



# Brackish Groundwater Characterization

by  
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# Texas Water Development Board

The logo for the Texas Water Development Board features the text "Texas Water" in a blue, sans-serif font, with "Development Board" in a black, sans-serif font below it. To the right of the text is a stylized graphic of three curved, overlapping lines in shades of blue, resembling waves or a fan.

The following presentation is based upon professional research and analysis within the scope of the Texas Water Development Board's statutory responsibilities and priorities but, unless specifically noted, does not necessarily reflect official Board positions or decisions.

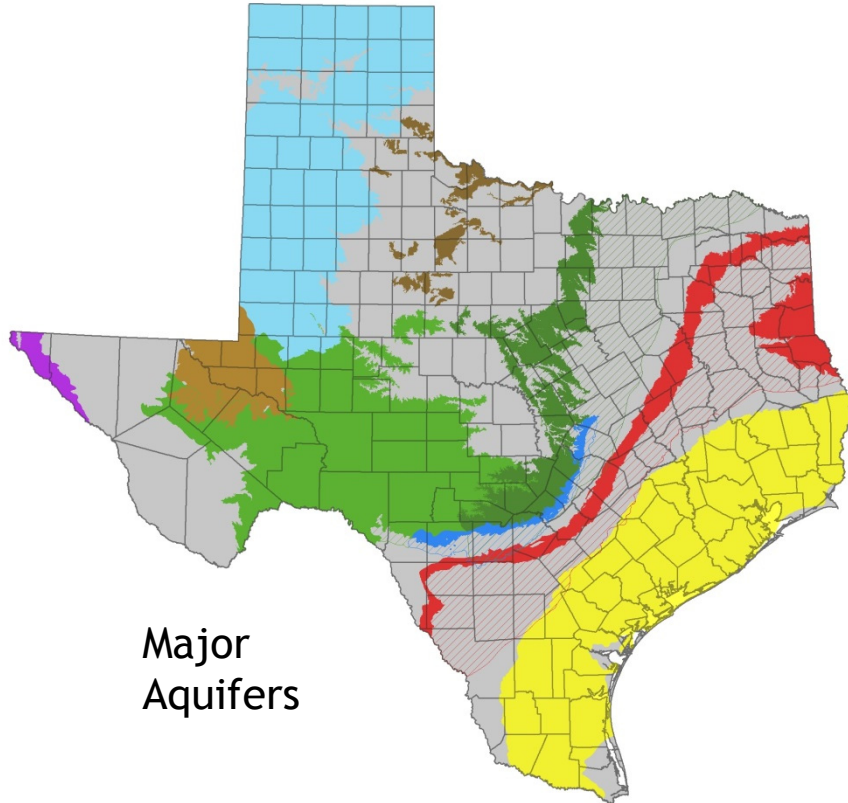
*Source: TWDB General Counsel*

A decorative graphic at the bottom of the slide consists of several overlapping, wavy lines in various shades of blue, creating a sense of movement and depth. The lines are more densely packed on the right side and spread out towards the left.

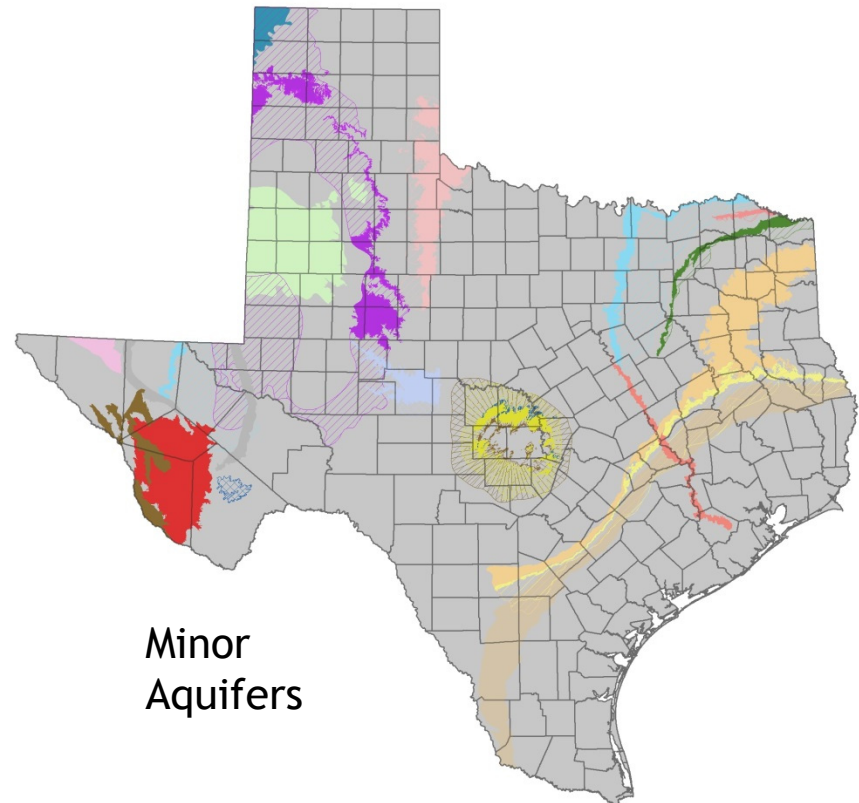
Fresh and slightly saline groundwater resources are well known.

TWDB has conducted/funded decades of projects defining the 30 major and minor aquifers:

well data, published reports, groundwater models.



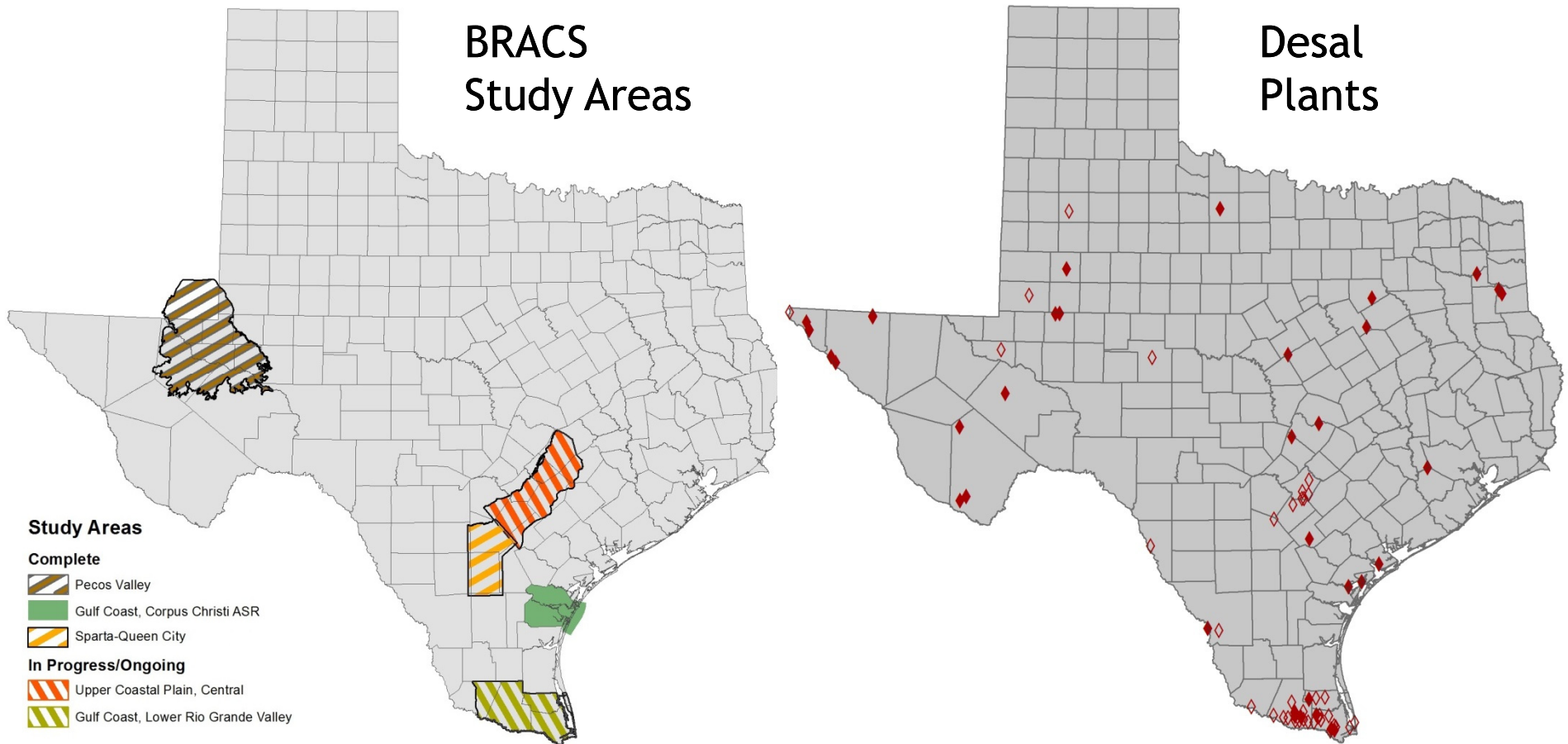
Major  
Aquifers



Minor  
Aquifers

Development of brackish groundwater requires the same level of effort as the fresh groundwater resources.

Texas needs fundamental data: wells, aquifer tests, aquifer characterization, water quality data, ...



# Groundwater Salinity Classification and Color Scheme

Groundwater Salinity Classification	Salinity Zone Code	Total Dissolved Solids Concentration (units: milligrams per liter)
Fresh	FR	0 to 1,000
Slightly Saline	SS	1,000 to 3,000
Moderately Saline	MS	3,000 to 10,000
Very Saline	VS	10,000 to 35,000
Brine	BR	Greater than 35,000

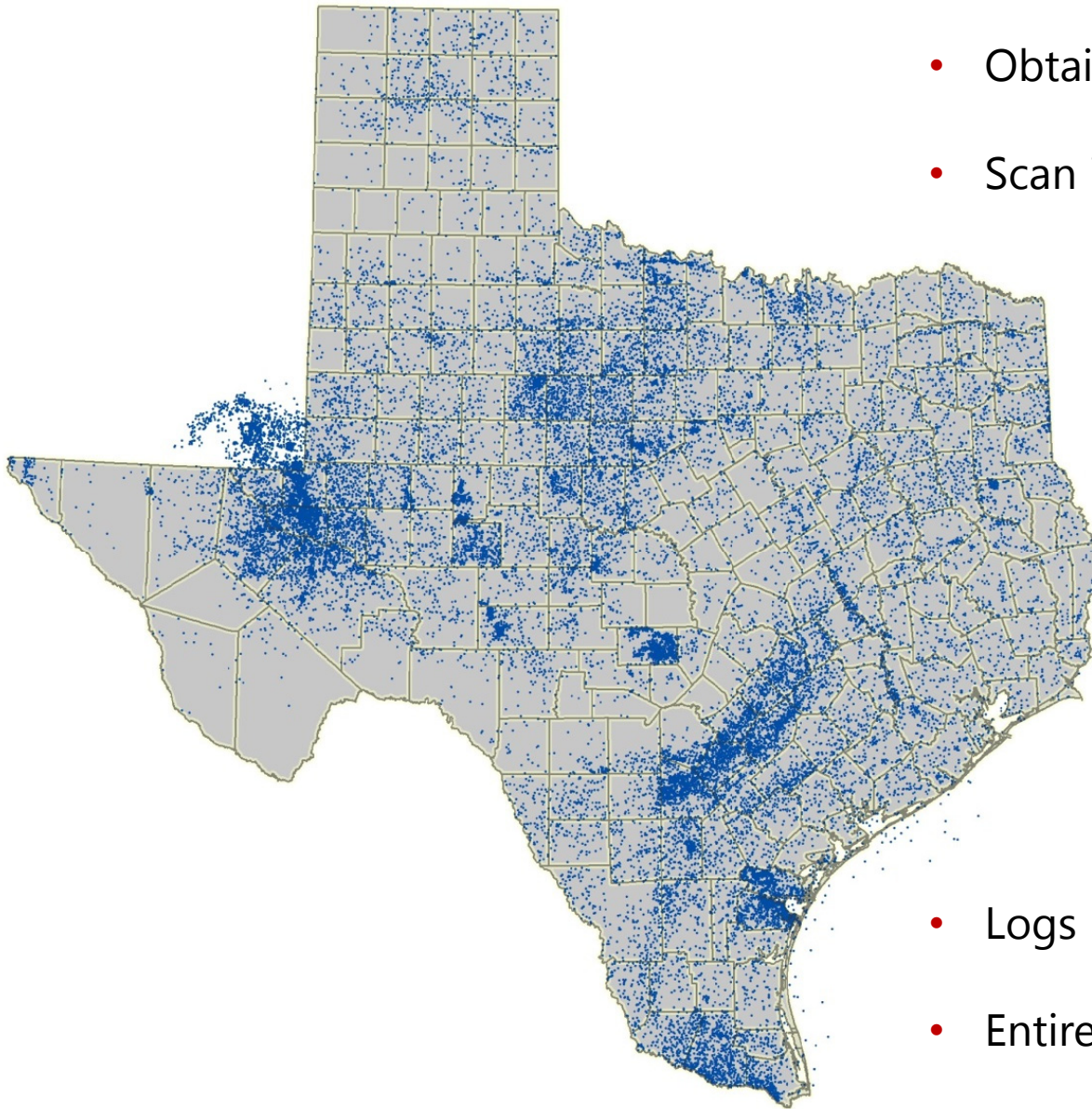
Source: modified from Winslow and Kister, 1956

## BRACS: Brackish Resources Aquifer Characterization System

- collect well logs (water, oil/gas)
- build geologic datasets (database, GIS)
- compile aquifer properties (chemistry; productivity)
- map aquifer extent to 10,000+ mg/L TDS
- map key desalination water quality parameters
- estimate volumes of water
- provide all data to stakeholders
- *each aquifer will require unique analysis based on data availability and local hydrogeology*

# BRACS Geophysical Well Log Collection

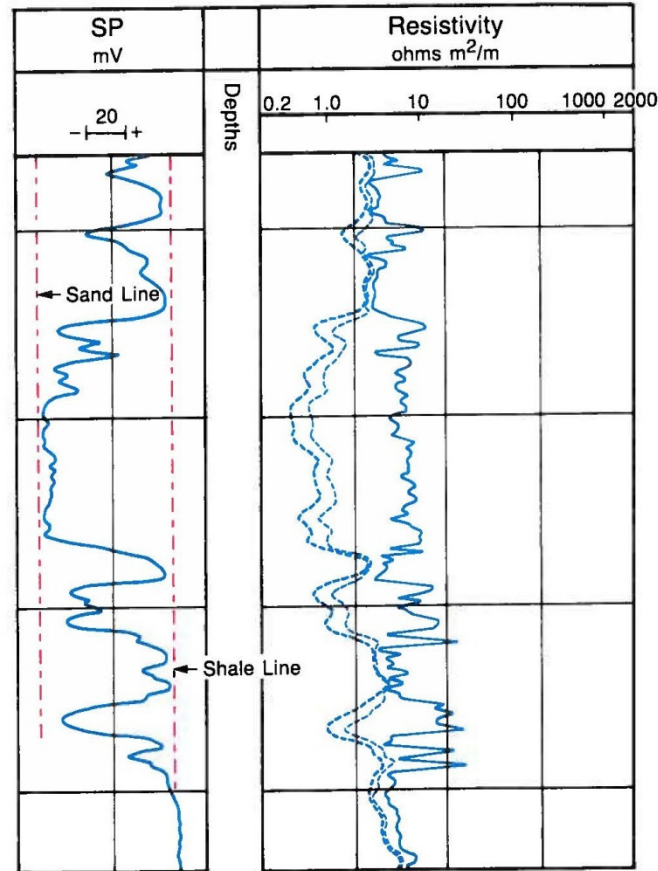
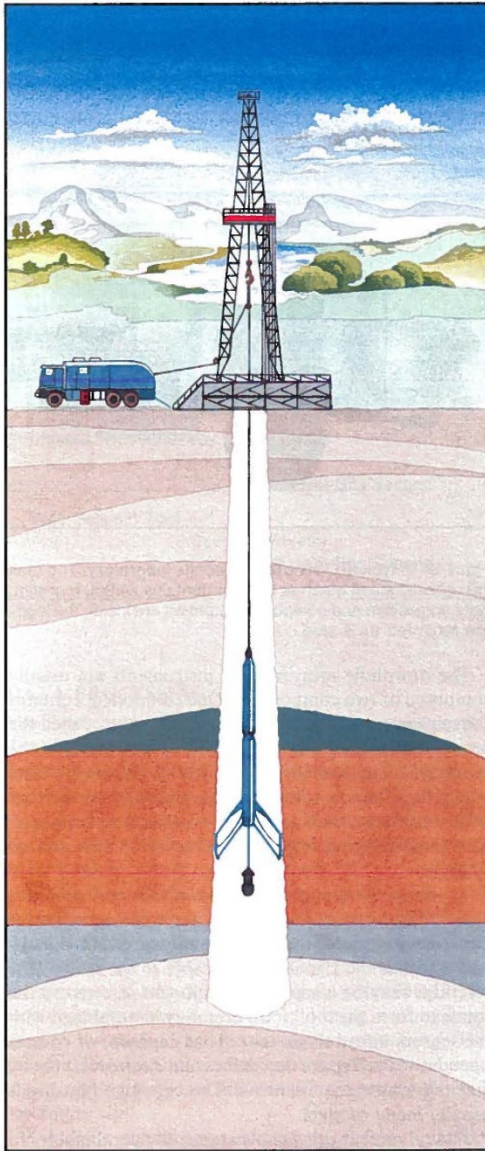
- Obtain oil, gas, and water well logs
- Scan into digital TIFF image files



- Logs must be non-confidential
- Entire collection available to the public

*BRACS well control > 45,000 wells*

# What is a Geophysical Well Log?



A tool or combination of tools lowered into a borehole on a wireline and retrieved to the surface.

Tools are designed to record specific parameters.

Also known as: electrical logging; wireline logging.

Logs must be corrected for a number of parameters.

Tool response recorded in left and right tracks.

Source: Schlumberger, 1987: *Log interpretation principles/applications*



# Database Tables

## TWDB Groundwater Database

(> 138,000 records)

- Well Data
- Remarks
- Water Levels
- Water Chemistry (2 tables)
- Casing
  
- (WIID: Digital Water Well Reports)

## TWDB BRACS Database

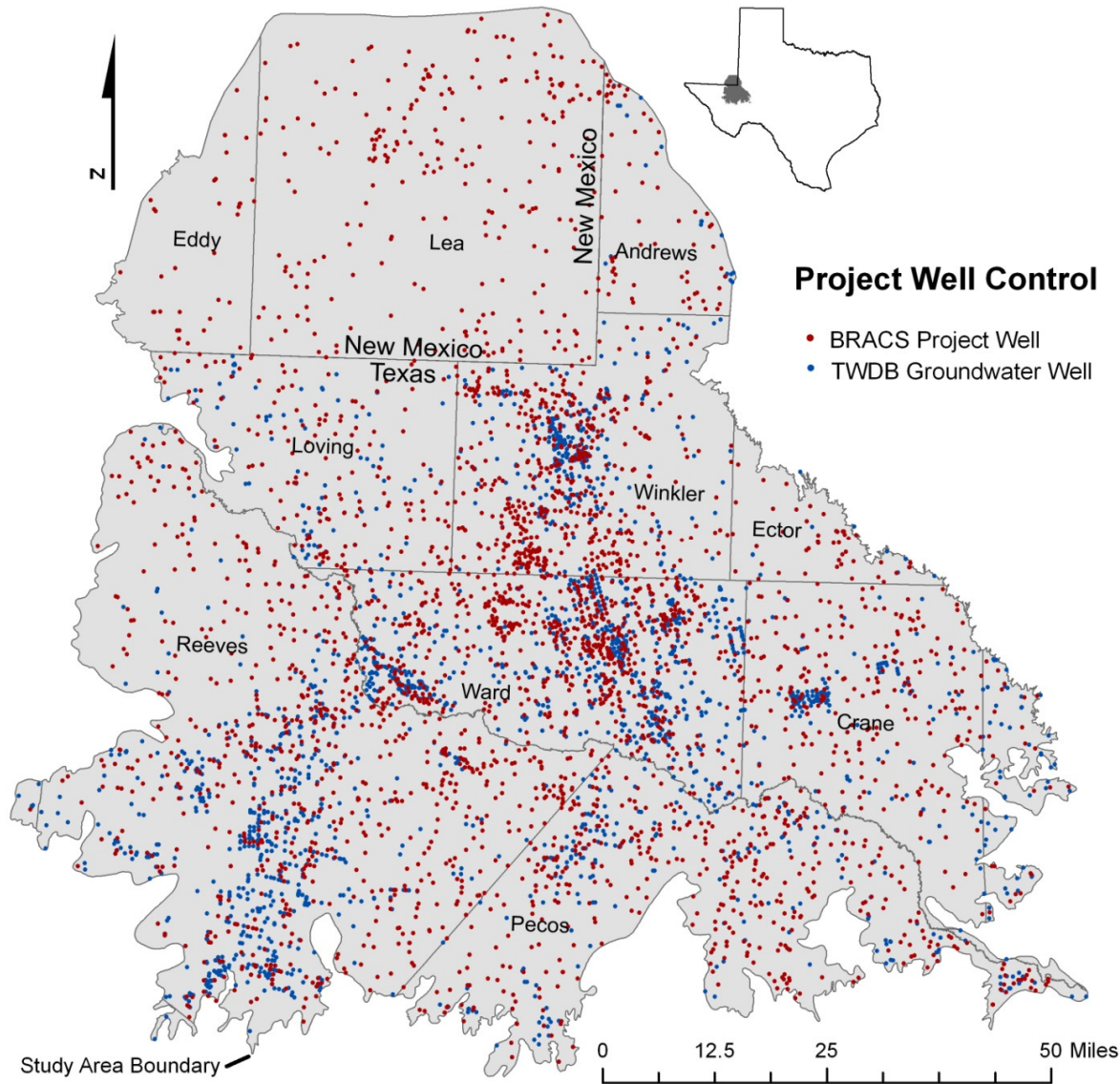
(> 45,000 records)

- Well Data (location, depth, owner, ...)
- Water Levels
- Water Chemistry (2 tables)
- Casing
  
- Digital Water Well Reports

New  
Tables

- Foreign Keys (well ids; links to other databases)
- Well Geology (lithology, stratigraphy, saline zones)
- Net Sand and Sand Percent
- Interpreted TDS from Geophysical Logs
- Aquifer Determination Analysis
- Digital Geophysical Well Logs
- Geophysical Well Log Suites
- Aquifer Test Information
- Study-specific data

# Project Well Control: oil/gas and water wells

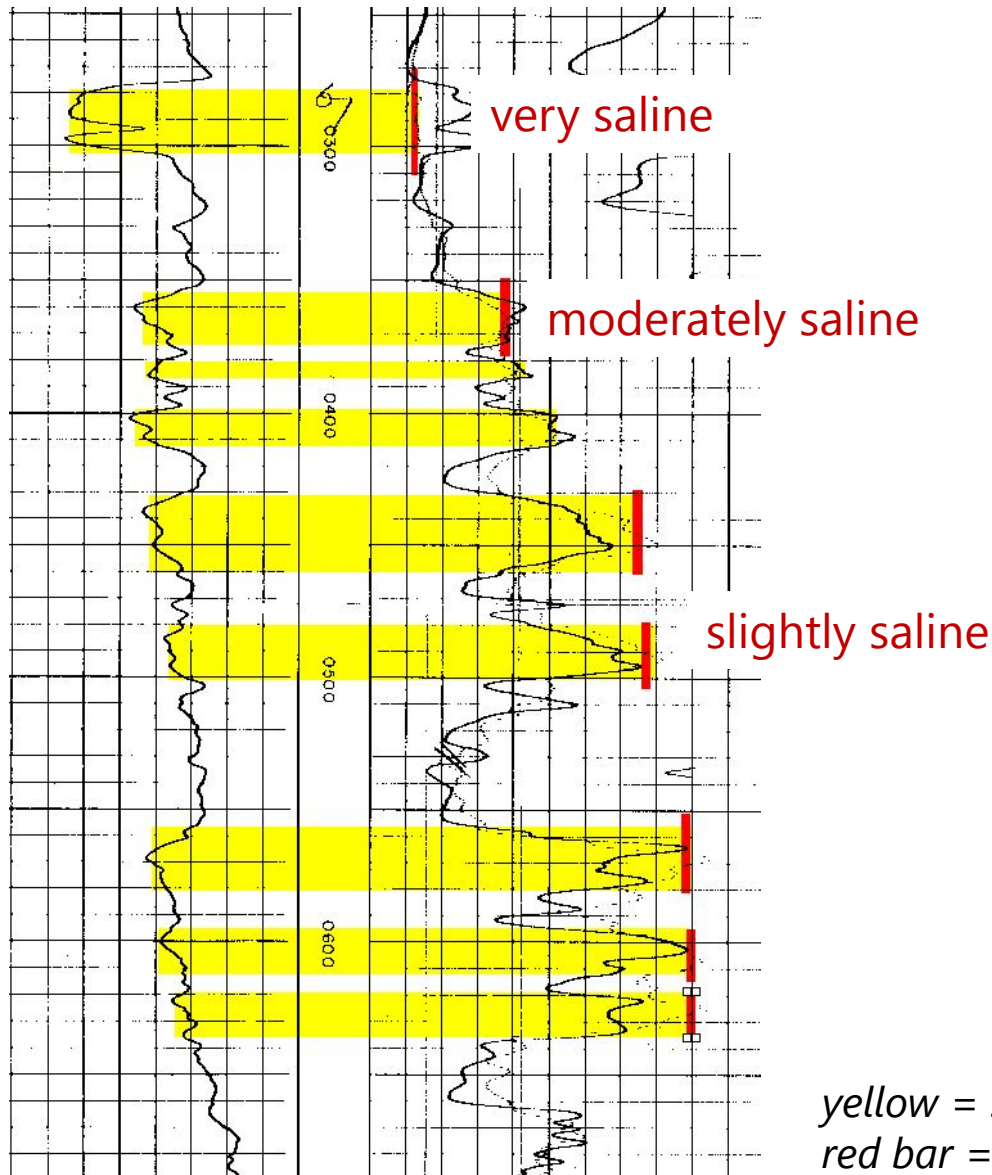


*Thousands of data points are added in a study*

Source: Pecos Valley Aquifer BRACS Study

## Geophysical Well Logs used for:

- Geology  
(sand, clay, ...  
depositional environment)
- Aquifer extent  
top and bottom depths
- Fault identification
- Salinity zone  
top and bottom depths

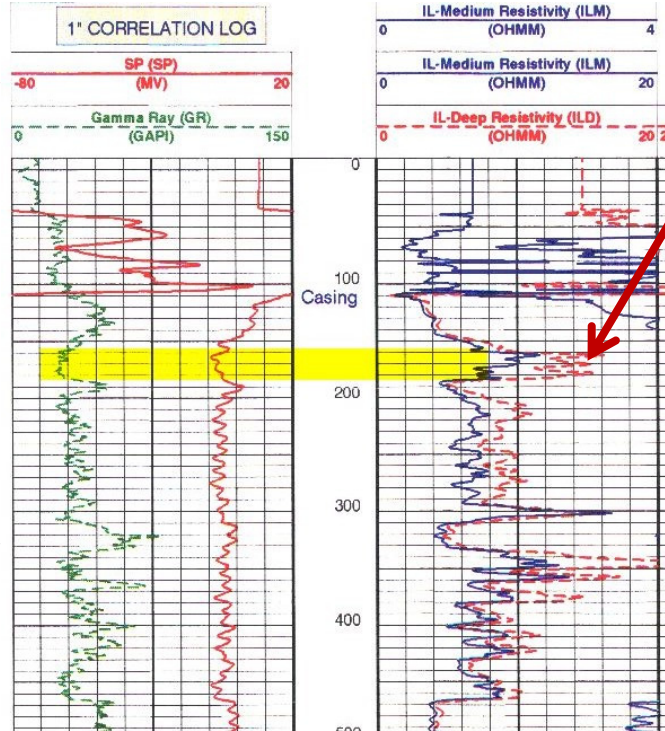
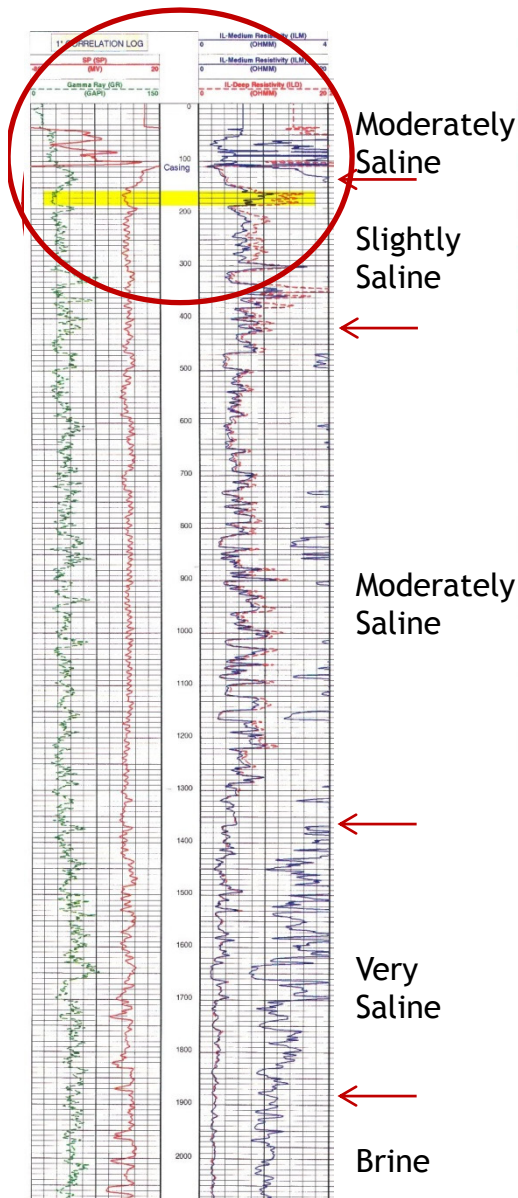


*Logs can be used to evaluate the entire aquifer, whereas data from water wells typically ends at the base of fresh to slightly saline water zones*

*yellow = sands  
red bar = maximum deep resistivity*

Source: Lower Rio Grande Valley BRACS Study

# Log Analysis



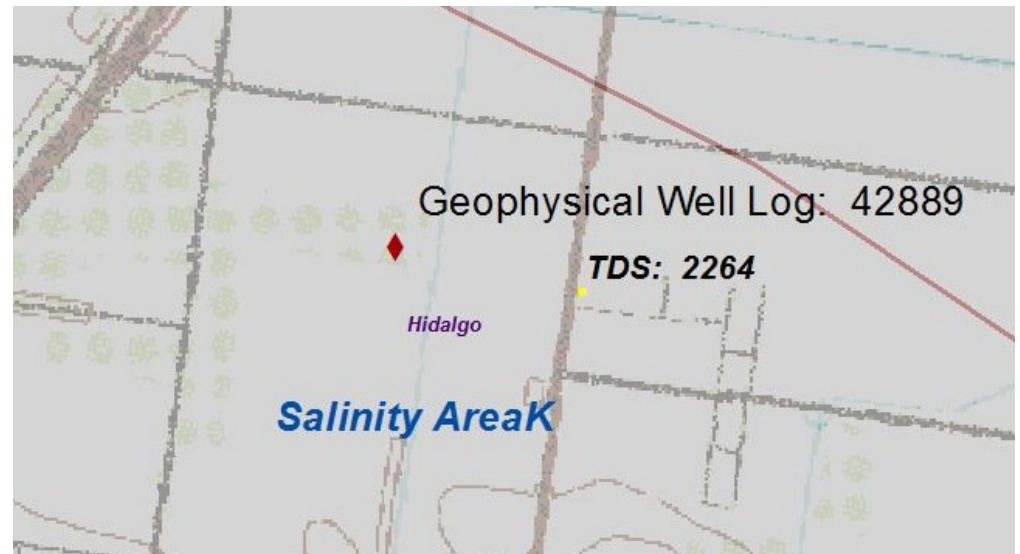
At 160 ft = 15 ohm-meter

Rwa Minimum Method  
interpreted TDS = 2,500 mg/L

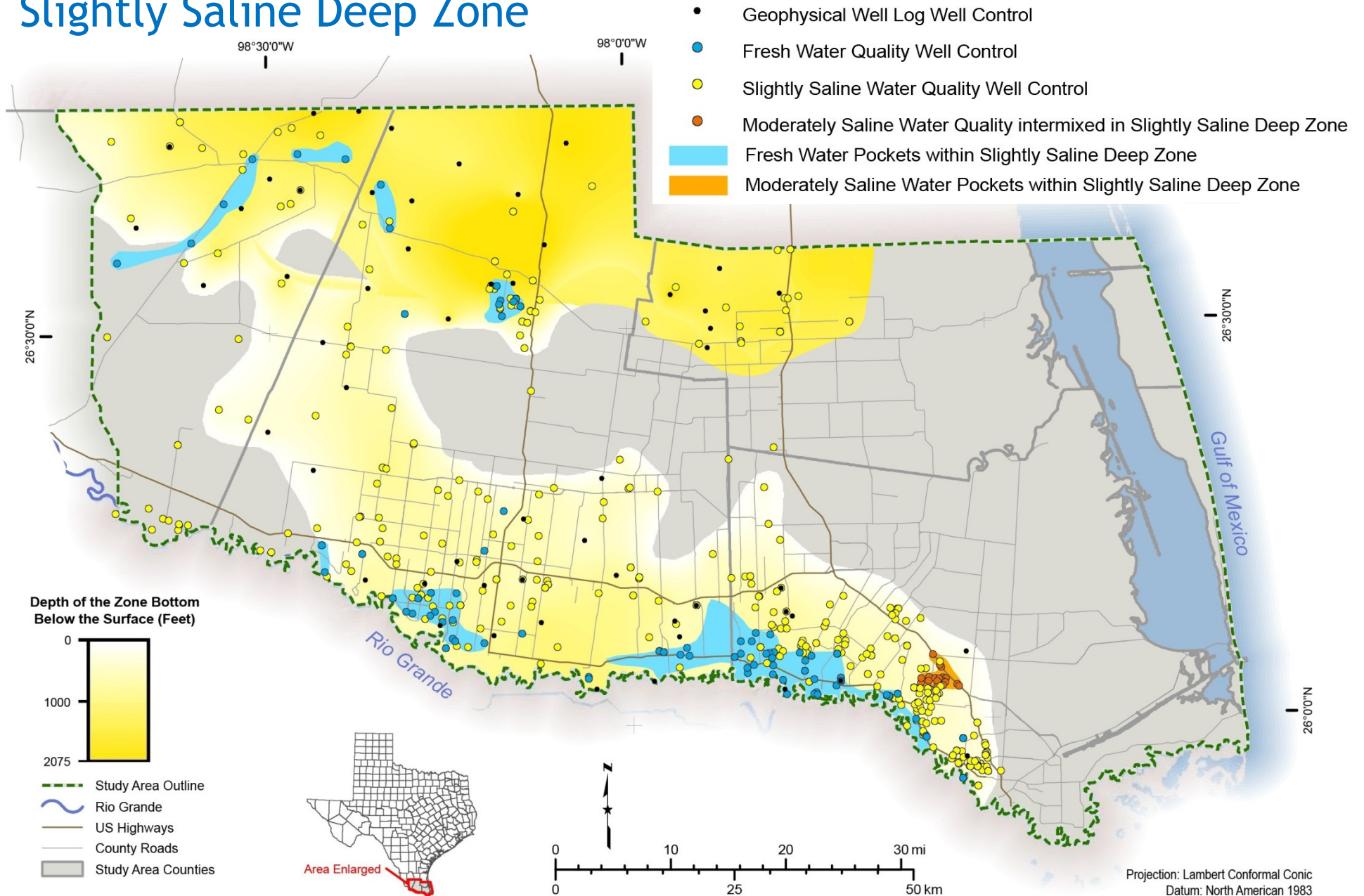
Water Well  
TDS concentration = 2,264 mg/L  
(well screen 170-349 ft)

BRACS Well ID 42889

Source: Lower Rio Grande Valley BRACS Study

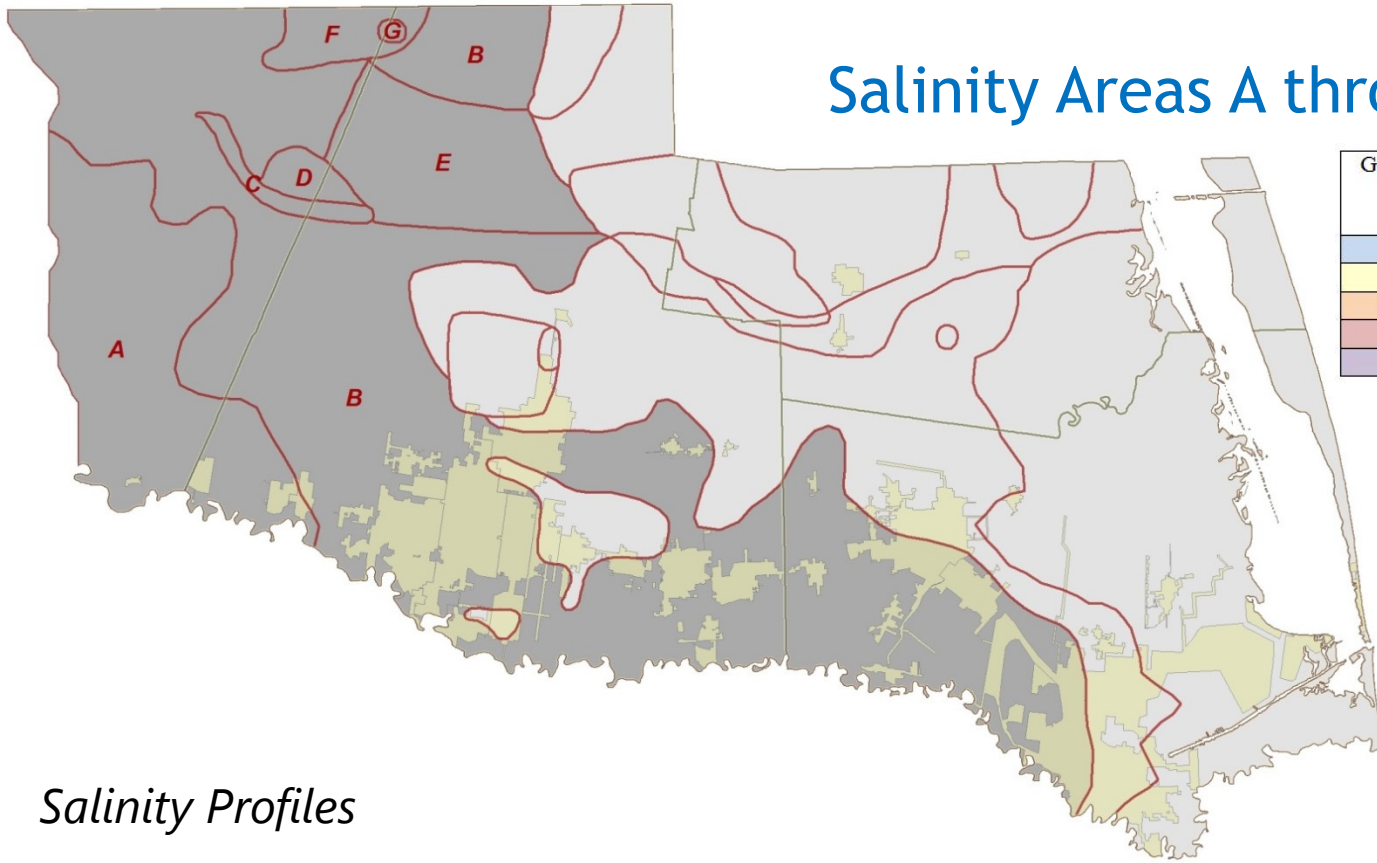


# Slightly Saline Deep Zone



Source: Lower Rio Grande Valley BRACS Study

# Salinity Areas A through G



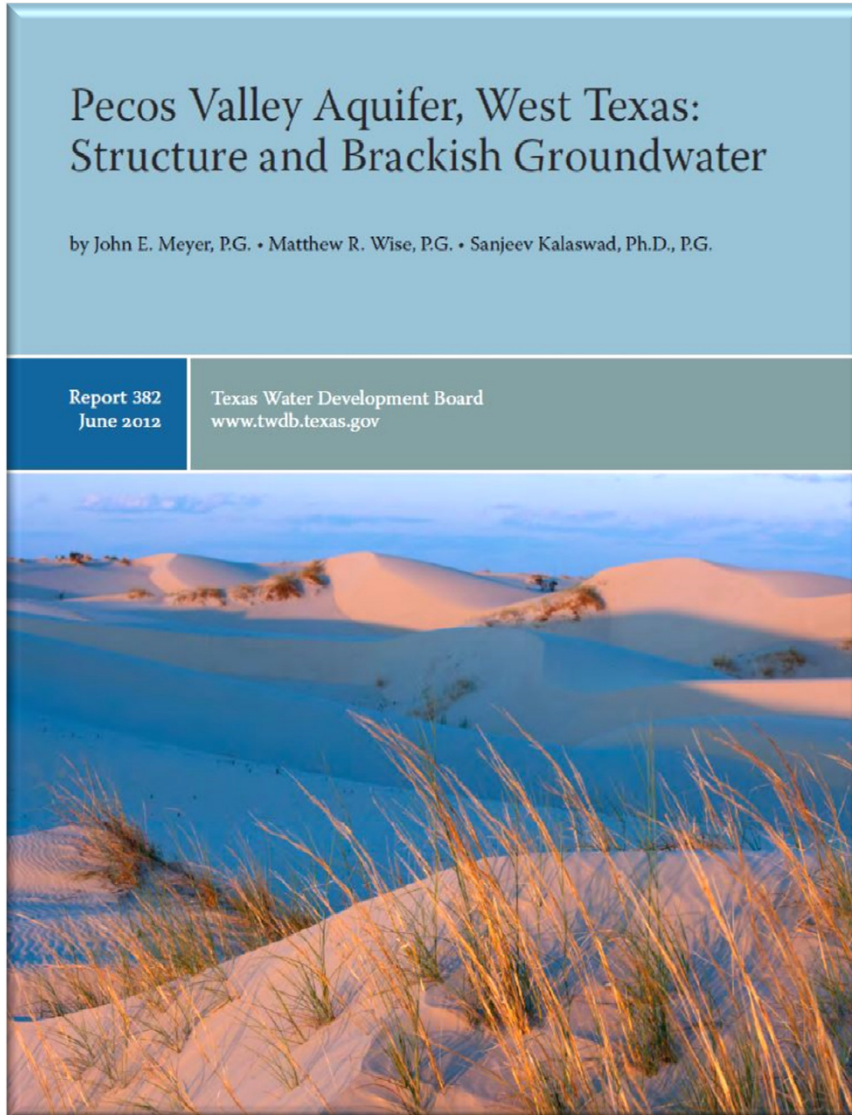
Groundwater Salinity Classification	Total Dissolved Solids Concentration (units: milligrams per liter)
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## Salinity Profiles

A	B	C	D	E	F	G
				SS Shallow 2		VS Shallow 1
		MS Shallow 5		MS Intermediate 1	MS Shallow 4	MS Shallow 4
	SS Deep	SS Deep		SS Deep	SS Deep	SS Deep
MS Deep	MS Deep	MS Deep	MS Deep	MS Deep	MS Deep	MS Deep
VS Deep	VS Deep	VS Deep	VS Deep	VS Deep	VS Deep	VS Deep
BR Deep	BR Deep	BR Deep	BR Deep	BR Deep	BR Deep	BR Deep

Source: Lower Rio Grande Valley BRACS Study

# Project Deliverables



- Published, peer-reviewed report
- GIS Datasets
- BRACS Database
- Well logs

*The real value is in the data:*

*Stakeholders can use this to evaluate potential groundwater exploration areas with GIS and review the interpreted and raw well logs.*

## Summary

- Detailed brackish groundwater resource evaluation – quantity, quality, distribution
- Significant areas of the state need to be evaluated
- BRACS studies (with this level of detail) take a lot of resources
- These studies can be used to support aquifer storage and recovery evaluations by characterizing an aquifer in great detail
- Continue evaluating techniques of geophysical well log interpretation
- BRACS study deliverables available on TWDB website
- Geophysical well log files available upon request
- Future efforts: variable-density modeling, airborne geophysics, collect more data



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