



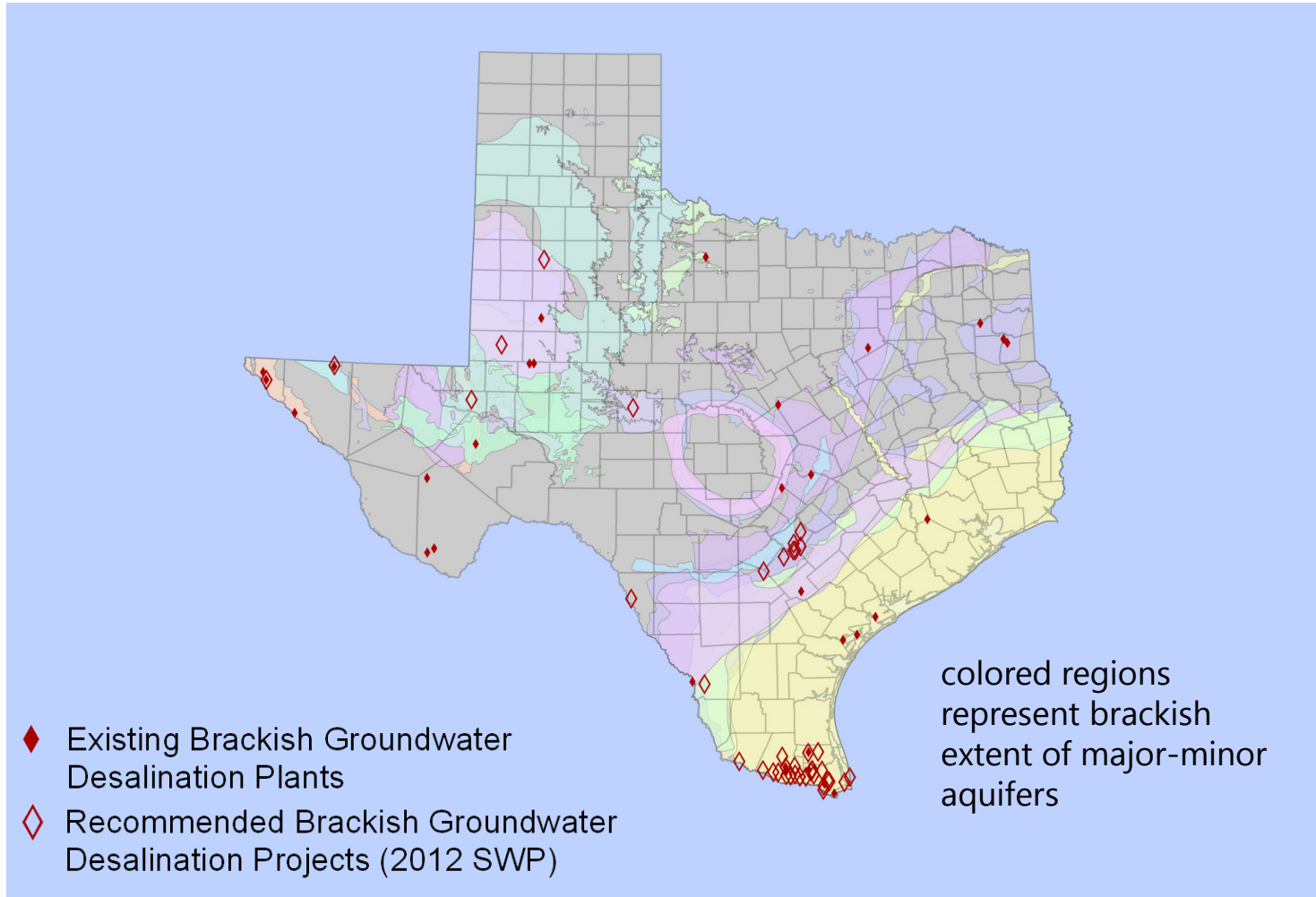
Brackish Groundwater Characterization
Carrizo-Wilcox and overlying aquifers
Central Texas

by
John Meyer, P.G.

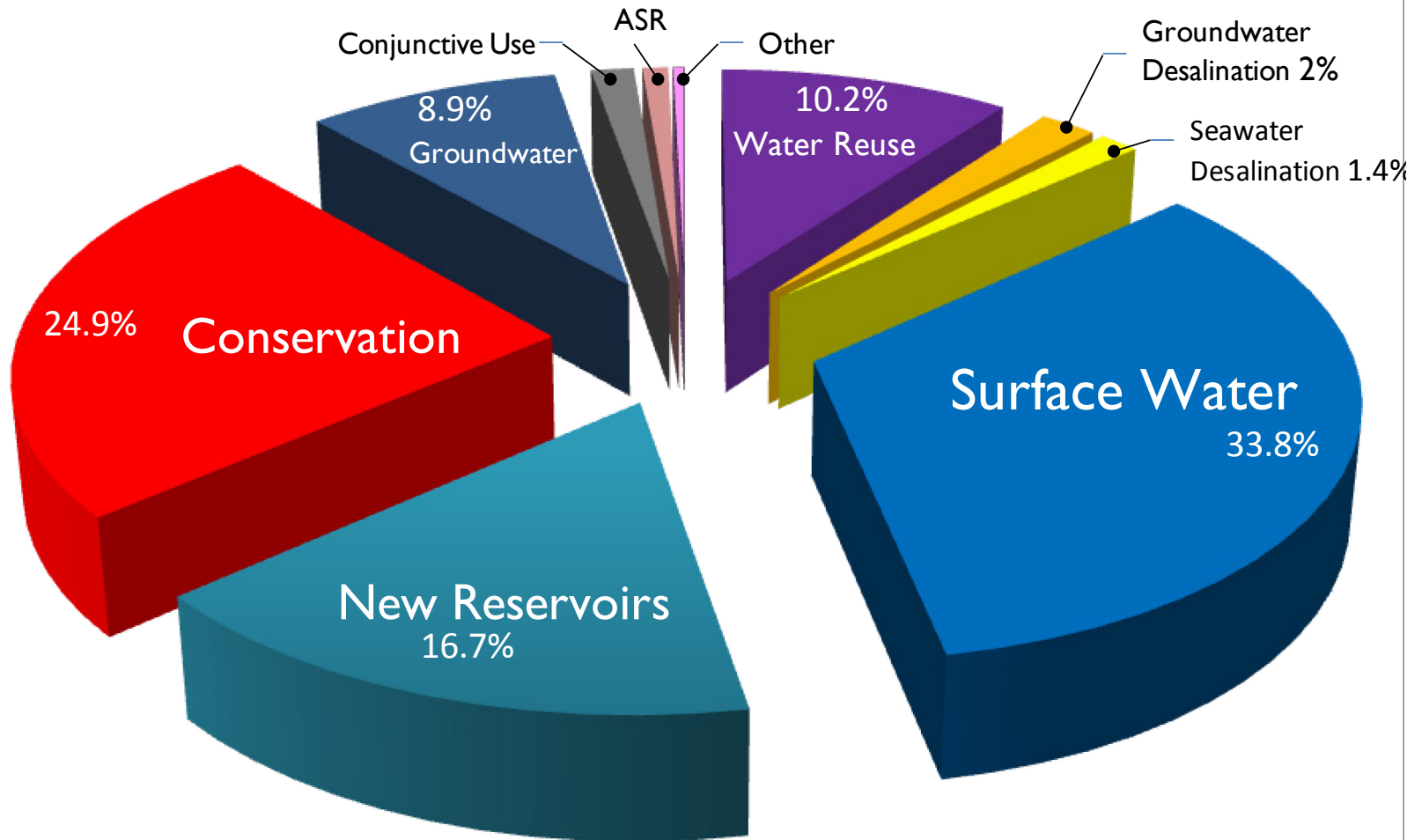
May 06, 2013

Why study brackish water?

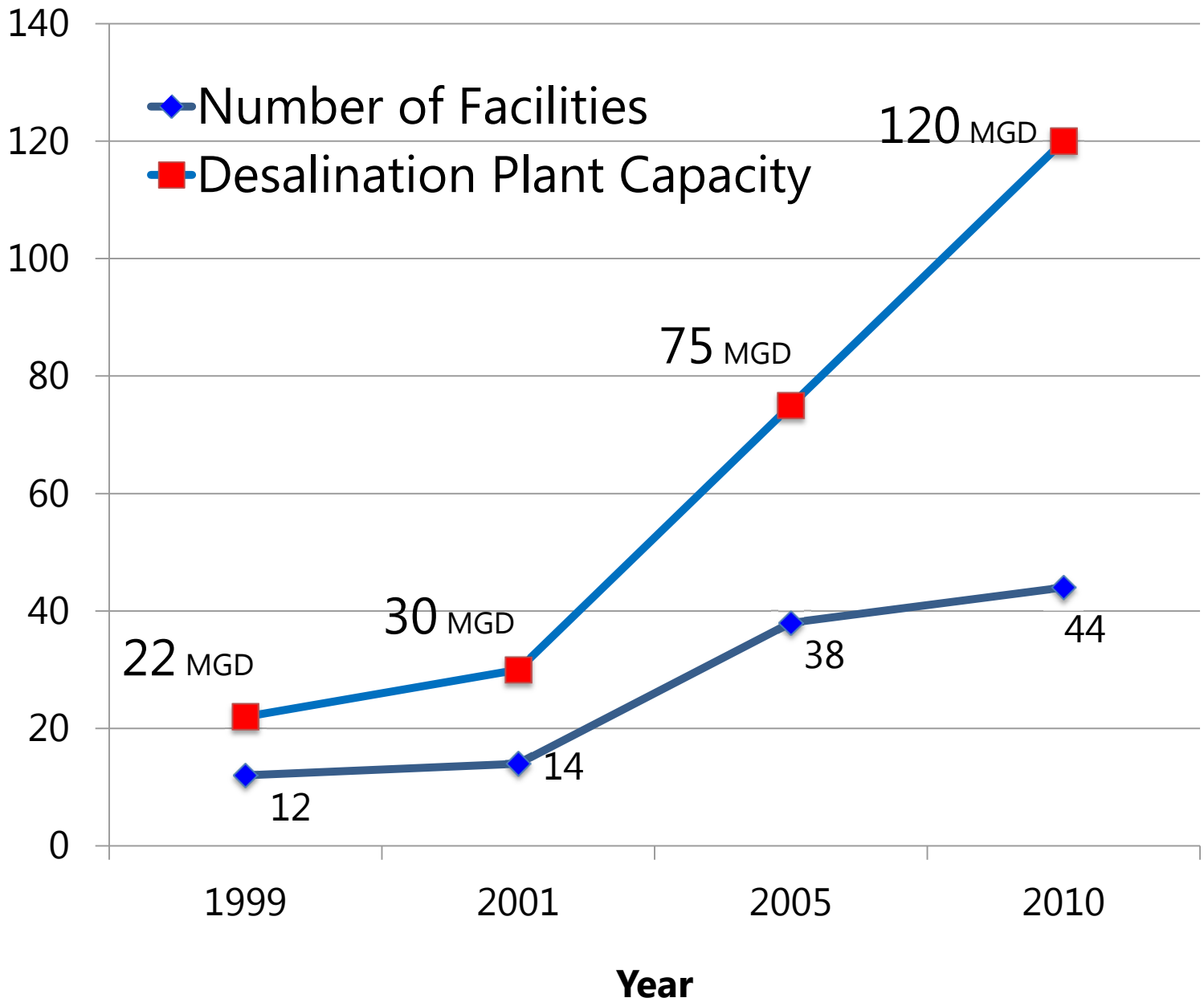
- 2.7 billion acre-feet brackish groundwater
- Need detailed information
- Growing interest in desalination



Cumulative Water Management Strategies by 2060



Number of Facilities Plant Capacity (MGD)

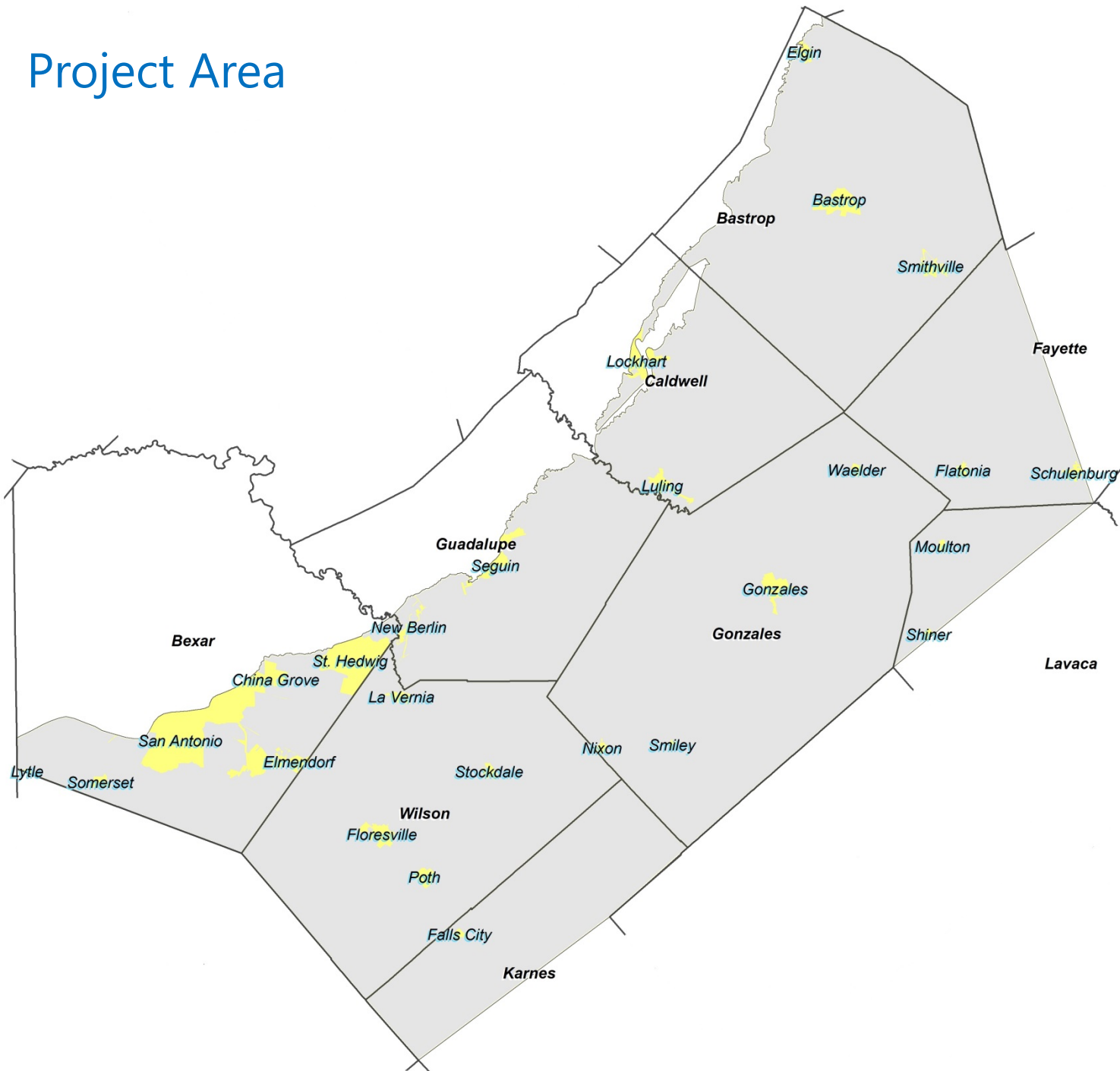


How does TWDB characterize brackish water?

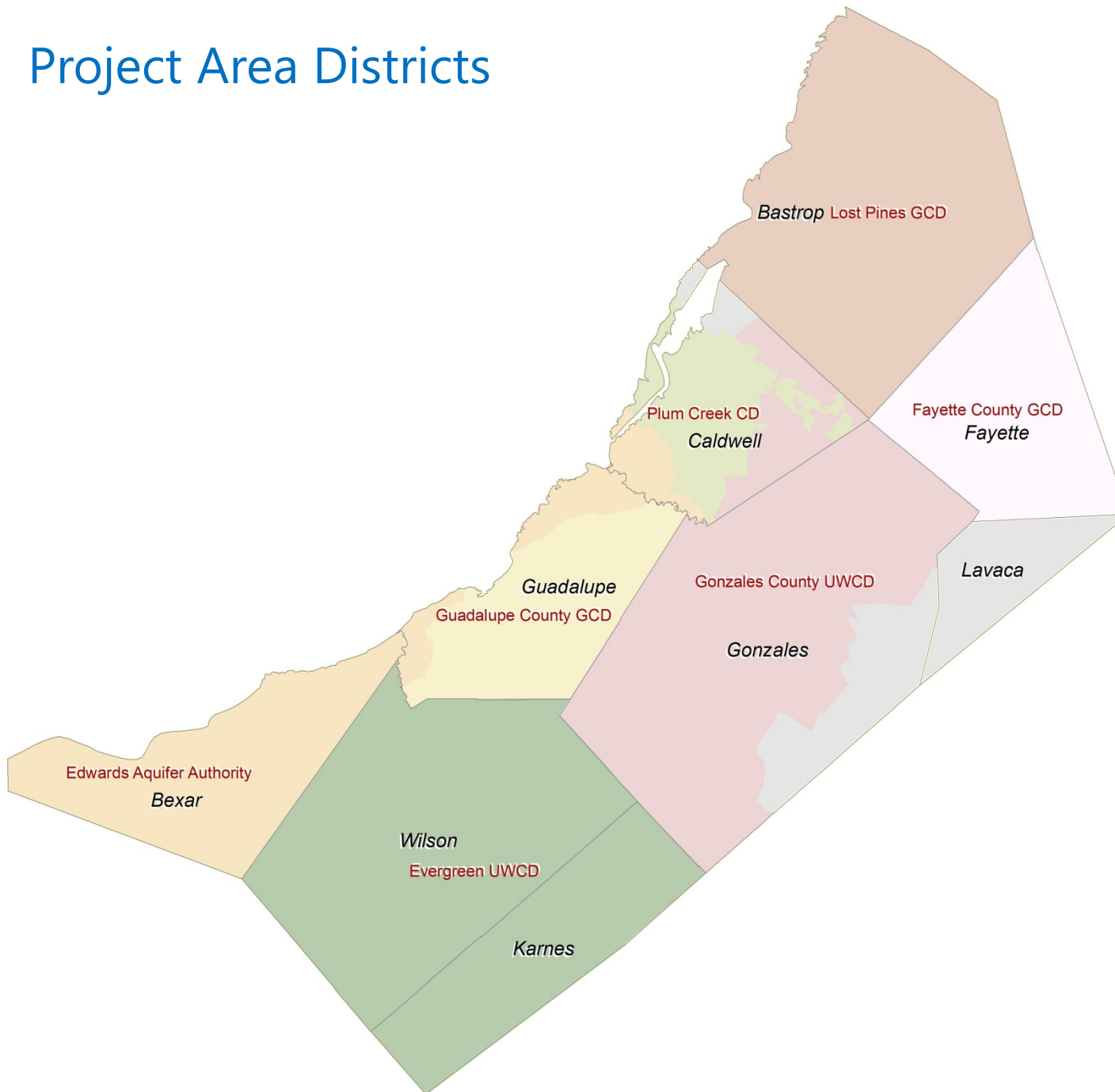
BRACS: Brackish Resources Aquifer Characterization System

- map aquifer extent to 10,000 mg/L TDS
- map key desalination parameters
- compile aquifer properties
- calculate volumes of water
- collect well logs (water, oil/gas) for interpretation
- build datasets (database, GIS) of project information
- provide ***all*** information to interested stakeholders
(well logs; database; GIS files; reports)

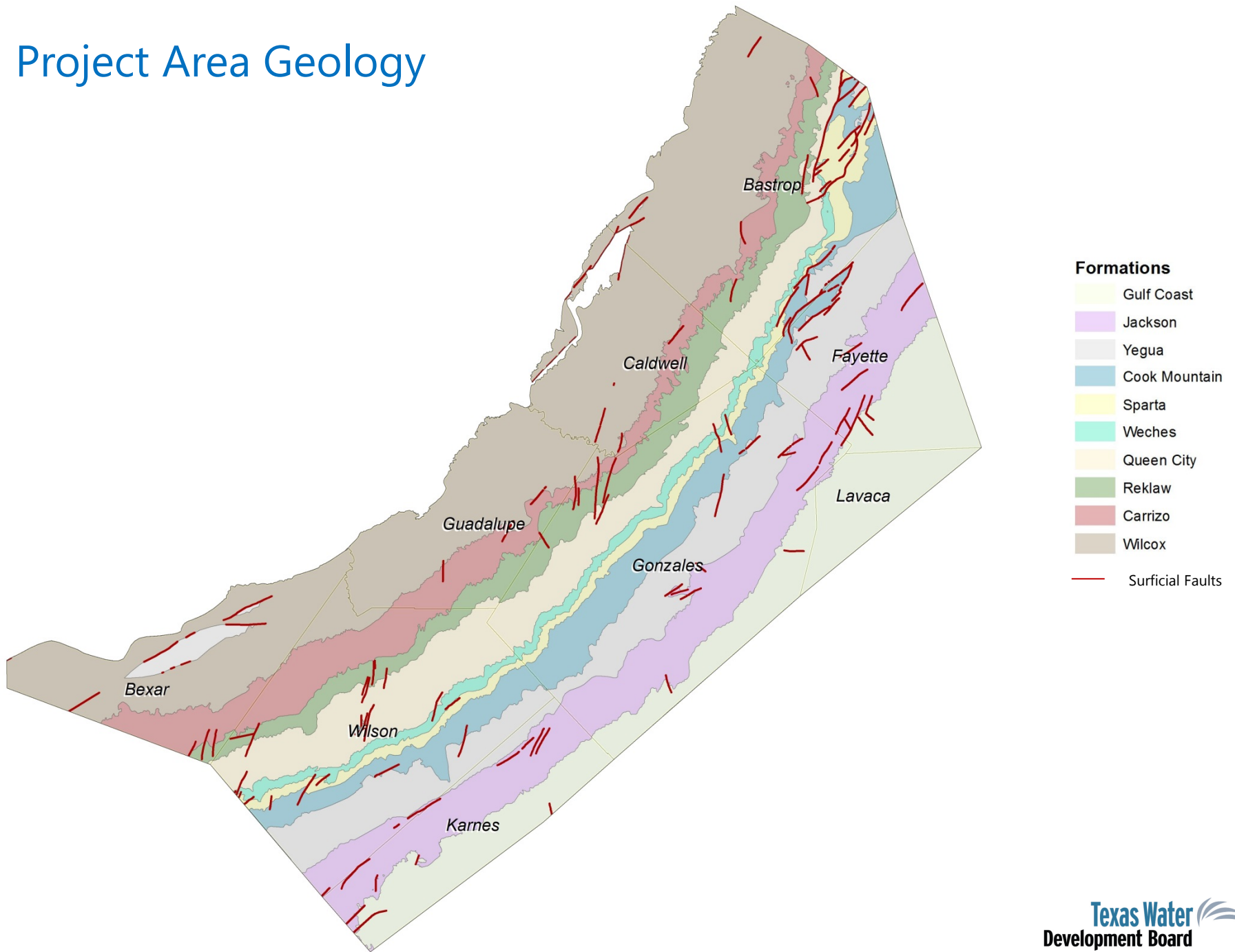
Project Area



Project Area Districts



Project Area Geology



TWDB Database Tables

TWDB Groundwater Database

Well Data

Remarks

Water Levels

Water Chemistry (2 tables)

Casing

TWDB BRACS Database

Well Data (location, depth, owner, ...)

Water Levels

Water Chemistry (2 tables)

Casing

New
Tables

Foreign Keys (well ids)

Well Geology (lithology\stratigraphy)

Net Sand and Sand Percent

Interpreted TDS from Geophysical W.L.

Aquifer Determination Analysis

Digital Water Well Reports

Digital Geophysical Well Logs

Geophysical Well Log Suites

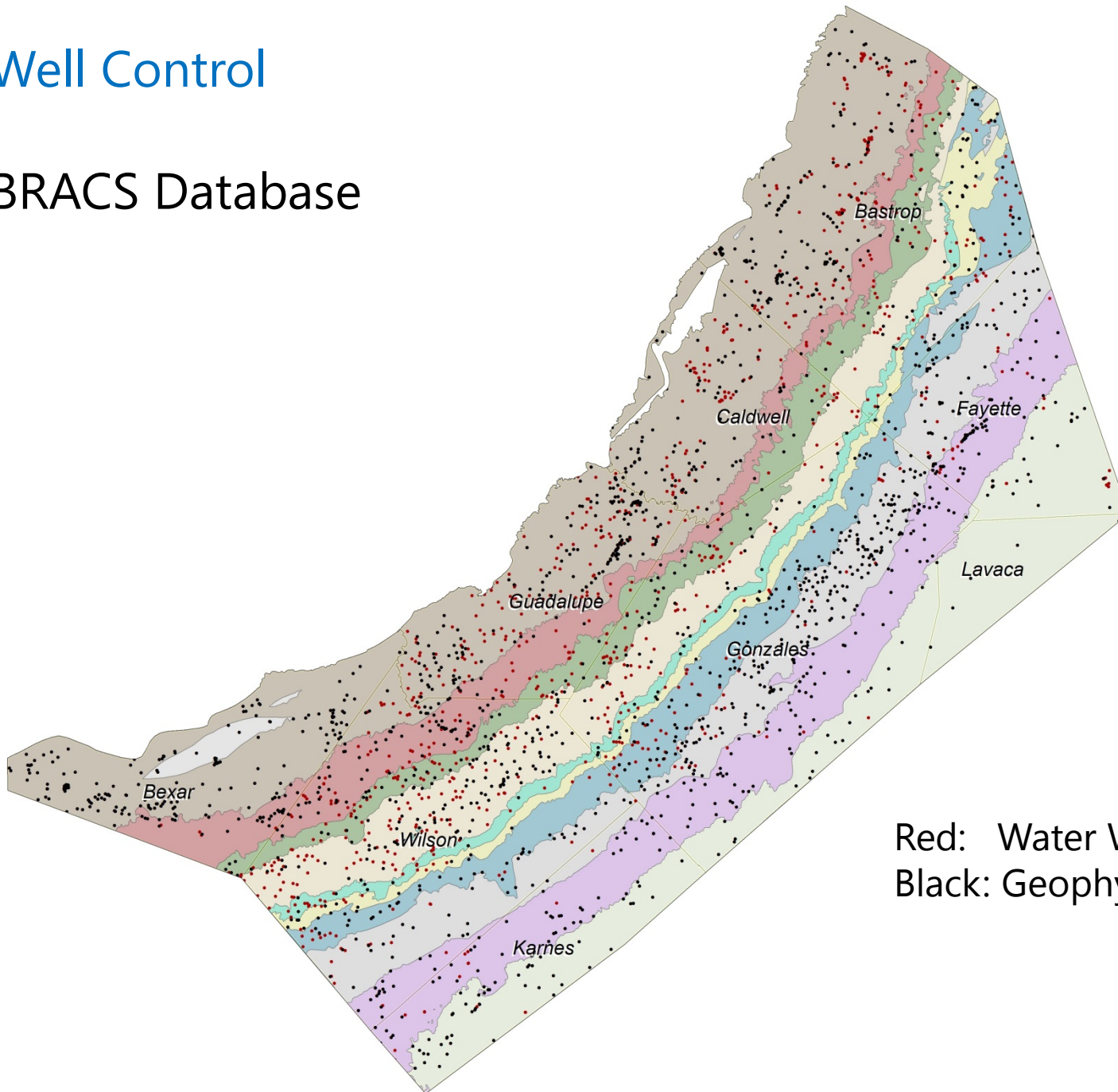
Aquifer Test Information

BRACS Database

- MS Access relational design
- Contains all the new information we are collecting
- Designed to process information (Visual Basic Code)
- Link to additional databases through key fields
- Available on our website (with data dictionary)
- Will be merged with the TWDB Groundwater Database in MS SQL Server

Well Control

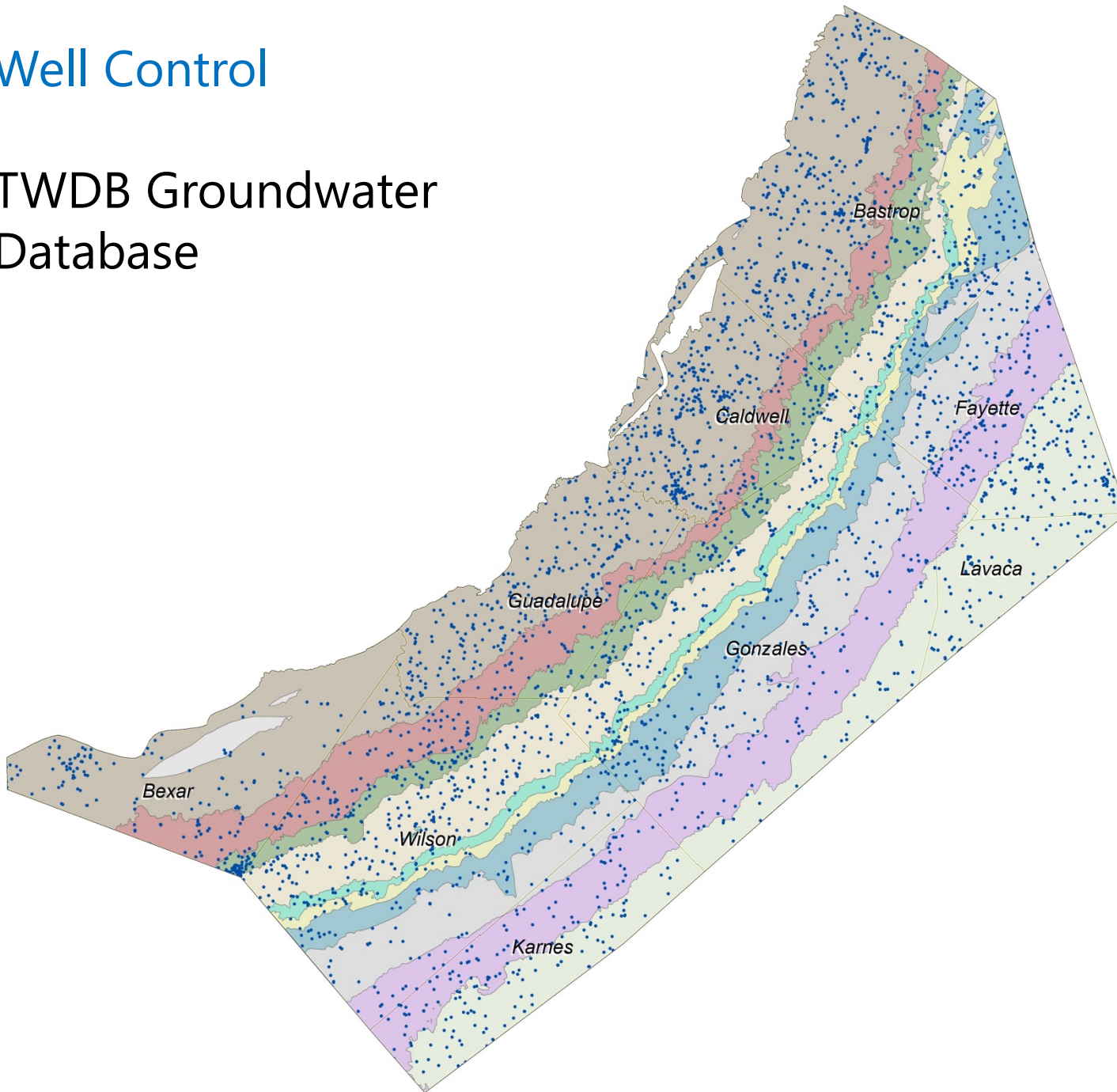
BRACS Database



Red: Water Wells
Black: Geophysical Well Logs

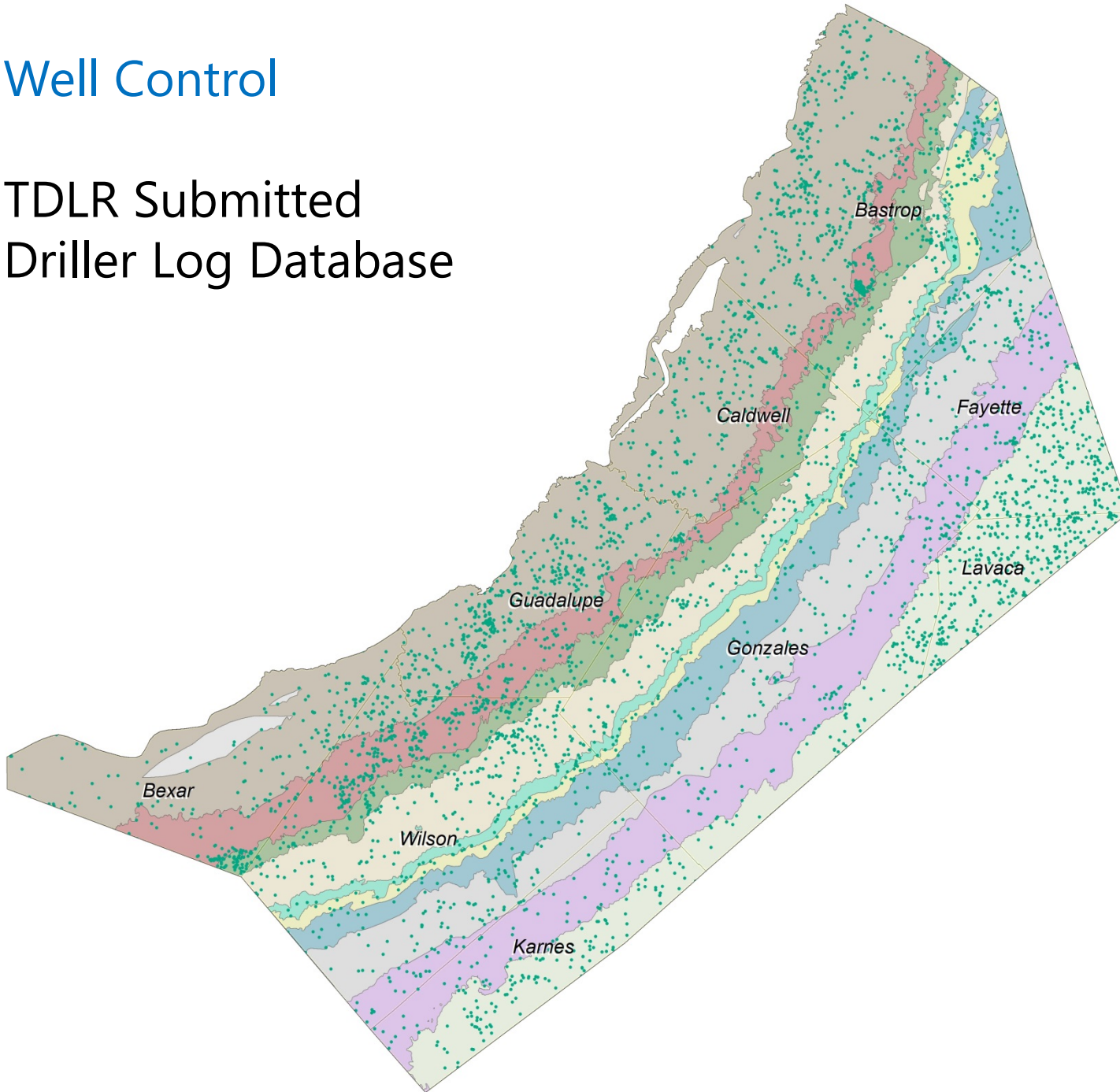
Well Control

TWDB Groundwater Database



Well Control

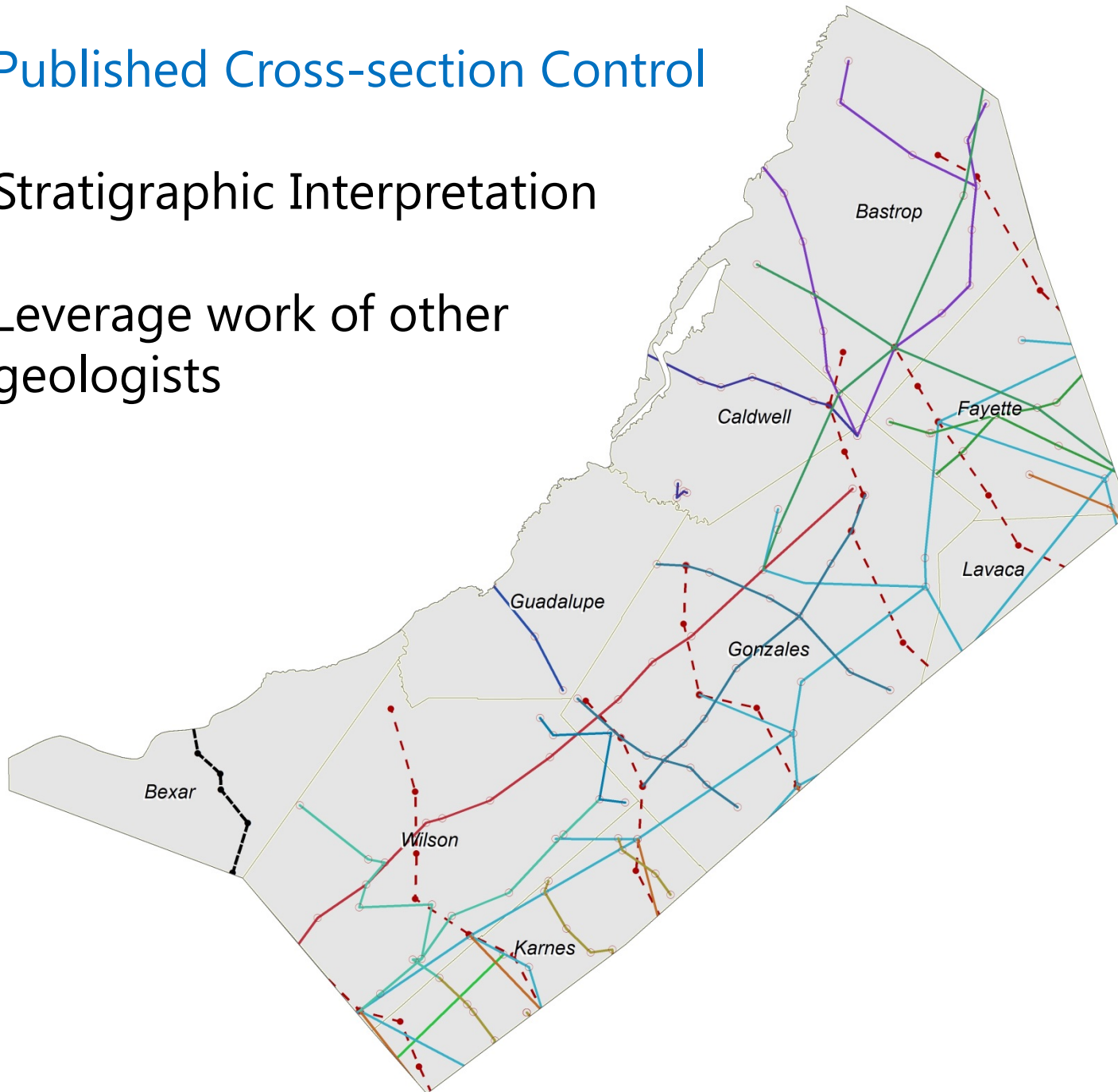
TDLR Submitted Driller Log Database



Published Cross-section Control

Stratigraphic Interpretation

Leverage work of other geologists



BRACS Database

Foreign Key Table

- Well name(s)
- Number(s)
- State Well Number
- API Number
- Q-number
- PWS ID
- Report numbers
- Cross-Section IDs

ID Name	Foreign Key Id (Text)	Remarks
ID Agency	Foreign Key Id (Numeric)	
Dodge_Posey_1981	16-3	Cross section 16, well no. 3
BEG		
Own	API	SWN
Q.num	TDLR	PWS
D/P		
INT_GulfCoast_Proj	17,1	Dip Section, Position; Strike Section, Position
INT		
Own	API	SWN
Q.num	TDLR	PWS
D/P		
API_NUMBER	4249301747	
API	4249301747	
Own	API	SWN
Q.num	TDLR	PWS
D/P		
STATE_WELL_NUMBER	7807704	
TWDB	7807704	
Own	API	SWN
Q.num	TDLR	PWS
D/P		
USGS_OF_87-677	851	TXWN03, log number
USGS		
Own	API	SWN
Q.num	TDLR	PWS
D/P		
Baer_YeguaJackson	DP16-3	
BAER		
Own	API	SWN
Q.num	TDLR	PWS
D/P		
WELL_NUMBER	J 12	TWDB Bull 5710 well number, X-section B-B'
OWNER		
Own	API	SWN
Q.num	TDLR	PWS
D/P		
Q_NUMBER	Q-11	N/A
RRC		
Own	API	SWN
Q.num	TDLR	PWS
D/P		
WELL_NUMBER	S.V. Houston 1	
OWNER		

Formation Lithology

Geophysical well logs, water well reports

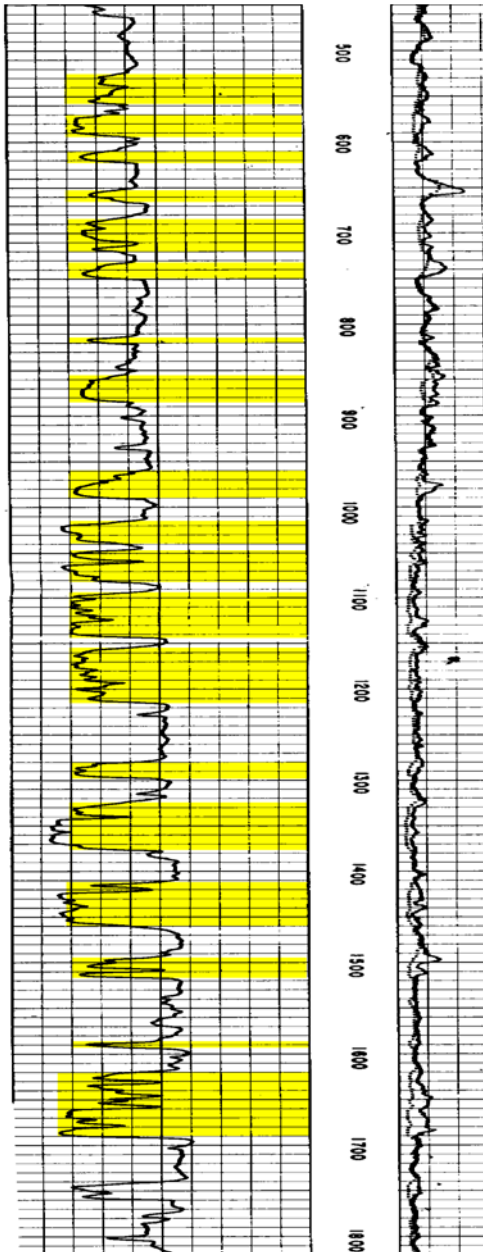
Net sand and sand percent

Clay thickness

Used for:

water volume calculations

evaluating sand thickness and occurrence



Lithologic and Stratigraphic Data in the BRACS Database

Lithologic Description

Record Number Geologic Pick Top Depth Lithologic Description
 Bottom Depth Source of Data
 Thickness Initials Last Change

10	Lithologic	0				
		10	Sand			
		10	GEOPHYSICAL WELL LOG			1/17/2013
11	Lithologic	10				
		120	Clay			
		110	GEOPHYSICAL WELL LOG			1/17/2013
12	Lithologic	120				
		145	Sand			
		25	GEOPHYSICAL WELL LOG			1/17/2013
13	Lithologic	145				
		166	Clay			
		21	GEOPHYSICAL WELL LOG			1/17/2013
14	Lithologic	166				
		409	Clay			
		142	GEOPHYSICAL WELL LOG			1/17/2013
15	Lithologic	308				
		320	Clay			
		12	GEOPHYSICAL WELL LOG			1/17/2013
16	Lithologic	320				

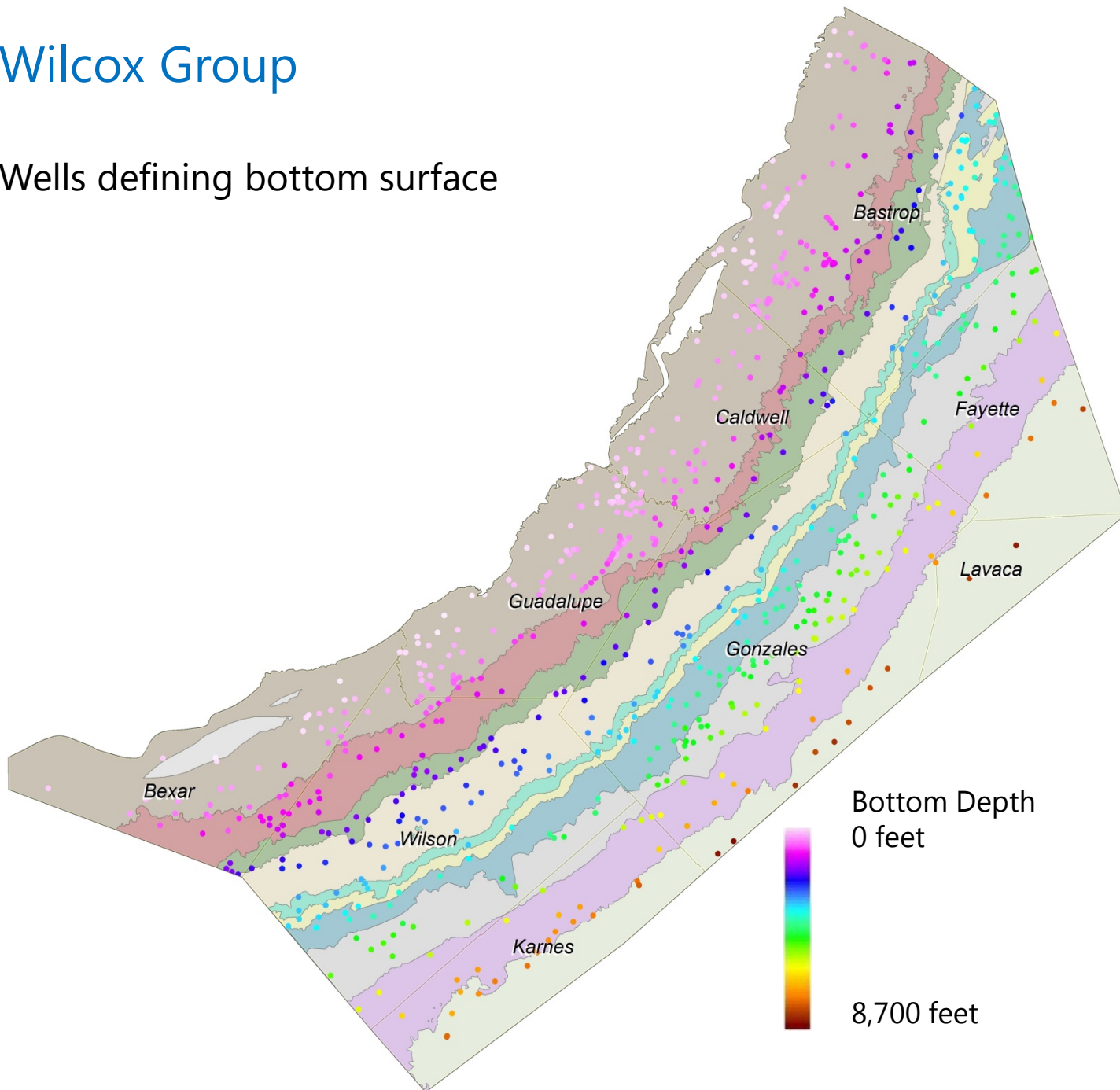
Stratigraphic Description

Record Number Geologic Pick Top Depth Stratigraphic Description
 Bottom Depth Source of Data
 Thickness Initials Last Change

1	Stratigraphic	0	Yegua Formation			
		745		Geophysical Well Log		
		745				10/1/2012
2	Stratigraphic	745	Cook Mountain Formation			
		1163		Geophysical Well Log		
		418				3/11/2013
3	Stratigraphic	1163	Sparta Formation			
		1375		Geophysical Well Log		
		212				3/11/2013
4	Stratigraphic	1375	Weches Formation			
		1430		Geophysical Well Log		
		55				3/11/2013
5	Stratigraphic	1430	Queen City Formation			
		2050		Geophysical Well Log		
		620				3/11/2013
6	Stratigraphic	2050	Reklaw Formation			
		2260		Geophysical Well Log		
		210				2/8/2013
7	Stratigraphic	2260	Carrizo Formation			
		2965		Geophysical Well Log		
		705				2/8/2013
8	Stratigraphic	2965	Wilcox Group			
		5860		Geophysical Well Log		
		2895				10/1/2012
9	Stratigraphic	5860	Midway Formation			
				Geophysical Well Log		
						10/1/2012
*						

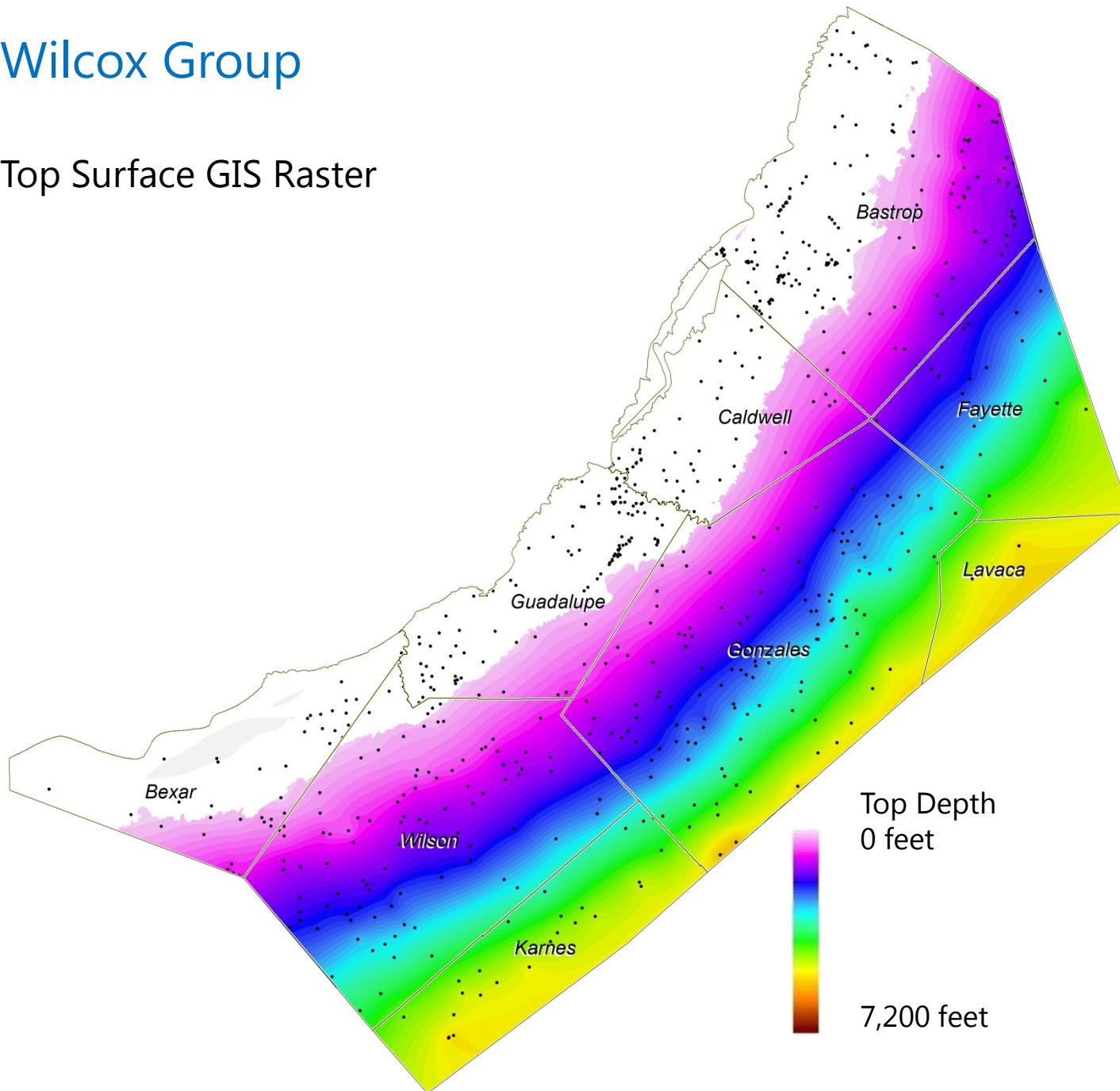
Wilcox Group

Wells defining bottom surface



Wilcox Group

Top Surface GIS Raster



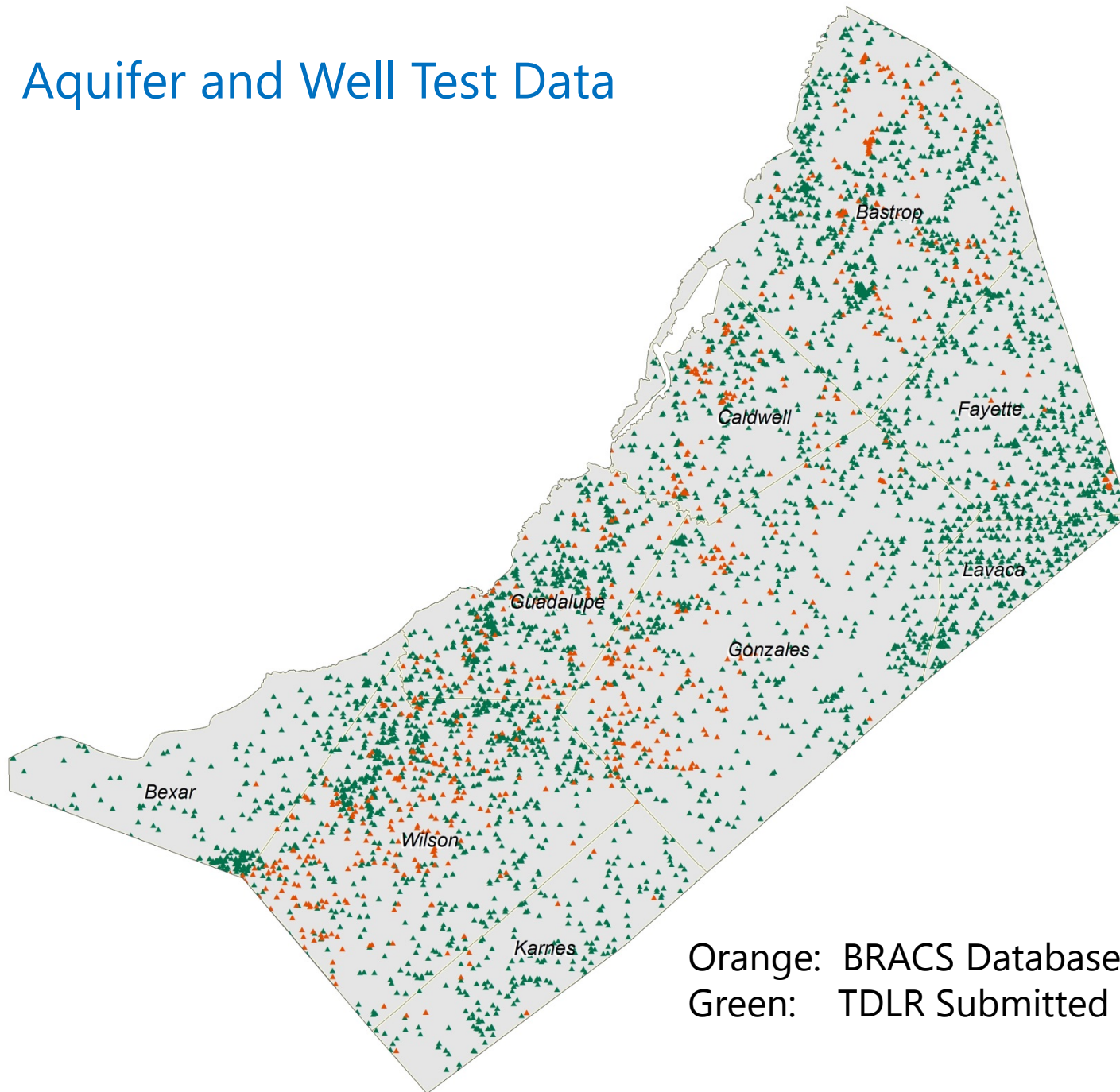
Aquifer Determination

- Assign aquifer(s) to each well in the project area
- Use screen top/bottom *or* well depth *or* total depth of hole
- Use the GIS-derived 3-D formation surfaces as vertical control

Why?

- Compare wells completed in same aquifer
- Consistent evaluation of aquifer water quality and properties
- Many new wells do not have TWDB aquifer code
- Some TWDB wells have incorrect aquifer code

Aquifer and Well Test Data



May include:

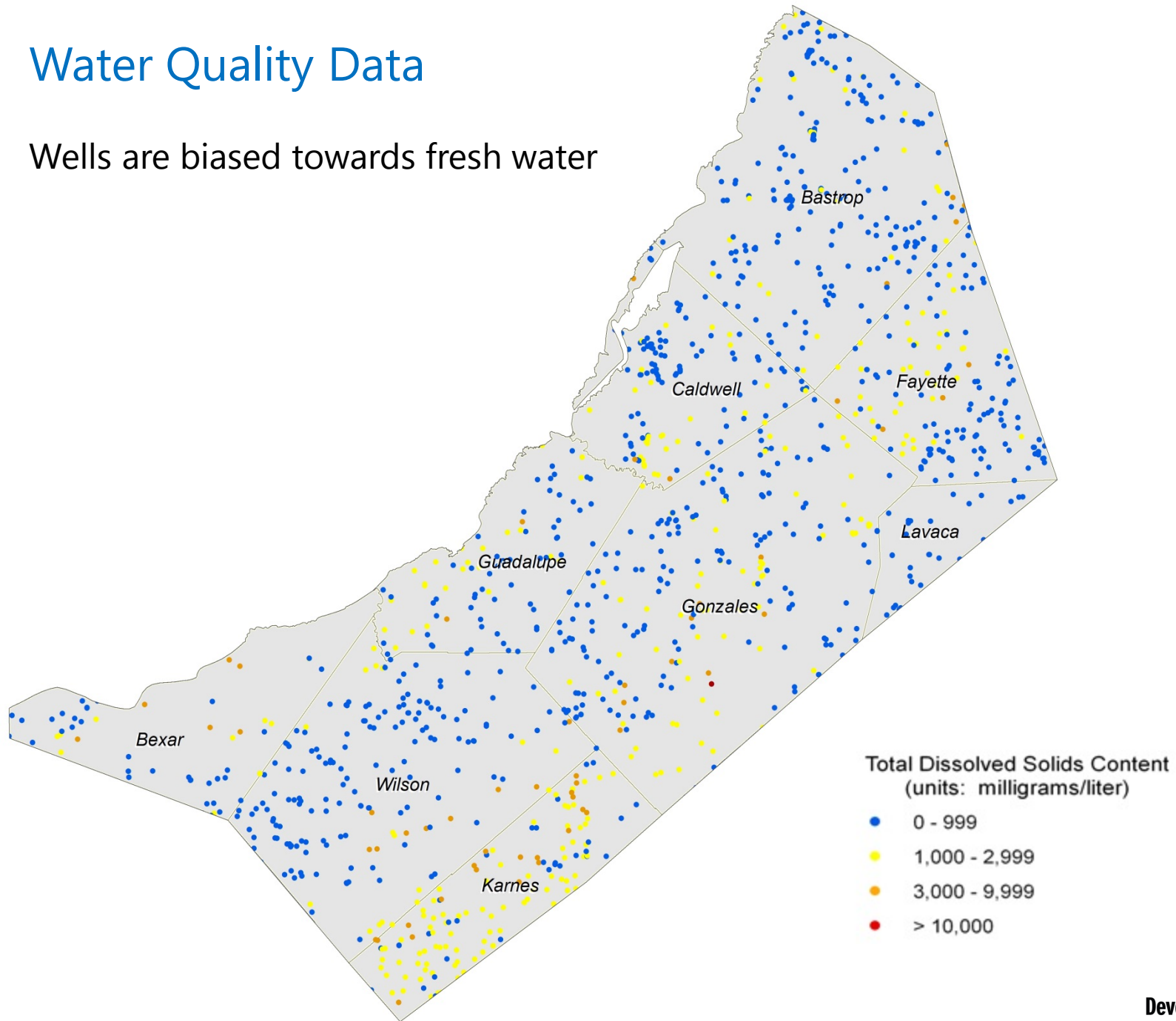
- Well yield
- Specific capacity
- Hydraulic conductivity
- Transmissivity
- Storativity
- Specific yield
- Test length
- Drawdown
- Report Reference (Myers, R 98)

Orange: BRACS Database

Green: TDLR Submitted Driller Logs

Water Quality Data

Wells are biased towards fresh water



Calculating TDS from Geophysical Well Logs

TWDB Water Science and Conservation Innovative Water Technologies Brackish Resources Aquifer Characterization System

Well Id **BRACS Geophysical Log Analysis for TDS Calculations** **White Field:** fill in **Load The New Data**
GL Number **Blue Field:** Auto Loaded **Close Form**
Depth Formation (Df): **Gray Field:** Calculated by CPU
Thickness Lithologic Unit: **SP Method** **Mean Ro**
TDS Interpreted **Ts** **Dt** **Alger - Harrison** **Rwa Method**
Consensus TDS Method **Tf** **Rmf** **Estepp** **Initials:** JEM
Tbh **Rmf Tf** **Remarks:** High sulfate water in the Pecos Valley Aquifer, Reeves County, Tx

TDS Method: **Rwe** **Rw** **Rw75** **Cw** **TDS** **Initials:** JEM

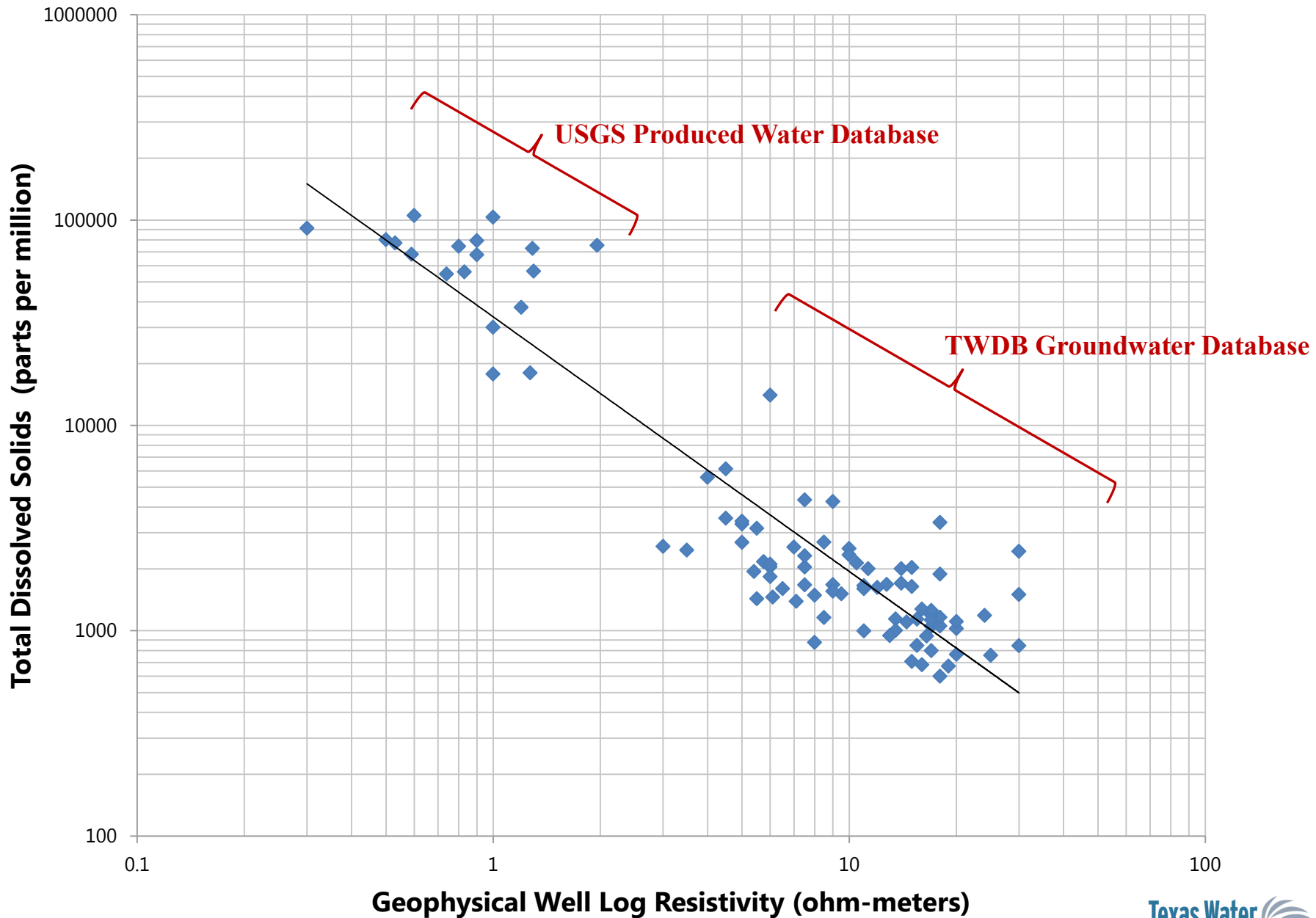
Geophysical Log Used:

SP **Correction Factors**
Rxo **70.21238** **K (Temperature):** SP Method
Ro **1.1** **Rwe Rw:** Sp, Alger Harrison, and Rwa Minimum Methods
Rxo / Ro **1** **Rmf:** SP and Alger Harrison Methods
m **0.7** **ct:** Many Methods
Source m **99** **Invasion Zone:** Alger Harrison Method
Porosity: **1** **m correction factor:** Estepp Method high anion waters
Source Porosity: **1** **Ro:** Mean Ro Method [Mean Ro Nomograph](#)

Chart
Remarks:

Record: of 1

Mean Ro TDS Method



Estimated Groundwater Volumes

Three TDS Ranges:

- Fresh (0-999 mg/L)
- Brackish (1,000 -2,999 mg/L)
(3,000 – 9,999 mg/L)
- Very Saline (> 10,000mg/L)

Organized by:

- Aquifer
- County
- Estimated Confined Availability
- Estimated Total Estimated Recoverable Storage

Use similar approach by:

“Brackish Groundwater Manual for Texas Regional Water Planning Groups”

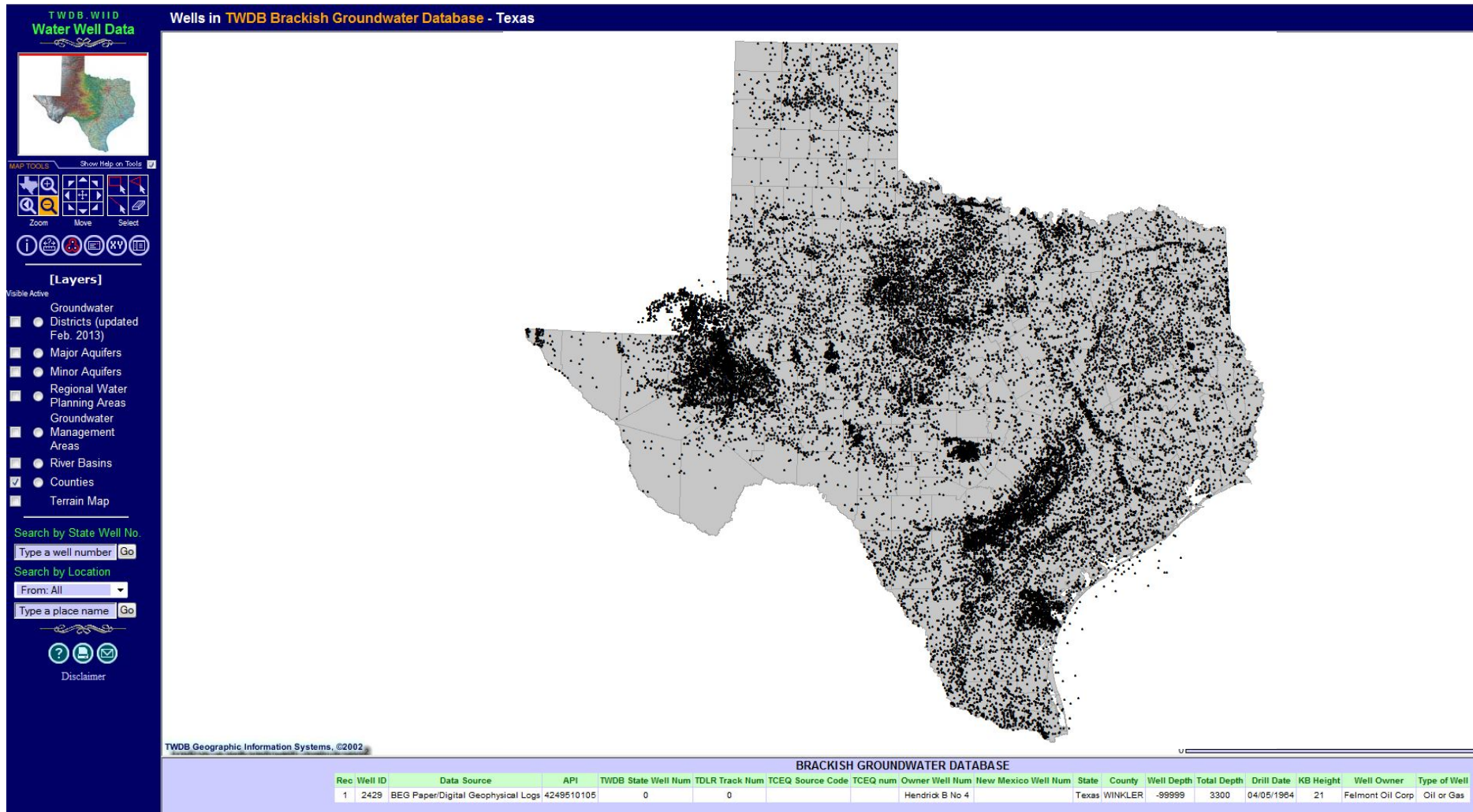
TWDB Groundwater Resources Division

Request for Information

Non-confidential data:

- Consultant reports
- Water quality data
- Well testing and aquifer parameters
- Geophysical well logs

BRACS well locations in WIID(*)



(*) WIID: Water Information Integration & Dissemination

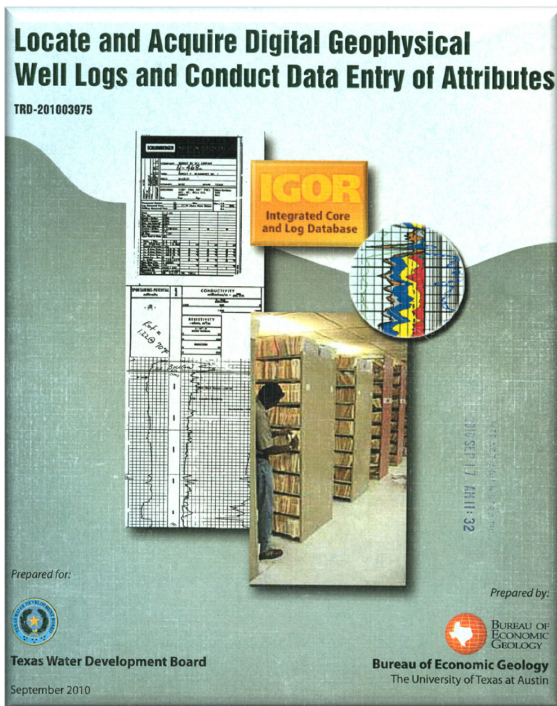
BRACS Projects

- Pecos Valley Aquifer, West Texas (*completed August 2011*)
- Gulf Coast Aquifer, Corpus Christi ASR Conservation District (*completed March 2012*)
- Queen City – Sparta Aquifer, Atascosa and McMullen counties (*final review in progress*)
- Carrizo – Wilcox Aquifer, Central Texas (*in progress*)
- Gulf Coast Aquifer, Lower Rio Grande Valley (*in progress*)

BRACS Contracted Studies

Well Log Collection

Locate and Acquire Digital Geophysical Well Logs and Conduct Data Entry of Attributes
TRD-201003975



IGOR
Integrated Core and Log Database

Prepared for:
Texas Water Development Board
September 2010

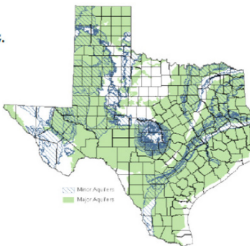
Prepared by:
BUREAU OF ECONOMIC GEOLOGY
The University of Texas at Austin

Geologic Bibliography

Aquifers of Texas Bibliography to Support the Brackish Resources Aquifer Characterization System (BRACS) Program

Final Report

Prepared by
Steven C. Young, Ph.D., P.E., P.G.
Bridget Ronayne



Prepared for:
Texas Water Development Board
P.O. Box 13231, Capitol Station
Austin, Texas 78711-3231

November 2011

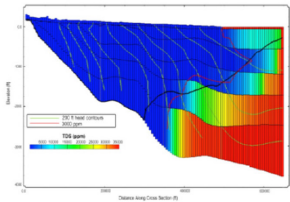
Texas Water Development Board

Variable Density Modeling

Assessment of Groundwater Modeling Approaches for Brackish Aquifers

Final Report

Prepared by
Neil E. Deeds, Ph.D., P.E.
Toya L. Jones, P.G.



Prepared for:
Texas Water Development Board
P.O. Box 13231, Capitol Station
Austin, Texas 78711-3231

November 2011

Texas Water Development Board

Desalination Studies and Demonstration Projects

Seawater pilot

FINAL Pilot Study Report Texas Seawater Desalination Demonstration Project



October 2008

Concentrate Management

Improving Recovery: A Concentrate Management Strategy for Inland Desalination



Report

by
Desmond F. Lawler, Ph.D., P.E.
Michael Cobb
Benny Freeman, Ph.D.
Lauren F. Greenlee, Ph.D.
Lynn Katz, Ph.D., P.E.
Kerry Kinney, Ph.D.
W. Shane Walker, Ph.D.

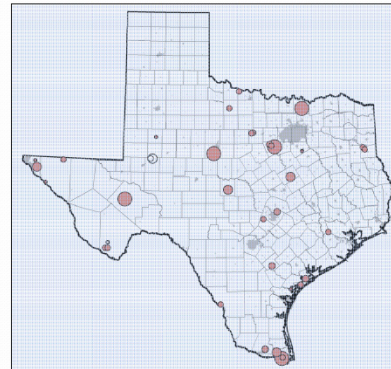
Texas Water Development Board

P.O. Box 13231, Capitol Station
Austin, Texas 78711-3231
August 2010



Information

A Desalination Database for Texas



Prepared for
Texas Water Development Board

Bureau of Economic Geology
Scott W. Tinker, Director
John A. and Katherine G. Jackson School of Geosciences
The University of Texas at Austin
Austin, Texas 78713-8924

Source Characterization

Brackish Groundwater Exploration Guidance Manual



Prepared for:

Upper Colorado River Authority and
Texas Water Development Board

April 2008

LBG-GUYTON ASSOCIATES
in association with
Freese and Nichols, Inc.



Summary

- Project completion scheduled for August 31, 2013
- All project information will be available on TWDB website
- All geophysical well log files available upon request
- Districts, public water systems, and other interested parties will be contacted by email when project is completed
- If you have non-confidential information to share we will gladly accept it

Texas Water Development Board



www.twdb.texas.gov

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John.meyer@twdb.texas.gov