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# Upstream Development Water Needs: Supply and Permitting Considerations

24th Annual Energy Law Institute  
South Texas College of Law  
August 31, 2011  
Houston, Texas

(Revised 08-29-  
2011)

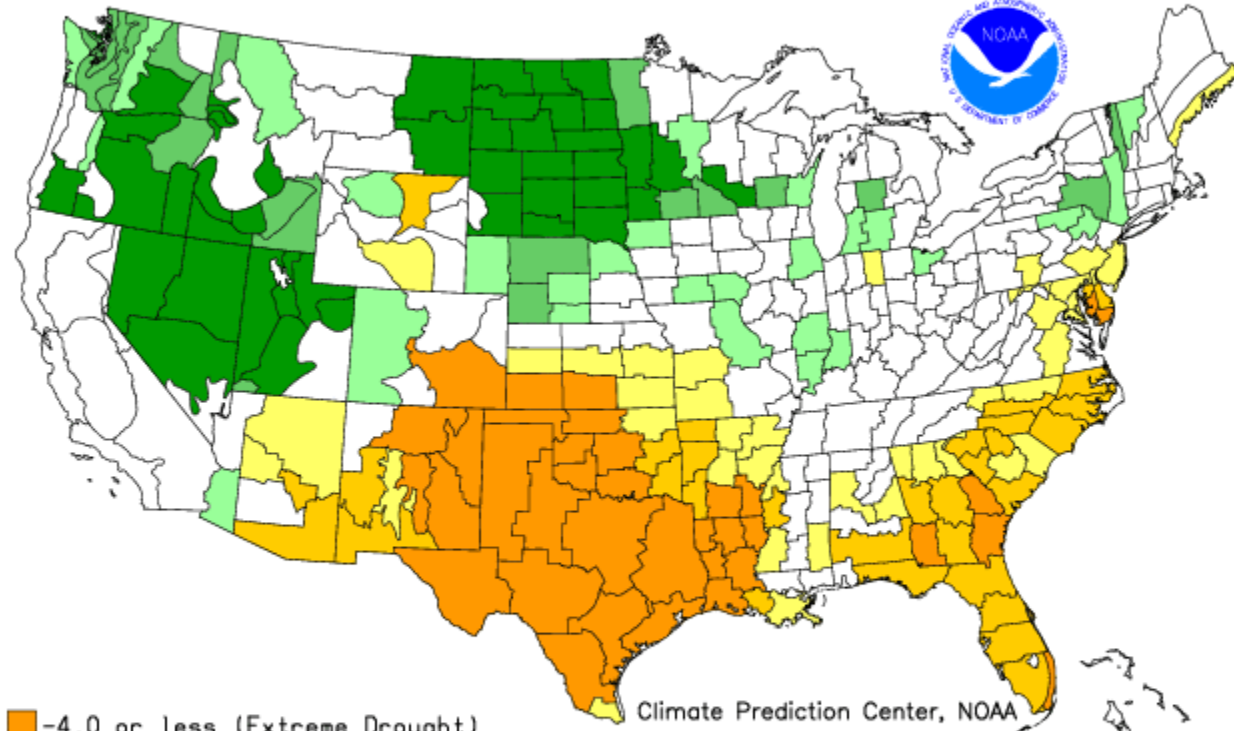


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# Introduction

- Current Drought Conditions
- State Water Planning Process
- Oil & Gas Needs/Usage
- Water Supply Regulatory & Permitting
  - Surface Water
  - Groundwater
  - Reuse

Drought Severity Index by Division  
Weekly Value for Period Ending JUL 30, 2011  
Long Term Palmer



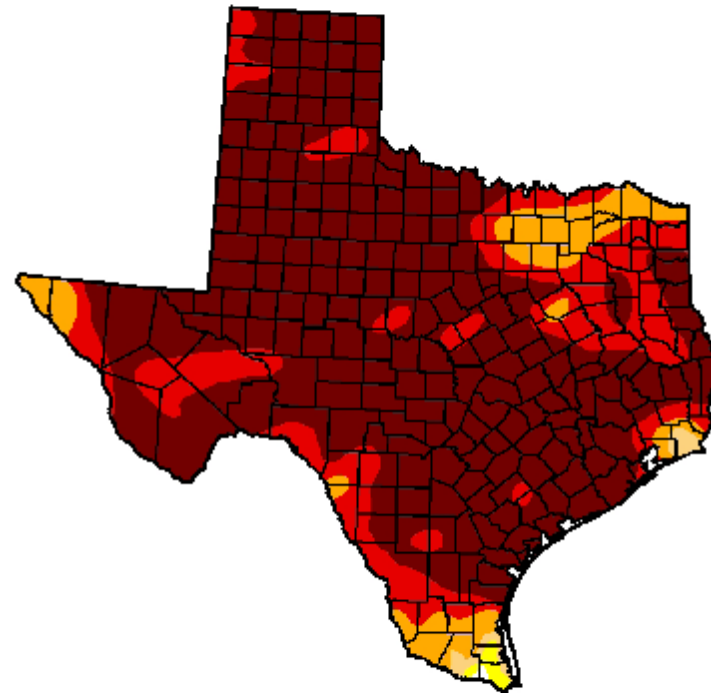
- Climate Prediction Center, NOAA
- 4.0 or less (Extreme Drought)
  - 3.0 to -3.9 (Severe Drought)
  - 2.0 to -2.9 (Moderate Drought)
  - 1.9 to +1.9 (Near Normal)
  - +2.0 to +2.9 (Unusual Moist Spell)
  - +3.0 to +3.9 (Very Moist Spell)
  - +4.0 and above (Extremely Moist)

# U.S. Drought Monitor

## Texas

August 2, 2011  
Valid 7 a.m. EST

	Drought Conditions (Percent Area)					
	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.07	99.93	99.48	98.67	91.73	73.49
Last Week (07/26/2011 map)	0.00	100.00	99.85	96.88	91.65	75.23
3 Months Ago (05/03/2011 map)	0.00	100.00	98.86	93.99	73.73	25.96
Start of Calendar Year (12/28/2010 map)	7.89	92.11	69.43	37.46	9.59	0.00
Start of Water Year (09/28/2010 map)	75.57	24.43	2.43	0.99	0.00	0.00
One Year Ago (07/27/2010 map)	89.01	10.99	2.74	0.44	0.00	0.00



### Intensity:

- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

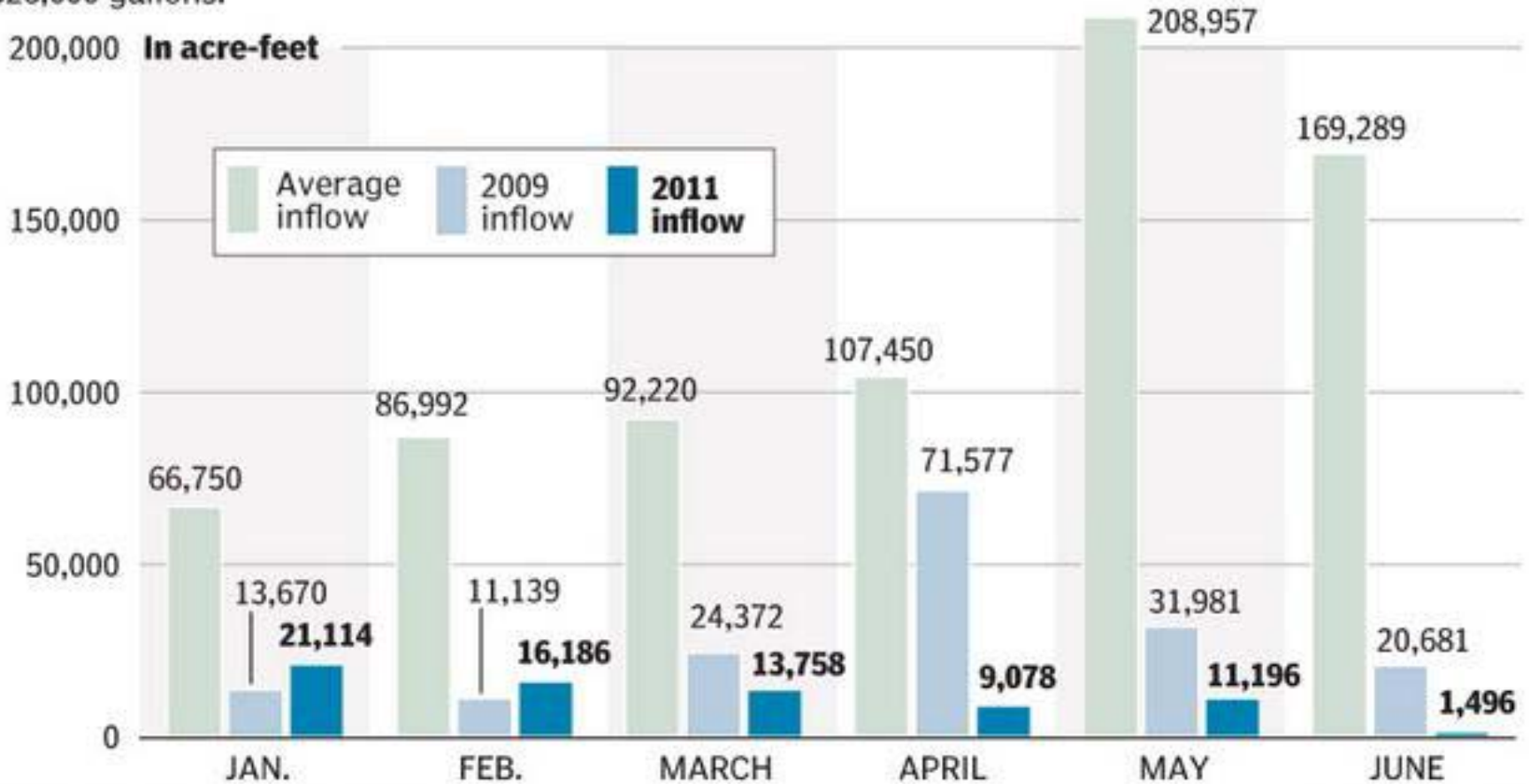
<http://drought.unl.edu/dm>



Released Thursday, August 4, 2011  
Brad Rippey, U.S. Department of Agriculture

# Less water flowing into the Highland Lakes

The amount of water from rivers and streams flowing into the Highland Lakes, as measured in acre-feet, has been dropping in recent months. An acre-foot equals about 326,000 gallons.



Source: Lower Colorado River Authority

AMERICAN STATESMAN



# Surface Water Resources

an important natural resource providing water for human use and a habitat for aquatic ecosystems

[Surface Water Resources Home](#)

[Evaporation Monitoring](#)

[Drought Summary](#)

[Reservoir-Map Tool](#)

[Texas Water Conditions](#)

Location: [TWDB Home](#) » [Water Science & Conservation](#) » [Surface Water Resources](#) » [Texas Water Conditions](#) » [South Central](#)

## Reservoir Storage

[Regional Storage Map](#)

[Reservoir Storage Map](#)

[North Central Reservoirs](#)

[State Total](#)

### Regions:

[East Region](#)

[Edwards Plateau](#)

[High Plains](#)

[Low Rolling Plains](#)

[North Central Region](#)

[South Central Region](#)

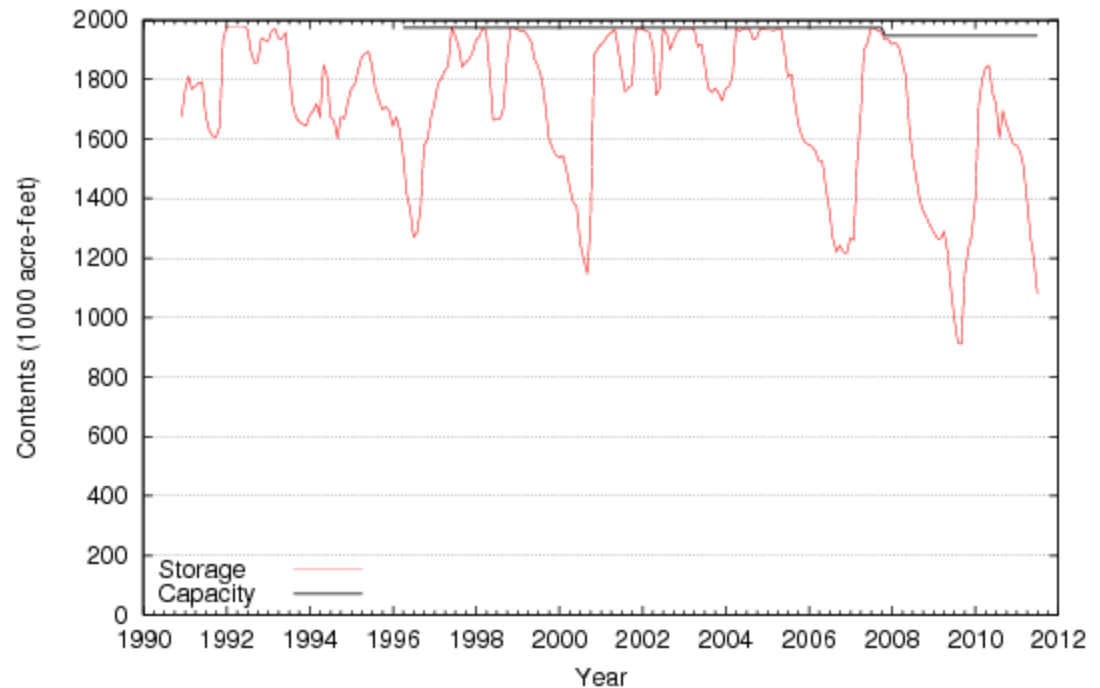
[Southern Region](#)

[Trans-Pecos](#)

[Upper Coast](#)

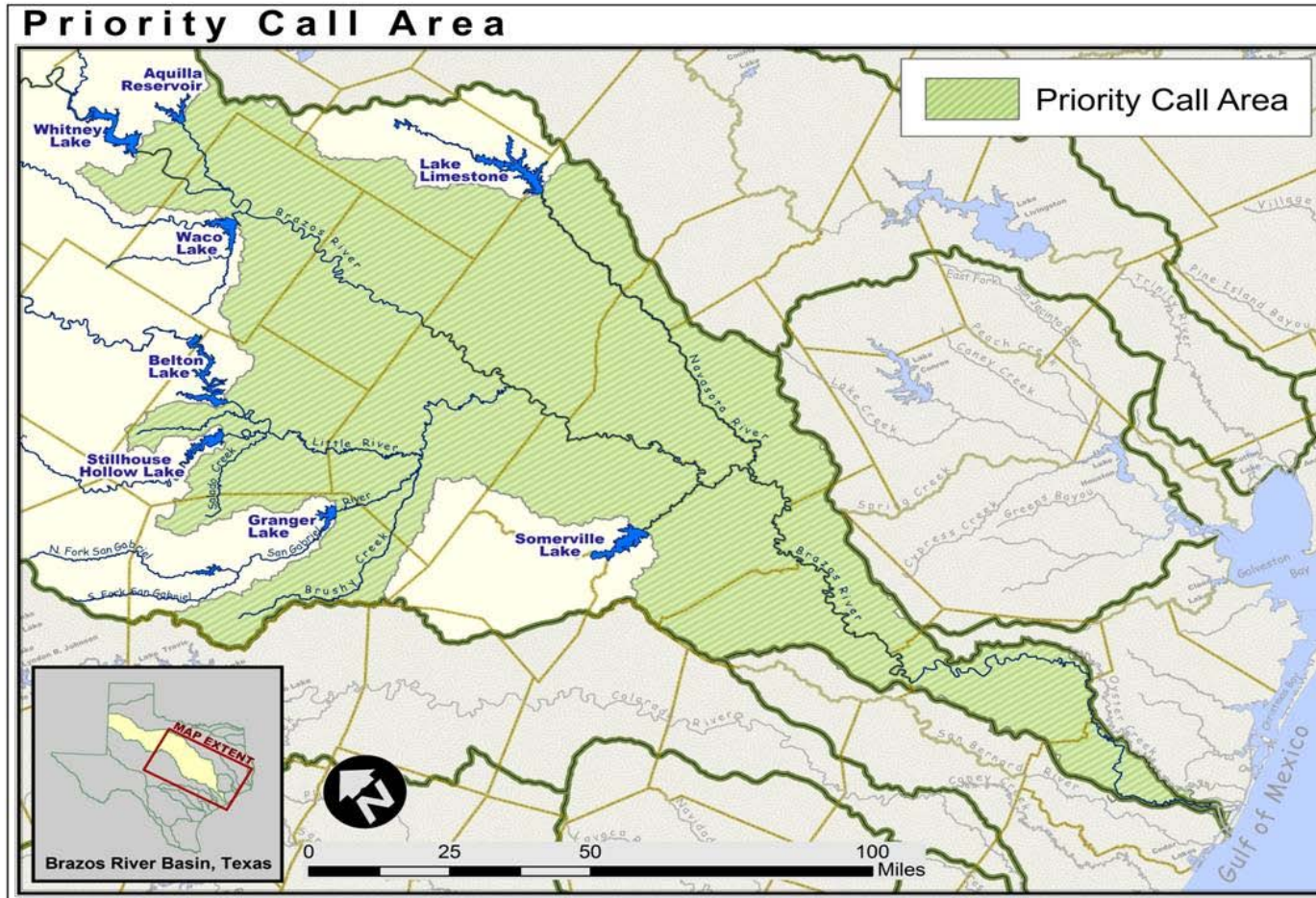
## South Central Texas Storage

Storage near end of Jul, 2011: 1.078 Million acre-ft (55%)  
Conservation Capacity: 1.947 Million acre-ft



# Brazos River Priority Call Area

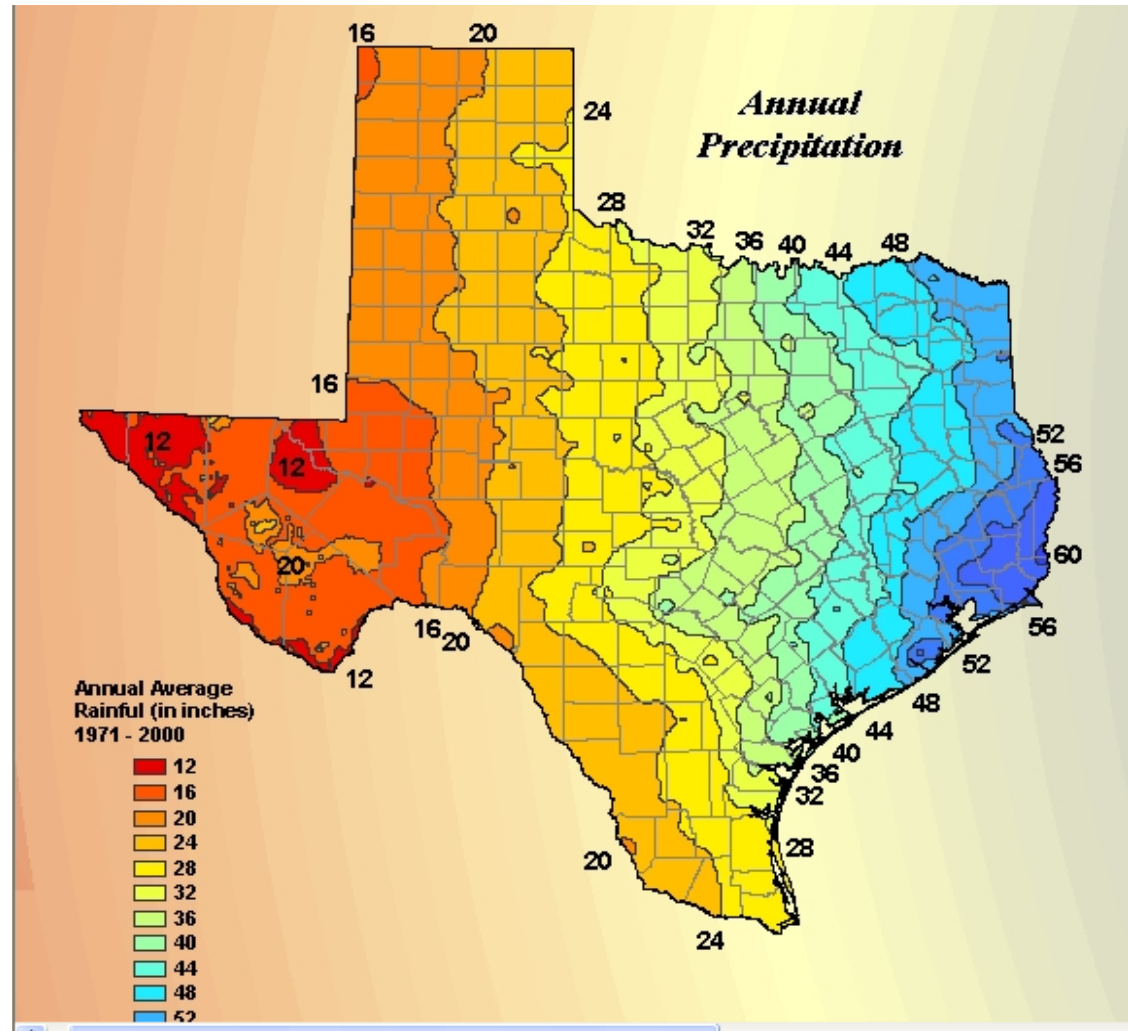
This map depicts the area of the Brazos River where junior surface water rights have been curtailed.



Source: TCEQ

# Where is Our Water Supply?

- Scarce in West Texas
- Abundant in East Texas
- Nearly 3M acre ft/yr. Potential Development in Sabine and Neches Basins
- Limitation on New Interbasin Transfers

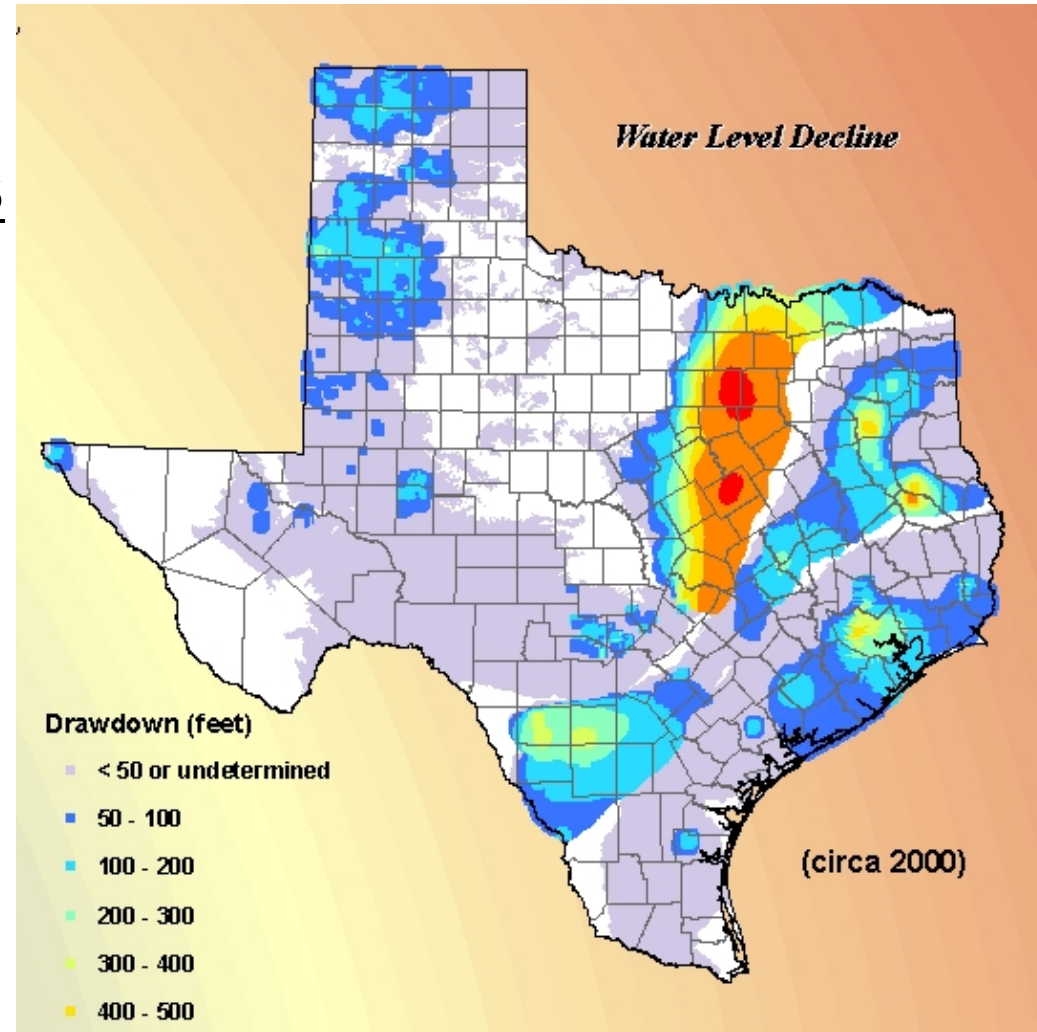


Source: TWDB



# Groundwater Status

- Nearly 60% Current Water Use from Groundwater
- 100+ Groundwater Conservation Districts



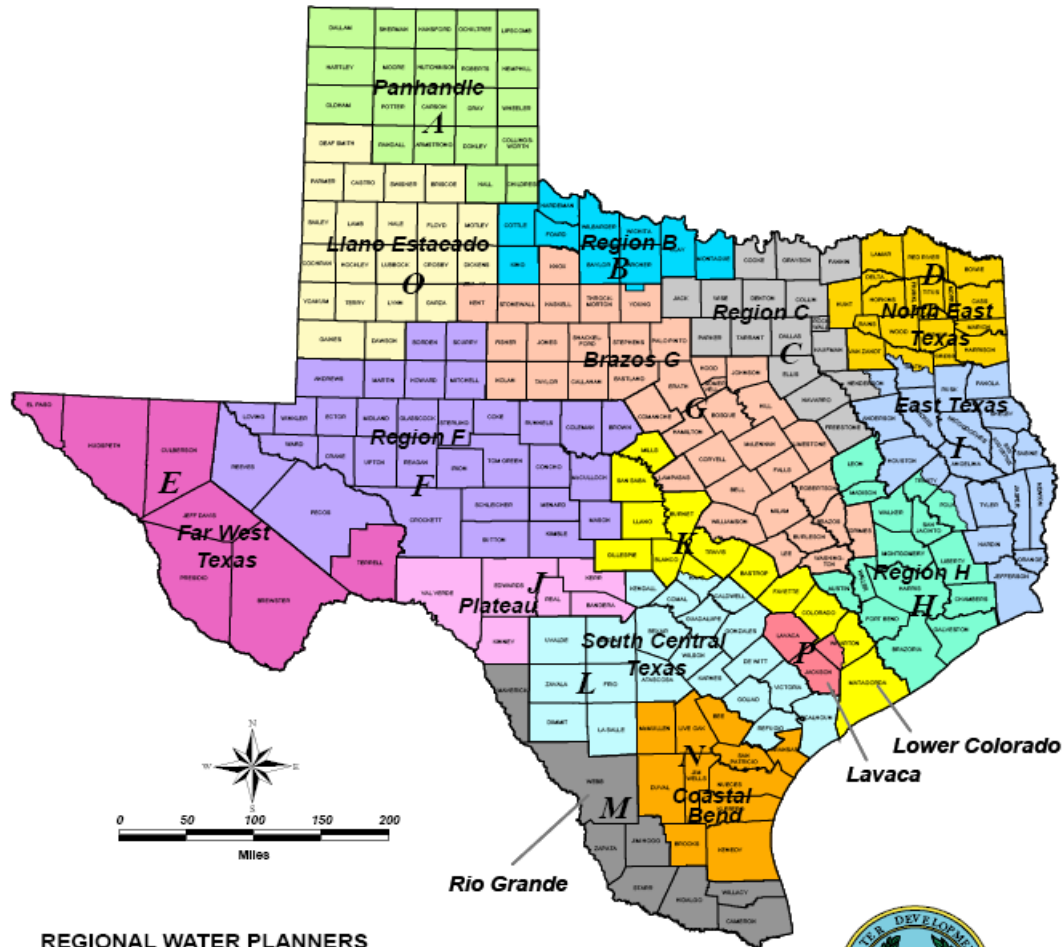
Source: Texas Water Development Board

# State Water Plan 2012

- Planning Process – Every 5 Years
- Locally Developed Regional Water Plans
- Total Texas 2060 Water Stats:
  - Supply = 15 million AcFt
  - Demand = 22 million AcFt
- Capital Cost \$53B to Meet Demand

Source: Water for Texas: Summary of the 2011 Region Water Plans, Texas Water Development Board, January 2011.

# Regional Water Planning Areas



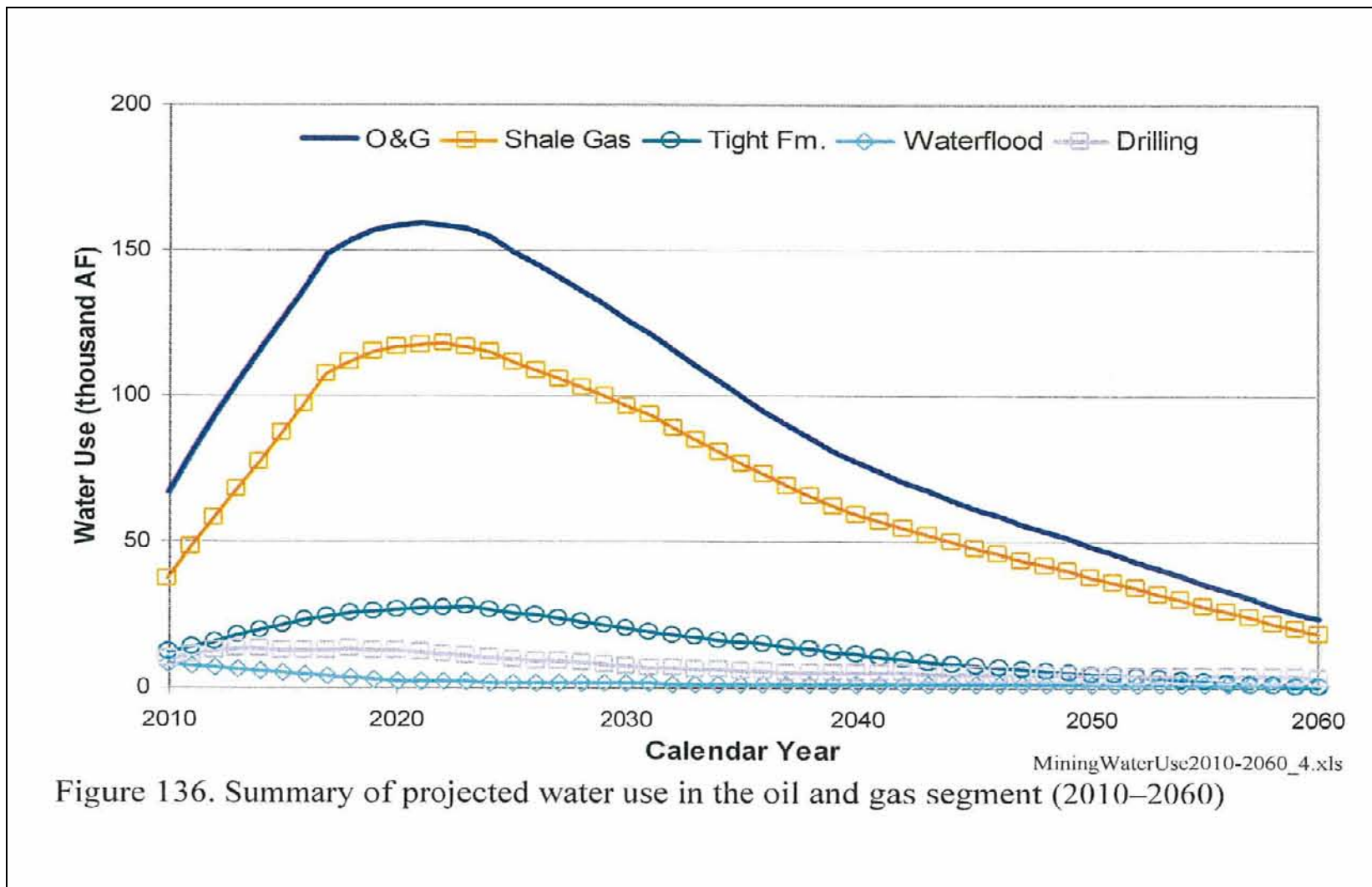
## REGIONAL WATER PLANNERS

Connie Townsend (512) 463 - 8290 - Regions E, J & M  
 Temple McKinnon (512) 475 - 2057 - Regions D, H & I  
 Angela Masloff (512) 936 - 0872 - Regions A, B & C  
 Matt Nelson (512) 936 - 3550 - Regions G, L & N  
 Angela Kennedy (512) 463 - 1437 - Regions F, O & P  
 David Meesey (512) 936 - 0852 - Region K



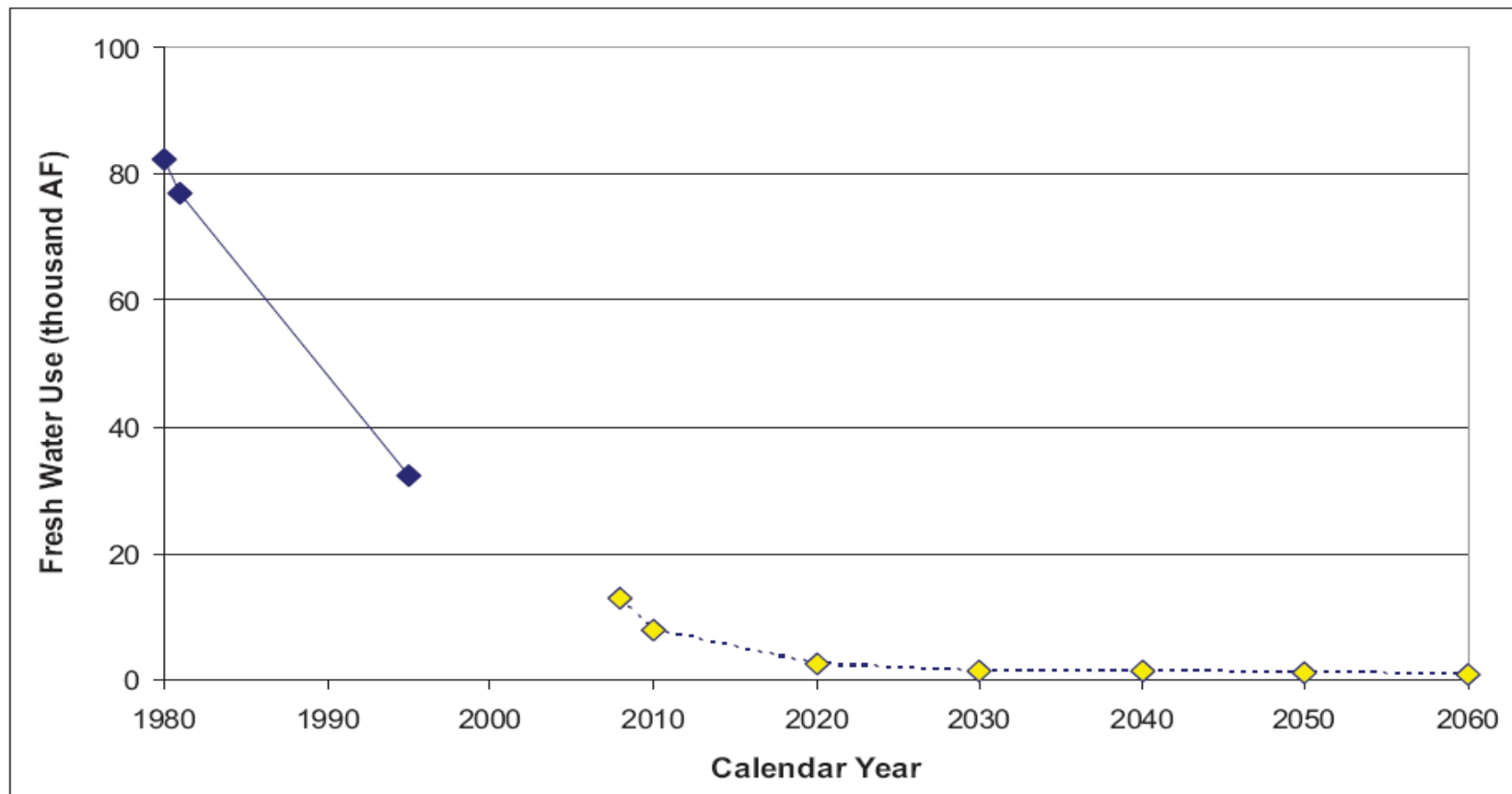
Updated by Mark Hayes  
 Mapping Coordinator

# Projected O&G Sector Water Use



Source: BEG/TWDB June  
2011

# Actual and Projected Water Use by O&G Secondary and Tertiary Recovery

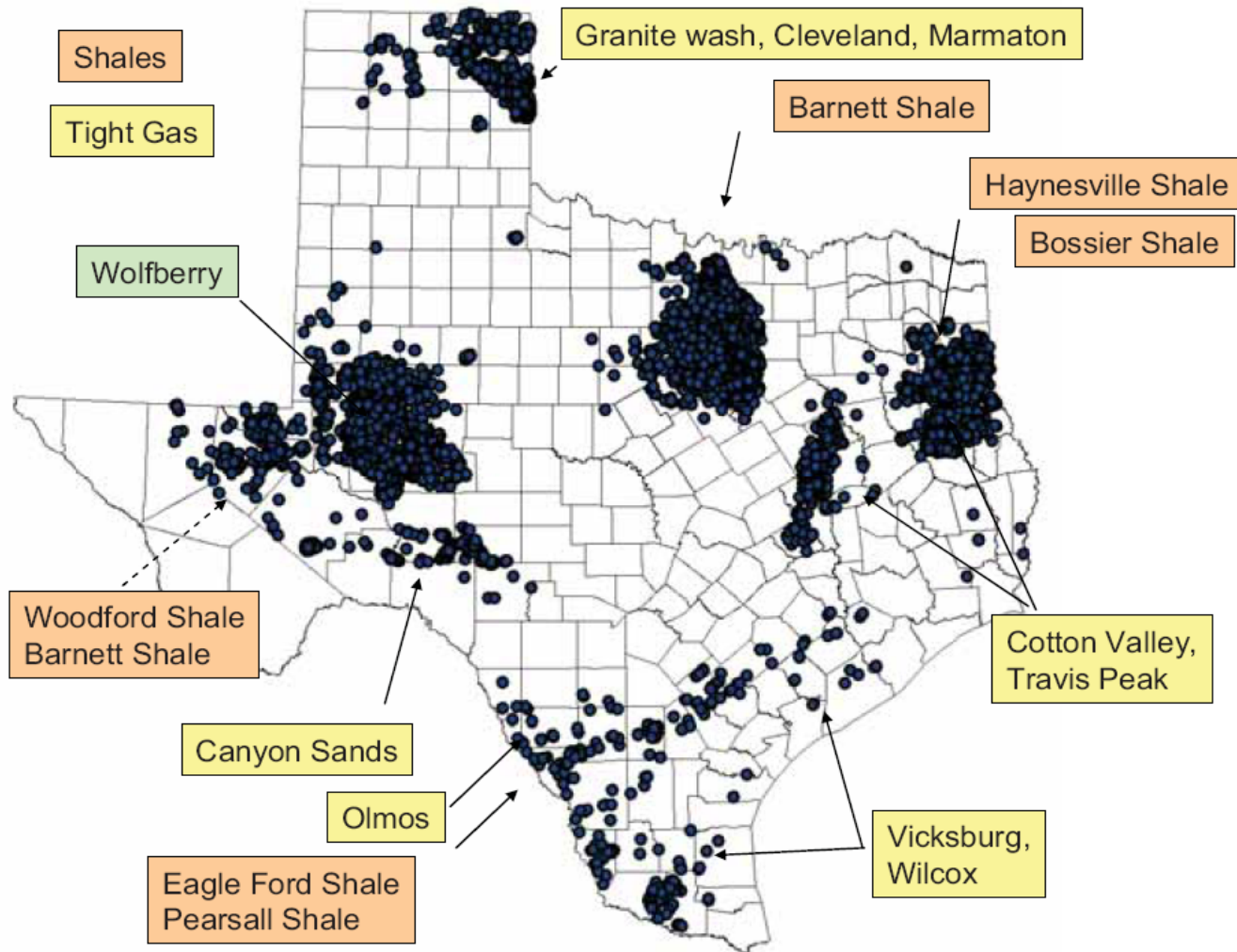


Source: RRC (1982) and De Leon (1996) for historical data

Historical Injection 2=fromRRC1982Report.xls

Source: BEG/TWDB June

# Location of Frac Jobs (2005–2009)



Source: IHS database

Figure 24. Map showing locations of all frac jobs 2005–2009, and main (mostly) gas plays

Source: BEG/TWDB June

# Projected Fracing Water Use

(Tones)

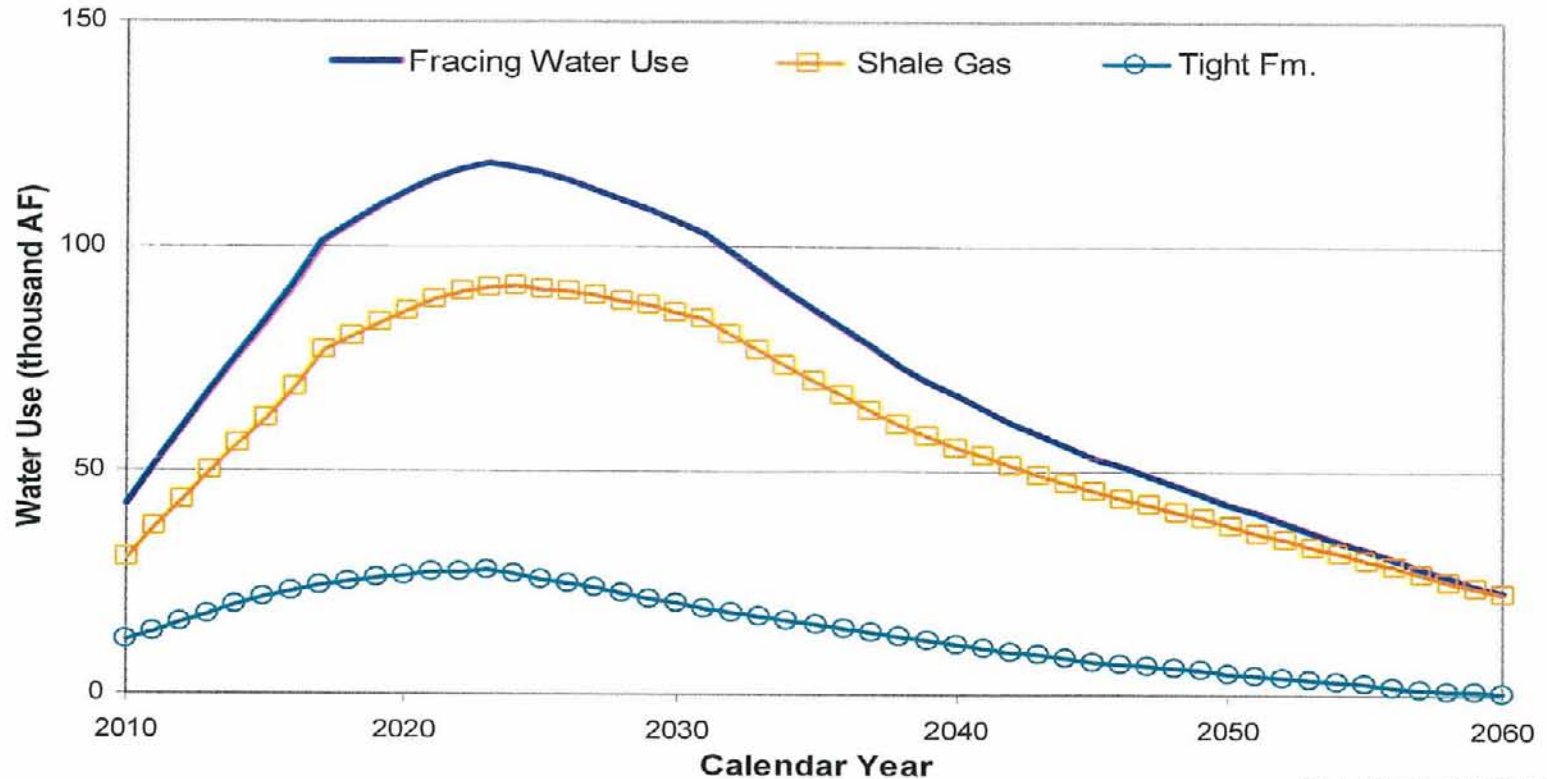
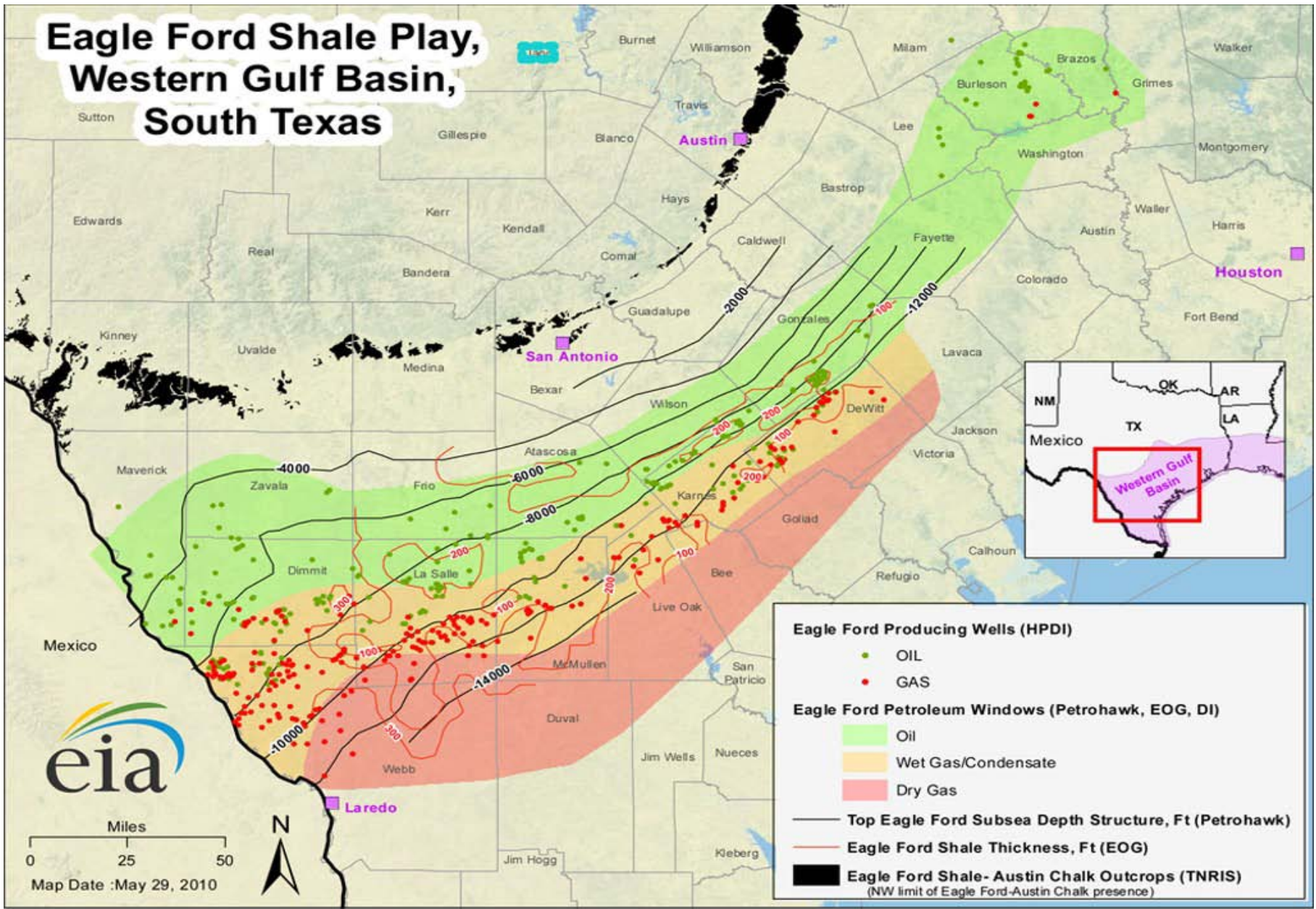


Figure 119. Projected state fracing water use

MiningWaterUse2010-2060\_2.xls

# Eagle Ford Shale Play, Western Gulf Basin, South Texas



**Eagle Ford Producing Wells (HPDI)**

- OIL
- GAS

**Eagle Ford Petroleum Windows (Petrohawk, EOG, DI)**

- Oil
- Wet Gas/Condensate
- Dry Gas

— Top Eagle Ford Subsea Depth Structure, Ft (Petrohawk)

— Eagle Ford Shale Thickness, Ft (EOG)

■ Eagle Ford Shale- Austin Chalk Outcrops (TNRIS)  
(NW limit of Eagle Ford-Austin Chalk presence)



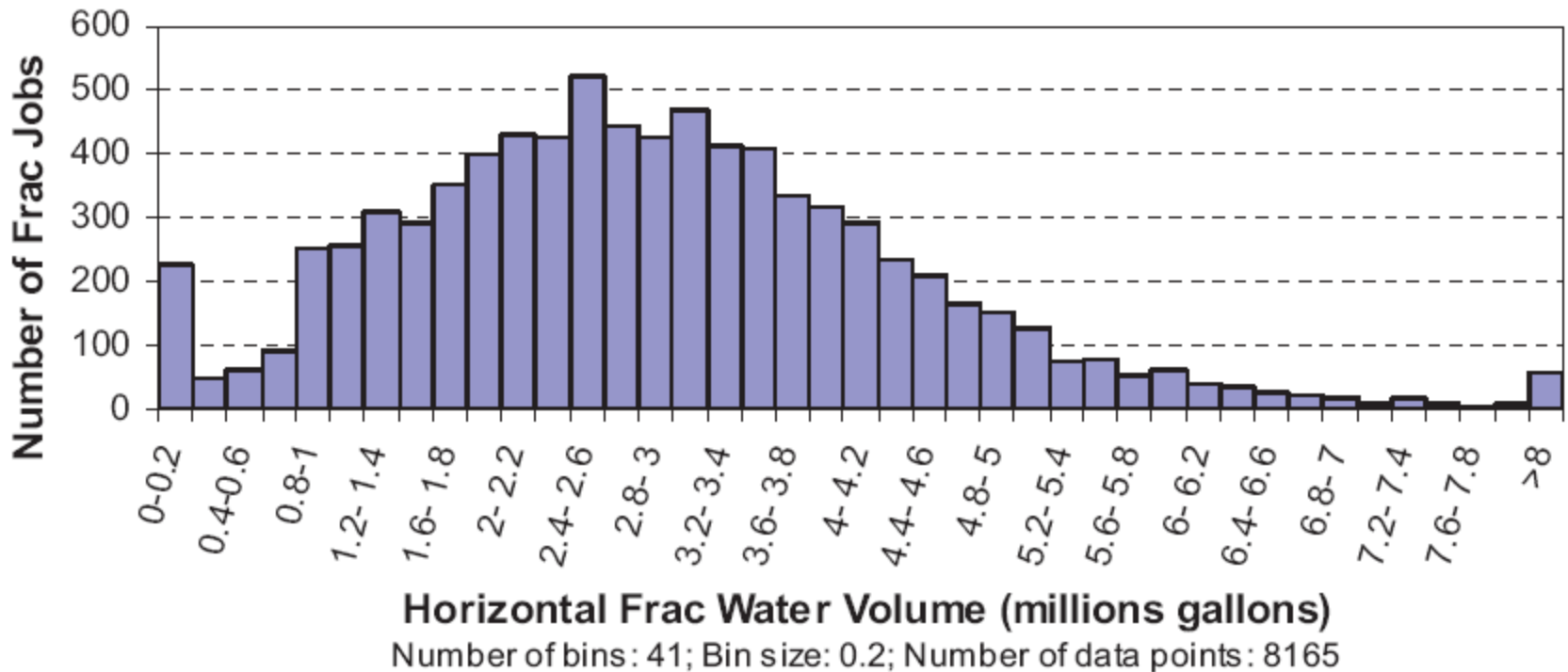
Miles  
0 25 50  
Map Date : May 29, 2010



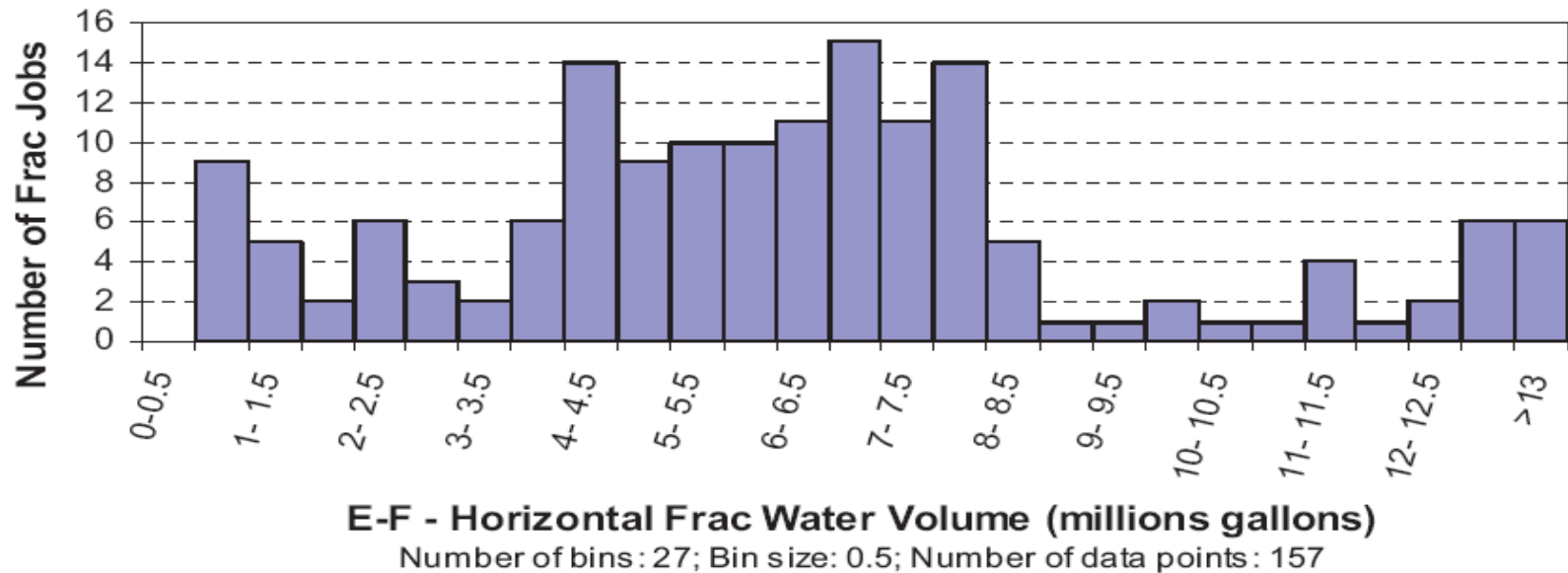
# Reported Average Frac Water Use (gallons/well)

- Barnett 2,300,000
- Haynesville 2,700,000
- Marcellus (PA) 3,800,000
- Eagle Ford 6,000,000

# Barnett Shale – Frac Water Use (per Well)



# Eagle Ford – Frac Water Use (per well)



(a)

# FracFocus.Org

**WELCOME**

Welcome to FracFocus, the hydraulic fracturing chemical registry website. This website is a joint project of the Ground Water Protection Council and the Interstate Oil and Gas Compact Commission.

On this site you can search for information about the chemicals used in the hydraulic fracturing of oil and gas wells. You will also find educational materials designed to help you put this information in perspective.

**Looking for information about a well site near you?**

**FIND A WELL**

Search for nearby well sites that have been hydraulically fractured to see what chemicals were used in the process.

**FAQs**

**Q.** Do states conduct ongoing testing of water wells and oil and gas well construction?

**A.** It depends on the state. When it comes to water wells, many states have water well construction standards but not routine testing requirements. As regards the construction of oil and gas wells, all states have well construction requirements. These can be reviewed by going to the [Specifications by State](#) page, selecting the state in question and then selecting 'View Regulations'.

**Groundwater Protection: Priority Number One**

Oil and natural gas producers have stringent requirements for how wells must be completed. The genesis of these requirements is water safety.

**Is groundwater protected?**

### Hydraulic Fracturing Fluid Product Component Information Disclosure

Fracture Date:	4/24/2011
State:	Louisiana
County:	De Soto
API Number:	11813125178
Operator Name:	Shell Western E&P
Well Name and Number:	Advanced LBT 11-1H
Longitude:	-93.87542344
Latitude:	32.85092298
Long/Lat Projection:	NAD83
Production Type:	Gas
True Vertical Depth (TVD):	12,130
Total Water Volume (gal):	7,966,938

### Hydraulic Fracturing Fluid Composition

Trade Name	Supplier	Purpose	Ingredients	Chemical Abstract Service Number (CAS #)	Maximum Ingredient Concentration in Additive (% by mass)**	Maximum Ingredient Concentration in HF Fluid (% by mass)**	Comments
Fresh Water	Operator				100.00%	92.62978%	Density = 8.330
SAND - COMMON WHITE	Halliburton	Proppant	Crystalline silica, quartz	14808-80-7	100.00%	3.31730%	
SAND - PREMIUM WHITE	Halliburton	Proppant	Crystalline silica, quartz	14808-00-7	100.00%	4.48342%	
PROPSAND PREMIUM	Halliburton	Proppant	Crystalline silica, quartz	14808-00-7	100.00%	1.05015%	
			Hexamethylenetetramine	1000-7-0	5.00%	0.02105%	
			Phenol / formaldehyde resin	900303-35-4	5.00%	0.02523%	
FR-88	Halliburton	Friction Reducer	Hydrotreated light petroleum distillate	84742-47-8	10.00%	0.03993%	
BE-9	Halliburton	Bioocide	Tributyl tetraethyl phosphonium chloride	81741-28-8	10.00%	0.03528%	
Clay#3	Halliburton	Clay Control	Sodium chloride	7647-14-5	10.00%	0.03855%	
VICON HF BREAKER	Halliburton	Breaker	Chloroacetic acid, sodium salt	7759-18-2	10.00%	0.03089%	
			Sodium chloride	7647-14-5	10.00%	0.03315%	
LOC-30 UC	Halliburton	Oiling Agent	Diur gum	9000-00-0	40.00%	0.03264%	
			Diethylene glycol tetrakis(hexyl ether)	94141-48-4	40.00%	0.03264%	
OP BREAKER	Halliburton	Breaker	Sodium persulfate	7775-27-1	100.00%	0.03084%	
Optimasec-10™	Halliburton	Surfactant	Sodium percarbonate tetrahydrate	13445-33-7	100.00%	0.03782%	

\* Total Water Volume sources may include fresh water, produced water, and/or recycled water

\*\* Information is based on the maximum potential for concentration and thus the total may be over 100%

All component information listed was obtained from the supplier's Material Safety Data Sheets (MSDS). As such, the Operator is not responsible for inaccurate and/or incomplete information. Any questions regarding the content of the MSDS should be directed to the supplier who provided it. The Occupational Safety and Health Administration's (OSHA) regulations govern the criteria for the disclosure of this information. Please note that Federal Law protects 'proprietary', 'trade secret', and 'confidential business information' and the criteria for how this information is reported on an MSDS is subject to 29 CFR 1910.1200(i) and Appendix D.

# Water Sources

- **Surface Water**
  - Owned by the State
  - TCEQ Permit Needed to Appropriate
  - Texas Water Code, Ch. 11
- **Groundwater**
  - Owned by Landowner (SB 332)
  - Rule of Capture, Modified
  - Local GW Conservation Districts (100+ )
- **Reuse/Recycling**

# Surface Water Regulatory Definition



State Water – The water of the ordinary flow, underflow, and tides of every flowing river, natural stream, and lake . . . and the stormwater, floodwater, and rainwater of every river, natural stream, and watercourse in the state.

30 TAC § 297.1

# What is Not State Water?

- Diffuse Surface Water (Rainfall)  
*Turner v. Big Lake Oil Co. (Tex. 1936).*
- Groundwater Seepage and Springwater
- Certain Gulf of Mexico Water
- Developed Water
  - Reuse of privately owned groundwater
  - Water from interbasin transfers
  - Capture of diffused surface water

# Surface Water Issues

- Most Basins are Fully Appropriated
- Permitting Timeframe is Long
  - Notice to Existing WR Holders
  - Hearing
- New Permit Priority will be Junior to All Existing WR Holders
- Term Permit Option



# Groundwater Regulation

- **Locally Controlled GCDs**
  - Elected Board
  - Preference for Regional GCDs
- **Rules Vary by District**
  - Permits for Drilling & Operating Wells
  - Spacing or Acreage Requirements
  - Transfer of Rights Between Wells
  - Transport Groundwater Out of District

**Confirmed Groundwater Conservation Districts**

- 1. Anderson County UWCD
- 2. Bandera County River Authority & Ground Water District
- 3. Barton Springs/Edwards Aquifer CD
- 4. Bee GCD
- 5. Blanco-Pedernales GCD
- 6. Bluebonnet GCD
- 7. Brazoria County GCD
- 8. Brazos Valley GCD
- 9. Brexeter County GCD
- 10. Brush Country GCD
- 11. Central Texas GCD
- 12. Clear Fork GCD
- 13. Clearwater GCD
- 14. Coastal Bend GCD
- 15. Coastal Plains GCD
- 16. Coke County UWCD
- 17. Colorado County GCD
- 18. Corpus Christi ASRCD
- 19. Cow Creek GCD
- 20. Crockett County GCD
- 21. Culberson County GCD
- 22. Duval County GCD
- 23. Edwards Aquifer Authority
- 24. Evergreen UWCD
- 25. Fayette County GCD
- 26. Fox Crossing Water District
- 27. Garza County UWCD
- 28. Gateway GCD
- 29. Glasscock GCD
- 30. Goliad County GCD
- 31. Gonzales County UWCD
- 32. Guadalupe County GCD
- 33. Hays Trinity GCD
- 34. Headwaters GCD
- 35. Hemphill County UWCD
- 36. Hickory UWCD No. 1
- 37. High Plains UWCD No. 1
- 38. Hill Country UWCD
- 39. Hudspeth County UWCD No. 1
- 40. Iron County UWCD
- 41. Jeff Davis County UWCD
- 42. Kenedy County GCD
- 43. Kimble County GCD
- 44. Kinney County GCD
- 45. Lipan-Kickapoo WCD
- 46. Live Oak UWCD
- 47. Llano Estacado UWCD
- 48. Lone Star GCD
- 49. Lone Wolf GCD
- 50. Lost Pines GCD
- 51. Lower Trinity GCD
- 52. McMullen GCD
- 53. Medina County GCD
- 54. Menard County UWCD
- 55. Mesa UWCD
- 56. Mesquite GCD
- 57. Mid-East Texas GCD
- 58. Middle Pecos GCD
- 59. Middle Trinity GCD
- 60. Neches & Trinity Valleys GCD
- 61. North Plains GCD
- 62. North Texas GCD
- 63. Northern Trinity GCD
- 64. Panhandle GCD
- 65. Panola County GCD
- 66. Pecan Valley GCD
- 67. Permian Basin UWCD
- 68. Pineywoods GCD
- 69. Plateau UWC and Supply District
- 70. Plum Creek CD
- 71. Post Oak Savannah GCD
- 72. Prairie Star GCD
- 73. Presidio County UWCD
- 74. Real-Edwards C and R District
- 75. Red River GCD
- 76. Red Sands GCD
- 77. Refugio GCD
- 78. Rolling Plains GCD
- 79. Rusk County GCD
- 80. San Patricio County GCD
- 81. Sandy Land UWCD
- 82. Santa Rita UWCD
- 83. Saratoga UWCD
- 84. South Plains UWCD
- 85. Southeast Texas GCD
- 86. Southern Trinity GCD
- 87. Starr County GCD
- 88. Sterling County UWCD
- 89. Sutton County UWCD
- 90. Texana GCD
- 91. Trinity Glen Rose GCD
- 92. Upper Trinity GCD
- 93. Uvalde County UWCD
- 94. Victoria County GCD
- 95. Wes-Tex GCD
- 96. Wintergarden GCD

**Pending Groundwater Conservation Districts**

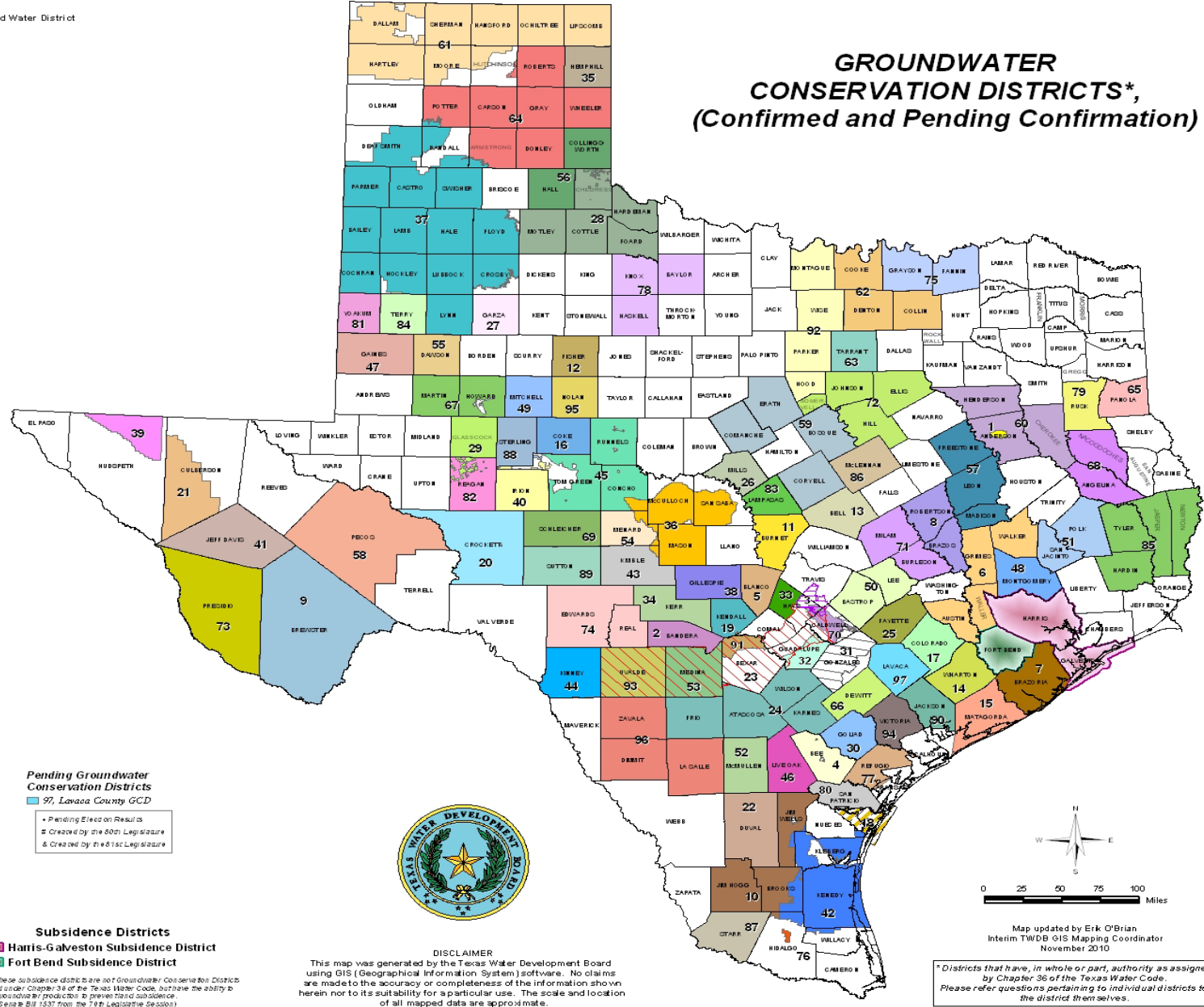
- 97. Lavaca County GCD

**Subsidence Districts**

- Harris-Galveston Subsidence District
- Fort Bend Subsidence District

NOTE: These subsidence districts are not Groundwater Conservation Districts as defined under Chapter 36 of the Texas Water Code, but have the ability to regulate groundwater by providing subsidence insurance. (P.L. 86-564, 86 Stat. 1537 from the 79th Legislative Session)

# GROUNDWATER CONSERVATION DISTRICTS\*, (Confirmed and Pending Confirmation)



**DISCLAIMER**  
 This map was generated by the Texas Water Development Board using GIS (Geographical Information System) software. No claims are made to the accuracy or completeness of the information shown herein nor to its suitability for a particular use. The scale and location of all mapped data are approximate.

Map updated by Erk O'Brian  
 Interim TWDB GIS Mapping Coordinator  
 November 2010  
 \*Districts that have, in whole or part, authority as assigned by Chapter 36 of the Texas Water Code. Please refer questions pertaining to individual districts to the district themselves.

# Looming Groundwater Conflict

## Landowner Rights v. GW Regulation

- **Desired Future Conditions**
  - DFC = Management Goal for Aquifer
  - DFC's Due to TWDB by Sept. 2010
  - TWDB Then Calculates **MAG**
  - MAG Sets Permitting Target for GW
- **The Conflict**
  - MAG Will Limit Future Permits and GW Production

# O&G Groundwater Permit Exemption Water Code 36.117(b)(2)

A [groundwater conservation] district may not require any permit issued by the district for . . . the drilling of a water well used solely to supply water for a rig that is actively engaged in drilling or exploration operations for an oil or gas well permitted by the Railroad Commission of Texas provided that the person holding the permit is responsible for drilling and operating the water well and the well is located on the same lease or field associated with the drilling rig.

# Purchasing Water

- Contract with WR Holder
  - River Authorities
- Pricing and Terms Vary
  - Colorado Basin = \$150/AcFt
  - Guadalupe = \$110/AcFt
  - Brazos = \$ 63/AcFt
- Drought and Population Growth are Increasing Demand

# Reclaimed Water

- WWTP Treated Effluent
- Recycled Frac Flowback
- Industrial Reclaimed Water
  - Cooling Water Blowdown
  - Washwater, Condensate
- TCEQ Regs at 30 TAC 210



★ THE TEXAS TRIBUNE

# Cost of Frac Water (Large Frac)

## Assume 10M Gal/Well

- \$0.70 per bbl = \$167,000
- \$3.00 per 1000gal = \$ 30,000
- \$100 per AcreFt = \$ 3,070

# QUESTIONS?

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