# Texas Water Desalination Initiatives

Presentation to the Coastal Plains GCD

By
Jorge A. Arroyo
Texas Water Development Board

## Conclusions

- Water desalination is a viable option for water supply in Texas
- All signs point to continued improvement in water desalination technology, making it more efficient and cost competitive with other water supply options
- Brackish groundwater desalination is becoming a mainstream application in Texas
- A challenge to developing brackish groundwater desalination is the lack of detailed information about brackish groundwater availability
- Initial development of seawater desalination supplies requires financial assistance to cover the cost vs. affordability gap

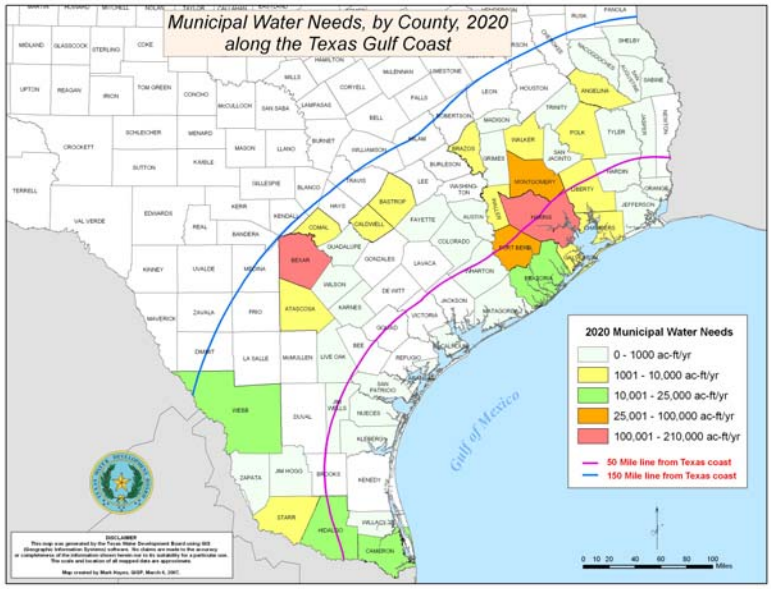
# Texas Water Development Board Desalination Activities

- TWDB Role
- Governor's Seawater Desalination Initiative
- Brackish Groundwater Demonstration Initiative

- The Texas Water Development Board's (TWDB) mission is **to provide leadership, planning, financial assistance, information, and education for the conservation and responsible development of water for Texas.**
- Section 16.060 of the Texas Water Code, directs the Texas Water Development Board to undertake or participate in research, feasibility and facility planning studies, investigations, and surveys as it considers necessary to **further the development of cost-effective water supplies from seawater desalination in the state**.

# The questions about desalination

- Too costly
- It uses too much energy
- We really don't need it
- There is relatively little experience with seawater desalination




NEWS

Local | Williamson | Texas | Legislature | Nation/World | AP Wire

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**Slowly, surely, Texas emerging from drought**

**Steady rains improve water levels in Ce… authorities urge conservation.**

**Severe drought would stop Comal Springs**

**Spring feeing Guadalupe River could be dry for more than two year…**

By Lavlan Copelin
AMERICAN-STATESMAN STAFF
Thursday, March 15, 2007

…storic drought on the magnitude of the one in the 1950s, when Texas was parched for seven years, would dry up Comal Springs in Ne… …n for 25 to 30 months even with water-saving standards contemplated in pending legislation, a new study shows.

…AP Wire

…ost popular

…m; lake goes up

…reservoir along the Colorado River, …ed from drought. It is still below average …but appears to be rebounding.

Monthly maximum water level, Lake Travis

March daily maximum water level, Lake Travis

Lake Travis has benefited this month from regional rainfall.

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NEWS Texas Legislature

**Senate approves water measure**

AUSTIN – Major water legislation that would mark off 19 future reservoir sites, improve supplies for drought-suffering areas and push local conservation policies won unanimous approval from the Senate on Tuesday.


August 12, 2002

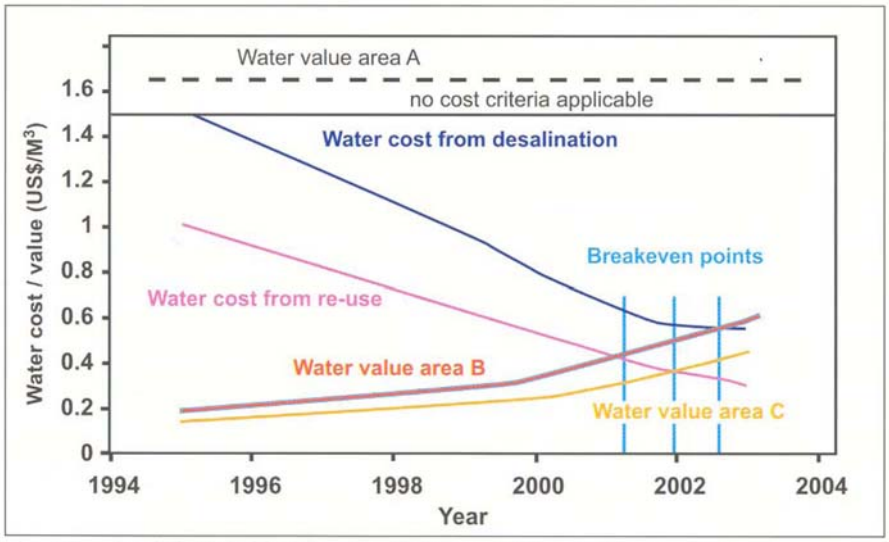
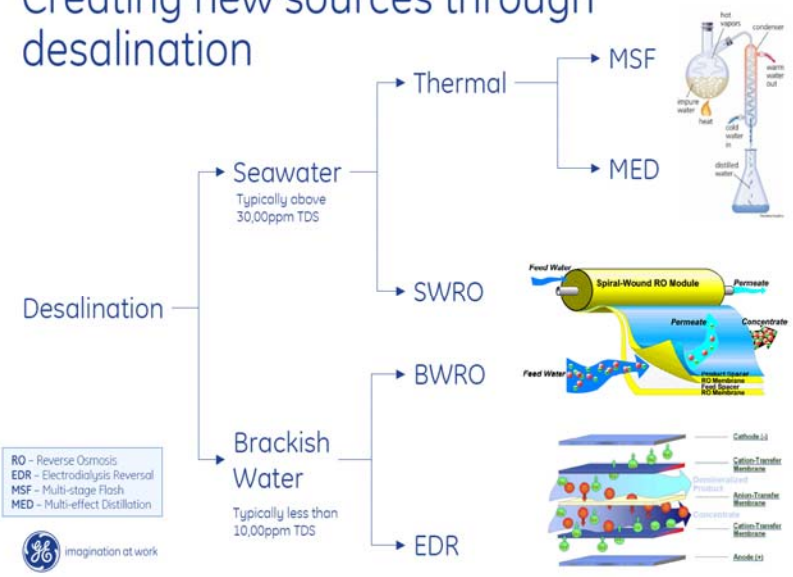



*Figure 3.6 Historical trend of fresh water abstraction and desalination market values*

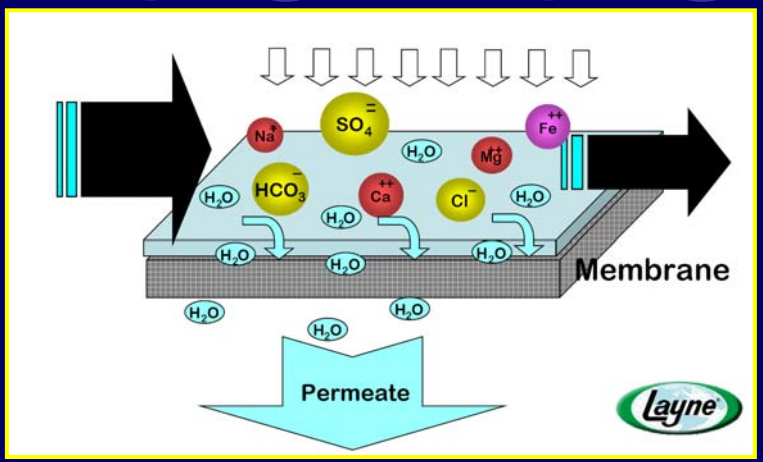
C. Sommariva-Desalination Management and Economics

## Creating new sources through desalination



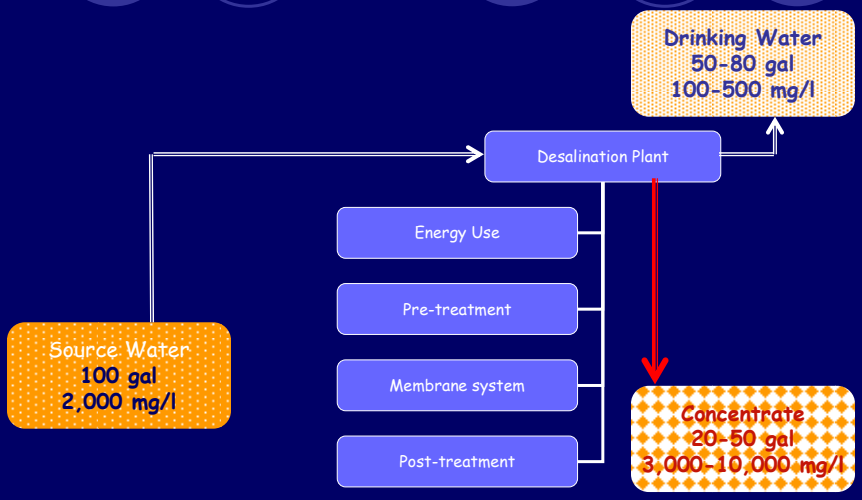

Shah Minesh, Addressing Water Scarcity through Energy and Water Integration-Presentation at the Energy Sustainability Summit-Texas Tech University, Sep 2006

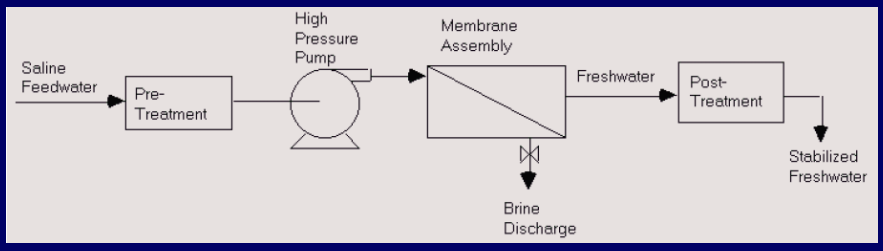
## Reverse-osmosis – Lead process




Layne Christensen Inc, Presentation to Texas Water Development Board-July 12, 2006

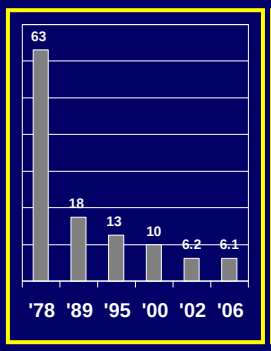
# Desalination by reverse-osmosis



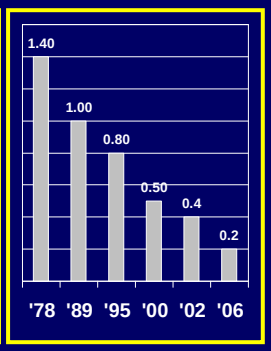



# Desalination Trends

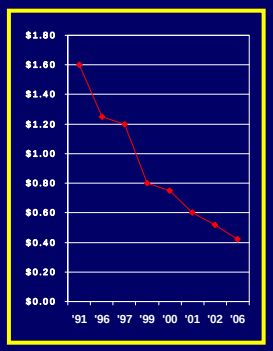
CAPEX-Cents per 1,000 gal




% Salt Passage



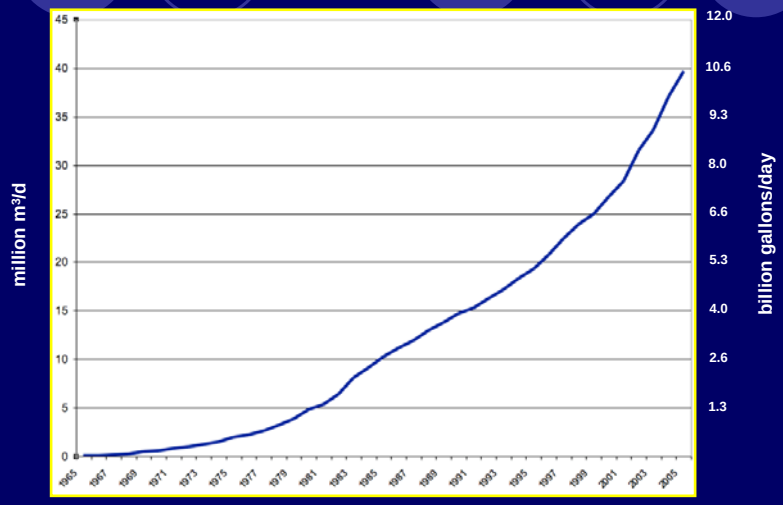

$/cubic meter

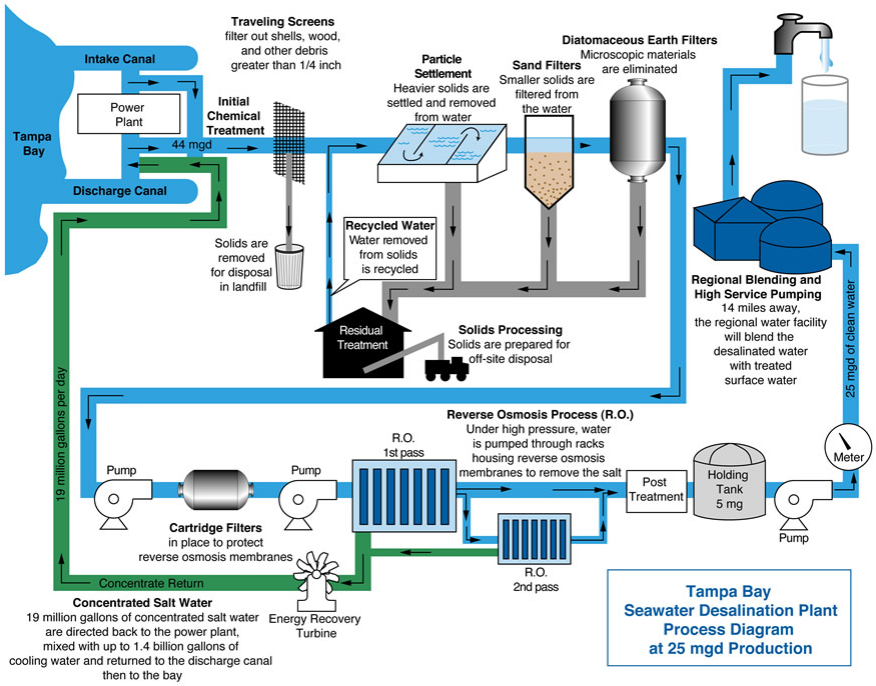


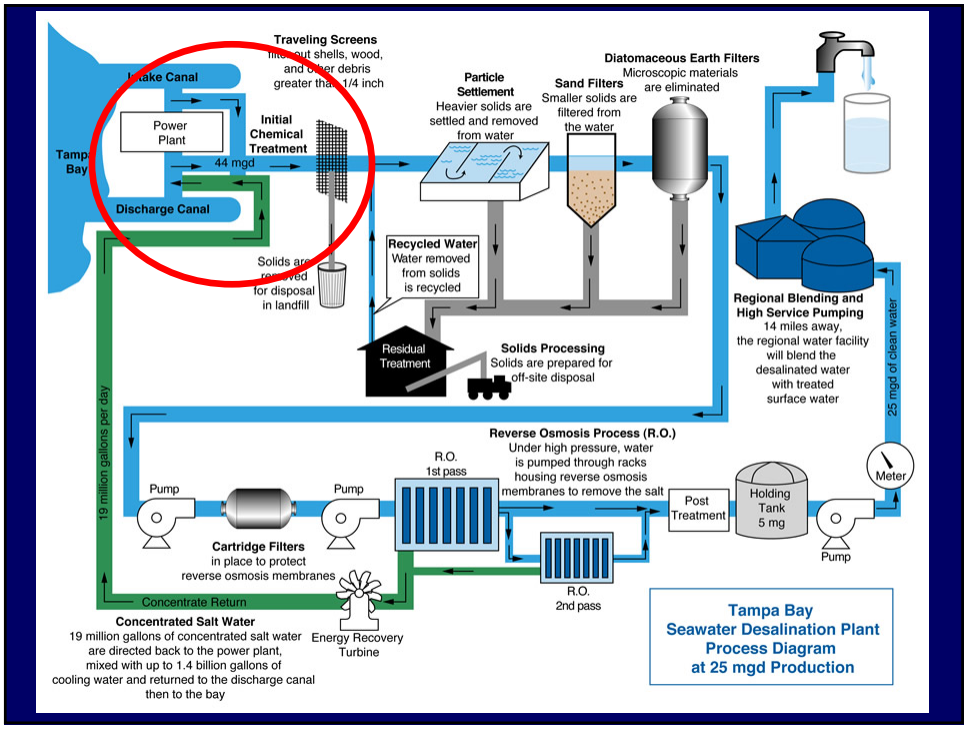

"It has been estimated that for the same capital investment spent on seawater reverse osmosis desalination in 1980, 27 times more water can be produced by today's systems."

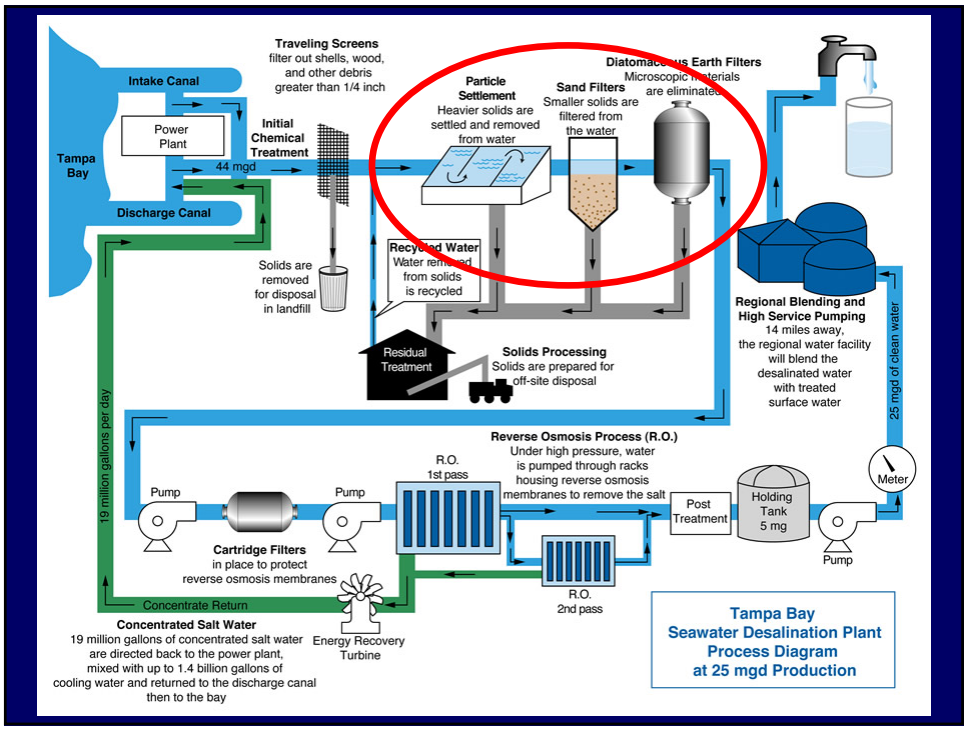
Tom Pankratz, Desalination Technology Trends, 2004
TWDB Biennial Report on Desalination – Volume 2

# Installed Desalination Capacity




Traveling Screens
filter out shells, wood, and other debris greater than 1/4 inch
Intake Canal
Power Plant
Initial Chemical Treatment
44 mgd
Tampa Bay
Discharge Canal
Particle Settlement
Heavier solids are settled and removed from water
Sand Filters
Smaller solids are filtered from the water
Diatomaceous Earth Filters
Microscopic materials are eliminated
Solids are removed for disposal in landfill
Recycled Water
Water removed from solids is recycled
Residual Treatment
Solids Processing
Solids are prepared for off-site disposal
Regional Blending and High Service Pumping
14 miles away, the regional water facility will blend the desalinated water with treated surface water
25 mgd of clean water
19 million gallons per day
Reverse Osmosis Process (R.O.)
Under high pressure, water is pumped through racks housing reverse osmosis membranes to remove the salt
R.O. 1st pass
Pump
Pump
Cartridge Filters
in place to protect reverse osmosis membranes
Post Treatment
Holding Tank 5 mg
Meter
Pump
R.O. 2nd pass
Concentrate Return
Concentrated Salt Water
19 million gallons of concentrated salt water are directed back to the power plant, mixed with up to 1.4 billion gallons of cooling water and returned to the discharge canal then to the bay
Energy Recovery Turbine
Tampa Bay
Seawater Desalination Plant
Process Diagram
at 25 mgd Production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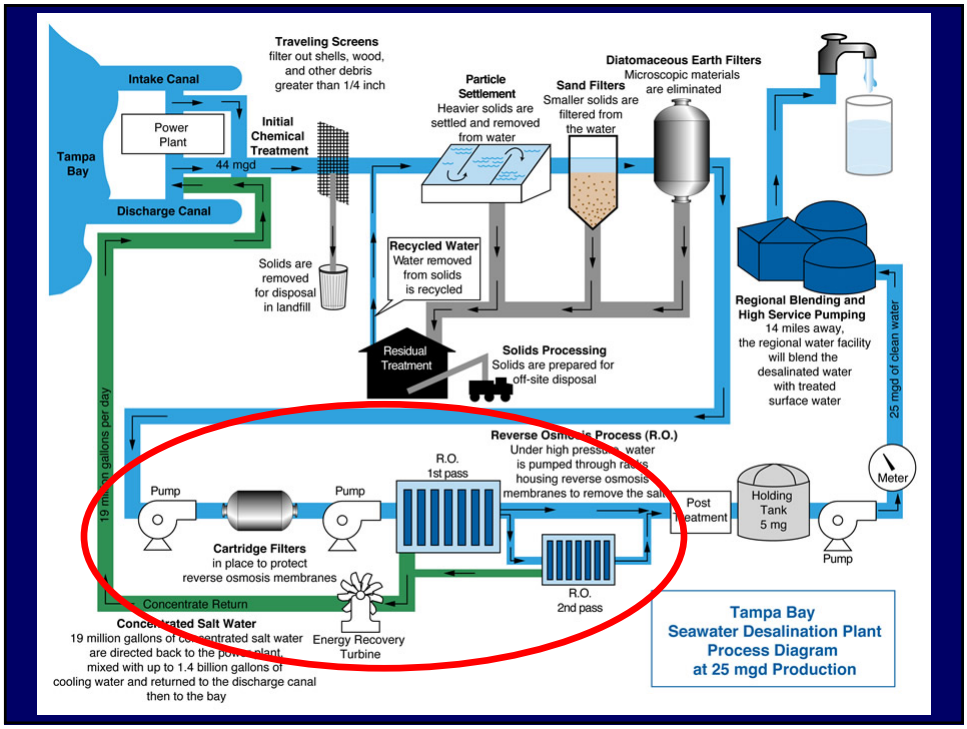
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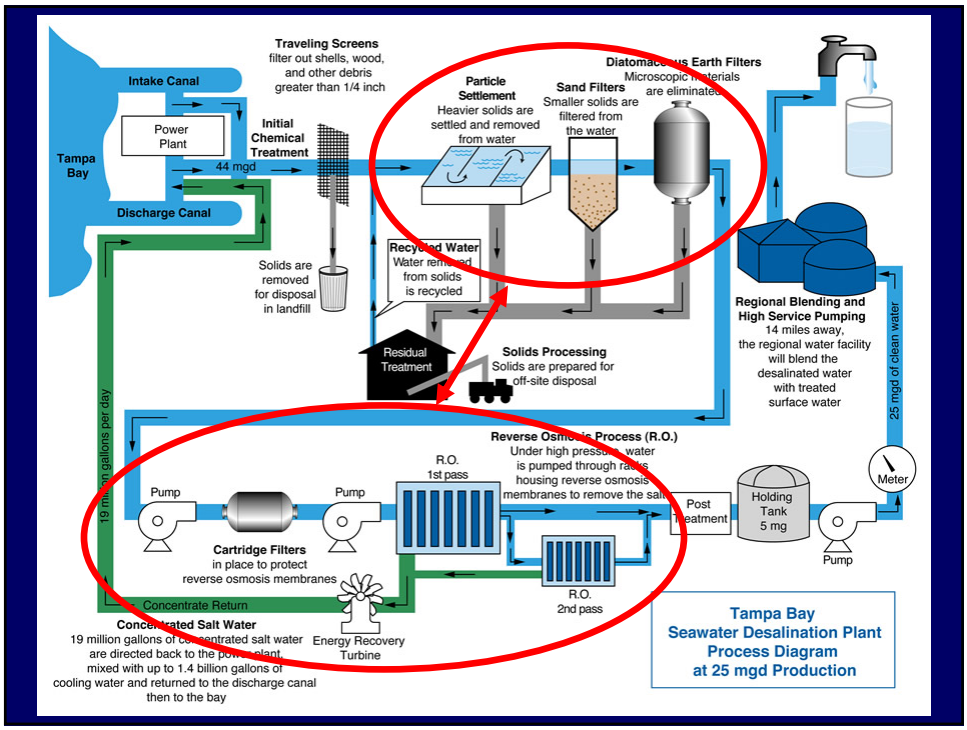
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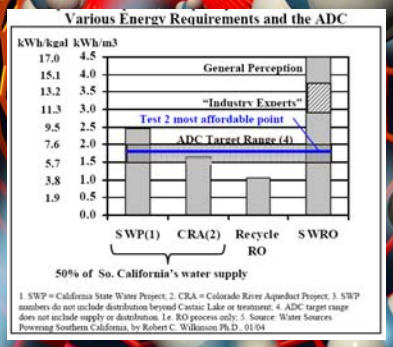
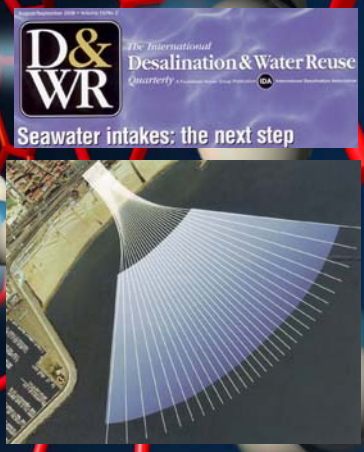
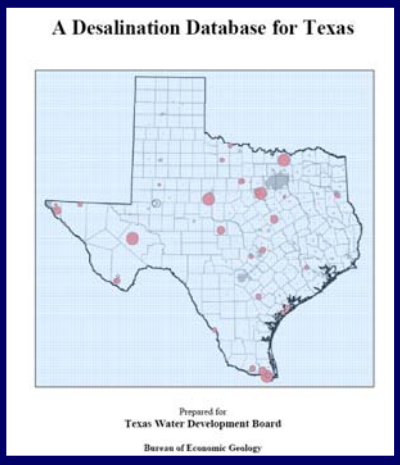
# Continued improvements




# Water Desalination in Texas



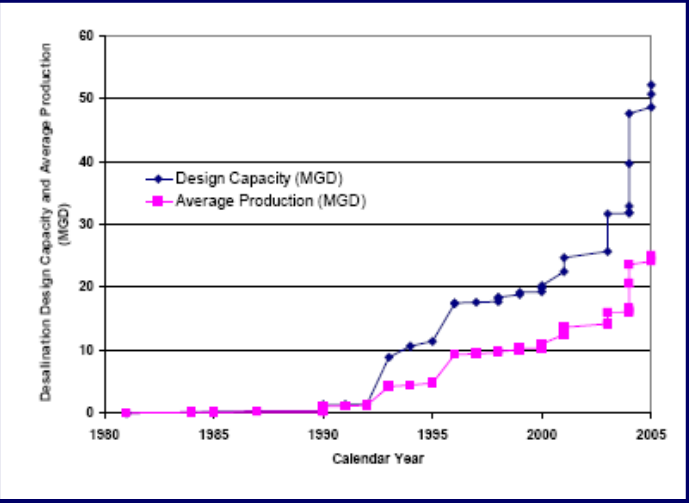

- TWDB Research Program
- Desalination Research
- Desalination Database
  - University of Texas Bureau of Economic Geology
  - Principal Investigator : Dr. J. P. Nicot
  - TWDB Contract Manager: Dr. H. Krishna

## Desalination Facilities in Texas (2005)

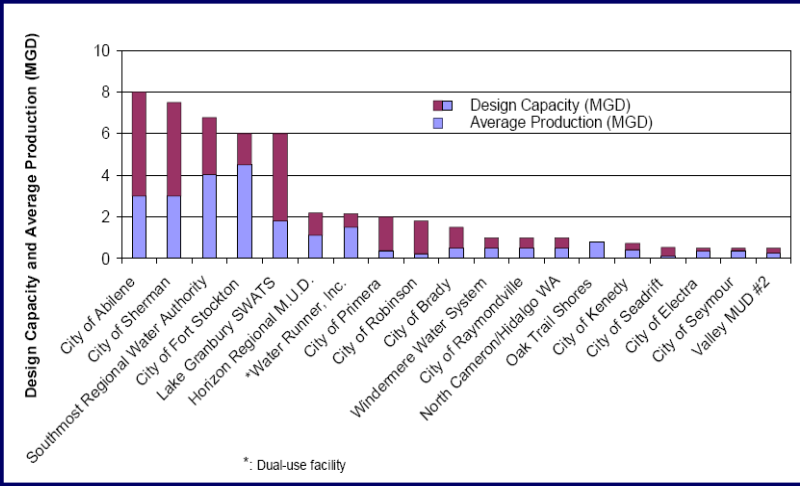
| Type of Desalination Facility | Number Of Facilities | Cumulative Design Capacity |
|---|---|---|
| PWS≥ .025 MGD | 38 | 52 MGD |
| PWS< .025 MGD | 50+ | Less than .5 MGD |
| Other desalination facilities | 100+ | 60-100 MGD |

- Over 100 **p**ublic **w**ater **s**ystems contacted
- Mailed survey with phone follow-up

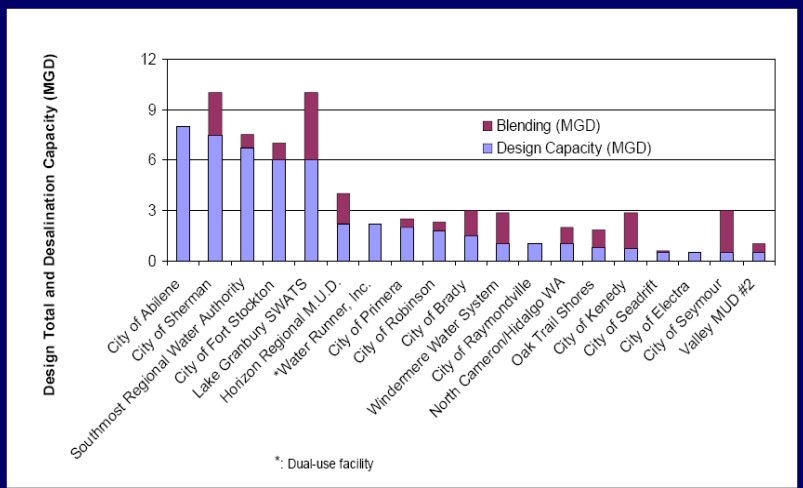
## Fig 1.2 – Design/Production over time



## Fig. 1.1- Largest facilities

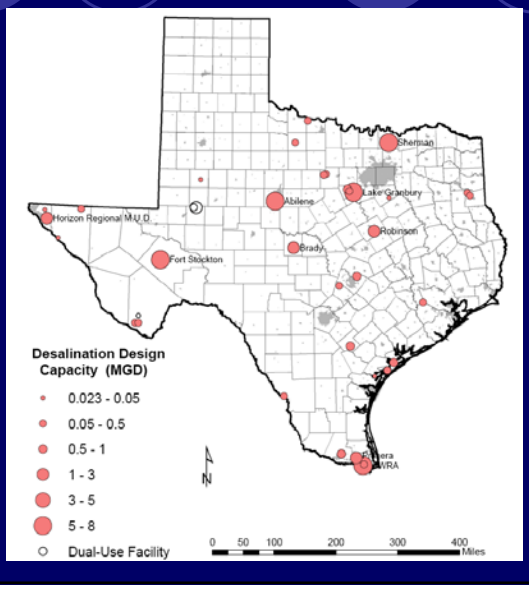



## Fig 4.3- Blending




Facilities with design capacity over .5 MGD

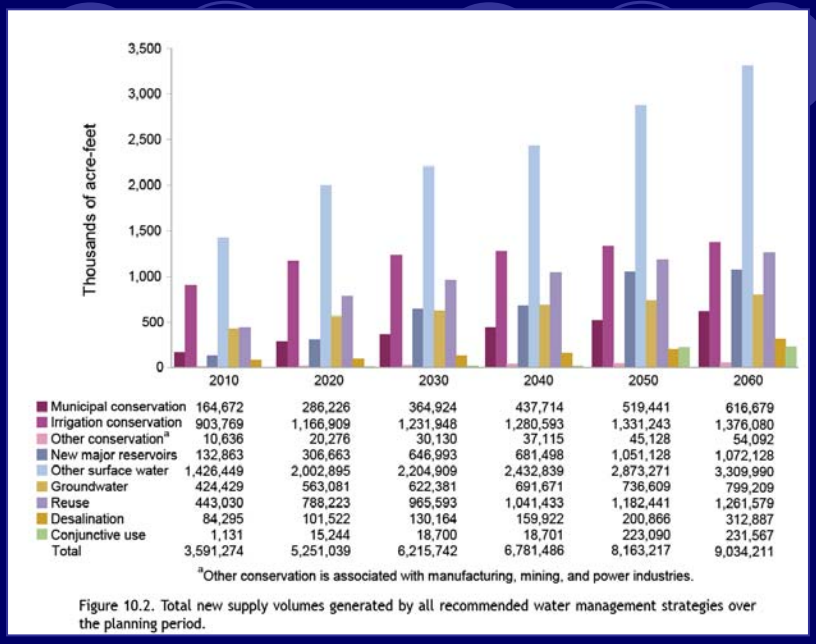
# Fig 4.5- Geographic Distribution




# Sample of costs – Brackish Groundwater Desalination

| FACILITY | CAPACITY (MGD) | $/1,000 Gal | | | CONSTRUCTION COSTS |
|---|---|---|---|---|---|
| | | O&M | DEBT SERVICE | TOTAL COST | |
| 1.NAWSC LASARA | 1.2 | $ 0.80 | $ 0.32 | $ 1.12 | $ 2,000,000.00 |
| 2. NCRWA | 2.2 | $ 0.78 | $ 0.57 | $ 1.35 | $ 6,500,000.00 |
| 4. NAWSC OWASSA SITE | 3.3 | $ 0.80 | $ 0.47 | $ 1.27 | $ 8,000,000.00 |
| 5. NAWSC DOOLITTLE SITE | 3.3 | $ 0.80 | $ 0.47 | $ 1.27 | $ 8,000,000.00 |
| 6. SRWA | 7.5 | $ 0.85 | | | $ 26,190,993.00 |

**Courtesy of NRS Engineers –April 2007**



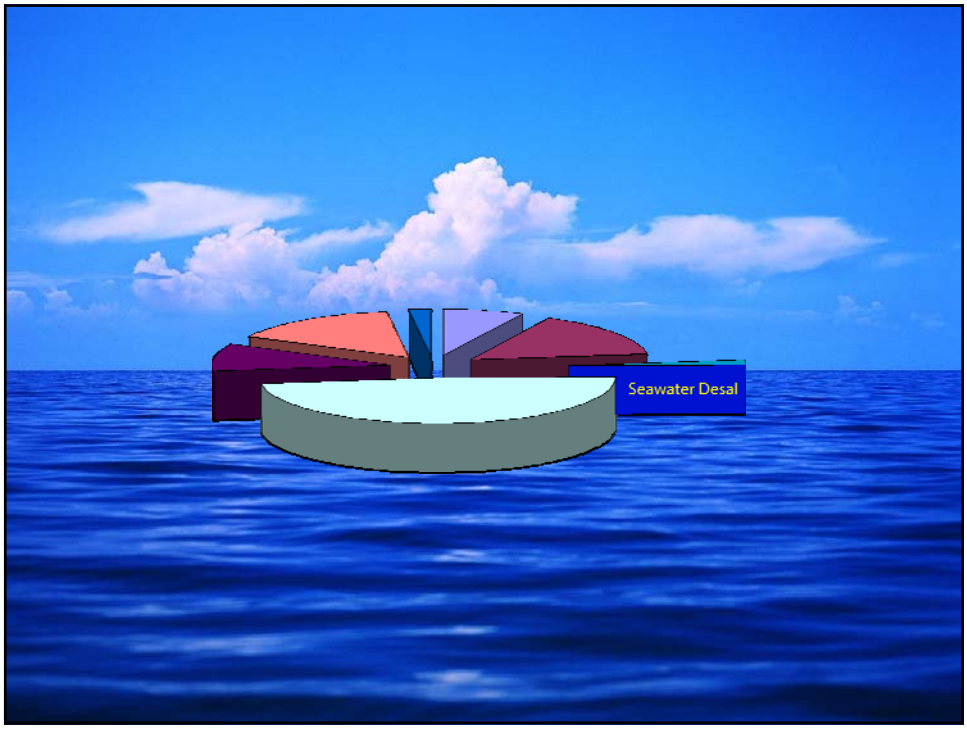

| | 2010 | 2020 | 2030 | 2040 | 2050 | 2060 |
|---|---|---|---|---|---|---|
| Municipal conservation | 164,672 | 286,226 | 364,924 | 437,714 | 519,441 | 616,679 |
| Irrigation conservation | 903,769 | 1,166,909 | 1,231,948 | 1,280,593 | 1,331,243 | 1,376,080 |
| Other conservation[a] | 10,636 | 20,276 | 30,130 | 37,115 | 45,128 | 54,092 |
| New major reservoirs | 132,863 | 306,663 | 646,993 | 681,498 | 1,051,128 | 1,072,128 |
| Other surface water | 1,426,449 | 2,002,895 | 2,204,909 | 2,432,839 | 2,873,271 | 3,309,990 |
| Groundwater | 424,429 | 563,081 | 622,381 | 691,671 | 736,609 | 799,209 |
| Reuse | 443,030 | 788,223 | 965,593 | 1,041,433 | 1,182,441 | 1,261,579 |
| Desalination | 84,295 | 101,522 | 130,164 | 159,922 | 200,866 | 312,887 |
| Conjunctive use | 1,131 | 15,244 | 18,700 | 18,701 | 223,090 | 231,567 |
| Total | 3,591,274 | 5,251,039 | 6,215,742 | 6,781,486 | 8,163,217 | 9,034,211 |

[a]Other conservation is associated with manufacturing, mining, and power industries.

Figure 10.2. Total new supply volumes generated by all recommended water management strategies over the planning period.

# 2006 Regional Water Plans

| Region | Additional Water Supply (AFY ) From Desalination by 2060 | |
|---|---|---|
| | Brackish Water (surface and groundwater) | Seawater |
| A | 0 | 0 |
| B | 26,550 | 0 |
| E | 50,000 | 0 |
| F | 16,221 | 0 |
| G | 200 | 0 |
| H | 0 | 28,000 |
| K | 29,568 | 0 |
| L | 5,562 | 84,012 |
| M | 69,832 | 7,902 |
| N | 0 | 18,200 |
| O | 3,360 | 0 |
| Total | 201,293 | 138,114 |




## 78th Texas Legislature

- HB 1370, directing TWDB to:
  - "undertake or participate in research, feasibility and facility planning studies, investigations, and surveys as it considers ***necessary to further the development of cost-effective water supplies from seawater desalination*** *in* the state."

# Seawater Desalination

2010-2012
New drought-proof water supply

Design, construction, commissioning

EIR, Discharge Permits & Others

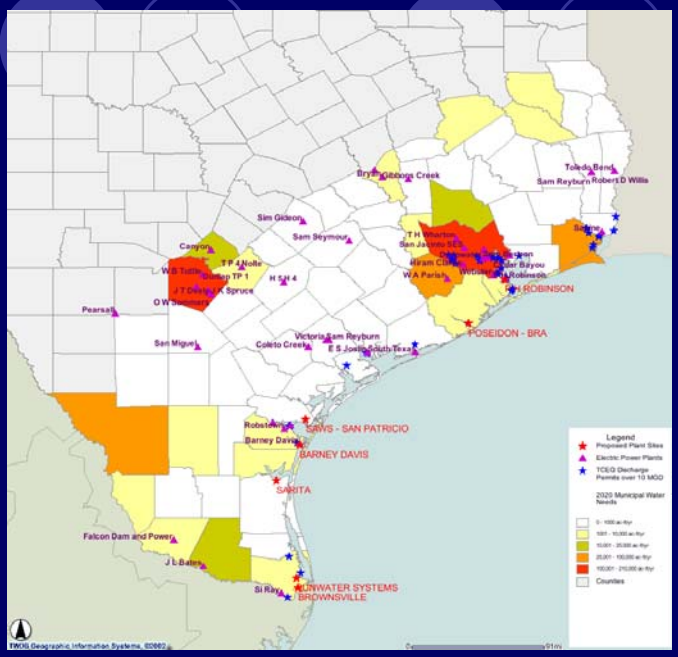
Pilot Plant Studies

79th Session

**Dec 2004**
Completed feasibility Studies

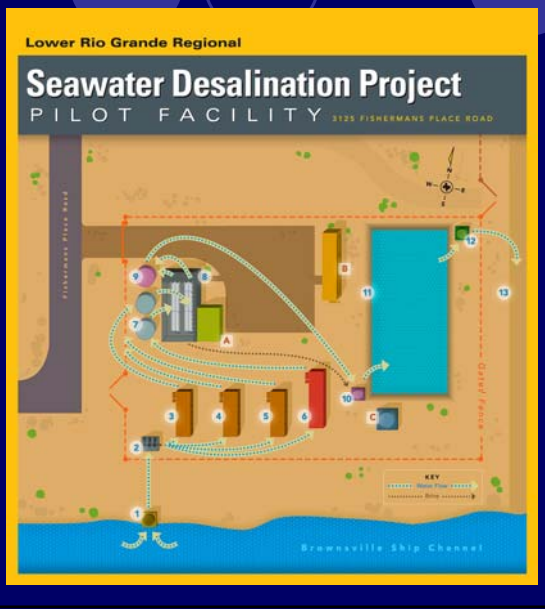
78th Session

**Dec 2002**
Statement of Interest
Selected Sites



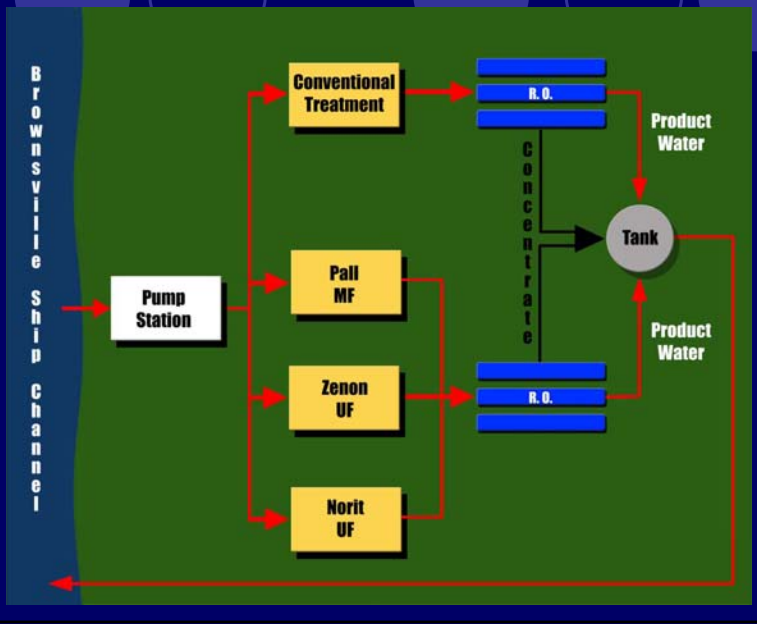
## Brownsville


## Pilot Plant at the Brownsville Ship Channel




**WATER TREATMENT PROCESS**

1. Intake
2. Intake Pumps
3. Norit Ultrafiltration Pretreatment Unit
4. ZENON Ultrafiltration Pretreatment Unit
5. Pall Microfiltration Pretreatment Unit
6. Eimco Conventional Pretreatment Unit
7. Pretreatment Filtrate Storage Tanks
8. Reverse Osmosis Treatment Facility
9. Water Storage Tanks
10. Mixing Tank
11. Lagoon
12. Neutralization Tank & Discharge Point
13. Discharge Ditch



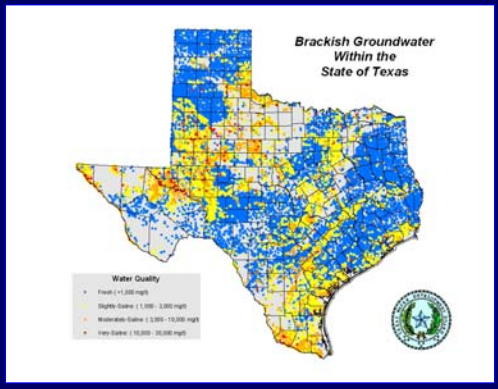
## Next steps

- Complete  the pilot plant study
- Determine pre-design specifications for the full-scale project
- Determine costs, funding and project procurement strategy
- Seek funding
- Desalinate by 2010

## Brackish groundwater availability

- Texas has an estimated 2.7 billion acre-feet of brackish groundwater(*)

(*) LBG-Guyton, Brackish Groundwater Manual for Regional Water Planning Groups, February 2003



## Brackish Groundwater Desalination Demonstration Projects

- Goal: to continue facilitating the development of brackish groundwater desalination supplies by creating replicable models of projects that may be effectively transferred to other communities with similar profiles.
  - Engineering facility roadmaps
  - Characterizing source water
  - Implementing desalination technologies
  - Managing desalination concentrate

## BGW Demonstration Projects North Cameron Regional WSC

- 2.3 mgd
- Start-up: fall 2006
- $150,000 TWDB grant
- Engineering facility roadmap
- Web-based virtual tours
- Educational focus

## BGW Demonstration Projects
## City of Kenedy

- 1.36 mgd
- $150,000 TWDB grant
- Assess performance of current operation
- Assess cost/benefit of upgrading to modern desalination technology

## BGW Demonstration Projects
## City of San Angelo

- $300,000 TWDB grant
- Exploratory drilling to characterize the suitability of the Whitehorse aquifer in Irion County as a brackish groundwater source for future water supply purposes
- Guidance manual for characterizing brackish groundwater resources

# BGW Demonstration Projects
# City of San Antonio

**Title: Evaluation of Concentrate Management and Assessment of the Vibratory Shear Enhanced Process**

**Project Summary:** The project will perform a pilot test and assess the cost and technical feasibility of the Vibratory Shear Enhanced Process (VSEP) as a tool for reducing the volume of brackish groundwater desalination concentrate. Additionally, the project will develop a model for evaluating enhanced recovery processes to aid in selecting concentrate management solutions for brackish groundwater desalination.

**TWDB Contract Manager:** Jorge Arroyo

**Funding Recipients:** San Antonio Water System

**Project Administrator:** San Antonio Water System

**Consultants:** Evergreen Underground Water Conservation District, R.W. Beck Inc., Mickley & Associates, New Logic Research, Inc., and LBG-Guyton Associates

**Project Start Date:** February 2007

**Project Completion Date:** April 2008

**Total Project Cost:** $877,000

**TWDB Share of Project Cost:** $205,000

**Benefits:** The model which will be developed to evaluate concentrate management options using the VSEP process will provide useful information for developing brackish groundwater desalination supplies in Texas.

**Project Details**

Statement of Interest
Participants
Project Milestones
Project Timeline
Photographs

# BGW Demonstration Projects
# Sandy Land UWCD

**Title: An Integrated Wind-Water Desalination System for Drip Irrigation: Sandy Land Underground Water Conservation District, Plains, Yoakum County**

**Project Summary:** The Sandy Land UWCD project will demonstrate that the vast but largely untapped brackish groundwater present in the Dockum Aquifer can be desalinated economically and used for drip irrigation. The project will use a renewable source of energy, wind, that is in abundant supply in the region and which has not been previously used for this purpose in the state.

**TWDB Contract Manager:** Sanjeev Kalaswad

**Funding Recipients:** Sandy Land UWCD

**Project Administrator:** Gary L. Walker, Sandy Land UWCD

**Participants:** Texas Tech University, Lubbock, Texas
Parkhill, Smith & Cooper, Inc., Lubbock, Texas
General Electric Global Research, Niskayuna, New York

**Project Start Date:** July 17, 2007

**Project Completion Date:** December 31, 2009

**Total Project Cost:** $1,149,500

**TWDB Share of Project Cost:** $263,500

**Benefits:** The Dockum Aquifer covers a large area of the Texas Panhandle and if it proves to be a reliable source of brackish water that can be desalinated economically, other entities in the area can begin to explore it for their own use. This will reduce stress on the overlying Ogallala Aquifer where water levels are declining, and concern is growing about the longevity of the aquifer.

**Project Details**

Statement of Interest
Participants
Project Milestones
Photographs

## BGW Demonstration Projects Sandy Land UWCD

**Title: Improving Recovery: A Concentrate Management Strategy for Inland Groundwater Desalination**

**Project Summary:** The objective of the proposed research is to develop strategies to increase the recovery in reverse osmosis (RO) desalination of brackish groundwater. The researchers will investigate two possible systems to enhance recovery in conventional RO systems: anti-scalant deactivation and precipitation, and electrodialysis.

**TWDB Contract Manager:** Dr. Hari Krishna

**Funding Recipients:** The University of Texas at Austin

**Project Administrator:** Dr. Desmond Lawler

**Consultant:** None

**Project Start Date:** February 2007

**Project Completion Date:** September 2009

**Total Project Cost:** $323,010

**TWDB Share of Project Cost:** $238,500

**Benefits:** The research will demonstrate, both at bench-scale and at small pilot-scale, that intermediate treatment of RO concentrate will allow higher water recovery in brackish groundwater desalination and thereby reduce the requirements for concentrate disposal.

**Project Details**

Statement of Interest

Participants

Project Milestones

Photographs

## Other research and planning studies on desalination issues

- Please Pass the Salt
- Development of Permitting and Decision Model for Desalination Projects in Texas
- Performance Verification of Capacitive Deionization Technology
- Desalination Facilities Database
- Self-sealing Evaporation Ponds for Small-scale Concentrate Disposal


http://www.twdb.state.tx.us/Desalination/Desal/Index.asp

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