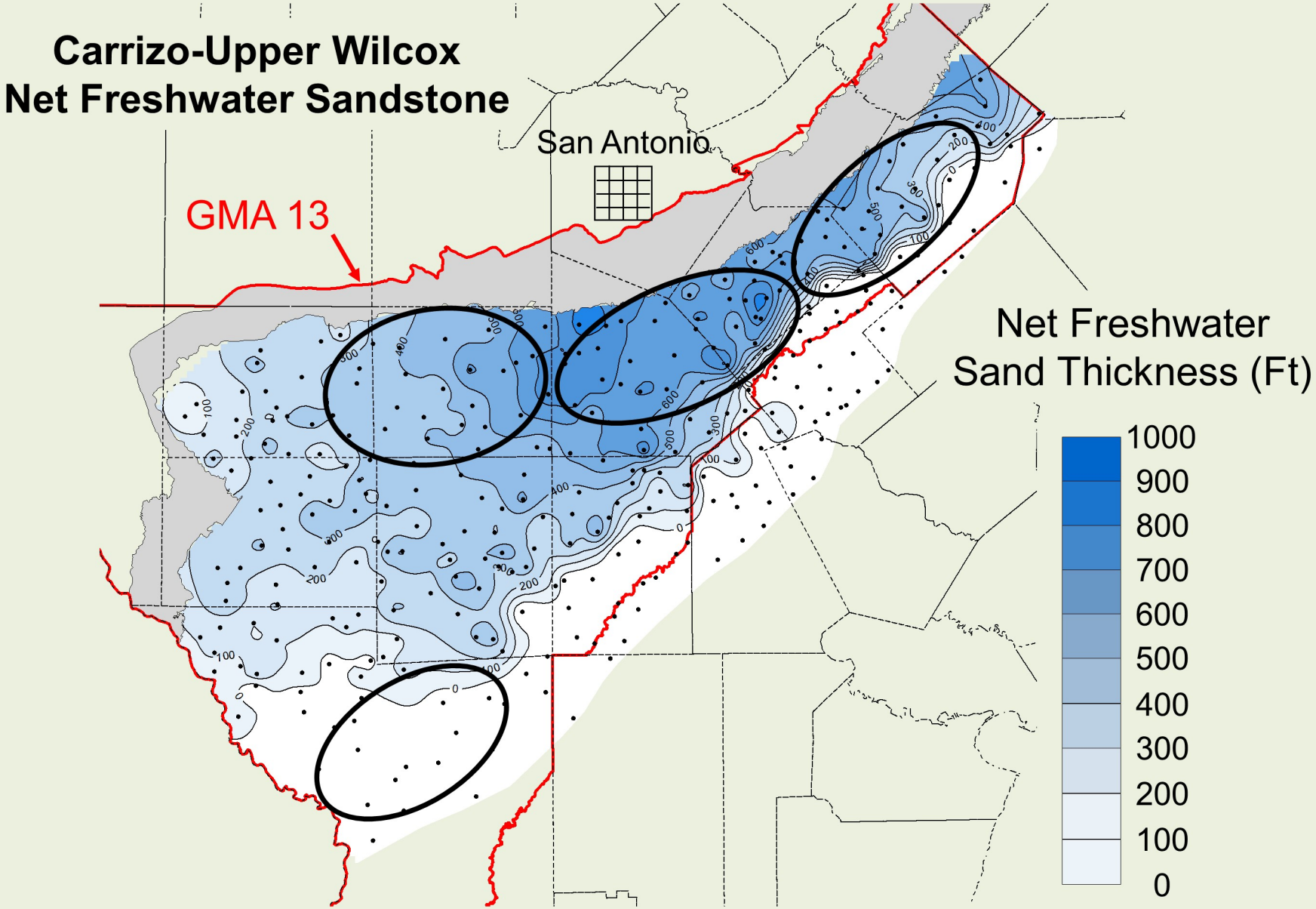


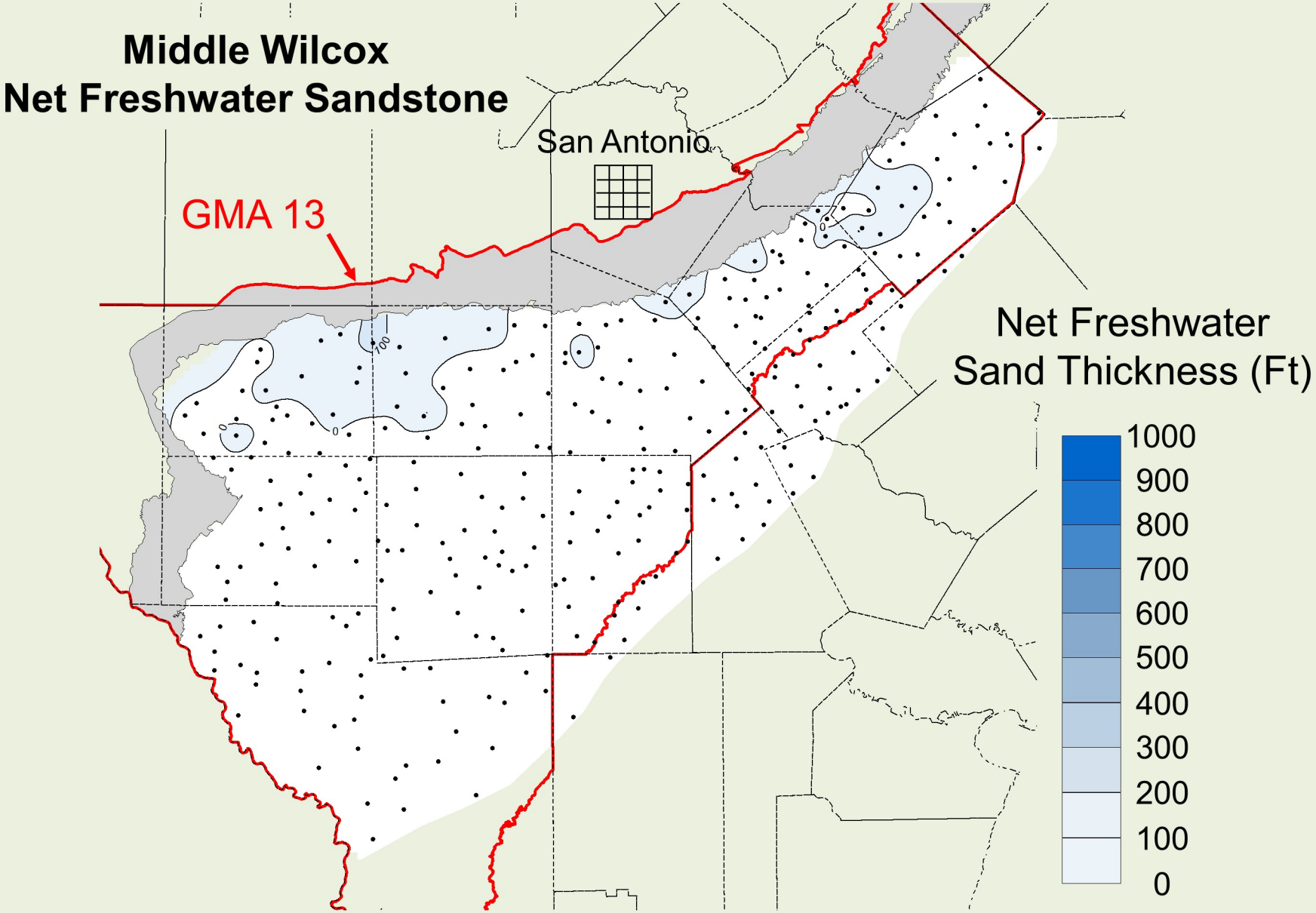
CARRIZO-WILCOX AQUIFER CROSS SECTION 3



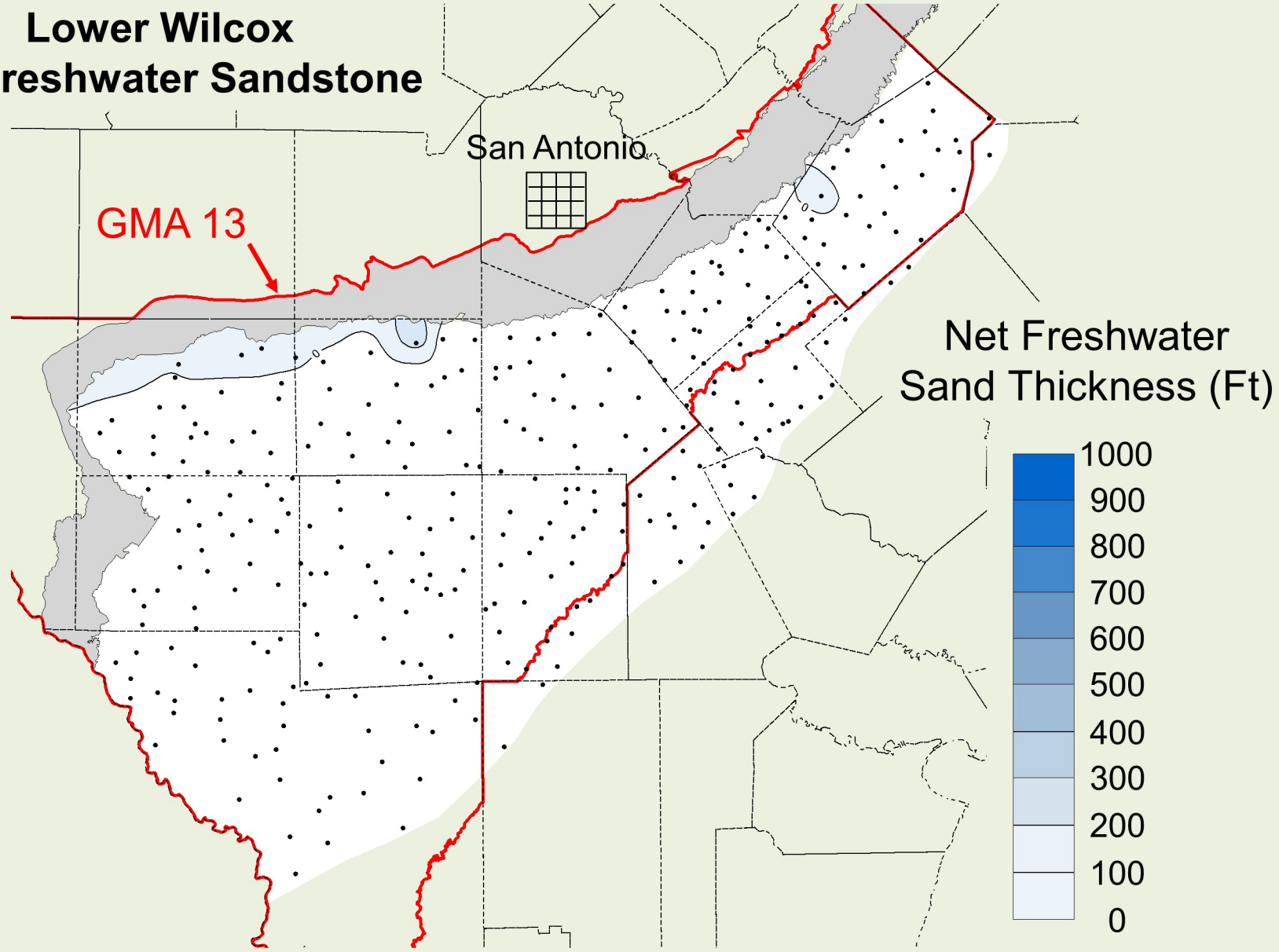
CARRIZO-WILCOX AQUIFER CROSS SECTION 4



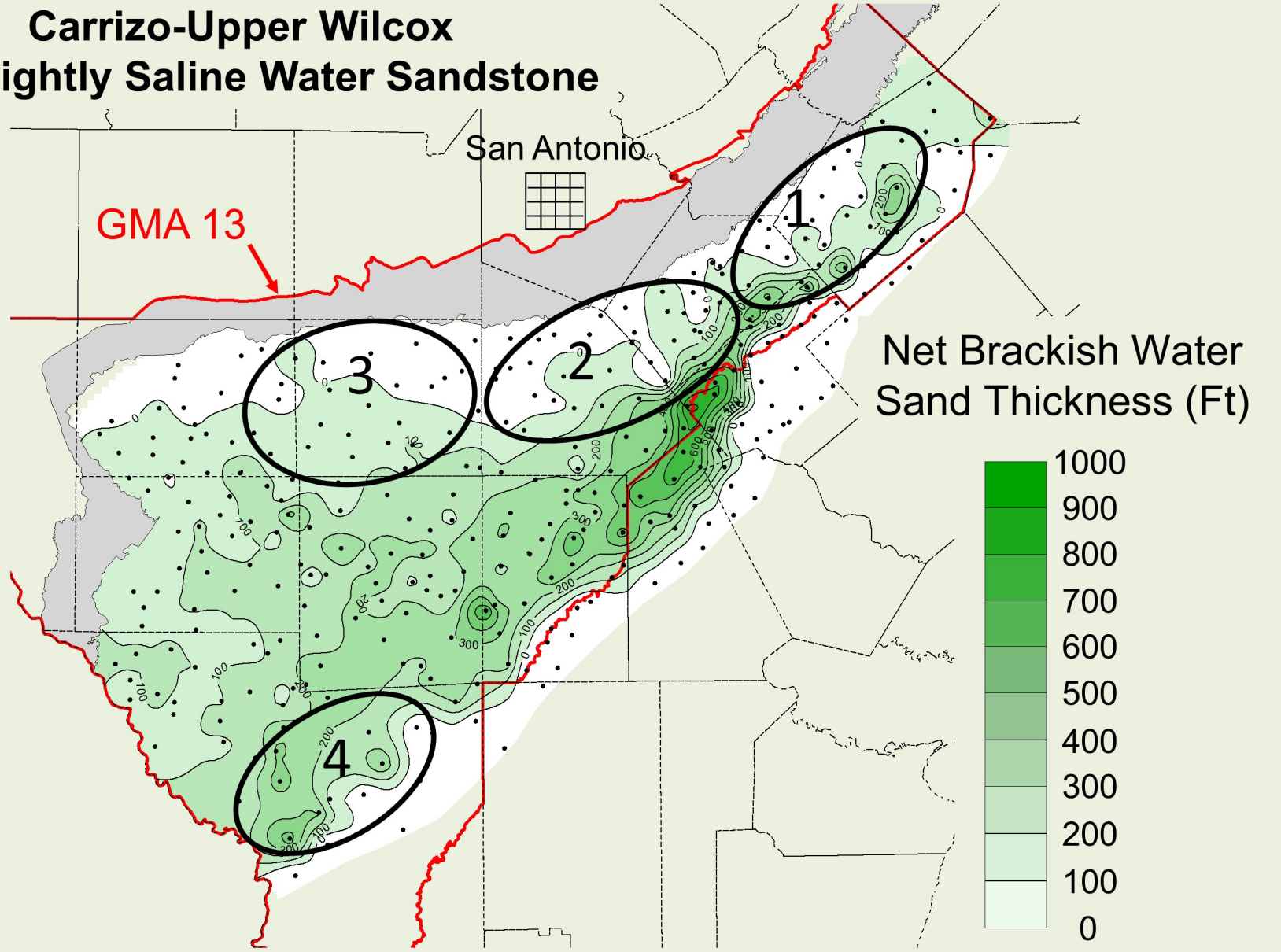

Carrizo-Upper Wilcox
Net Freshwater Sandstone
San Antonio
GMA 13
Net Freshwater
Sand Thickness (Ft)
1000
900
800
700
600
500
400
300
200
100
0


Middle Wilcox
Net Freshwater Sandstone
San Antonio
GMA 13
100
0
0
Net Freshwater
Sand Thickness (Ft)
1000
900
800
700
600
500
400
300
200
100
0

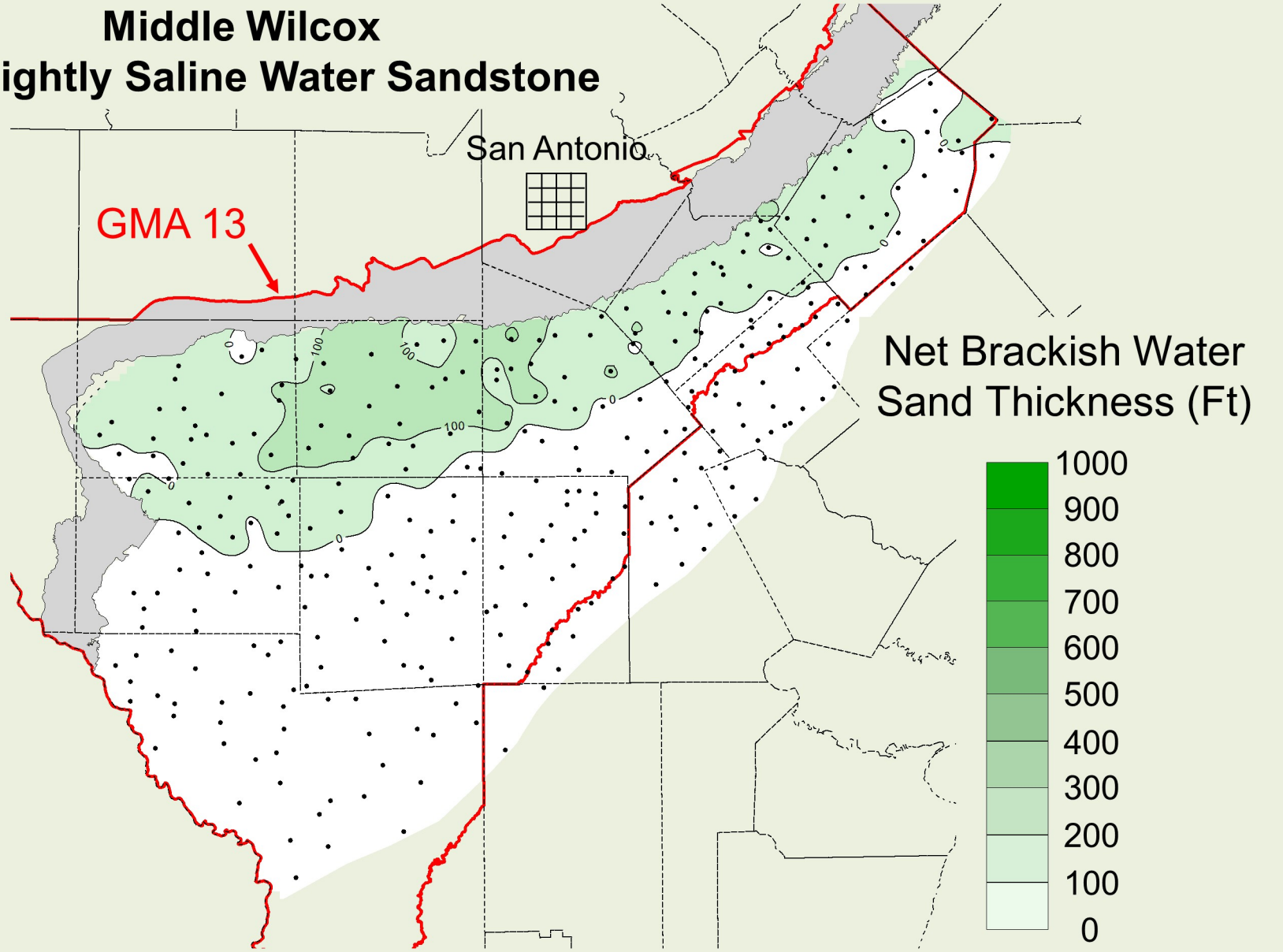
Lower Wilcox
Net Freshwater Sandstone



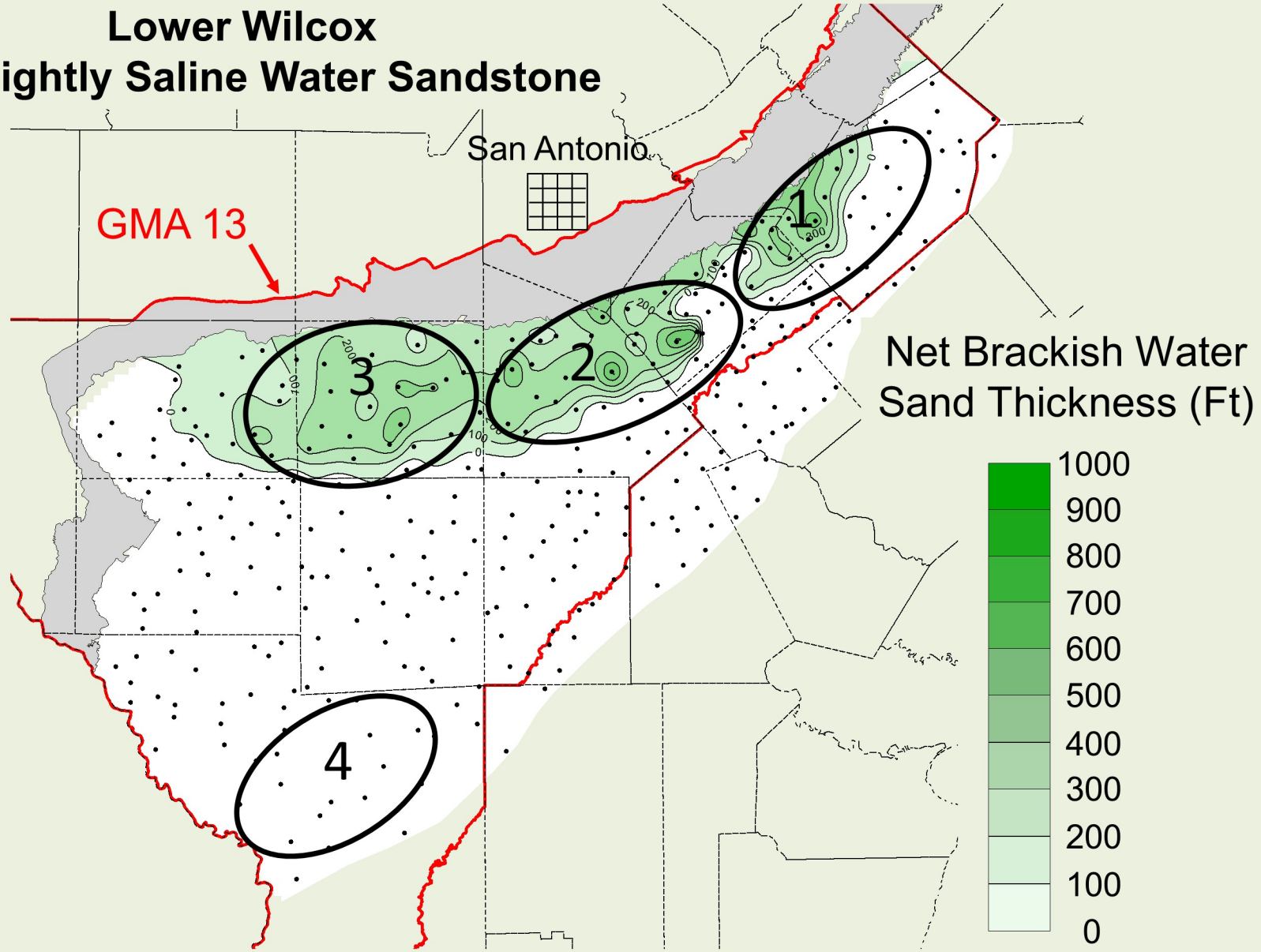
Carrizo-Upper Wilcox
Net Slightly Saline Water Sandstone



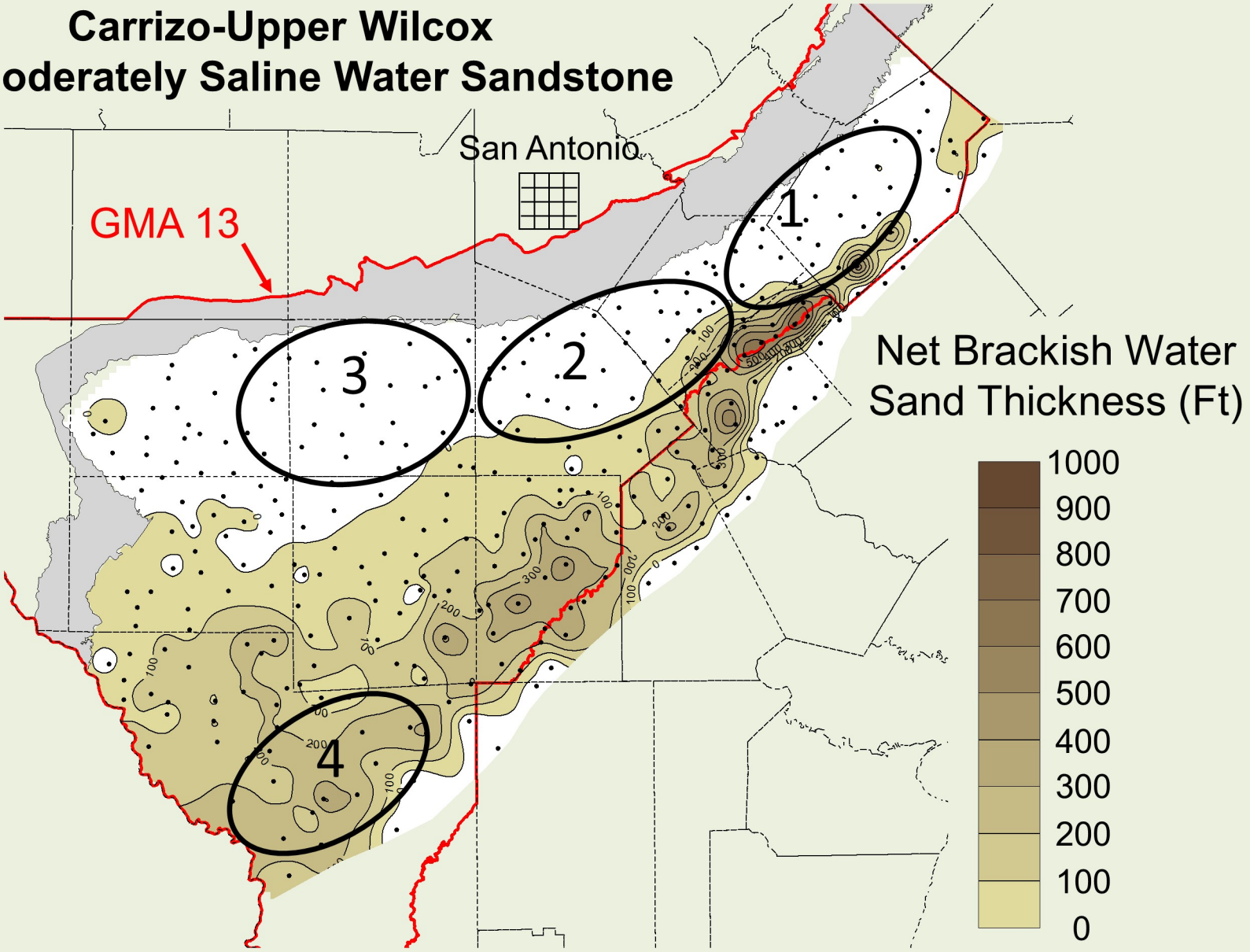
Middle Wilcox
Net Slightly Saline Water Sandstone



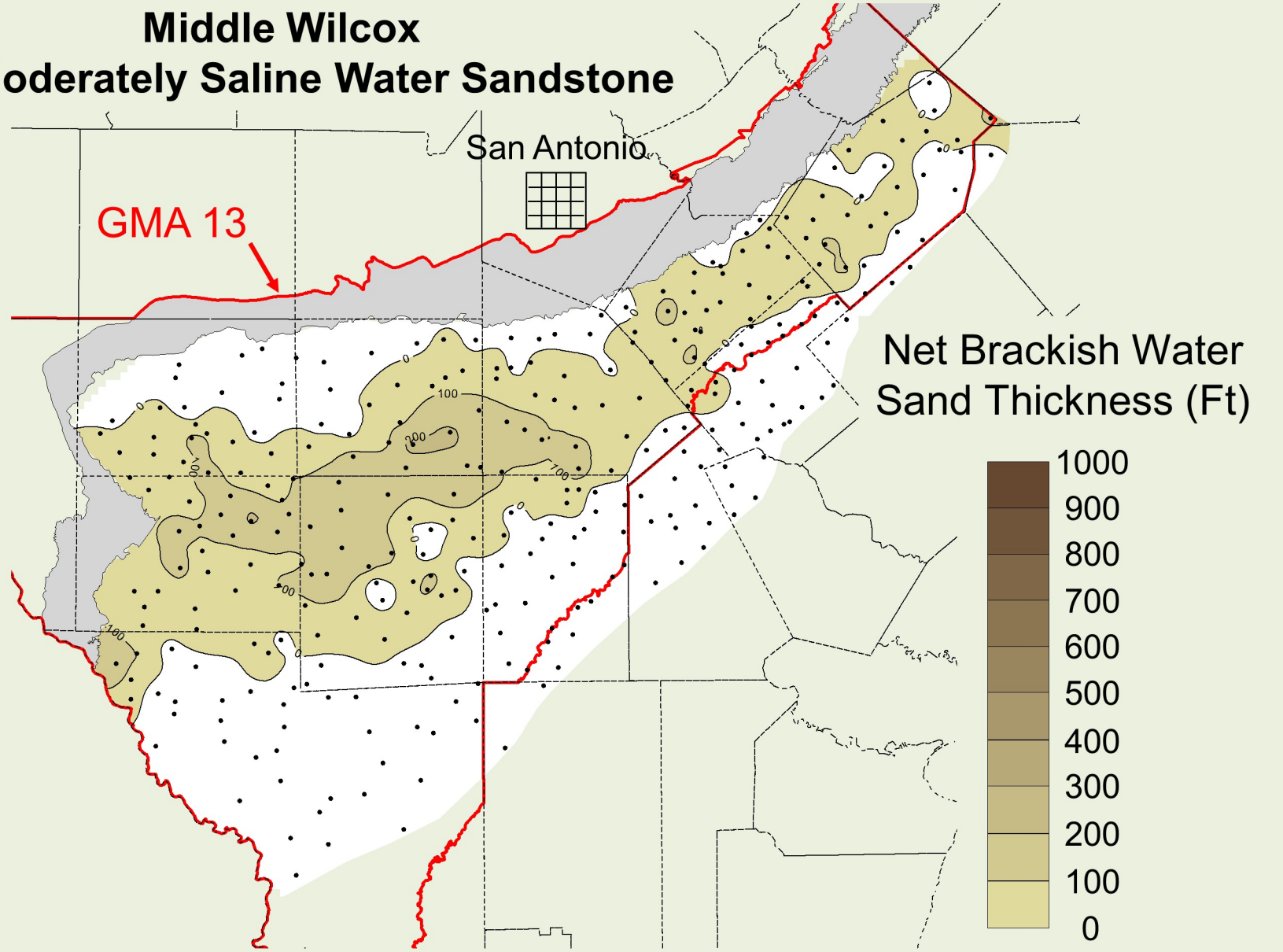
Lower Wilcox
Net Slightly Saline Water Sandstone



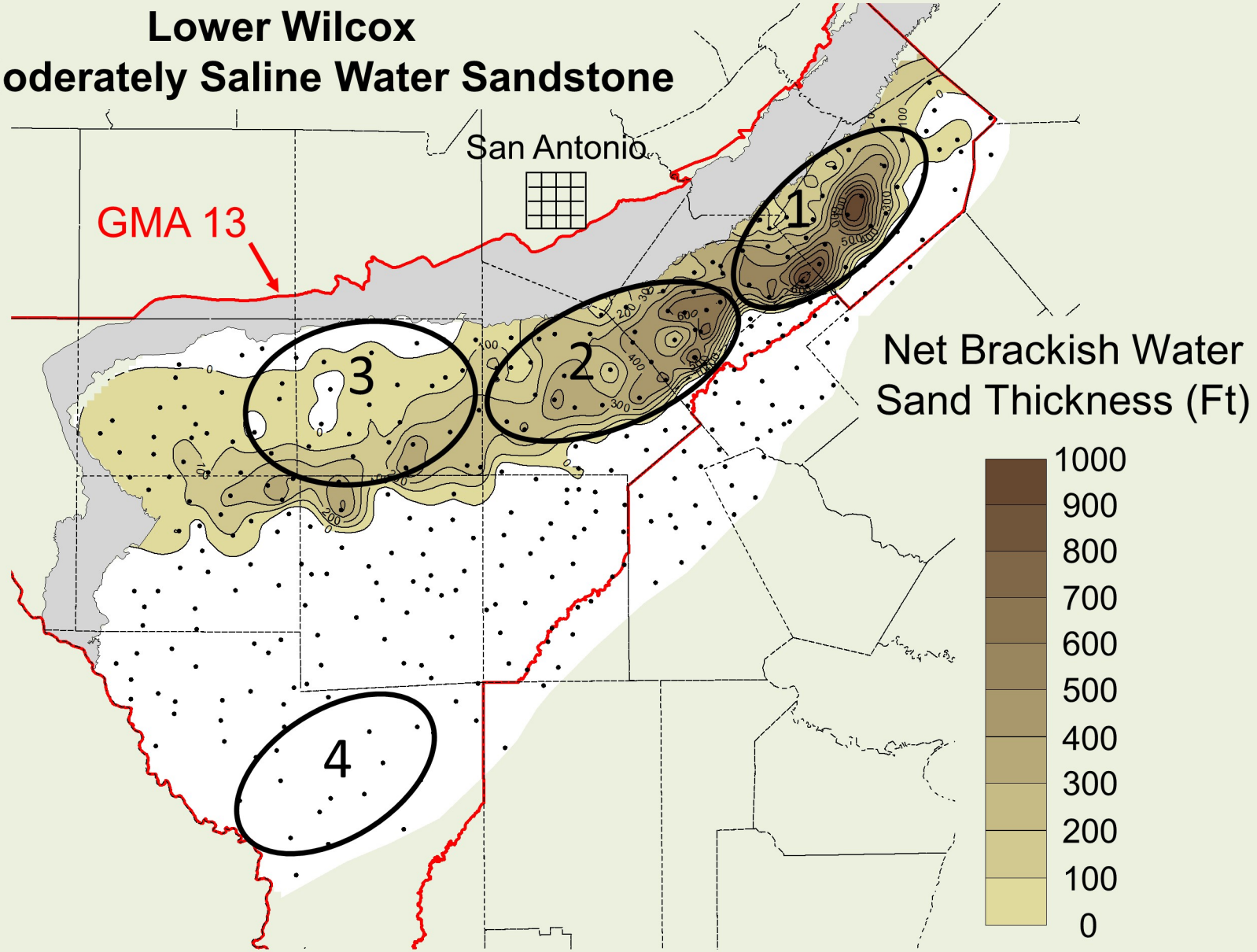
Carrizo-Upper Wilcox
Net Moderately Saline Water Sandstone



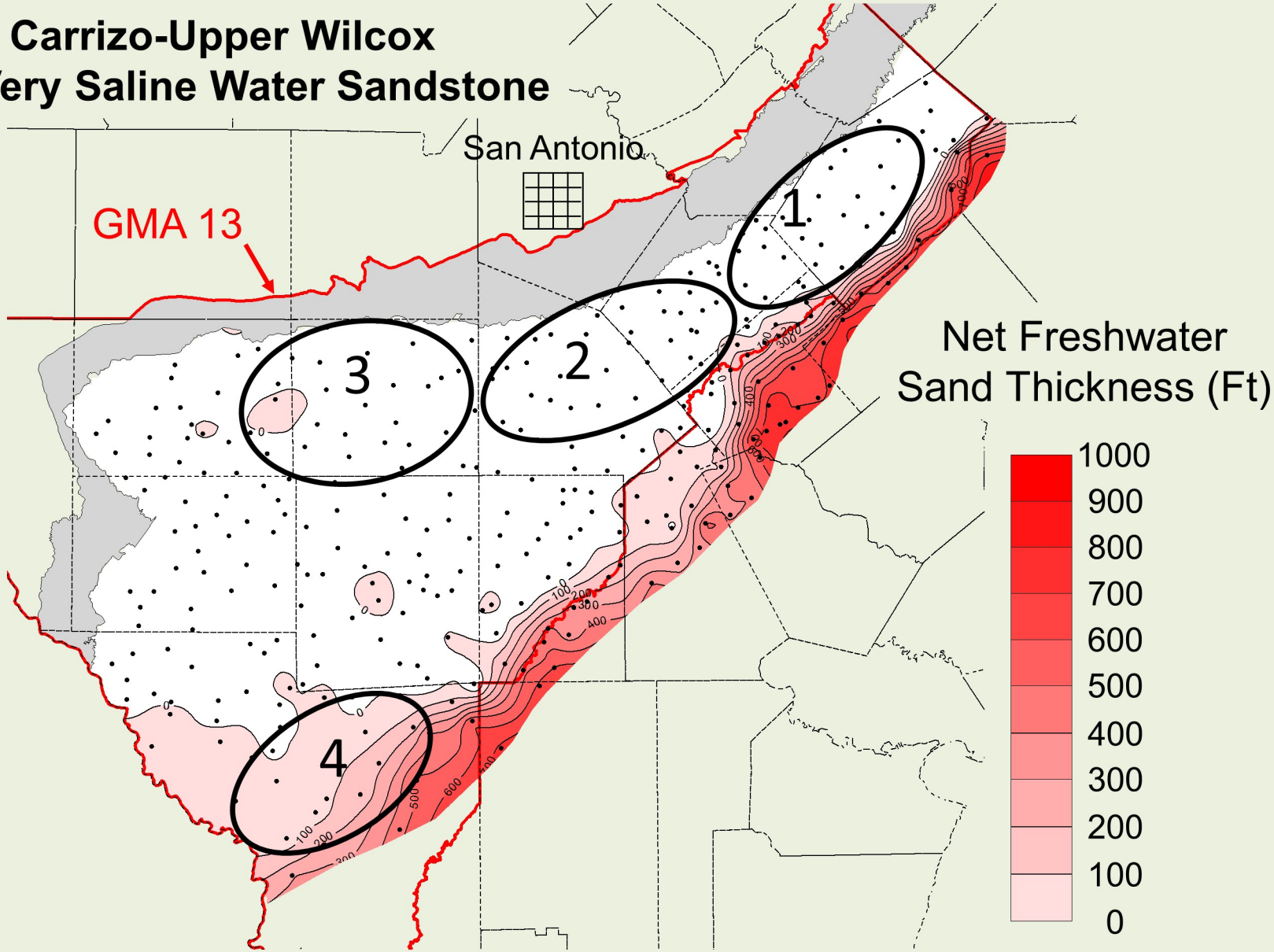
Middle Wilcox
Net Moderately Saline Water Sandstone



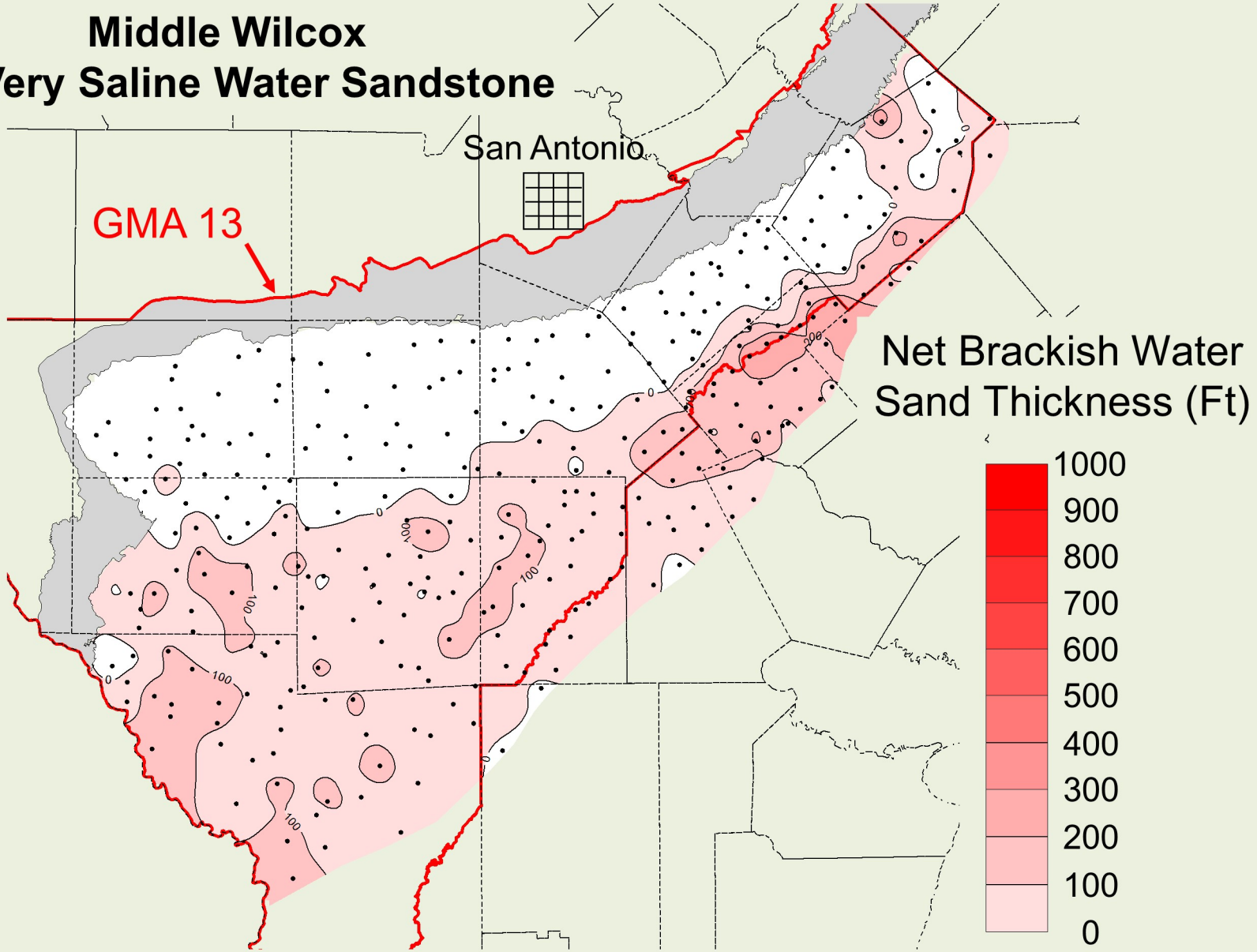
Lower Wilcox
Net Moderately Saline Water Sandstone



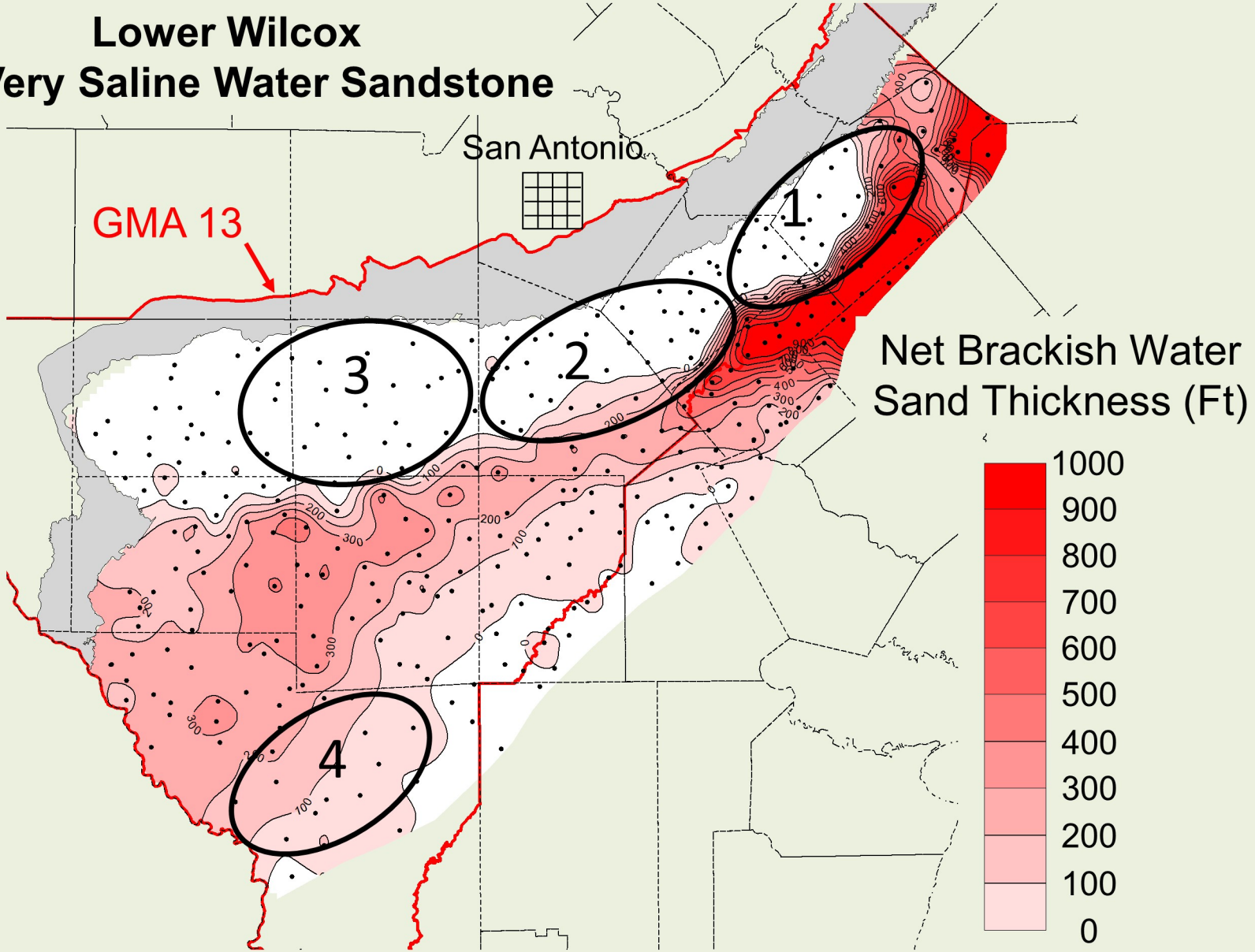
Carrizo-Upper Wilcox
Net Very Saline Water Sandstone

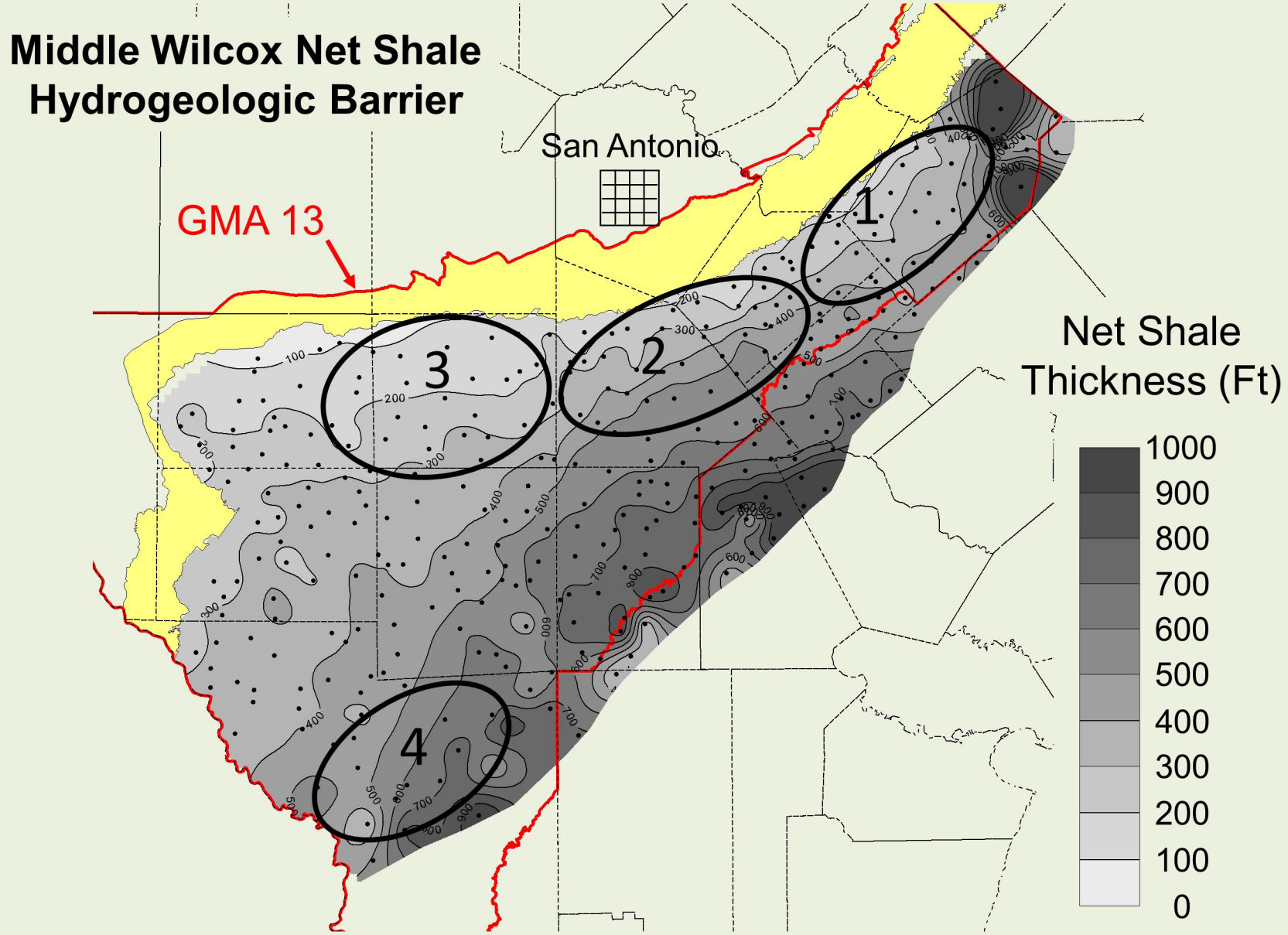


Middle Wilcox
Net Very Saline Water Sandstone

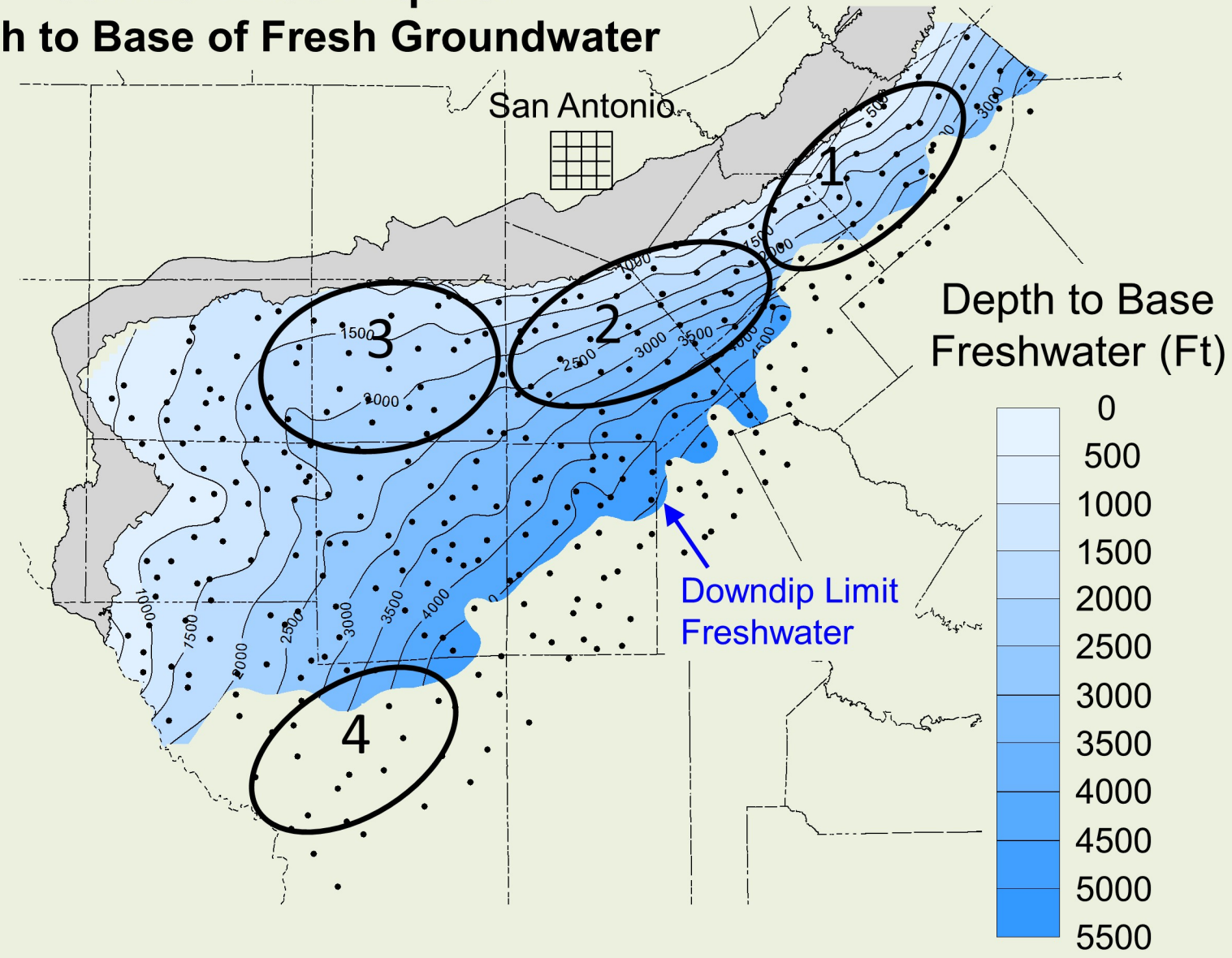


Lower Wilcox
Net Very Saline Water Sandstone

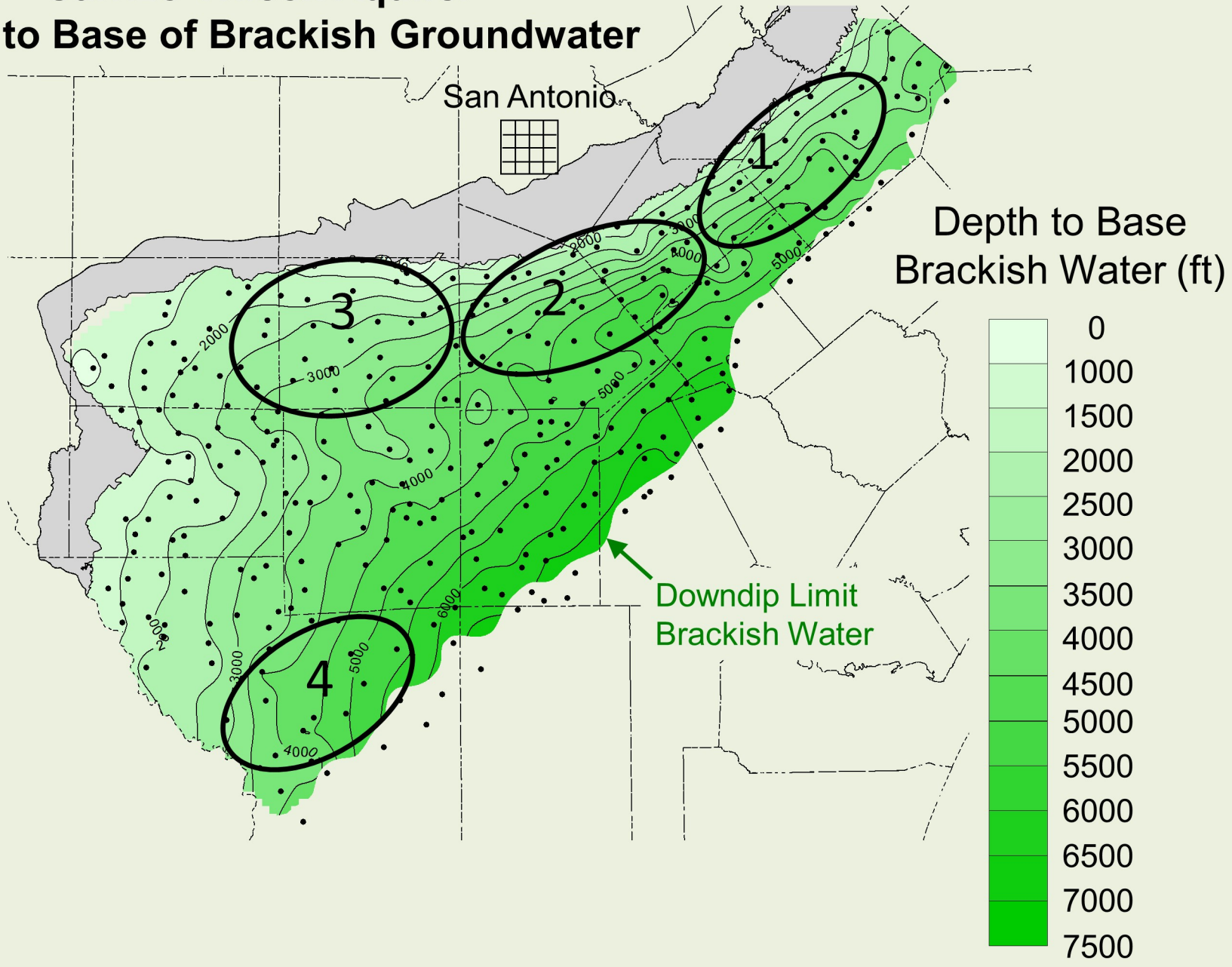



Middle Wilcox Net Shale
Hydrogeologic Barrier
San Antonio
GMA 13
1
2
3
4
Net Shale
Thickness (Ft)
1000
900
800
700
600
500
400
300
200
100
0

Carrizo-Wilcox Aquifer
Depth to Base of Fresh Groundwater



Carrizo-Wilcox Aquifer
Depth to Base of Brackish Groundwater



Stakeholder advisory forum for the GMA 13 Brackish Groundwater Mapping Project

April 15, 2016 10–12am.

Meeting held at the Evergreen Underground Water Conservation District, Pleasanton, TX.

List of Stakeholder Statements (S), questions (Q), and responses (R).

Note: This list is based on meeting notes. A video recording was not made.

1. **S: The Yoakum Channel in the middle Wilcox Group is very important. You need to mention this in the report.**
   R: The Yoakum Channel has been mapped and data will be used in the report.

2. **Q: How will you calculate the volume of brackish groundwater ?**
   R: The method will be the same as the TWDB's Total Estimated Recoverable Storage (TERS).

3. **Q: Is this brackish groundwater being recharged or is it fossil water?**
   R: Some groundwater recharges in the outcrop area and moves downdip. Some of the higher salinity groundwater is probably fossil (very old) groundwater.

4. **S: Age-dating of Carrizo groundwater 5 miles downdip from the outcrop in the Guadalupe – Caldwell county area is about 2,000 years old and the Wilcox groundwater is about 40,000 years old. Suggest TWDB procure money to age-date groundwater.**

5. **Q: Will modeling consider usage of water concurrently?**
   R: Modeling of potential production areas will be done using a simple approach and will not consider all water pumping in the region. The model will harvest aquifer property data from existing groundwater availability model.

6. **Q: Will an updated Groundwater Management Area 13 Groundwater Availability Model be prepared with this new brackish groundwater data?**
   R: Eventually a new model will be prepared with study data; however, TWDB has not yet set a date.

7. **S: The shale layers mentioned in the presentation also contain layers of silt and sand, so the shale will not act like an engineered dam to prevent water leakage. Faults in the area will also allow water to move.**
   R: The shale and sand layers are mapped and will be used in the model. Some of the shale is interbedded with sand and silt. The thickness of the units is determined. The model will consider the shale layers and faults. The modeling task will evaluate impact.

8. **S: Wilcox sediments contain clay clasts containing bound water that will affect resistivity analysis of the sands. Carrizo sands are cleaner and do not contain the clay clasts.**
   R: The character of the Wilcox and Carrizo sands is taken into account during analysis.

9. **S: In 2007 San Antonio Water System drilled a well in northeast Atascosa County. No study was performed showing the relationship between the Carrizo and Wilcox. Evergreen Underground Water Conservation District contracted with Mr. Hargis to map the Carrizo and Wilcox to study the water resources. Mr. Hargis mapped the major shale units. There are buried hills of Wilcox underneath the Carrizo. There is a major unconformity between the Carrizo and Wilcox as seen in outcrops. Where this unconformity exists, the shale between the Carrizo and Wilcox is missing. The middle Wilcox does contain some sand and shale. In northwest Atascosa County the Carrizo overlies the lower Wilcox and the middle Wilcox shale is missing. Continuous pumping in the lower Wilcox will affect the Carrizo. There is over 300 years of experience with the Carrizo in the Evergreen Underground Water Conservation District region. The solution is that San Antonio should desalinate seawater. The study must tie in outcrop work. Was the Hargis study used for this project?**
   R: Yes, the Hargis study was used, and shale layers in his report are also in the cross sections.

10. **S: The legacy of big [aquifer] drawdowns will be left to the landowners. Desired Future Conditions is an issue. Edwards Aquifer Authority versus Bragg will affect districts. Large districts can afford lawsuits, smaller districts cannot.**

11. **S: Cross-section 2 showed a shale layer that can be considered a hydrogeologic barrier but on cross-section 4 there is no barrier – just distance downdip.**
    R: Modeling will estimate impact. In the area of cross-section 4 if there is impact then this area will be re-evaluated as a zone.

12. **S: Any impact to fresh water is significant impact.**

13. **Q: The dots on the map in the areas of potential production areas – are these monitor wells?**
    R: No, the dots represent well control used for interpretation of geology.

14. **S: The well density in the study means some areas have no control. How can you draw conclusions in these areas? You will need more monitor wells in these areas to see impact.**
    R: This is a regional study with a set timeframe. We cannot use every well. This is a desktop study based on existing information. We are estimating aquifer properties for the modeling task since there are few to no deep brackish wells in the region. One of the requirements of House Bill 30 is to recommend monitor well locations. Once an entity proposes a well or well field, test wells will need to be drilled and evaluated. Once pumping begins, monitor wells will indicate if there is impact.

15. **S: San Antonio Water System drilled Wilcox wells.**

R: We (Bureau of Economic Geology) were not involved with that work.

16. **Q: Do you mean you did not know of this work? You should use this data.**
    R: Neither the Bureau of Economic Geology or the Texas Water Development Board were consultants to San Antonio Water System for their brackish water well field. The well data from San Antonio was made available to TWDB and the contractor for our studies.

17. **S: San Antonio Water System drilled one monitor well in the Wilcox, Carrizo, and Queen City aquifers in Atascosa County.**

18. **S: San Antonio has unlimited brackish groundwater production in southern Bexar County.**
    R: There is no groundwater conservation district in southern Bexar County regulating the Wilcox (response from another participant in the meeting).

19. **Q: So you have existing well control with brackish groundwater use?**
    R: We are using publicly available well control for the study. One of the requirements of House Bill 30 is to exclude areas with existing brackish groundwater use from the designation of brackish groundwater production zones. These areas, in conjunction with modeling, will be used to refine the boundaries of the proposed production areas.

    The next step, after the study is completed in August, is for TWDB staff to review the data and make recommendations to our Executive Administrator. These recommendations will be presented to our Board next fall and the final brackish groundwater production zones will be presented in our biennial Brackish and Seawater Desalination Report to the Legislature due December 1. The Board meetings discussing brackish groundwater production zones and the biennial report will be open to the public and offer another meeting for stakeholder input. If you have any comments after this meeting, please forward them to TWDB. This presentation will be available on our website next week.

20. **Q: What will the final shape of the brackish groundwater production zones look like?**
    R: They will be three-dimensional blobs based on study data and modeling.
    We will exclude areas where wells are currently using brackish groundwater. We will also exclude areas where Class II injection wells (produced water from oil/gas operations) are used. Typically injection is in zones with total dissolved solids greater than 10,000 (U.S. EPA definition of Underground Source of Drinking Water), but there are Railroad Commission exceptions to this.

21. **Q: Will you consider the fault zones? Some of these faults will allow water to move between aquifers.**
    R: The faults will be considered during the modeling phase of the study.

22. **S: The modeling needs to account for the Carrizo – Wilcox unconformity.**

Participant	Affiliation
Art Troell	McCoy W .S. Corp.
Morris Cowley	
Wendi Denton	Fayette County Groundwater Conservation District
Humberto Ramos	Canyon Regional Water Authority
Ian Jones	Texas Water Development Board
Nathan van Oort	Texas Water Development Board
Lonnie Stewart	McMullen Groundwater Conservation District
Amy Banerji	Bureau of Economic Geology
Bridget Scanlon	Bureau of Economic Geology
Richard Donat	San Antonio Water System
Kelley Vickers	Guadalupe County Groundwater Conservation District
Andy Garza	Kenedy County Groundwater Conservation District
Felix Saenz	Brush Country Groundwater Conservation District
Larry Fox	Evergreen Underground Water Conservation District
Justin Westmoreland	GCWCD
John Meyer	Texas Water Development Board
Scott Hamlin	Bureau of Economic Geology
Daniel Meyer	Plum Creek Conservation District
Ginger Coleman	
Diane Savage	Evergreen Underground Water Conservation District
Greg Sengelmann	Gonzales County Underground Water Conservation District
Kay Love	
James Beach	LBG-Guyton Associates
Thomas D. Hill	GBRA
Clifton R. Stacy	Evergreen Underground Water Conservation District
Jay Troell	Evergreen Underground Water Conservation District
Monica Jacobs	Kelly Hart
Bob Ulrich	Pleasanton, TX
Natalie Bartek	

Participant	Affiliation
Larry Bartek	Poteet
Bob Reedy	Bureau of Economic Geology