Aquifer characterization for brackish groundwater production and ASR

Case study: Carrizo-Wilcox aquifer in Central Texas

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Authors and reports

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50-year State Water Plan
every 5 years

BGW Desal
State Water Plan 2022

ASR or AR
State Water Plan 2022

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## TWDB Study Mandates

<table>
<thead>
<tr>
<th>Brackish groundwater</th>
<th>ASR &amp; AR</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 2015 Texas House Bill 30</td>
<td>• 2019 Texas House Bill 721</td>
</tr>
<tr>
<td>• Brackish groundwater production zones (BGPZ) criteria</td>
<td>• Statewide survey of aquifer suitability for ASR or AR projects in Texas</td>
</tr>
<tr>
<td>• Report to the legislature</td>
<td>• Conduct ASR and AR studies</td>
</tr>
<tr>
<td>• 2019 Texas Senate Bill 1041</td>
<td>• Report to the regional water planning groups</td>
</tr>
<tr>
<td>– Identify and designate BGPZ for the entire state by</td>
<td></td>
</tr>
<tr>
<td>December 1, 2032</td>
<td></td>
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</tbody>
</table>
ASR mandate accomplishments

Statewide survey of aquifer suitability for ASR or AR projects in Texas

Webpage

StoryMap

First completed study is “Aquifer Storage and Recovery Report: Carrizo-Wilcox Aquifer Characterization for Eastern Gonzales and parts of Caldwell and Guadalupe Counties, Texas”
Study selection

**Brackish groundwater**

- Prioritized areas with
  - Strategies in the state water plan
  - Data
  - Growing water demands
  - Staff skills and abilities

**ASR & AR**

- Prioritized areas with
  - Strategies in the state water plan
  - Data
  - Staff skills and abilities
  - Sponsor interest
  - Project status, timeline
Brackish Resources Aquifer Characterization System (BRACS) Program - Study Status

Completed studies
- Be. Blaine aquifer
- Bm. Blossom aquifer
- CW. Carrizo-Wilcox aquifer
- GC1. Gulf Coast aquifer
- GC2. Gulf Coast aquifer
- GC3. Gulf Coast aquifer
- Lp. Lipan aquifer
- NT. Northern Trinity aquifer
- Nh. Nacatocah aquifer
- PV. Pecos Valley aquifer
- QS1. Queen City-Sparta aquifer
- Rr. Rustler aquifer
- WCQSY. Carrizo-Wilcox, Queen City, Sparta, and Yegua

Current studies
- ESp. Eastern Sparta aquifer
- ETP. Edwards-Trinity (Plateau) aquifer
- EWCQ. Eastern Carrizo-Wilcox and Queen City aquifers
- HCT. Hill Country Trinity aquifer
- Wd. Woodbine aquifer
<table>
<thead>
<tr>
<th>Study area</th>
<th>Report 385 - Brackish Groundwater</th>
<th>Report 387 - ASR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Regiona</td>
<td>Sub-regional</td>
</tr>
<tr>
<td></td>
<td>lal</td>
<td>Parts of only 3 counties</td>
</tr>
<tr>
<td></td>
<td>Parts of 14 counties</td>
<td>Parts of only 3 counties</td>
</tr>
<tr>
<td></td>
<td>5,900 sq mi</td>
<td>568 sq mi</td>
</tr>
<tr>
<td></td>
<td>4 aquifers</td>
<td>1 aquifer (Carrizo-Wilcox)</td>
</tr>
<tr>
<td></td>
<td>1,600 Carrizo Sand wells</td>
<td>662 wells</td>
</tr>
<tr>
<td></td>
<td>Base of aquifer depth limit</td>
<td>2,000 ft depth limit</td>
</tr>
<tr>
<td></td>
<td>– Carrizo as deep as ~8,400 ft</td>
<td></td>
</tr>
</tbody>
</table>
Stratigraphic column showing the relationship between the epochs, formations, and hydrogeologic units. The United States Geological Survey (USGS) nomenclature is based on Ryder (1996). Texas hydrogeologic units are based on TWDB (2007) and George and others (2011). This table does not reflect the entire Jackson or Midway stratigraphy. This table is not scaled vertically in uniform units of time.
Report 387 ASR study area

- Existing infrastructure
- 2,000-foot depth limit
Aquifer characterization

Report 385 - Brackish Groundwater

• WHERE is the water?
• WHAT is the salinity?
• HOW much is there?

Report 387 - ASR & AR

• WHERE can the water be stored?
  – How deep?
  – How thick?
• WHAT is the host water quality?
Aquifer characterization

Stratigraphy – Lithology - Salinity

Salinity Classification

<table>
<thead>
<tr>
<th>Total Dissolved Solids (milligrams per liter)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh</td>
</tr>
<tr>
<td>Slightly Saline</td>
</tr>
<tr>
<td>Moderately Saline</td>
</tr>
<tr>
<td>Very Saline</td>
</tr>
<tr>
<td>Brine</td>
</tr>
</tbody>
</table>

Groundwater Salinity Classification:
- Fr: Fresh
- Ss: Slightly Saline
- Ms: Moderately Saline
- Vs: Very Saline
- Br: Brine
Carrizo thickness
Carrizo net sand
Carrizo salinity classes

Measured TDS
- Fresh
- Slightly Saline
- Moderately Saline
- Very Saline
- Brine

Calculated TDS
- Fresh
- Fresh and Slightly Saline
- Fresh, Slightly, and Moderately Saline
- Slightly Saline
- Slightly and Moderately Saline
- Slightly, Moderately, and Very Saline
- Moderately Saline
- Moderately and Very Saline
- Very Saline
- Very Saline and Brine
- Brine
Brackish groundwater results

• >230 million acre-feet of brackish groundwater in the central region of the Upper Coastal Plains aquifers (284 km³)
• Excellent framework for additional studies

ASR results

• Most favorable portion of study area is in a 9-mile x 25-mile swath of Carrizo Sand
• Variability in sand and water quality distribution
• Results delivered in a timeframe to benefit the ASR project moving forward
Conclusions

• Texas’ water planning process and the state legislature drive the necessity for studying our aquifers
• Study area, data collection, and analysis needs to match objectives
• Different mandates, different results
• Regional BGW study framework expedited the ASR study
• Additional data for ASR study revealed details for site selection and well design
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https://www.twdb.texas.gov/groundwater/bracs/studies/UCPC/index.asp