

# Innovative Water Technologies- Subsurface Impacts

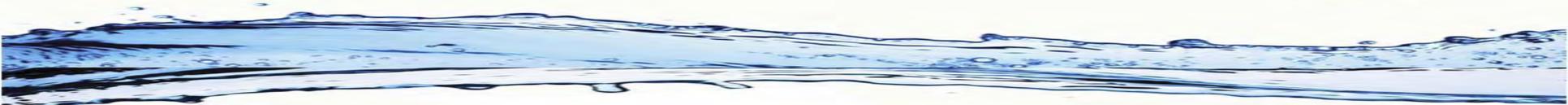
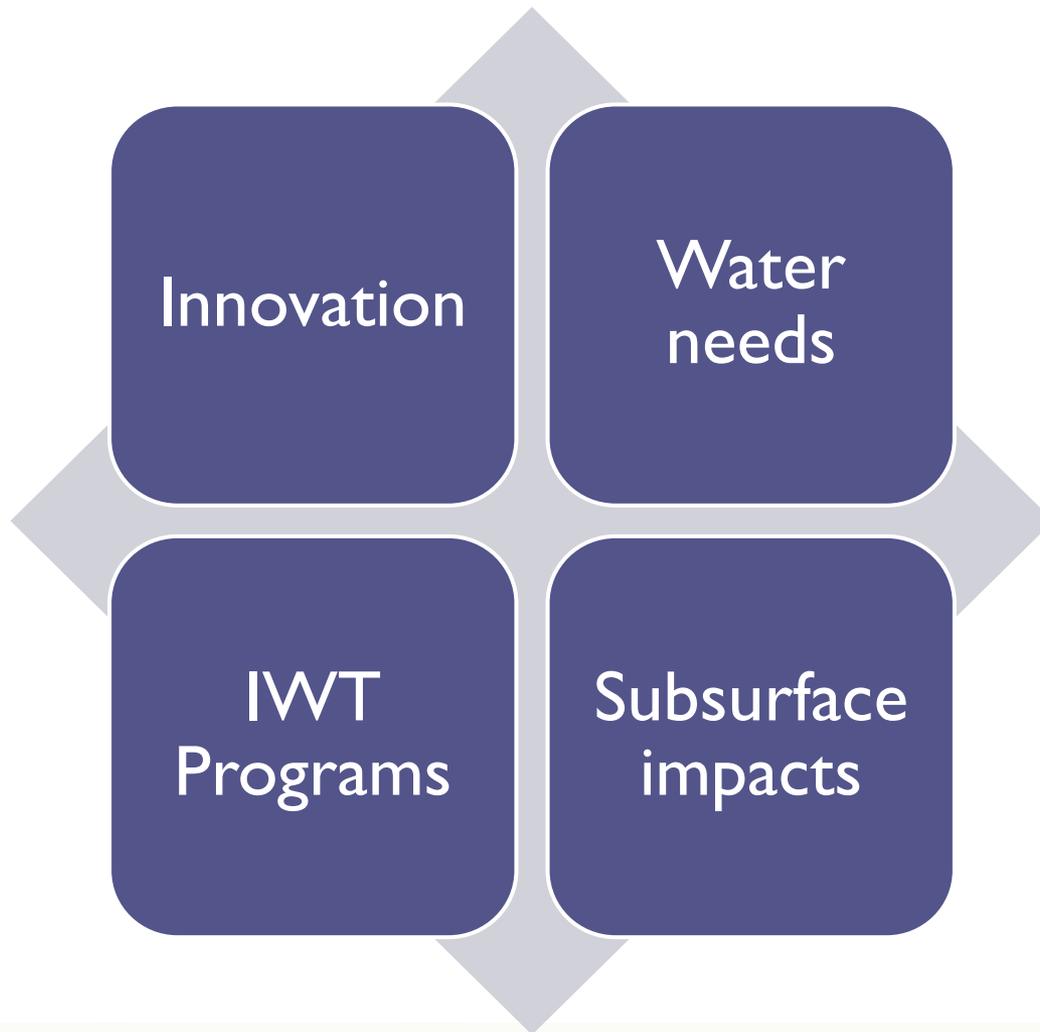
**Jorge Arroyo PE**  
**Texas Water Development Board**

Presented at the Underground Injection Conference  
Austin, Texas, January 2011



# Innovative Water Technologies and the Subsurface

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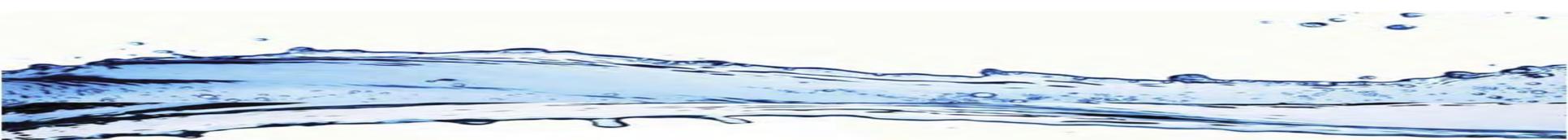




# Innovation and water planning

## Innovation

- ▶ “to make changes in something established, especially by introducing new methods, ideas, or products”
- ▶ State Water Plans
  - ▶ 1961-1997
  - ▶ 2001-2007 (75<sup>th</sup> TX Leg.-SB 1)





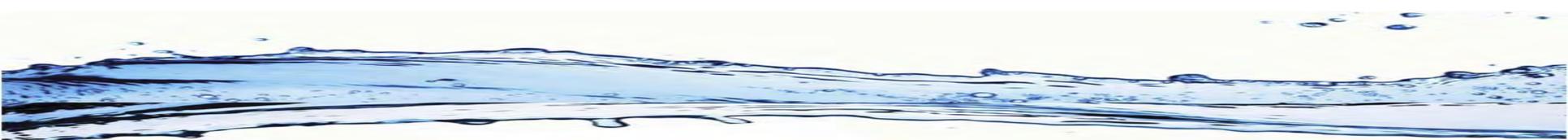
# Innovation and regional water planning

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Innovation

## Regional Water Planning Guidelines

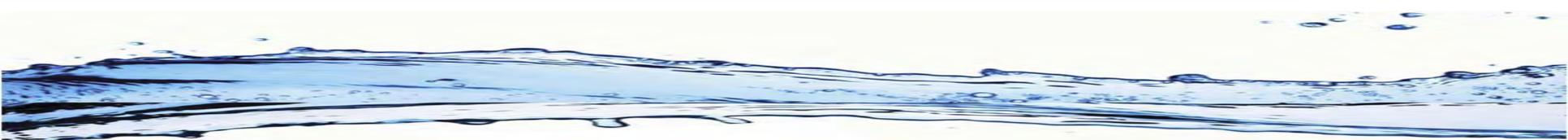
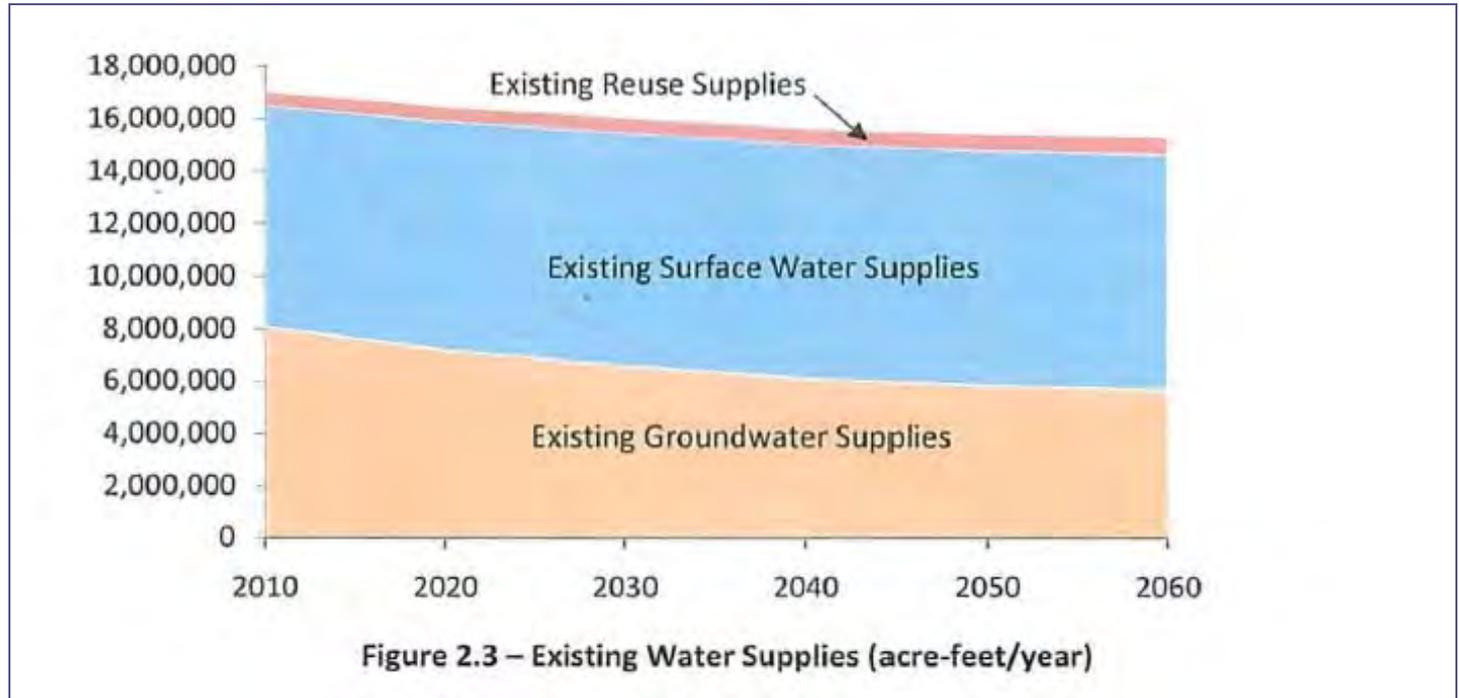
- ▶ Provide recommendations of water management strategies
  - ▶ Consider all potentially feasible water management strategies
  - ▶ including reuse and desalination





# Draft Summary of the 2011 Regional Water Plans

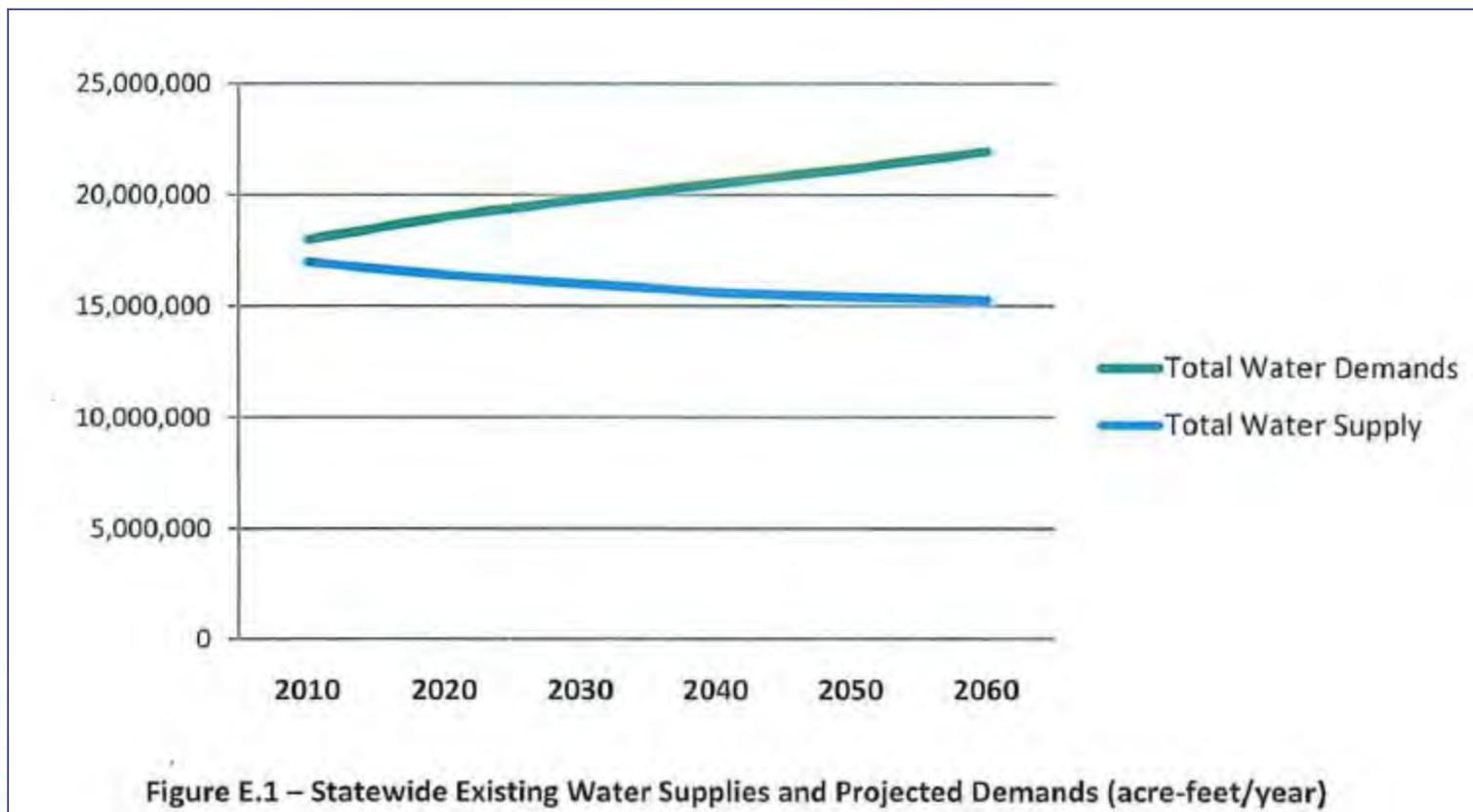
Water needs





# Draft Summary of the 2011 Regional Water Plans

Water needs





# Draft Summary of the 2011 Regional Water Plans

Water needs

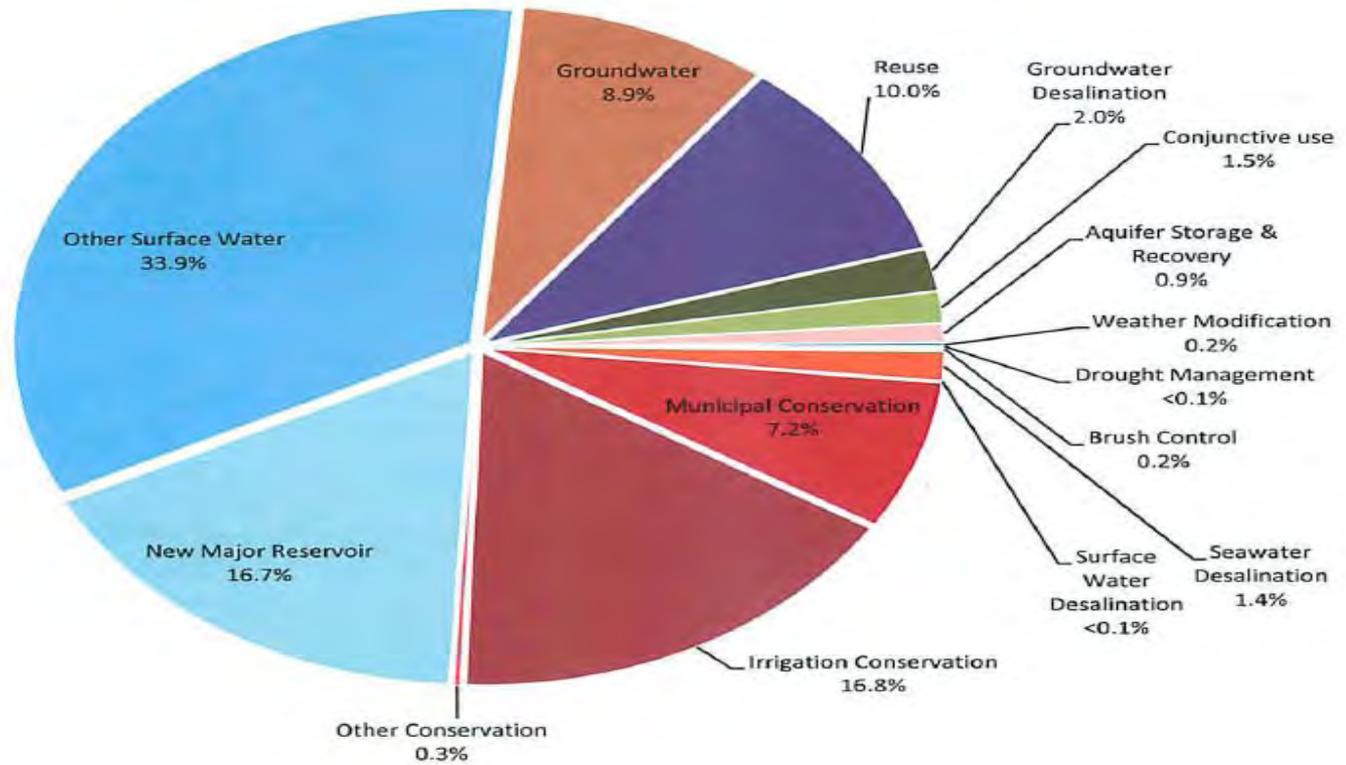


Figure 2.8 – 2060 Recommended Water Management Strategies - Relative Volumes



# IWT-Focus areas

IWT  
Programs

Water Science and Conservation

## Innovative Water Technologies

- ▶ Desalination
  - ▶ Seawater
  - ▶ Brackish Groundwater
- ▶ Reuse
- ▶ Aquifer Storage and Recovery
- ▶ Rain Harvesting





# IWT-Deliverables

IWT  
Programs

<http://www.twdb.state.tx.us/iwt/>

RWH: Impact of roof material on water quality

Seawater Pilot Plant Studies

Assessment of Forward Osmosis

Advancing Water Reuse in Texas

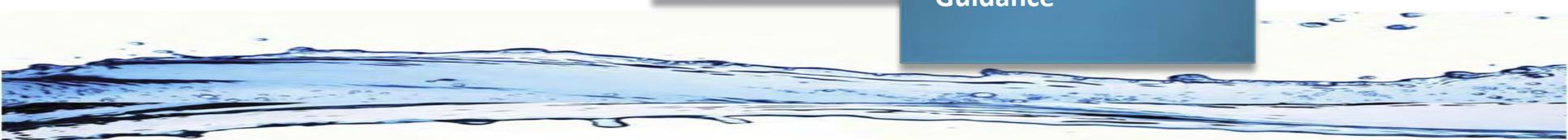
Aquifer Storage Recovery in Texas

Technology Demonstration Projects

Brackish GW Desalination Guidance

Stormwater Harvesting Guidance

Rainwater Harvesting Guidance





# Areas of subsurface interest

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Subsurface  
impacts

- ▶ Brackish Groundwater Desalination
  - ▶ Source Characterization
  - ▶ Concentrate disposal by injection wells

Aquifer Storage  
Recovery

Water Reuse





# Brackish Groundwater Desalination Source characterization

Subsurface  
impacts

- ▶ Brackish Groundwater Manual for Texas Regional Water Planning Groups (TWDB, 2003)
  - ▶ 1,000 and 10,000 mg/L TDS
  - ▶ Over 2.7 billion acre-feet
- ▶ Cost of Water Desalination in Texas (TWDB White Paper, 2009)
  - ▶ \$410-\$847/acre-ft

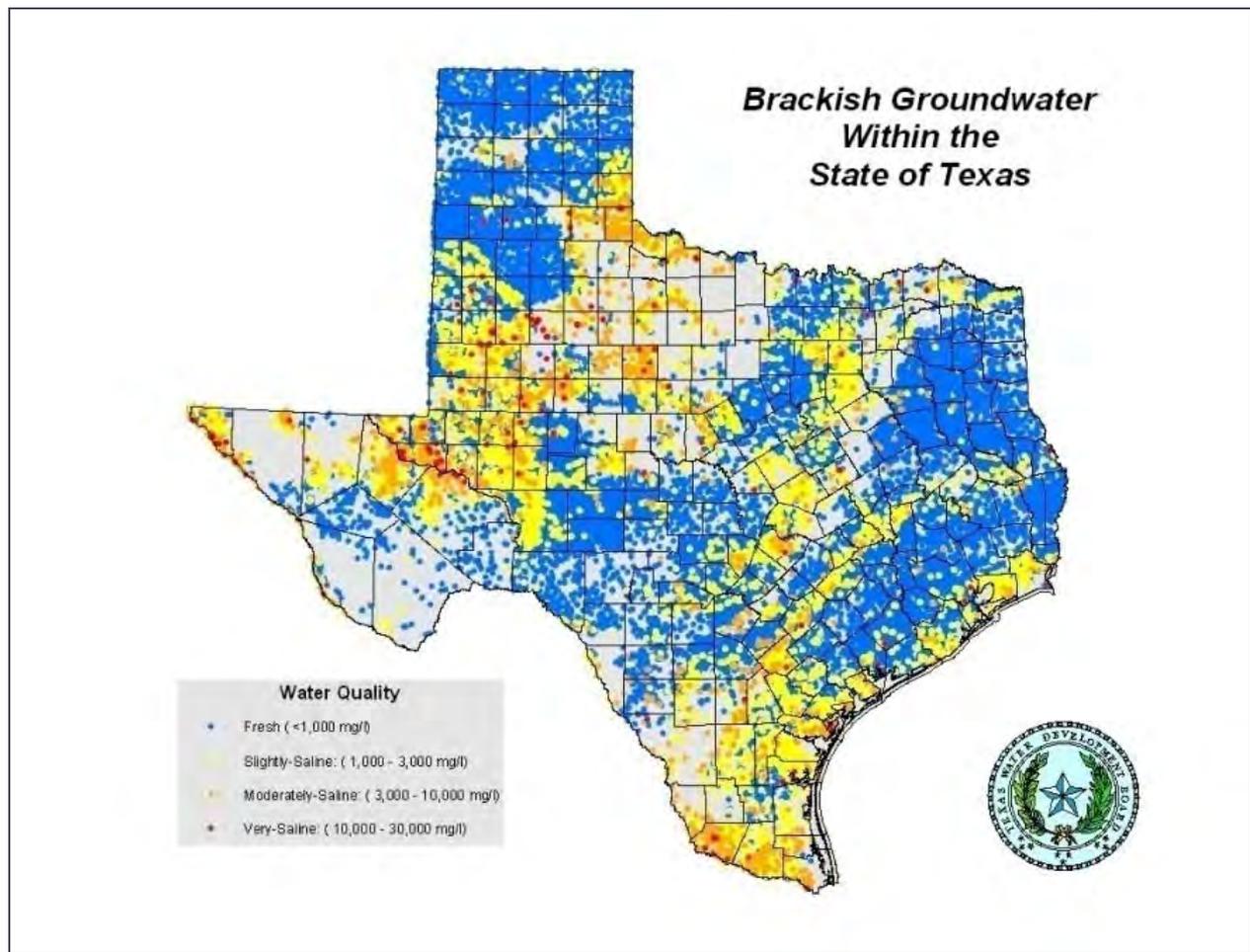


|       | 1,000 mg/L      | 3,000 mg/L        | 10,000 mg/L |
|-------|-----------------|-------------------|-------------|
| Fresh | Brackish        |                   | Saline      |
| Fresh | Slightly-saline | Moderately-saline | Very-saline |



# Brackish Groundwater Desalination Source characterization

Subsurface  
impacts





# Brackish Resources Aquifer Characterization System

Subsurface impacts

- Characterize brackish portion of aquifers up to 10,000 mg/L TDS
- Collect well information statewide
- Research and develop methods of data analysis
- Build database and GIS
- Build models to estimate aquifer productivity
- Develop parameter-screening tool
- Publish and broadcast results

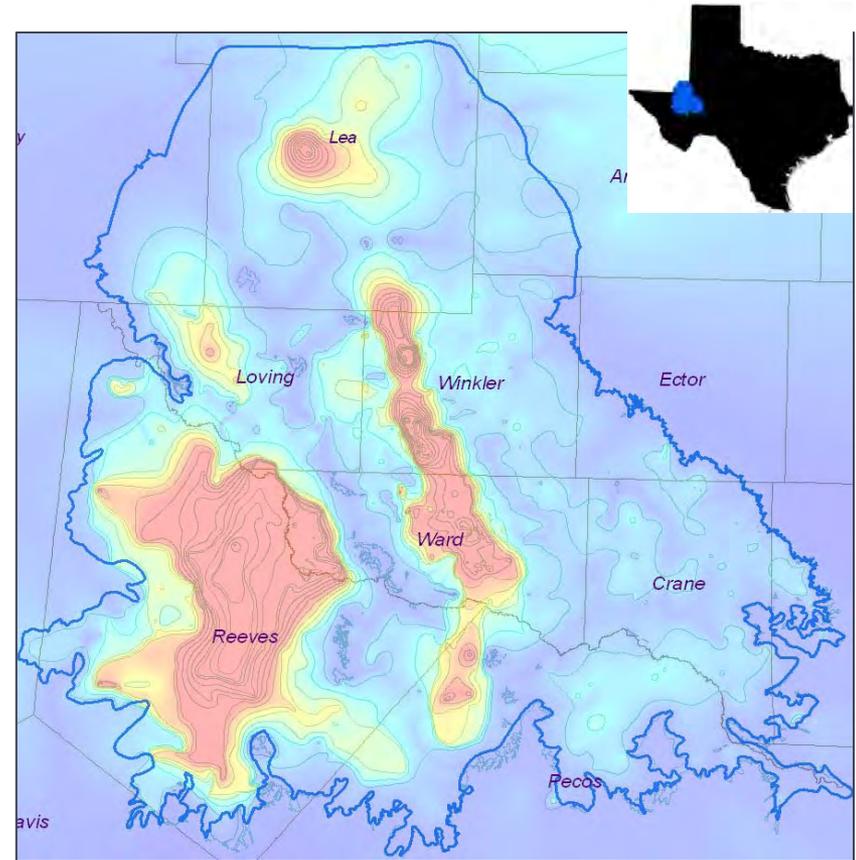




# Brackish Resources Aquifer Characterization System

Subsurface impacts

- Pecos Valley Aquifer chosen as pilot study area
- Three contracts awarded for data collection and model support



Pecos Valley Aquifer, Depth to Bottom

Shallow   
Deep



# Awarded contracts

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Subsurface  
impacts

Variable Density  
Modeling

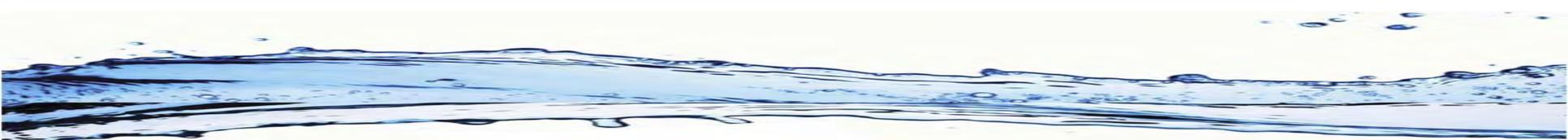
INTERA

Geophysical Log  
Collection

Bureau of  
Economic Geology

Digital Bibliography  
Texas Geology

INTERA





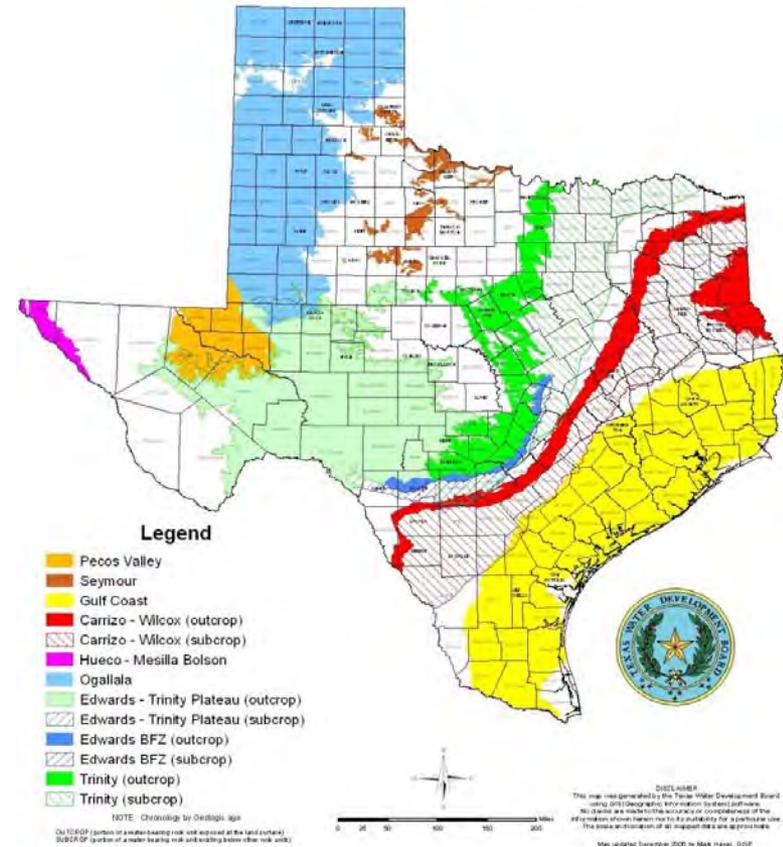
# Future Work

Subsurface  
impacts

- Extend to all aquifers in Texas
- Integrate the BRACS Groundwater Database
- Web access to BRACS data
- Report on methodology and results
- *Provide more accurate estimates of the brackish resource in Texas*



Major Aquifers of Texas





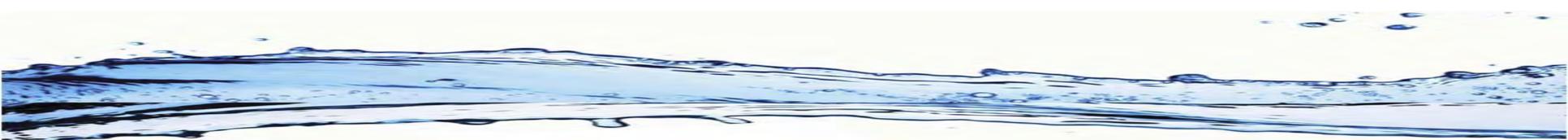
# Brackish Groundwater Desalination Concentrate Disposal

Subsurface  
impacts

$$Q_{feed} \times C_{feed} = Q_{product} \times C_{product} + Q_{concentrate} \times C_{concentrate}$$

$$Recovery(R) = \frac{Q_{product}}{Q_{feed}}$$

$$C_{concentrate} = \frac{C_{feed} - R \times C_{product}}{1 - R}$$

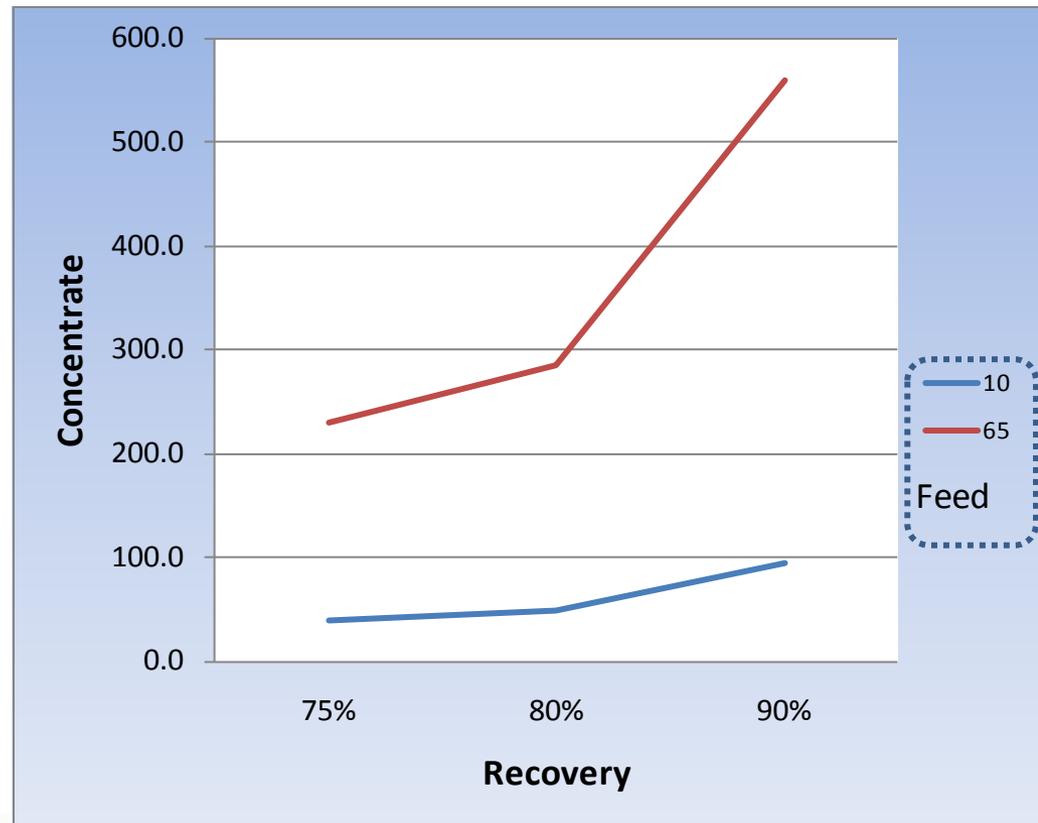




# Brackish Groundwater Desalination Concentrate Disposal

Subsurface impacts

$$C_{concentrate} = \frac{C_{feed} - R \times C_{product}}{1 - R}$$





# Brackish Groundwater Desalination Concentrate Disposal

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Subsurface impacts

- ▶ Pass the Salt Study (TWDB)
  - ▶ Feasibility of using Class II well for disposal of desalination concentrate
- ▶ Roadmap for Permitting a Class II injection Well for dual Class I & II (CDM & SAWS)





# Innovative Water Technologies and the Subsurface

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