Brackish Groundwater in the Gulf Coast Aquifer, Lower Rio Grande Valley, Texas

by
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Texas Alliance of Groundwater Districts
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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
BRACS Studies and Existing/Recommended Desal Plants

Source: TWDB, Innovative Water Technologies
Lower Rio Grande Valley

- Groundwater in the study area is mostly brackish
- Population will more than double in the next 50 years
  1.7 to 3.9 million people
- Municipal water demand will more than double in the next 50 years
  260,000 to 581,000 acre-feet per year
- Brackish groundwater use will more than quadruple in next 50 years
  20,000 to 92,000 acre-feet per year
- Highest density of desalination plants in Texas
  7 existing brackish groundwater desalination plants
  23 recommended brackish groundwater desalination projects

Source: Region M statistics from 2012 State Water Plan
Study Objectives

- Map salinity areas (2-dimensional) with a unique vertical salinity profile
- Create 3-dimensional salinity zone GIS datasets
- Determine volumes of brackish groundwater
- Map sand and clay layers within the Gulf Coast Aquifer
- Map water quality parameters
- Map aquifer tests
- Collect water well reports and oil/gas geophysical well logs
- Compile all data into BRACS Database
- Study deliverables: Report, Database, GIS Datasets, and well logs
## Groundwater Salinity Classification and Color Scheme

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

Source: modified from Winslow and Kister, 1956
Existing Desalination Plants

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

Source: Lower Rio Grande Valley BRACS Study
Recommended Desalination Plants

Source: 2011 Recommended Innovative Strategies of the Regional Water Planning Groups
Well Control: oil/gas and water wells

Source: Lower Rio Grande Valley BRACS Study
## Water Well Logs

- Geology (sand, clay, ... depositional environment)
- Well screen
- Aquifer productivity
- Water quality
- Static water level

**Source:** Lower Rio Grande Valley BRACS Study
Total Dissolved Solids

Total Dissolved Solids (mg/L)
- 198 - 500
- 500 - 1000
- 1000 - 2000
- 2000 - 3000
- 3000 - 5000
- 5000 - 10000
- 10000+

Study Area Outline
Rio Grande
US Highways
County Roads
Urban Areas
Study Area Counties

Source: Lower Rio Grande Valley BRACS Study
Aquifer Test Data

Source: Lower Rio Grande Valley BRACS Study
Geophysical Well Logs

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

Source: Lower Rio Grande Valley BRACS Study

BRACS well 4161

yellow = sands
red bar = maximum deep resistivity
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
21 Salinity Areas Labeled A - U

Source: Lower Rio Grande Valley BRACS Study
Salinity Areas A through G

Salinity Profiles

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td>MS Deep</td>
<td>MS Deep</td>
<td>MS Deep</td>
<td>MS Deep</td>
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Groundwater Salinity Classification

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Source: Lower Rio Grande Valley BRACS Study
Salinity Areas H through N

Salinity Profiles

<table>
<thead>
<tr>
<th>H</th>
<th>I</th>
<th>J</th>
<th>K</th>
<th>L</th>
<th>M</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>VS Shallow 3</td>
<td>MS Shallow 2</td>
<td>SS Shallow 1</td>
<td>MS Shallow 1</td>
<td>MS Intermediate 2</td>
<td>MS Intermediate 1</td>
<td>MS Intermediate 1</td>
</tr>
<tr>
<td>MS Shallow 2</td>
<td>MS Shallow 2</td>
<td>MS Shallow 1</td>
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<td>MS Intermediate 1</td>
<td>MS Intermediate 1</td>
</tr>
<tr>
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<td>SS Intermediate</td>
<td>MS Shallow 1</td>
<td>MS Shallow 1</td>
<td>MS Intermediate 2</td>
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<tr>
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Source: Lower Rio Grande Valley BRACS Study
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Salinity Profiles

Source: Lower Rio Grande Valley BRACS Study
Slightly Saline Deep Zone

Source: Lower Rio Grande Valley BRACS Study
Slightly Saline Deep Zone

Top Depth (feet below ground surface)

Source: Lower Rio Grande Valley BRACS Study
Slightly Saline Deep Zone

Thickness (feet)

Source: Lower Rio Grande Valley BRACS Study
Slightly Saline Deep Zone

Net Sand Thickness (feet)

Source: Lower Rio Grande Valley BRACS Study
Brackish Groundwater Volume

<table>
<thead>
<tr>
<th>Type</th>
<th>Volume</th>
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<tbody>
<tr>
<td>Slightly Saline</td>
<td>40 million acre-feet</td>
</tr>
<tr>
<td>Moderately Saline</td>
<td>112 million acre-feet</td>
</tr>
<tr>
<td>Very Saline</td>
<td>123 million acre-feet</td>
</tr>
</tbody>
</table>
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

Source: TWDB, Innovative Water Technologies
## 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

- 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

*Source: TWDB, Innovative Water Technologies*
Summary

• Study report is in final editing stage

• Mapped brackish groundwater resource evaluation – quantity, quality, distribution

• There is substantial brackish groundwater for development

• This study can support the location of favorable exploration sites

• Well field drilling and testing is required to provide site-specific details that this study cannot provide

• BRACS study deliverables will be available on TWDB website

• Geophysical well log files available upon request

• Future efforts: modeling ?, collection of additional log and well data
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