



Brackish Groundwater Characterization

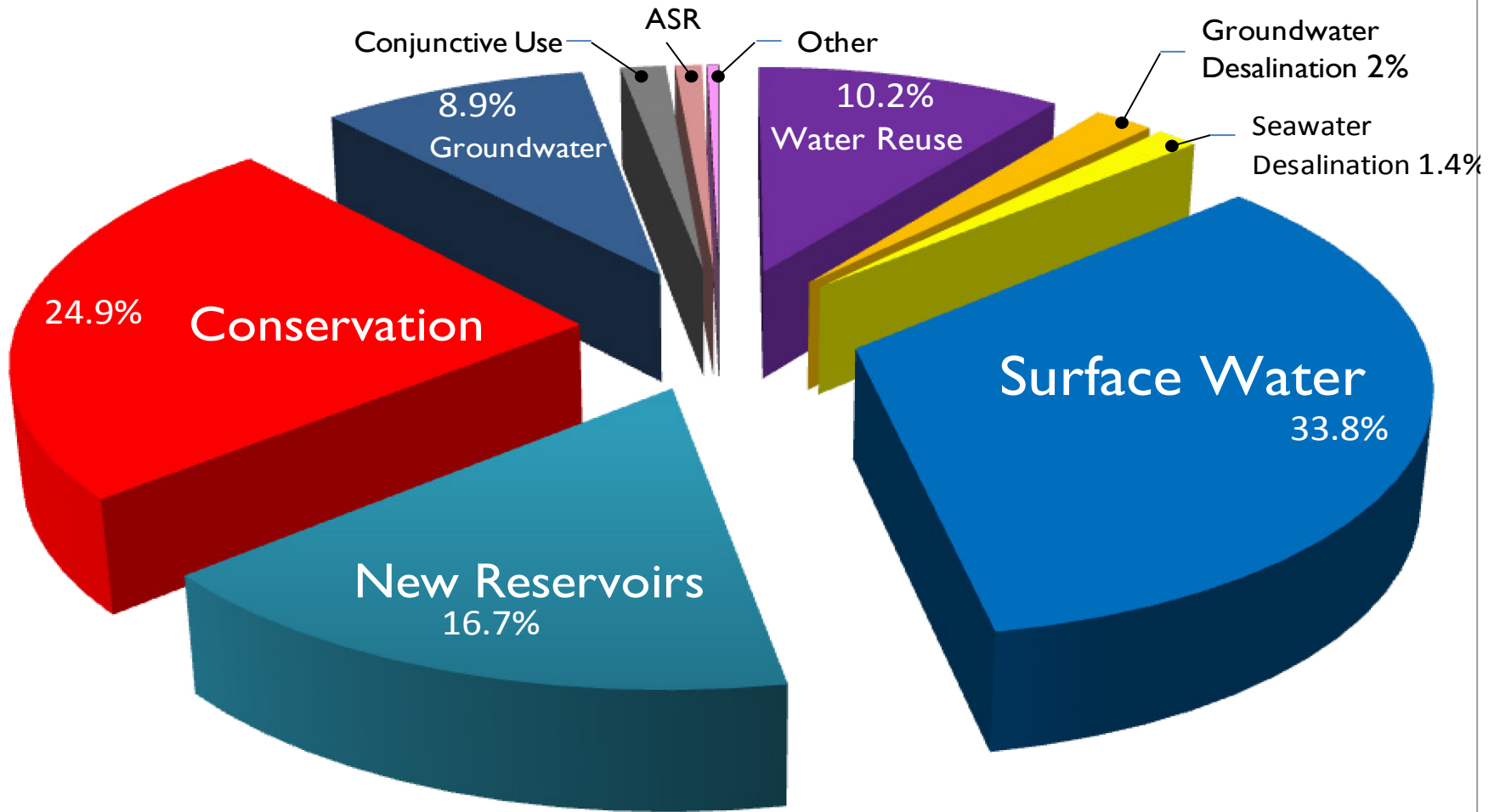
by
John Meyer, P.G.

Texas Aquifer Conference
June 2, 2014

The statements contained in this presentation are my current views and opinions and are not intended to reflect the positions of, or information from, the Texas Water Development Board, nor is it an indication of any official policy position of the Board.

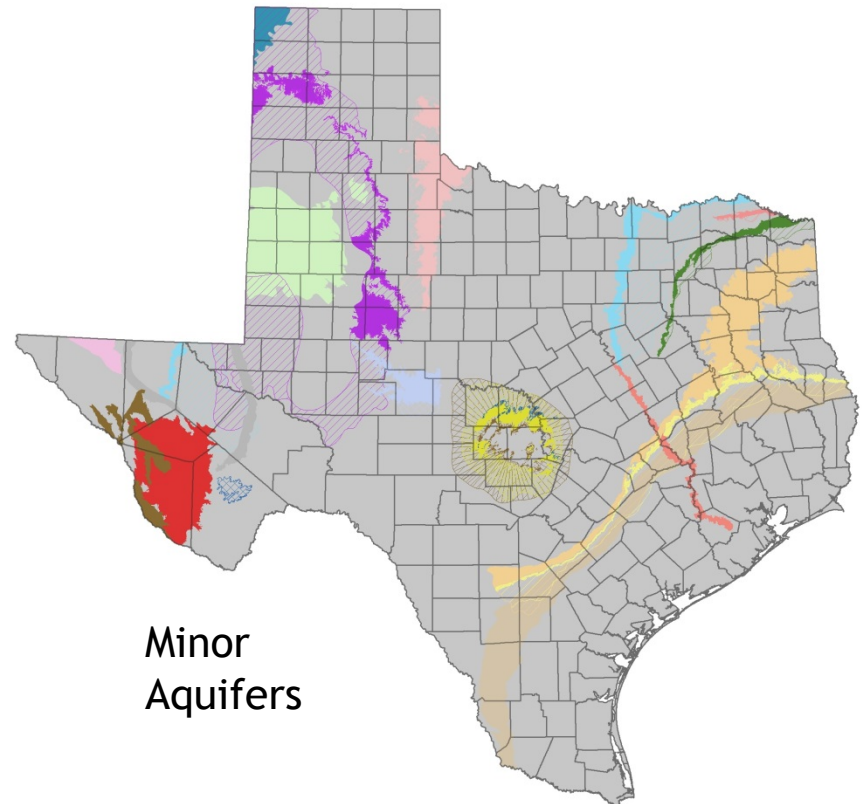
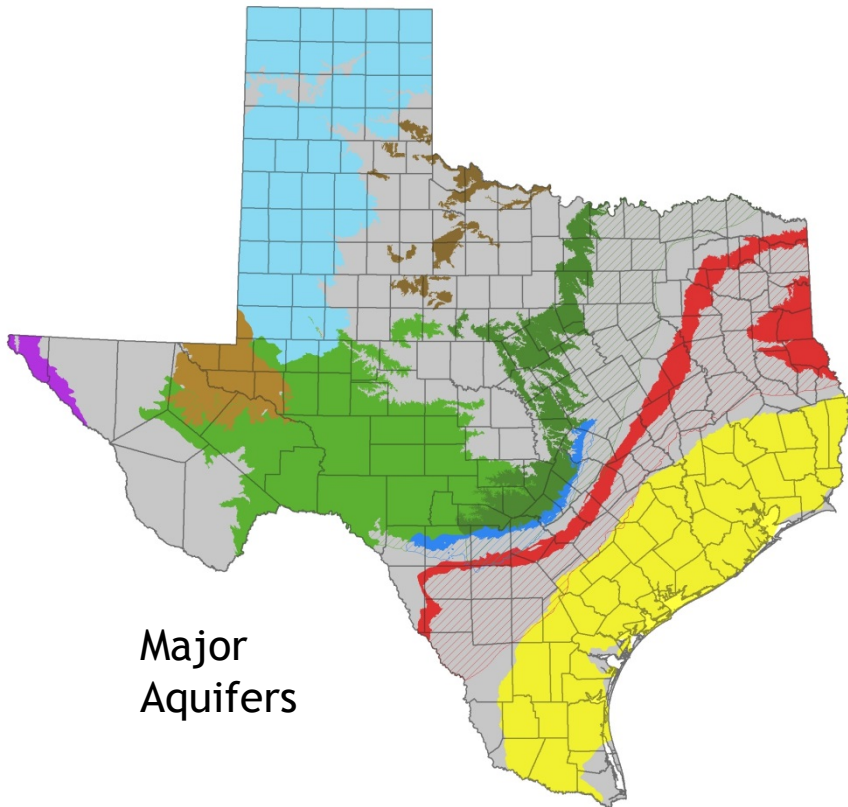


Cumulative Water Management Strategies by 2060



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



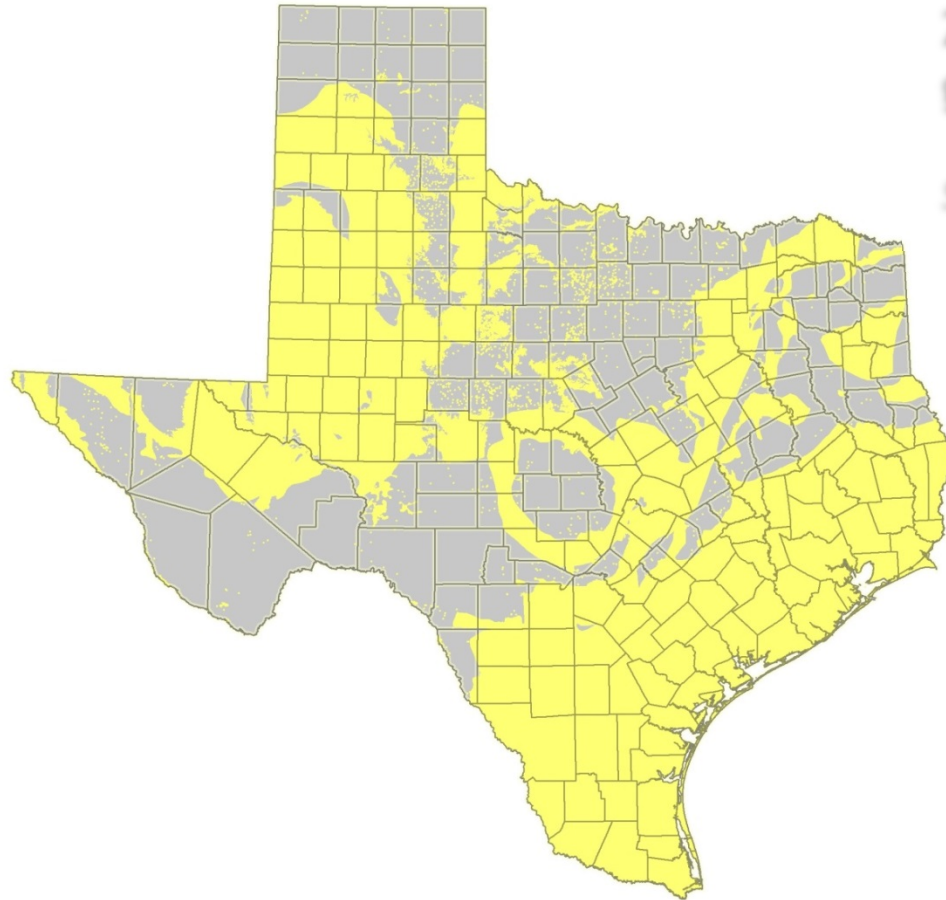
Brackish groundwater resources have been used throughout Texas' history for domestic, livestock, and agriculture.

The first well at the Capitol was brackish



Aquifer: Trinity
Depth: 1,554 ft
Flow: 60 gpm
TDS: 1,460 mg/L

- 81st Texas Legislature (2009) provided funding to implement the TWDB Brackish Resources Aquifer Characterization System (BRACS) program
- 83rd Texas Legislature (2013) provided additional funding for personnel



2.7 billion acre-feet of brackish groundwater estimated in Texas

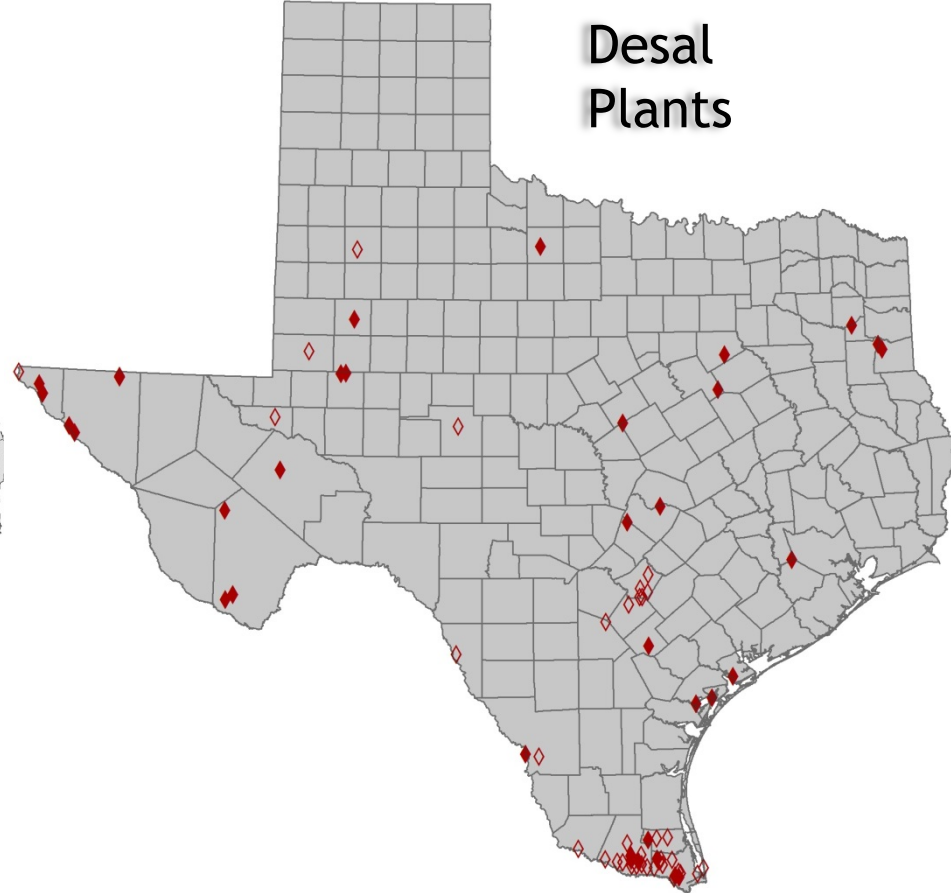
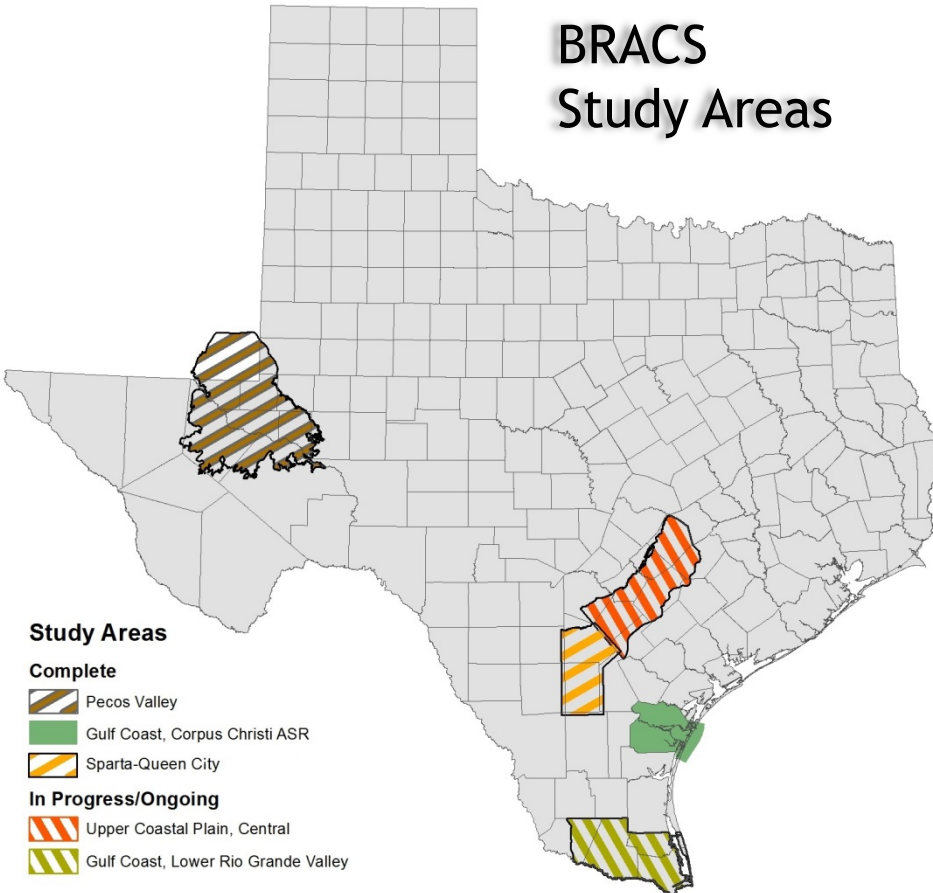
Source: LBG-Guyton, 2003

Brackish groundwater in the major and minor aquifers

Large-scale development of brackish groundwater requires the same level of evaluation as the fresh groundwater resources.

BRACS Study Areas

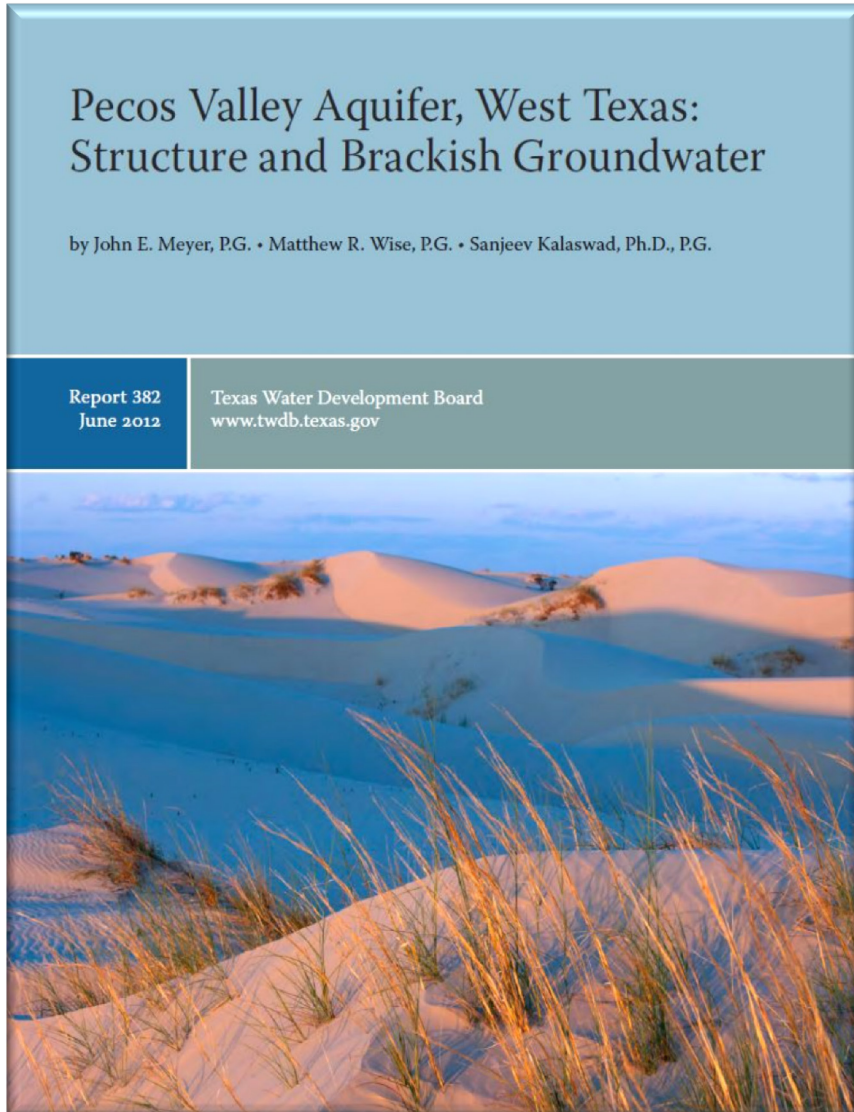
Desal Plants



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
- *each aquifer may will require unique analysis based on data availability and local hydrogeology*

Project Deliverables

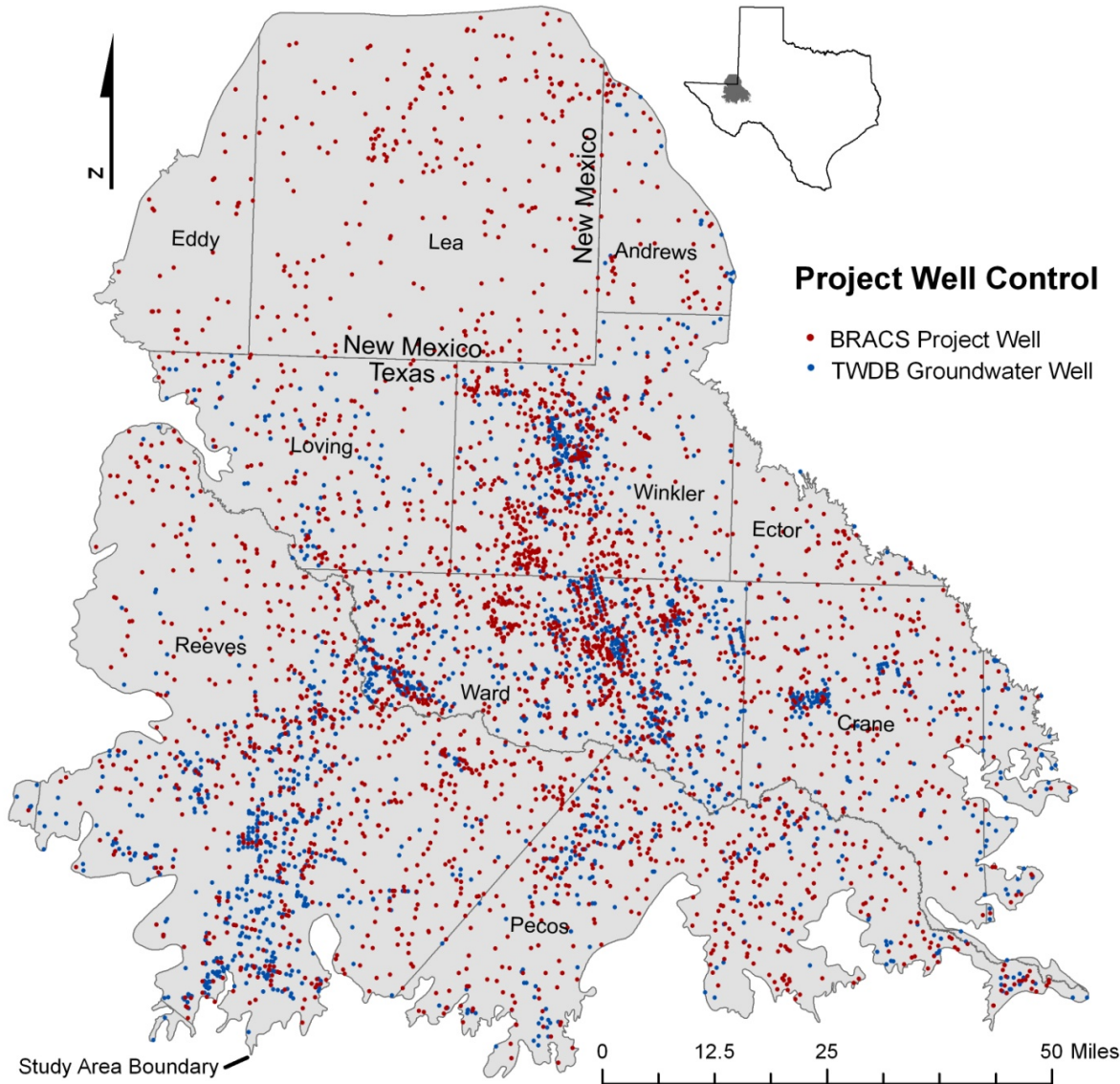


- Published, peer-reviewed report
- GIS Datasets
- BRACS Database
- Well logs

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.

Project Well Control: oil/gas and water wells



Thousands of data points are added in a study

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

(> 43,000 records)

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

- Digital Water Well Reports

New
Tables

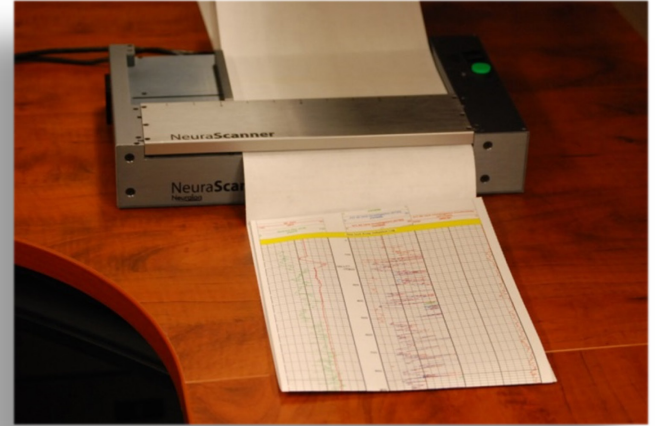
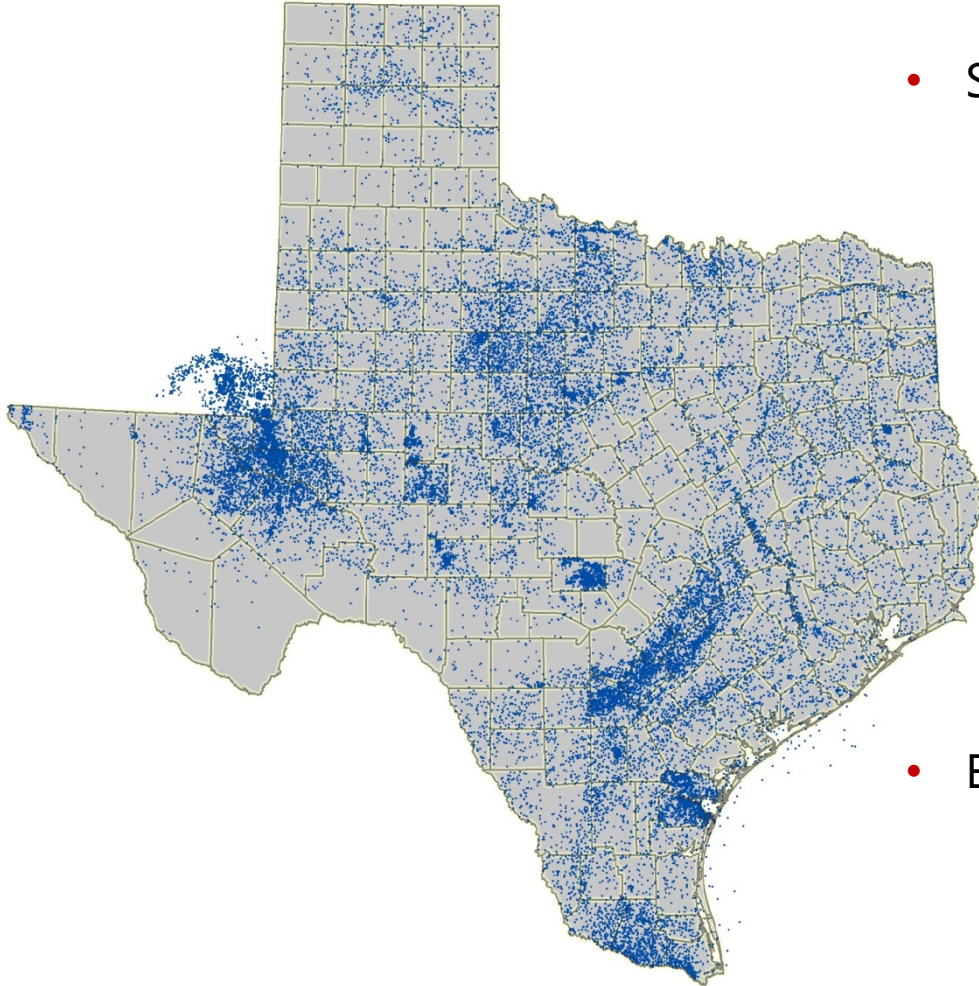
- Foreign Keys (well ids; links to other databases)
- Well Geology (lithology, stratigraphy, saline zones)
- Net Sand and Sand Percent
- Interpreted TDS from Geophysical Logs
- Aquifer Determination Analysis
- Digital Geophysical Well Logs
- Geophysical Well Log Suites
- Aquifer Test Information
- Study-specific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

BRACS Database

- Microsoft Access® relational design
- Contains all of the well data and interpretations
- Hyperlinks to thousands of digital geophysical well logs and water well reports
- Designed to process information (Visual Basic Code)
- Link to additional databases through key fields
- Available on our website
- Well locations on a GIS layer on the WIID website

BRACS Geophysical Well Log Collection

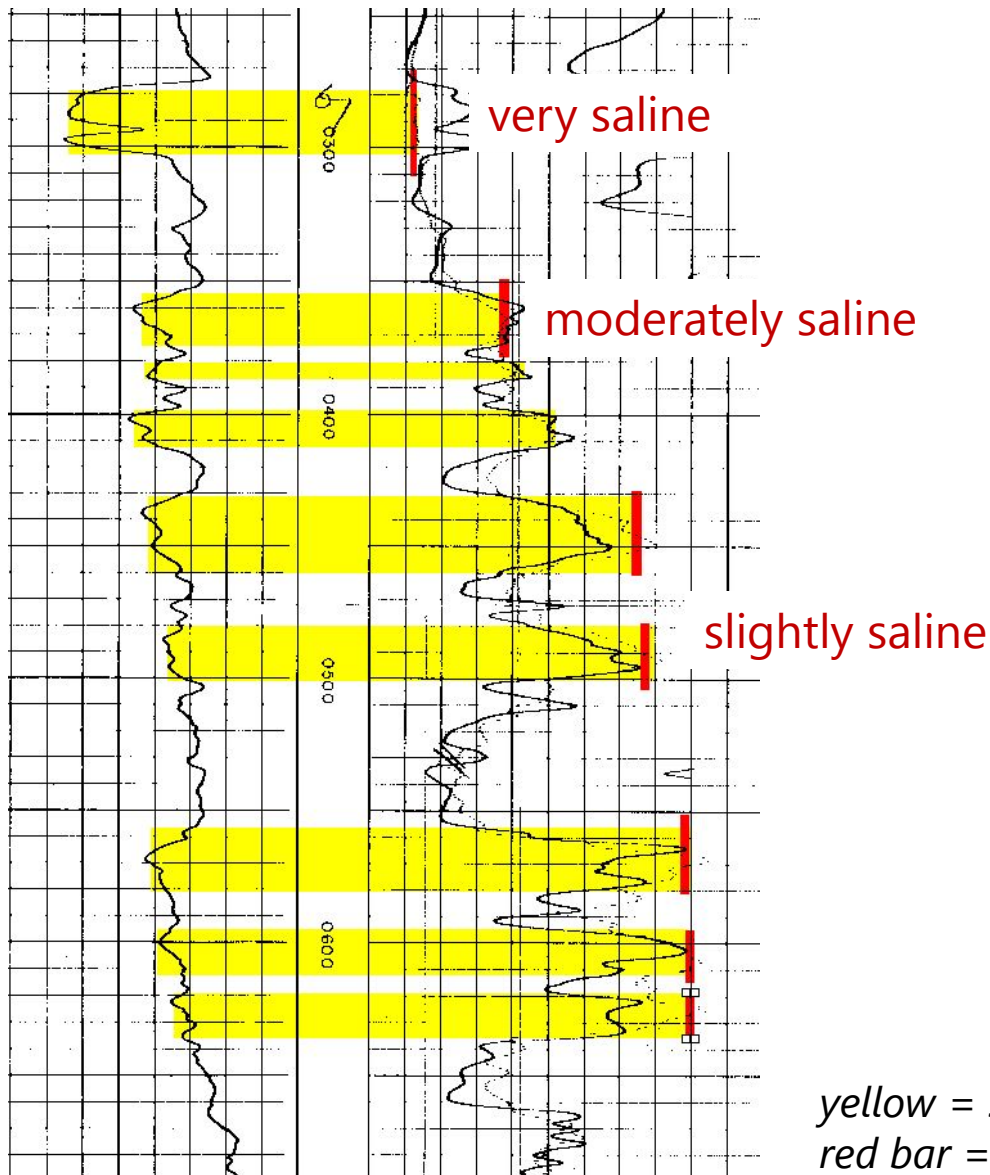
- Obtain oil, gas, and water well logs
- Scan into digital TIFF image files



- Entire collection available to the public

BRACS well control > 43,000 wells

Geophysical Well Logs used for:

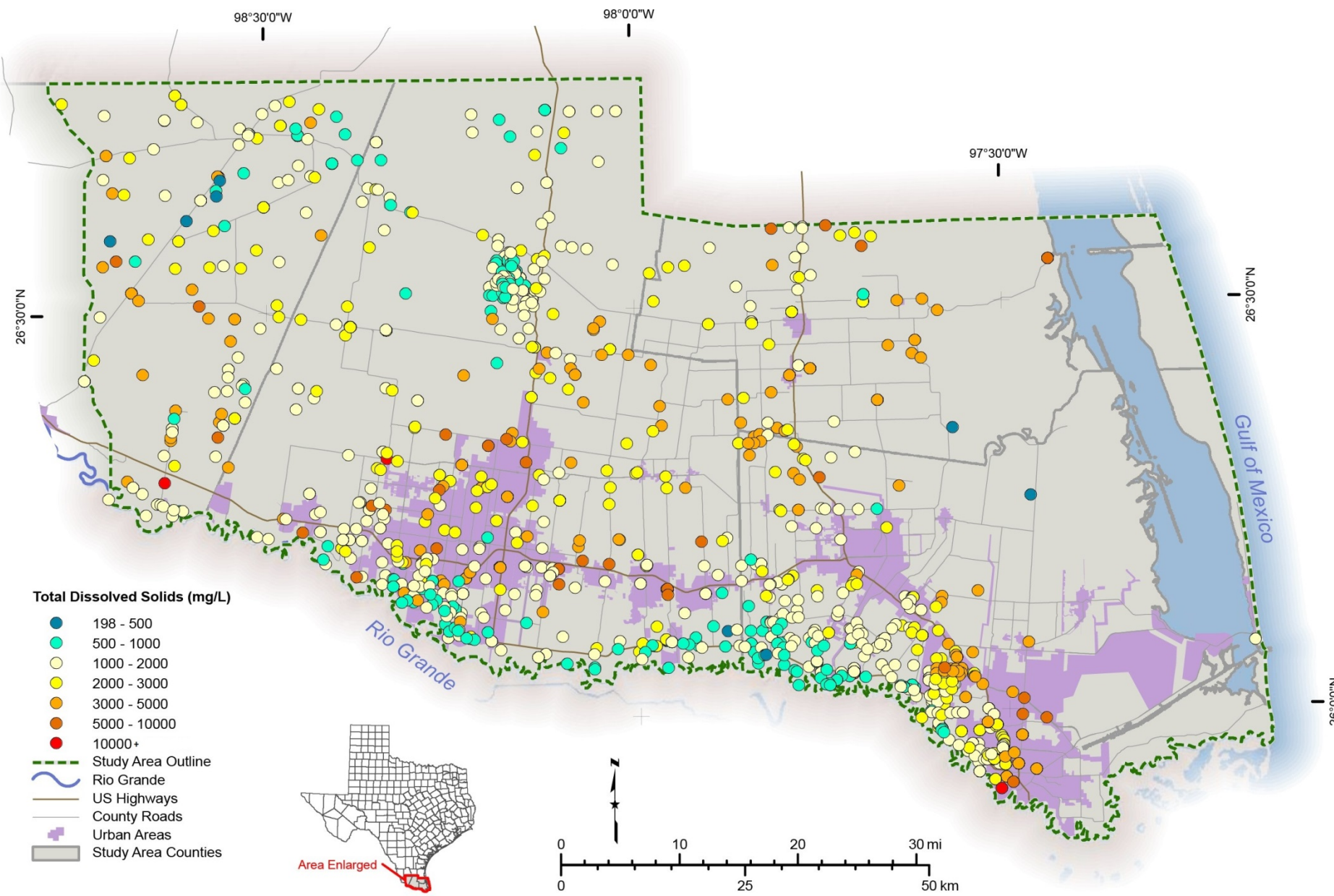


- Geology
(sand, clay, ...
depositional environment)
- Aquifer extent
top and bottom depths
- Fault identification
- Salinity zone
top and bottom depths

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

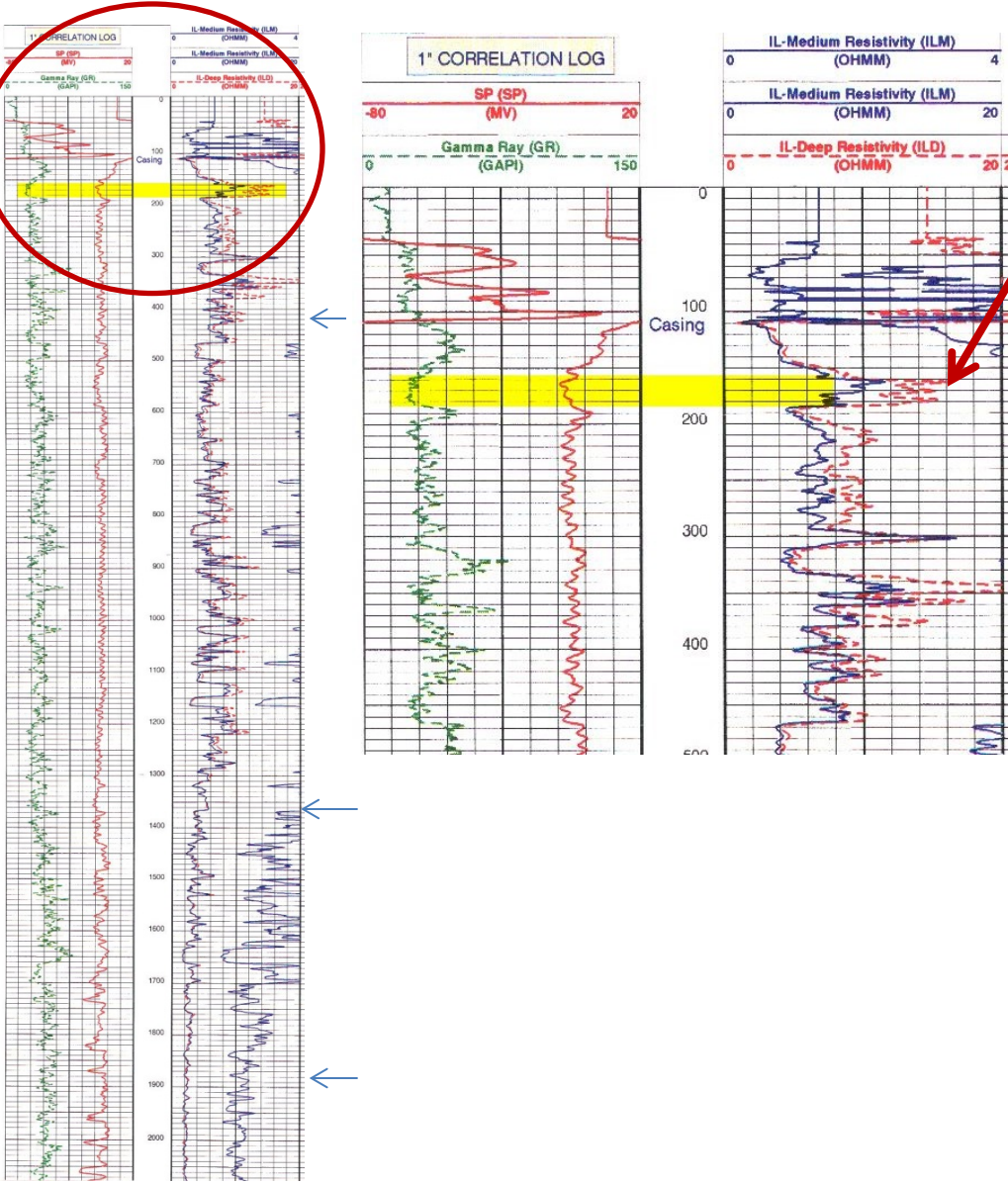
*yellow = sands
red bar = maximum deep resistivity*

Lower Rio Grande Valley Gulf Coast Aquifer: Total Dissolved Solids



Source: Lower Rio Grande Valley BRACS Study

Lower Rio Grande Valley Gulf Coast Aquifer: Log Analysis



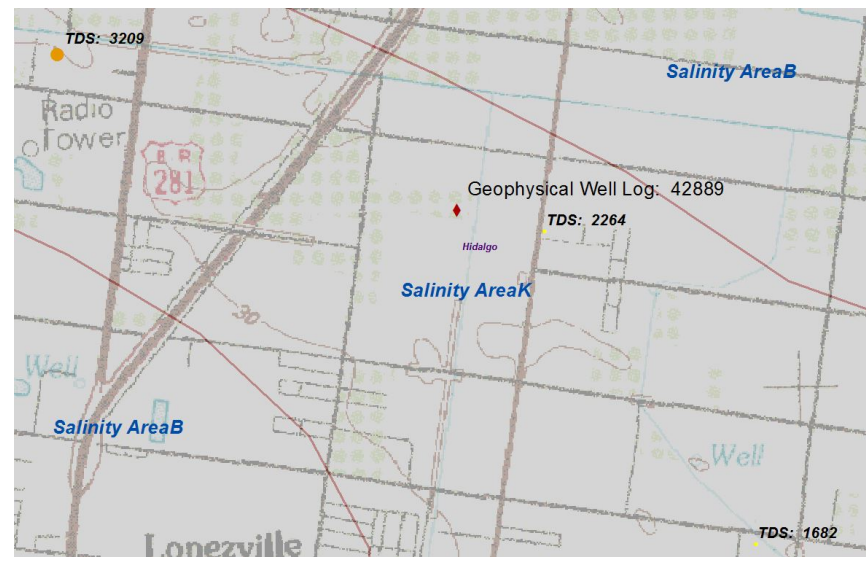
At 160 ft = 15 ohm-meter

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



Log Analysis Methods to calculate interpreted Total Dissolved Solids

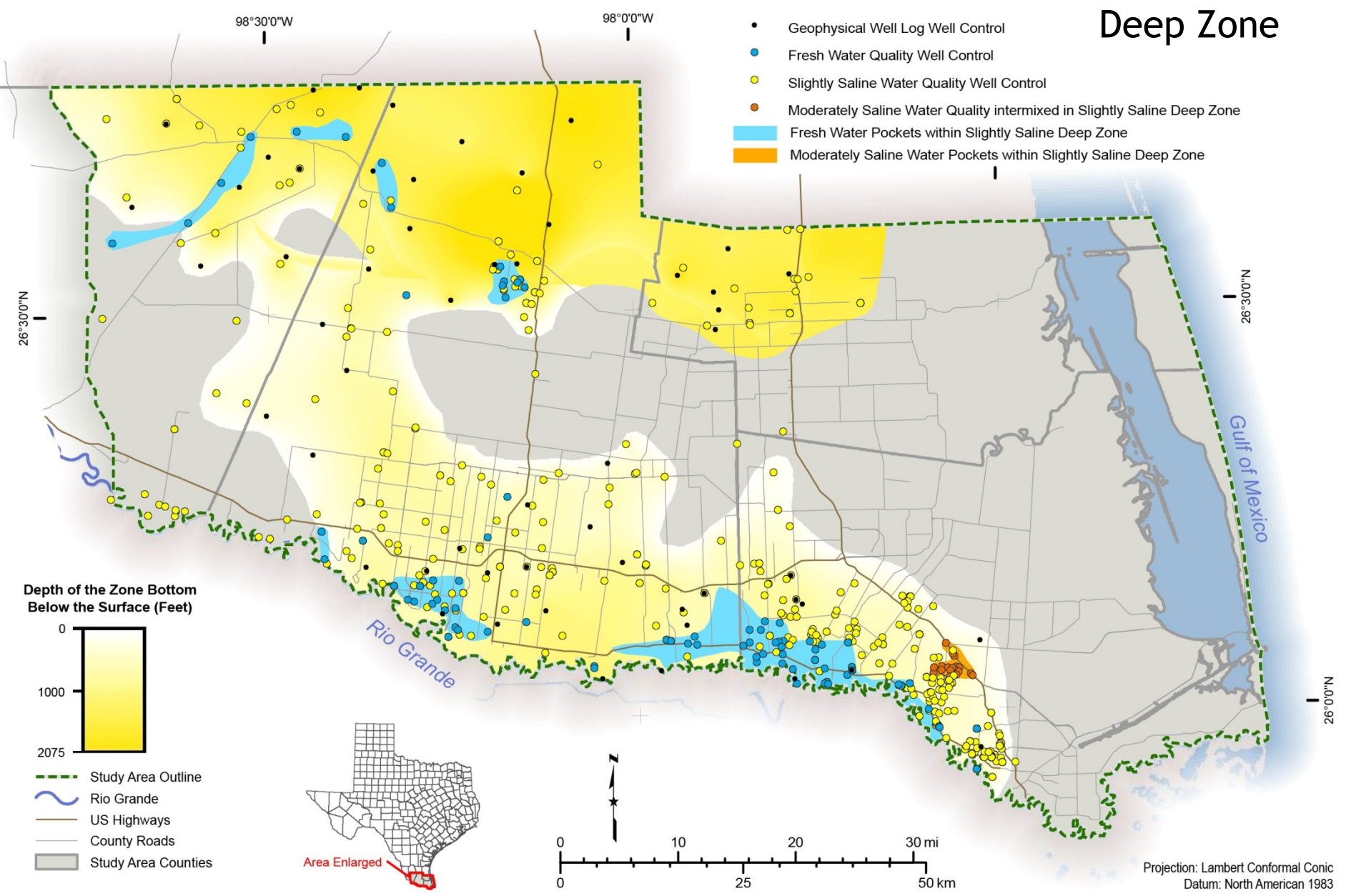
Six methods described by:

Estepp, J.D., 1998, Evaluation of ground-water quality using geophysical logs: Texas Natural Resource Conservation Commission, unpublished report, 516 p.

Methods require some/all of these parameters and corrections:

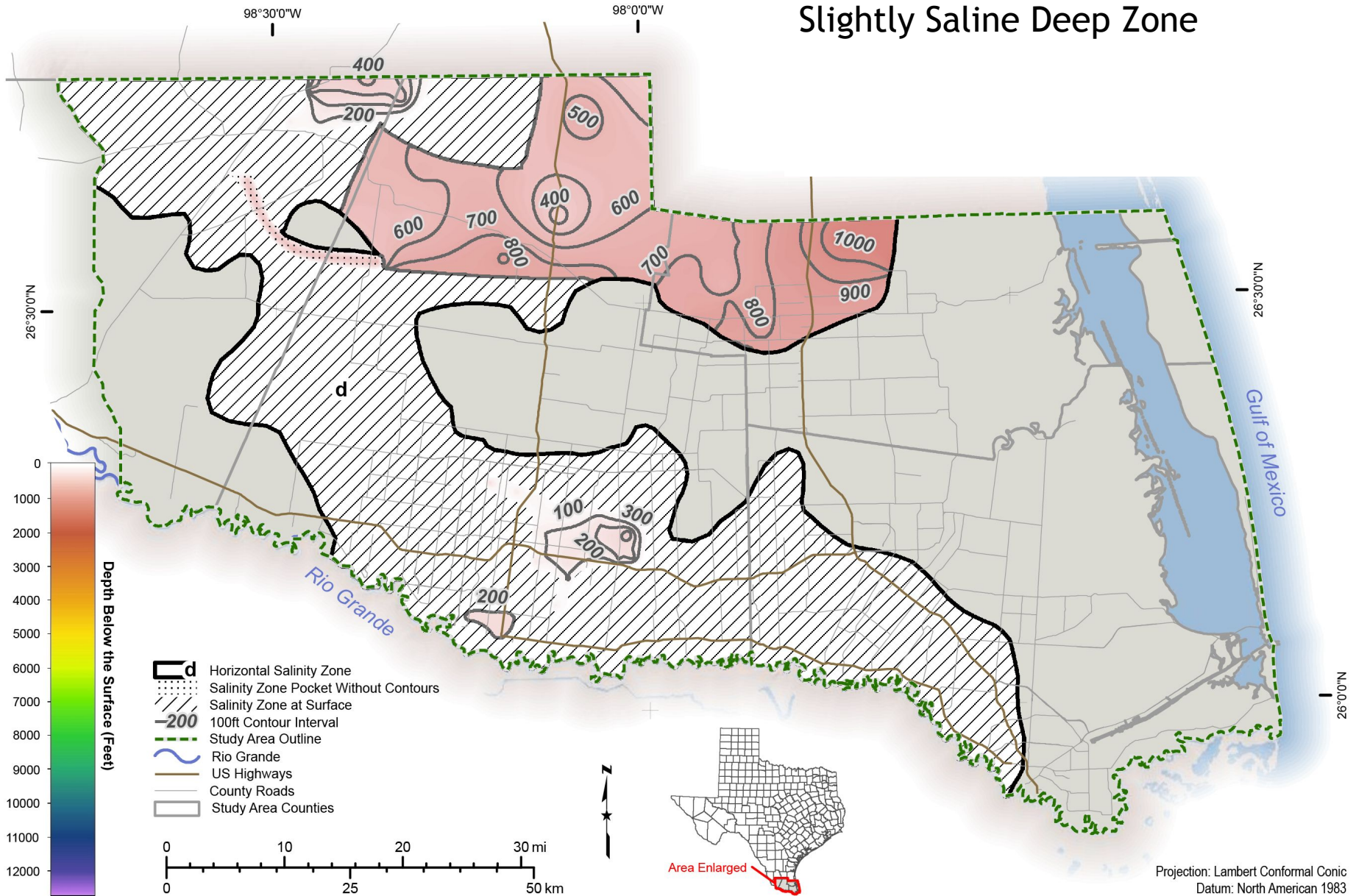
- Mean annual surface temperature
- Maximum bottom depth temperature
- Temperature correction for resistivity
- Depth well
- Depth formation to be evaluated
- Resistivity mud filtrate
- Mud filtrate temperature
- Formation Spontaneous Potential value
- Formation Resistivity value (deep; shallow reading)
- Invasion zone correction
- Mud type correction
- Cementation factor
- Porosity
- Groundwater quality corrections
- Conversion factor from resistivity to total dissolved solids
- Nearby water quality data to “calibrate” log analysis

Lower Rio Grande Valley Gulf Coast Aquifer: Well Control, Slightly Saline Deep Zone



Source: Lower Rio Grande Valley BRACS Study

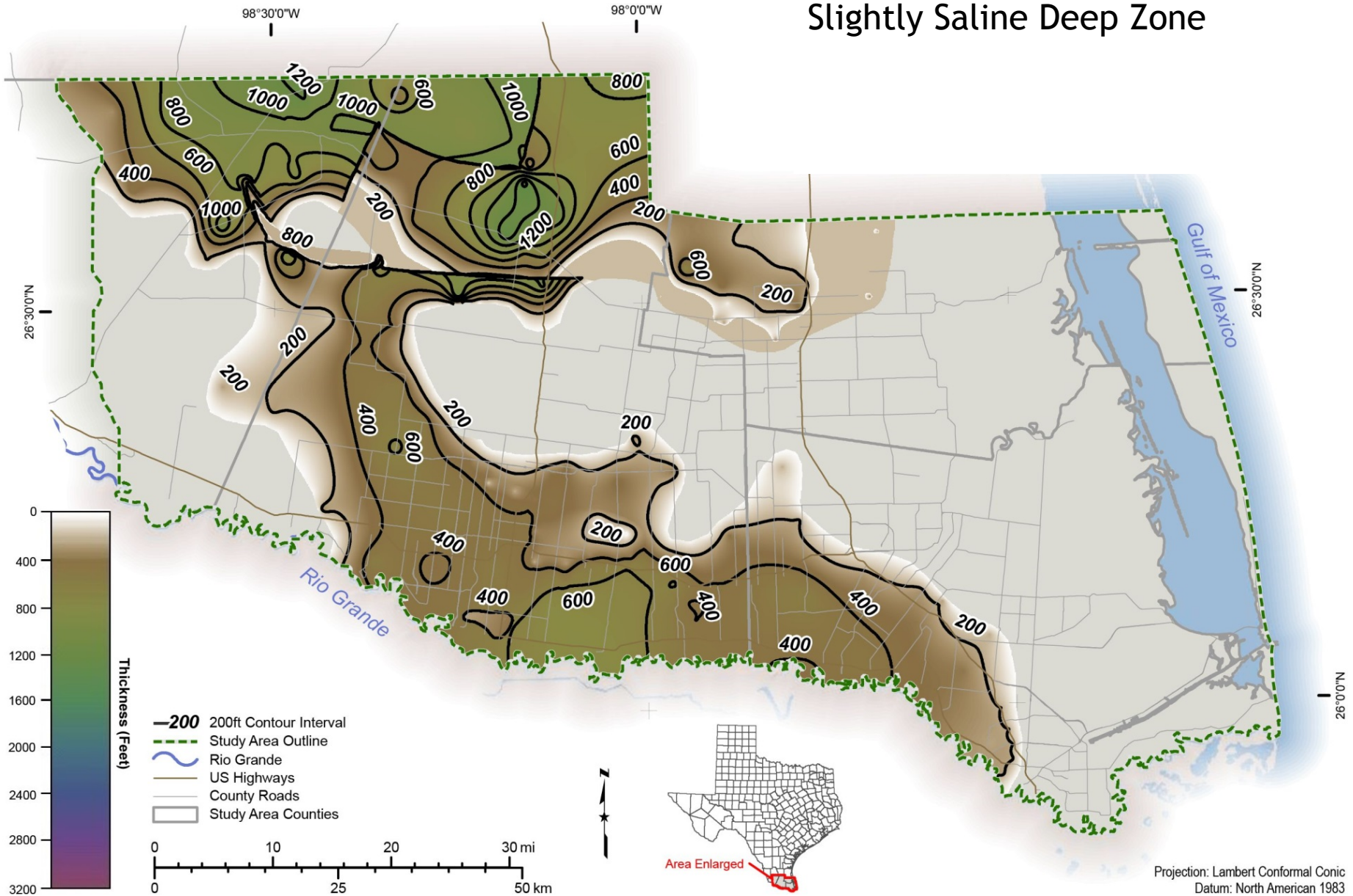
Lower Rio Grande Valley Gulf Coast Aquifer: Top Depth (feet below ground surface) Slightly Saline Deep Zone



Source: Lower Rio Grande Valley BRACS Study

Lower Rio Grande Valley Gulf Coast Aquifer:

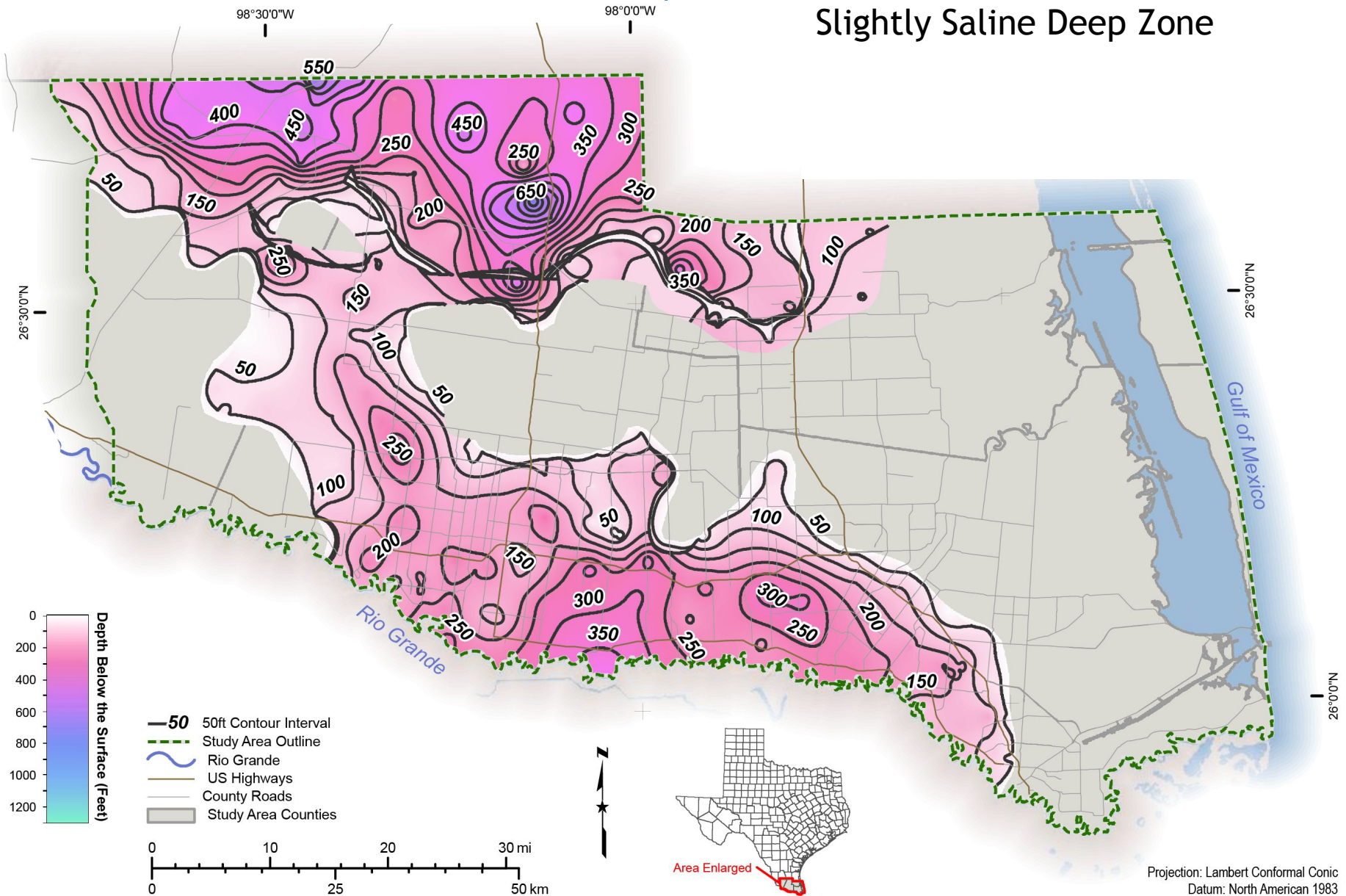
Thickness (feet)
Slightly Saline Deep Zone



Source: Lower Rio Grande Valley BRACS Study

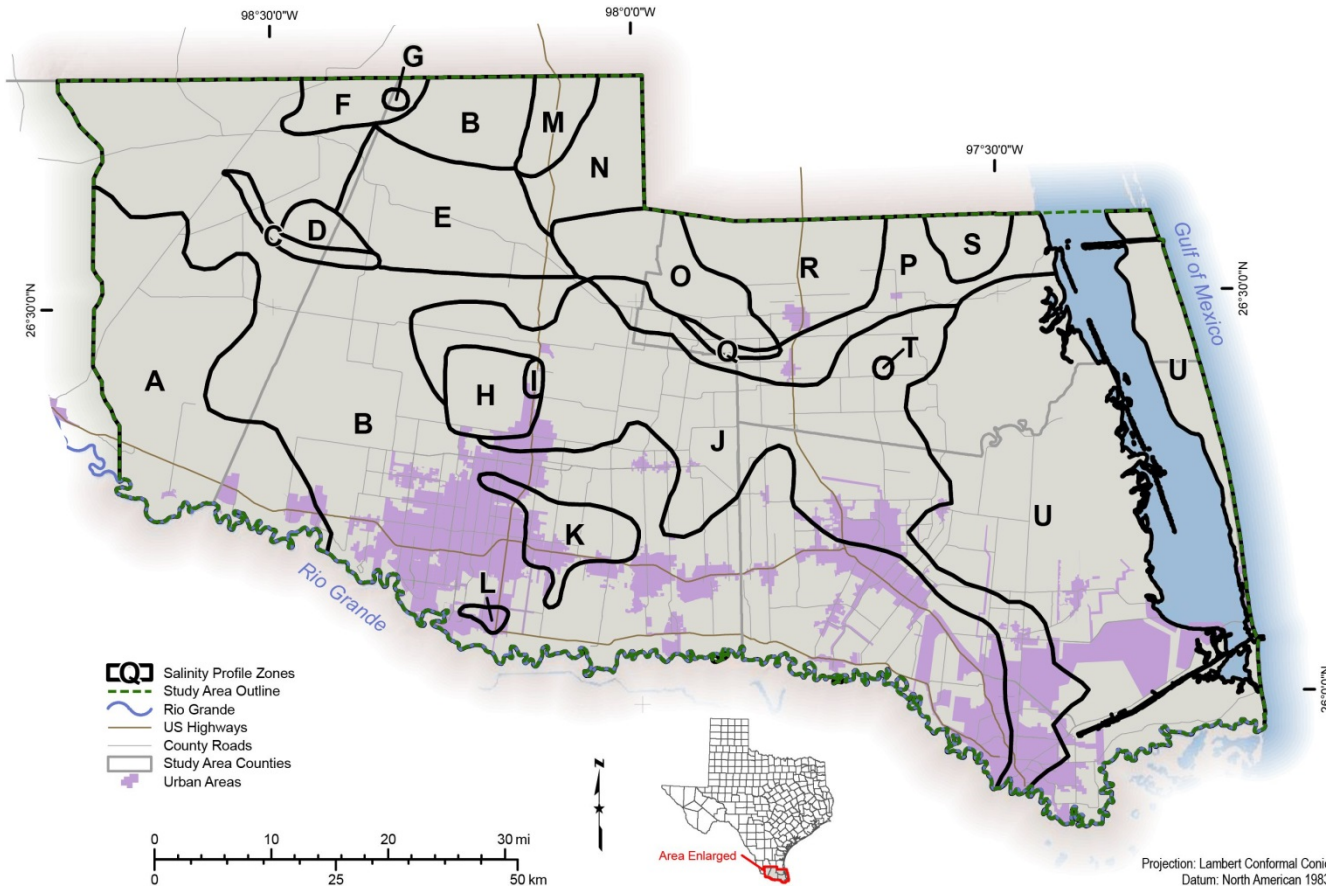
Lower Rio Grande Valley Gulf Coast Aquifer:

Net Sand Thickness (feet)
Slightly Saline Deep Zone



Source: Lower Rio Grande Valley BRACS Study

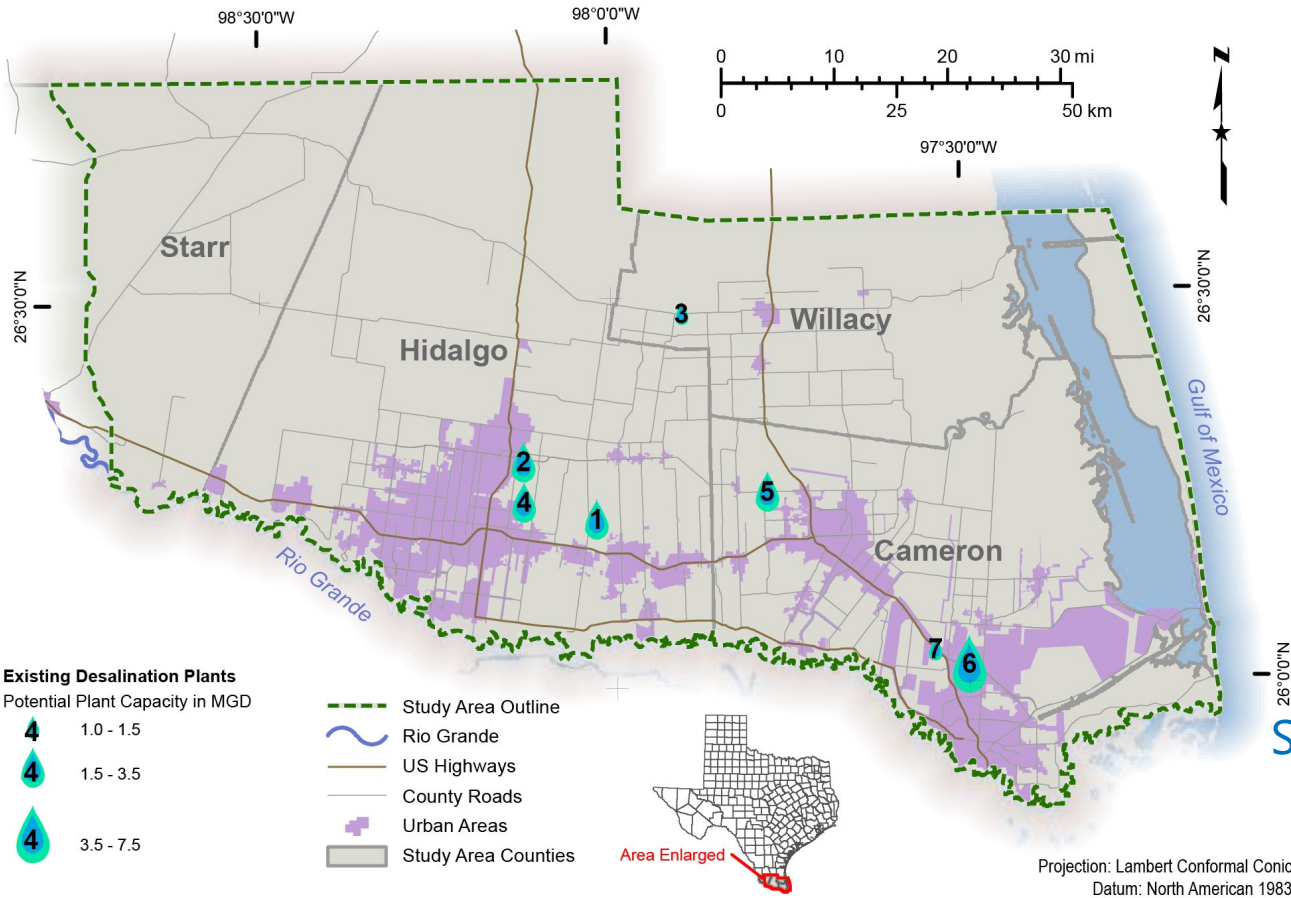
Lower Rio Grande Valley Gulf Coast Aquifer: Salinity Zone Areas



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

A	B	C	D	E	F	G	H	I	J
				SS Shallow 2		VS Shallow 1		VS Shallow 3	
		MS Shallow 5		MS Intermediate 1	MS Shallow 4	MS Shallow 4	MS Shallow 2	MS Shallow 2	
	SS Deep	SS Deep		SS Deep	SS Deep	SS Deep	SS Intermediate	SS Intermediate	
MS Deep	MS Deep	MS 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	VS Deep	VS Deep	VS Deep
BR Deep	BR Deep	BR Deep	BR Deep	BR Deep	BR Deep	BR Deep	BR Deep	BR Deep	BR Deep

Lower Rio Grande Valley Gulf Coast Aquifer: Existing Desalination Plants



Salinity zones used by plants

SS = Slightly Saline

MS = Moderately Saline

Projection: Lambert Conformal Conic
Datum: North American 1983

MS Deep

SS Deep and MS Deep

SS Deep

SS Deep

MS Deep

SS Deep

MS Deep

ID	Plant Name	Potential Plant Capacity (MGD)
1	North Alamo Water Supply Corporation (Donna)	2.25
2	North Alamo Water Supply Corporation (Doolittle)	3.50
3	North Alamo Water Supply Corporation (Lasara)	1.20
4	North Alamo Water Supply Corporation (Owassa)	2.00
5	North Cameron/Hidalgo WA	2.50
6	Southmost Regional Water Authority	7.50
7	Valley MUD #2	1.00

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 long time
- These studies can be used to support aquifer storage and recovery evaluations by characterizing an aquifer in great detail
- Evaluating techniques of geophysical well log interpretation
- BRACS study deliverables available on TWDB website
- Geophysical well log files available upon request
- Contract reports and deliverables available on TWDB website
- Future efforts: modeling, collection of additional log and well data

Texas Water Development Board



www.twdb.texas.gov

Conservation and Innovative Water Technologies Division

Sanjeev Kalaswad, Ph.D., P.G. Director

sanjeev.kalaswad@twdb.texas.gov

(512) 936-0838

Andrea Croskrey

andrea.croskrey@twdb.texas.gov

(512) 463-2865

John E. Meyer, P.G.

john.meyer@twdb.texas.gov

(512) 463-8010

Matthew Webb

matthew.webb@twdb.texas.gov

(512) 463-6929

Matthew Wise, P.G.

matthew.wise@twdb.texas.gov

(512) 936-9488

Who Has
Questions ?

