

Water Resource Problems and Challenges in Texas

Raymond Slade, Jr.
Professional Hydrologist





In Texas

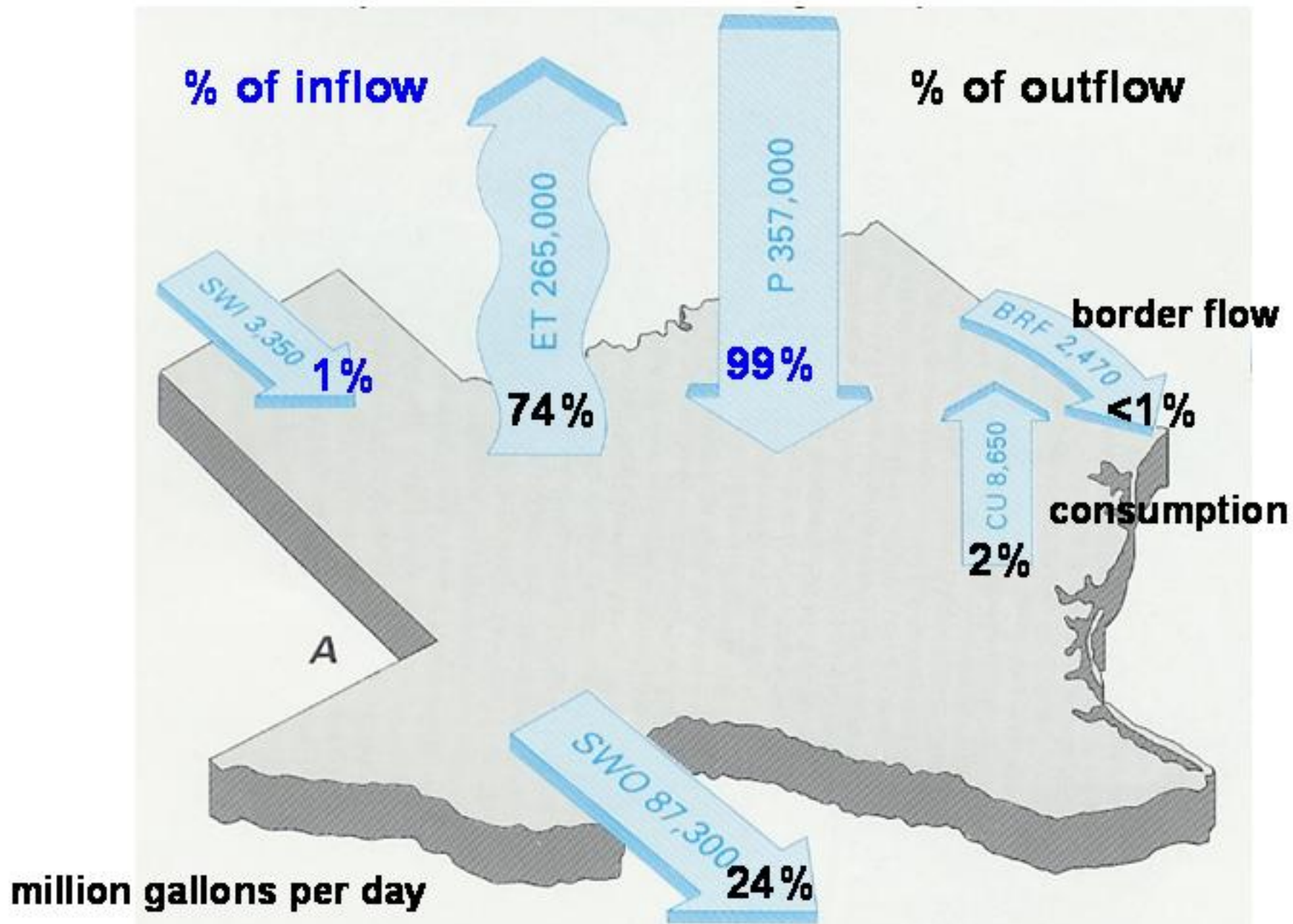
Whiskey is for drinkin'
and water is for fightin'



Background: How much water do we have and where is it?

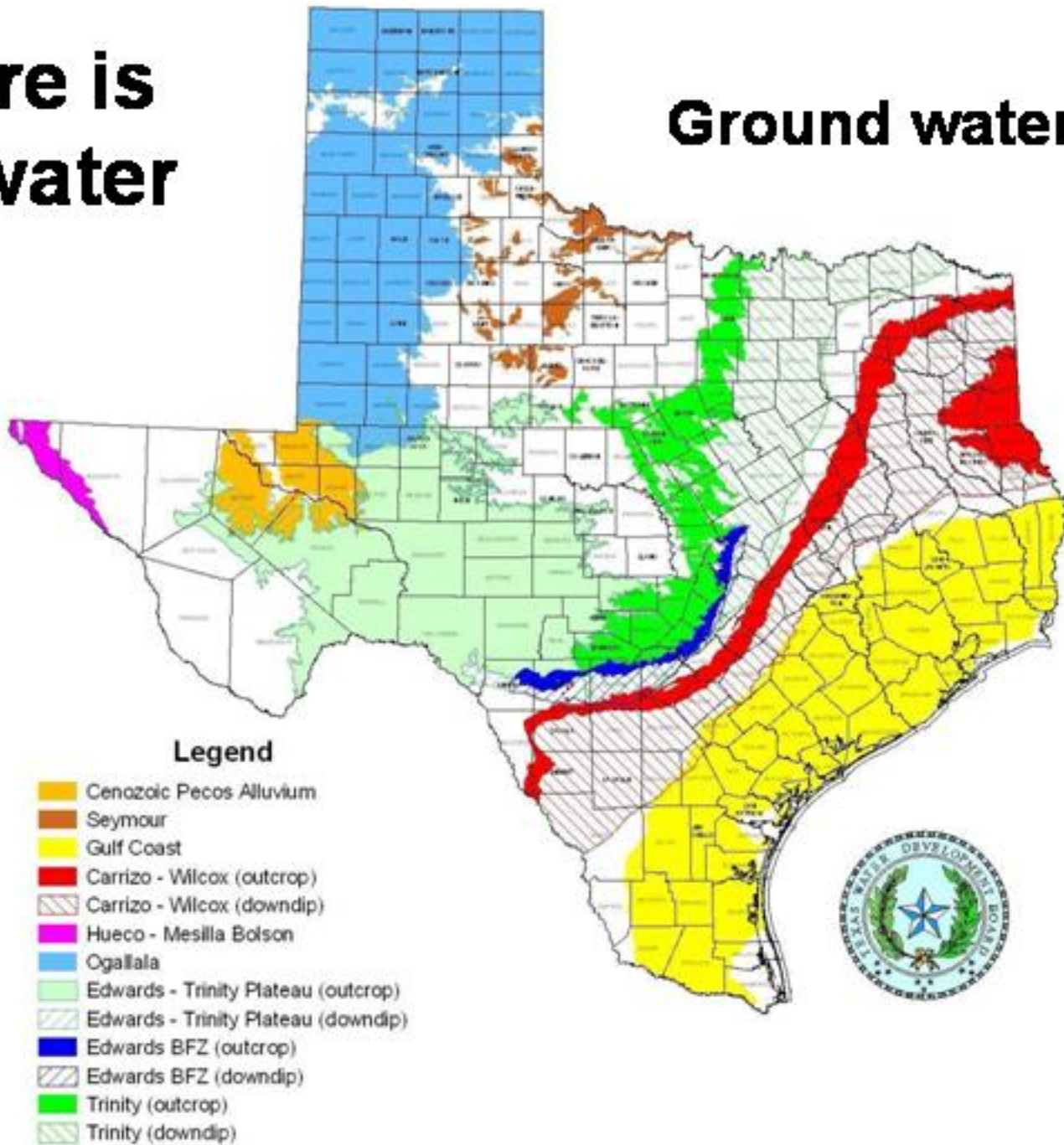


How much water



Where is the water

Ground water

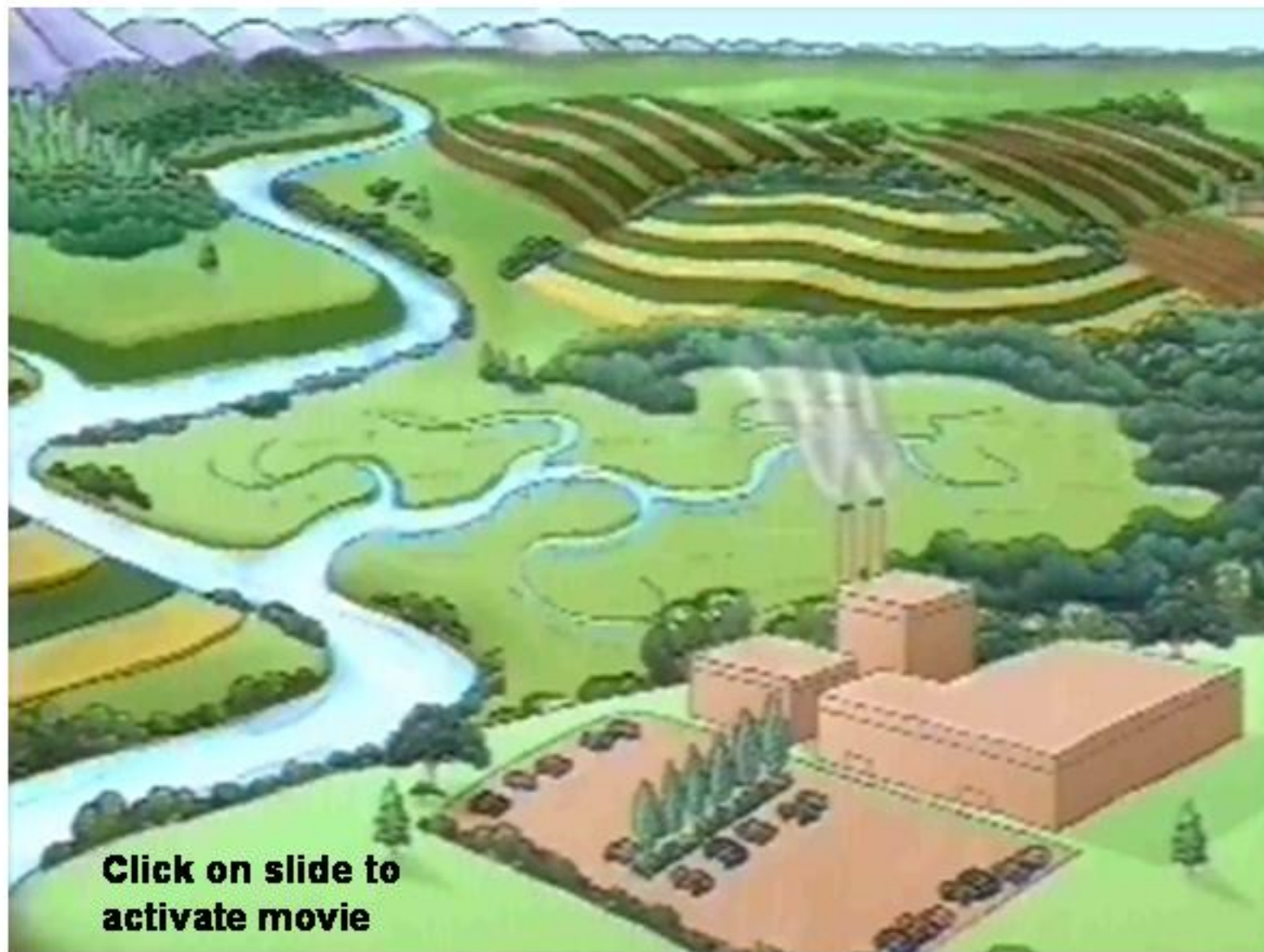


Where is the water

Surface water Streams and reservoirs



What is a watershed?



**Click on slide to
activate movie**

Are rivers important?

We must begin thinking like a river if we are to leave a legacy of beauty and life for future generations.

-David Brower quoted by E-Wire, 7 Apr 2000

Background concluded

Water Issues

- 1. Who owns the water and where do we put it**
- 2. Water use, availability, demands, and needs**
- 3. Floods**
- 4. Droughts**
- 5. Water quality contamination**

1. Who owns the water...

Public Entities

Surface water

Texas Commission on Environmental Quality

Water use, impoundments, point and non-point contamination, waste discharges

River Authorities

Reservoirs, water sales & distribution, hydroelectric

International Boundary and Water Commission

Rio Grande Basin

Ground water

Quantity: Right of free capture, Groundwater

Districts (Texas Water Development Board)

Quality: TCEQ

1. Who owns the water...

Private owners

Pickens, Water District Reach Deal To Allow Pumping Permit

By David Bowser

MIAMI, Texas —T. Boone Pickens says his group of Roberts County landowners, operating as Mesa Water Inc., and the groundwater district have now reached agreement and the pumping permit will be granted.

The notorious oilman has acquired land overlying the Ogallala aquifer and wants to pump and sell as much as 200,000 acre-feet of groundwater annually to one of Texas' metropolitan centers.

**Water has become a public commodity—
sold and traded for profit**

1. Who owns the water...

Private owners (cont.)

One acre-foot water right to be auctioned on eBay

May 2002

U.S. Water News Online

SAN ANTONIO -- An online auction to benefit an effort to build a new library, archives and museum in Uvalde will include the right to pump 326,000 gallons of water a year from the Edwards Aquifer.

Edwardswater.com donated the permit, valued at \$3,700, for one-acre foot of water to the online auction to benefit the West Main Project, a \$5.5 million, 35,000-square-foot project.

1. ...where do we put it

- **"[Texas] thrives, even survives, by moving water from where it is and presumably isn't needed, to where it isn't and presumably is needed."**

- Marc Reisner, Cadillac Desert.

How do we move it?

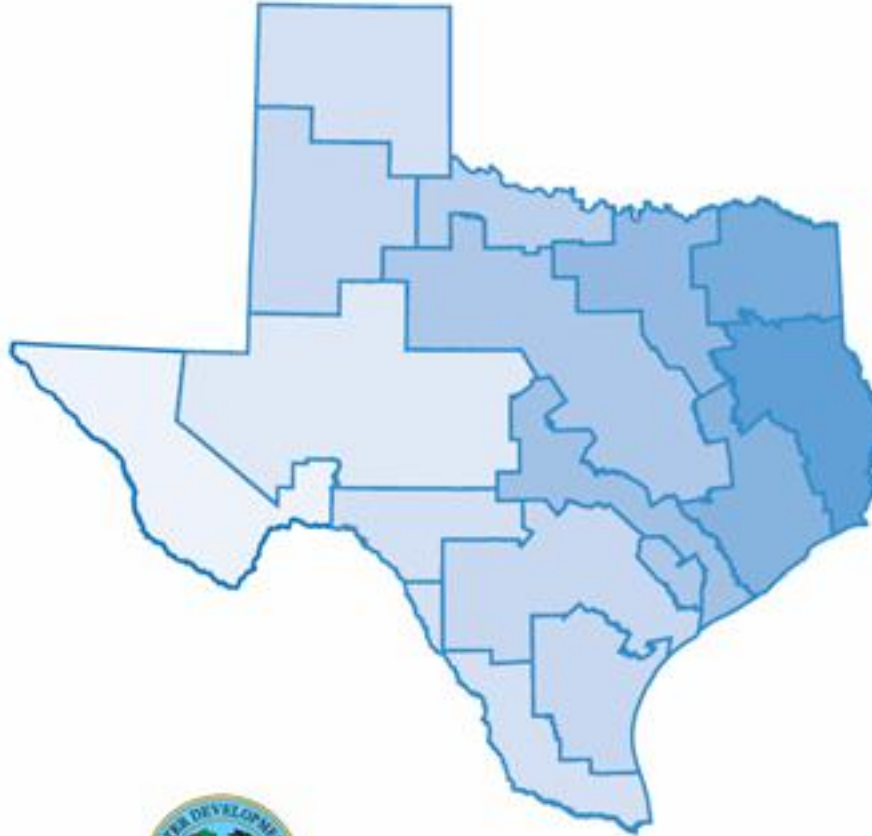
- **Withdrawals, dams, canals, recharge enhancement**

Where do we put it and why?

- **Streams** - water use, recreation, wildlife, aesthetics
- **Aquifers** - storage, water use for non-stream areas
- **Springs** - water use, recreation, biology, history
- **Reservoirs** - flood control, storage, water use
- **Bays and Estuaries** - freshwater inflow for fish

2. Water use, availability, demands, and needs

Water for Texas – 2002



*Texas Water Development Board
January 2002*

Water Use

City of Savoy

SAVOY, TEXAS 75479

TEXAS DEPARTMENT OF WATER RESOURCES
P. O. Box 13087 Capitol Station
Austin, TX 78711

Dear Sir:

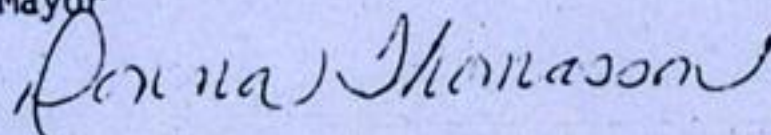
The City of Savoy does not use Ground & Surface Water. We use water pumped from a Water Tower.

If we received the form to be filled out and returned to you, I cannot locate it. I am sorry for the delay in answering your request.

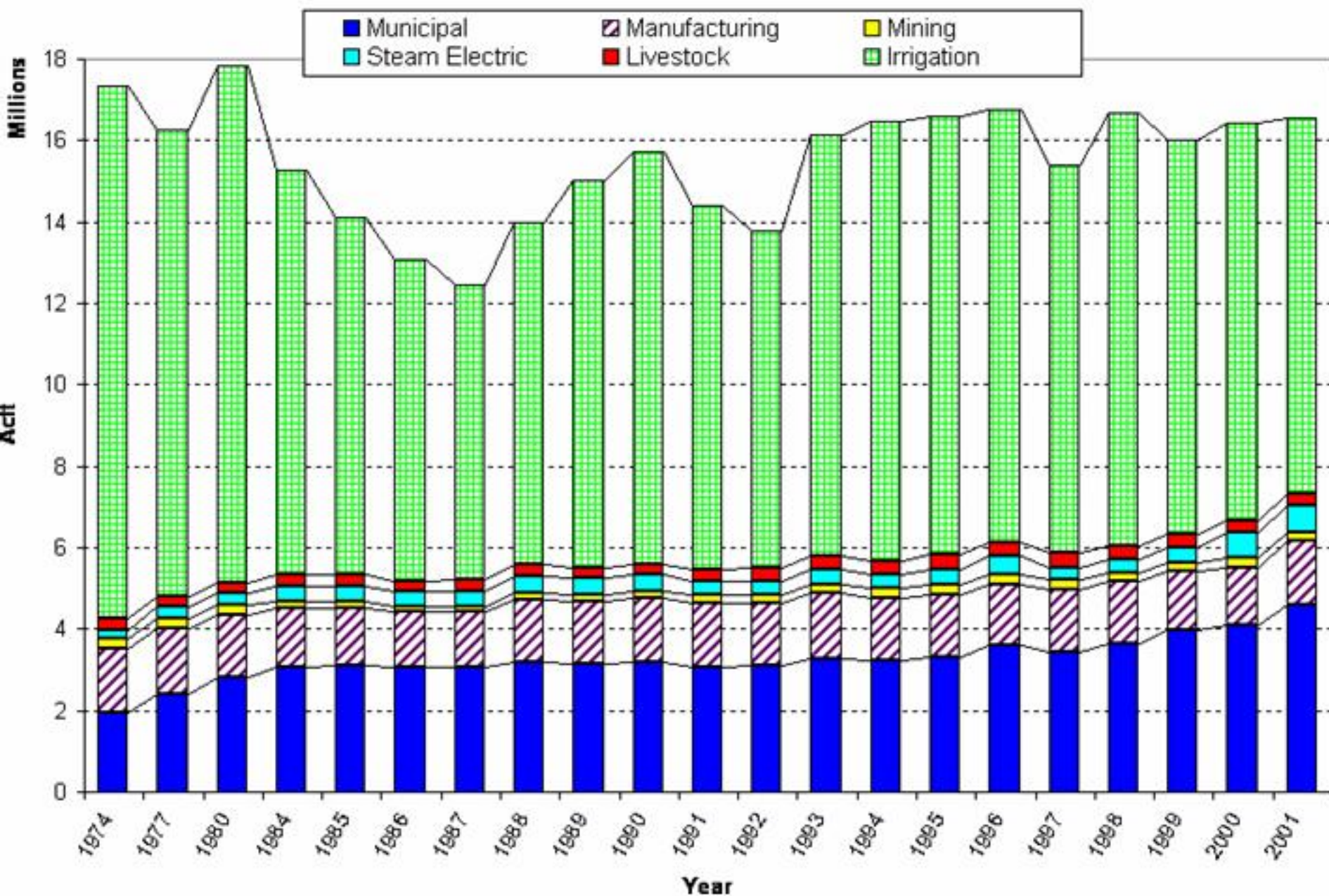
Thank You.

Sincerely,

Donna Thomasson
Mayor



Historical Water Use Summary in Texas 1974 - 2001



Water availability, demand, needs, and unmet needs

Definitions:

- How much useable water can you get
- Amount of water expected to be used
- Amount of additional water required for use (demand minus available)
- Amount of additional water that does not exist, even with mitigation

During droughts:

- availability decreases
- demand increases
- needs and unmet needs increase

Water availability, demand, and needs data online at

<http://wiid.twdb.state.tx.us/>

Click on "Water planning and water-use survey"

Texas Population by year

1990	2000	2010	2020	2030	2040	2050
16,985,761	20,864,990	24,542,579	28,802,922	32,791,383	36,436,265	39,647,767

2006 Regional Water Plan

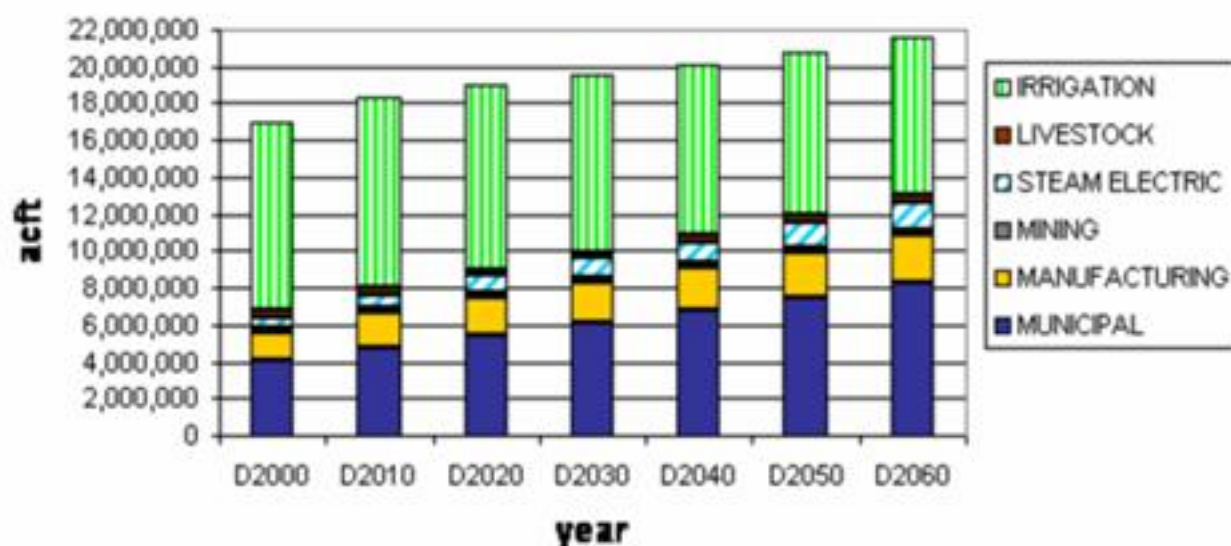
Summary of Water Demand Projections for 2000-2060 (in acft¹)

TEXAS

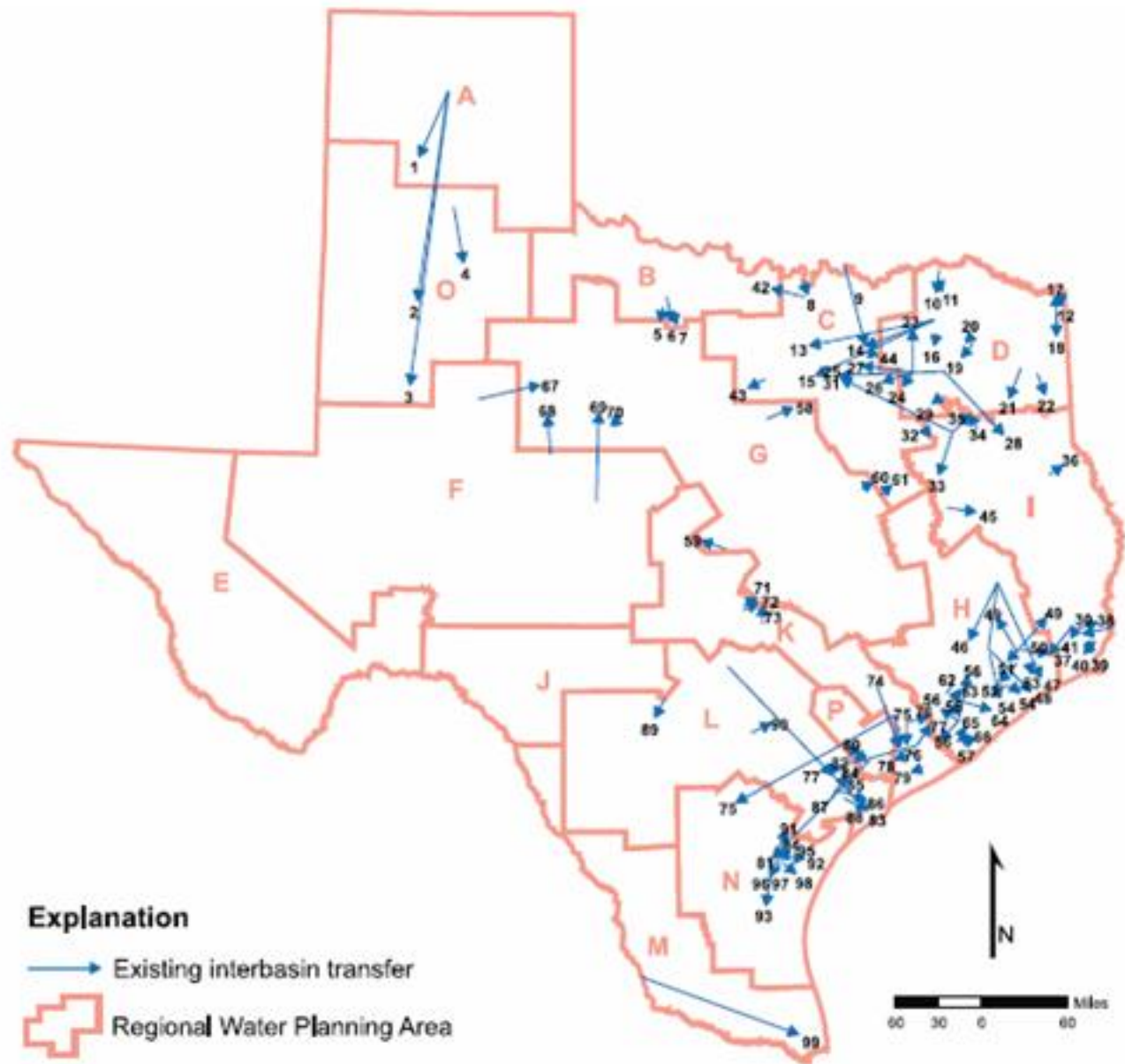
Category	D2000	D2010	D2020	D2030	D2040	D2050	D2060
MUNICIPAL	4,047,661	4,770,501	5,483,790	6,120,377	6,739,592	7,450,792	8,258,942
MANUFACTURING	1,559,912	1,825,686	2,004,666	2,163,421	2,319,913	2,452,107	2,578,582
MINING	278,624	270,845	280,815	285,964	276,054	276,931	285,573
STEAM ELECTRIC	561,394	755,170	886,580	1,030,212	1,174,170	1,339,733	1,533,556
LIVESTOCK	300,441	344,495	374,724	381,241	388,243	395,945	404,397
IRRIGATION	10,228,528	10,345,131	9,980,301	9,585,833	9,206,620	8,843,094	8,556,224
TEXAS TOTAL	16,976,560	18,311,828	19,010,876	19,567,048	20,104,592	20,758,602	21,617,274

¹ An acft is an amount of water to cover one acre with one foot of water and equals 325,851 gallons.

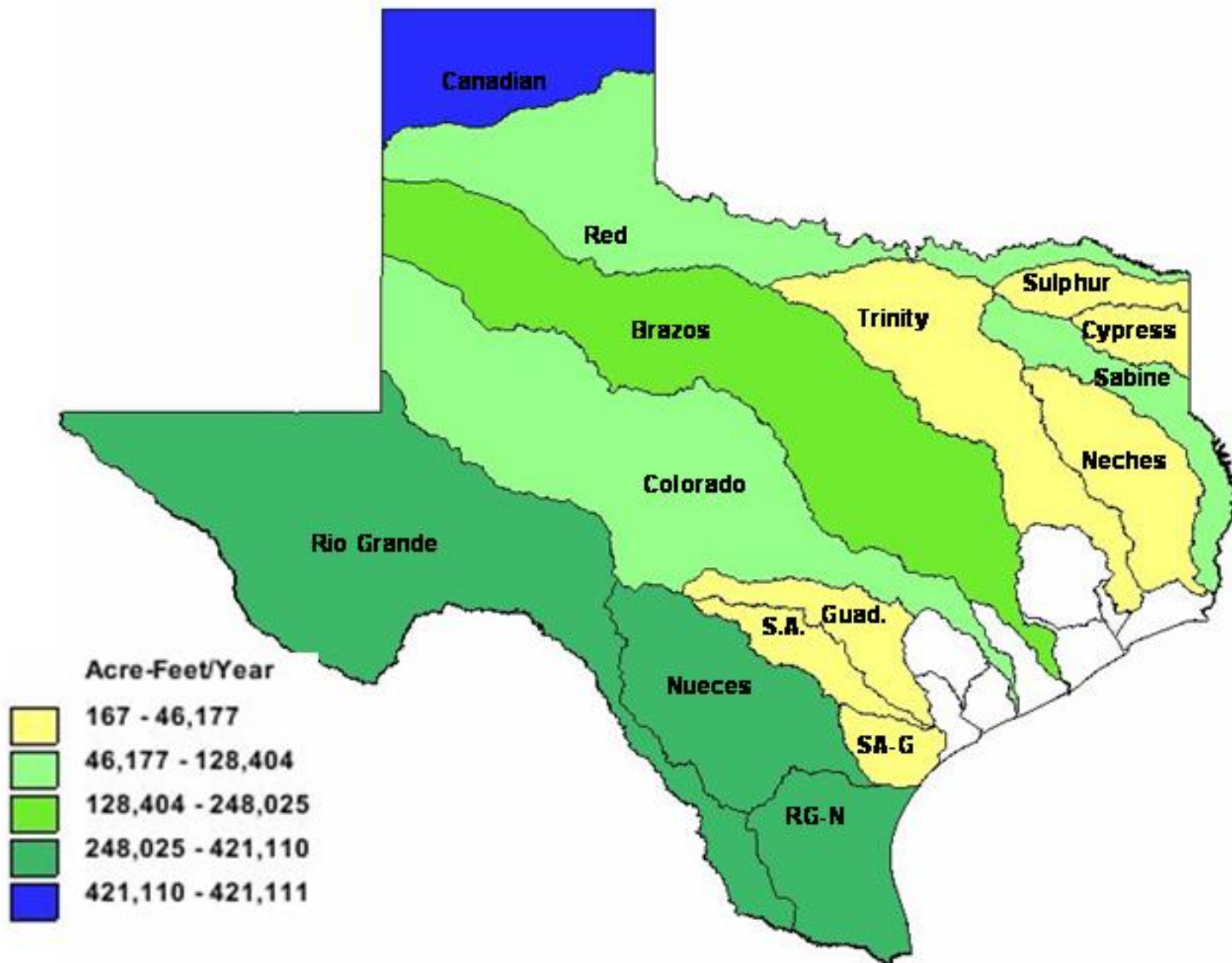
Water Demand Projections for 2000-2060
Texas



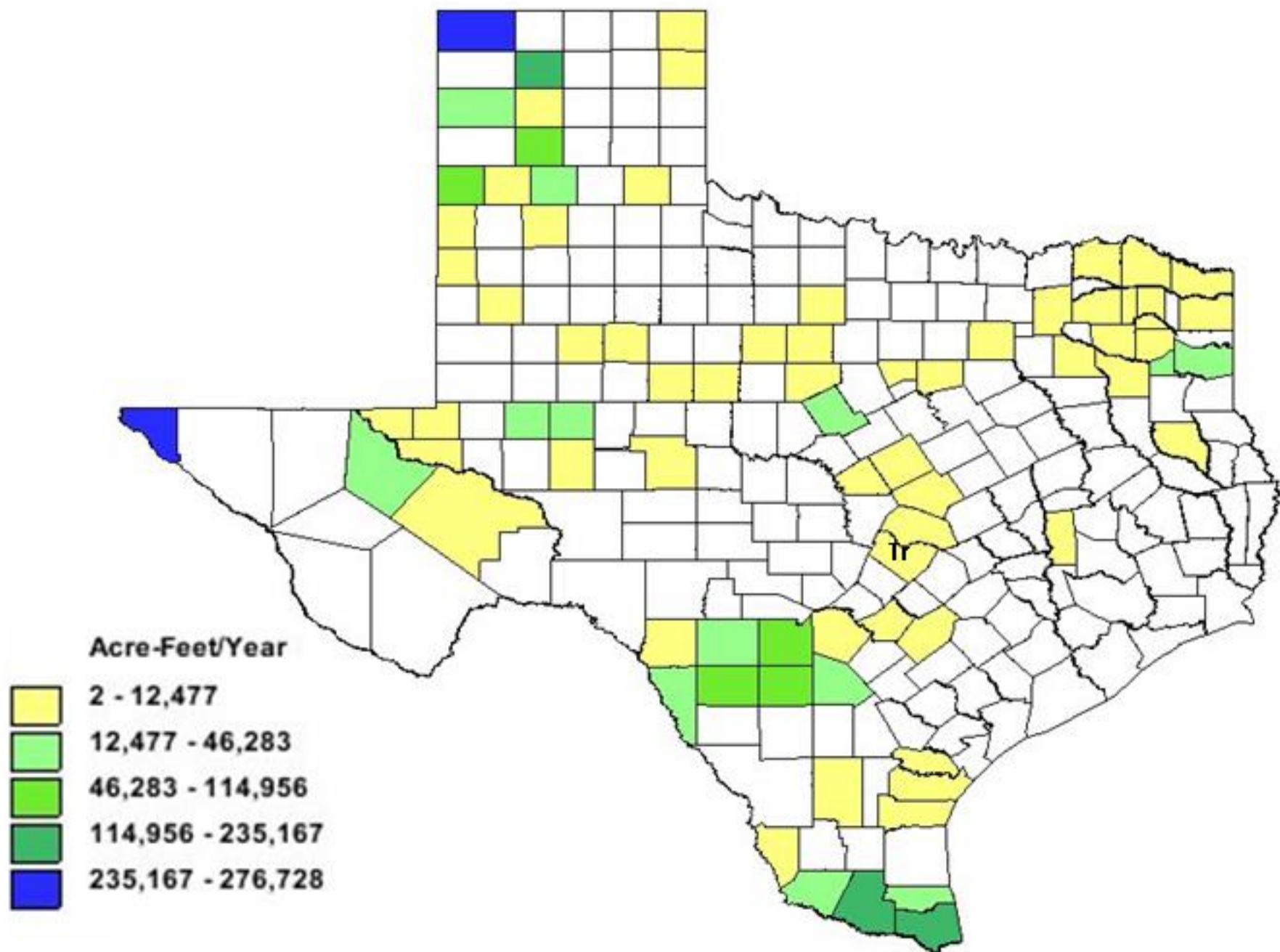
Texas interbasin transfer



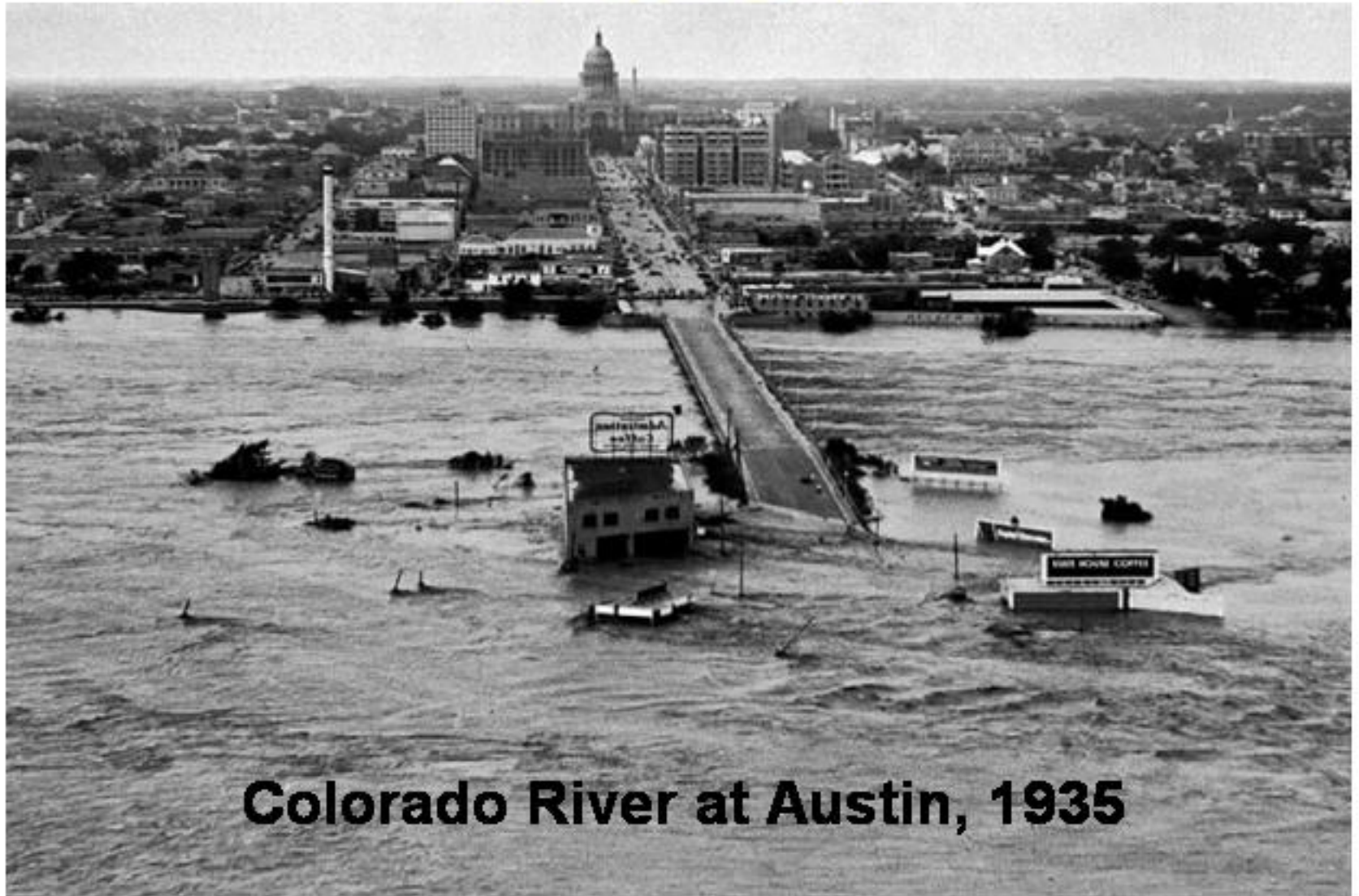
Total unmet water needs by river basin, 2050



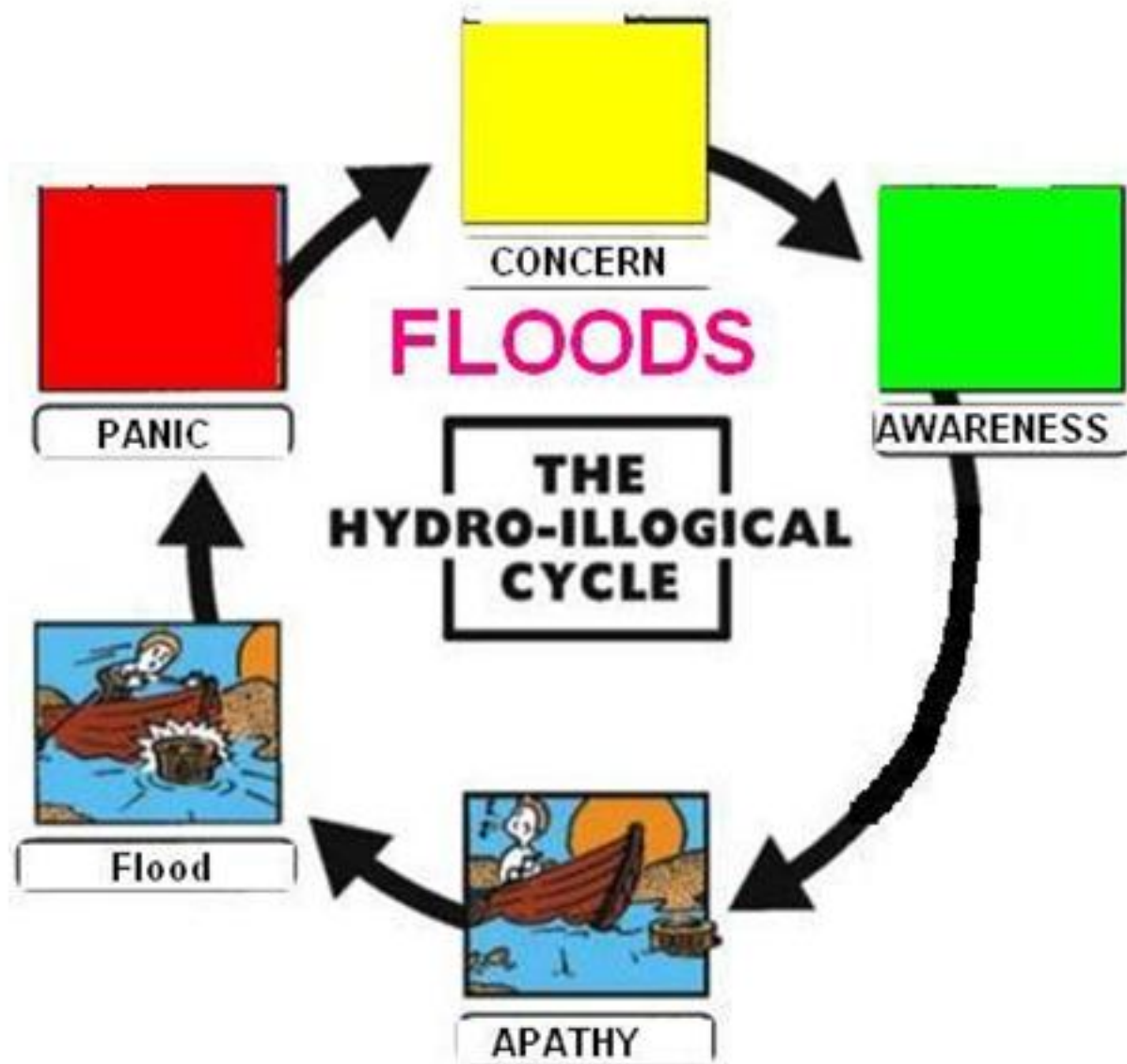
Total unmet water needs by county, 2050

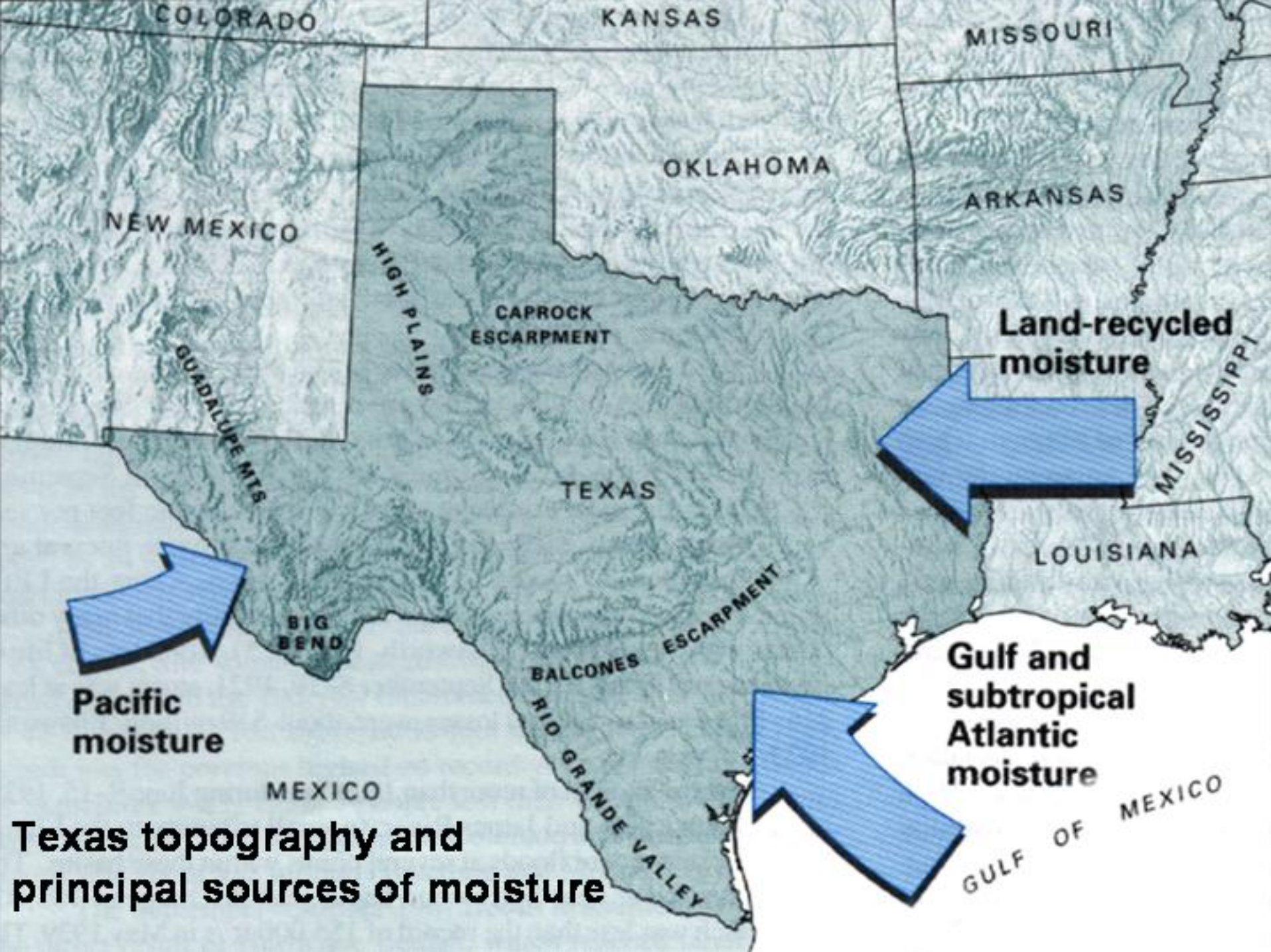


3. Floods



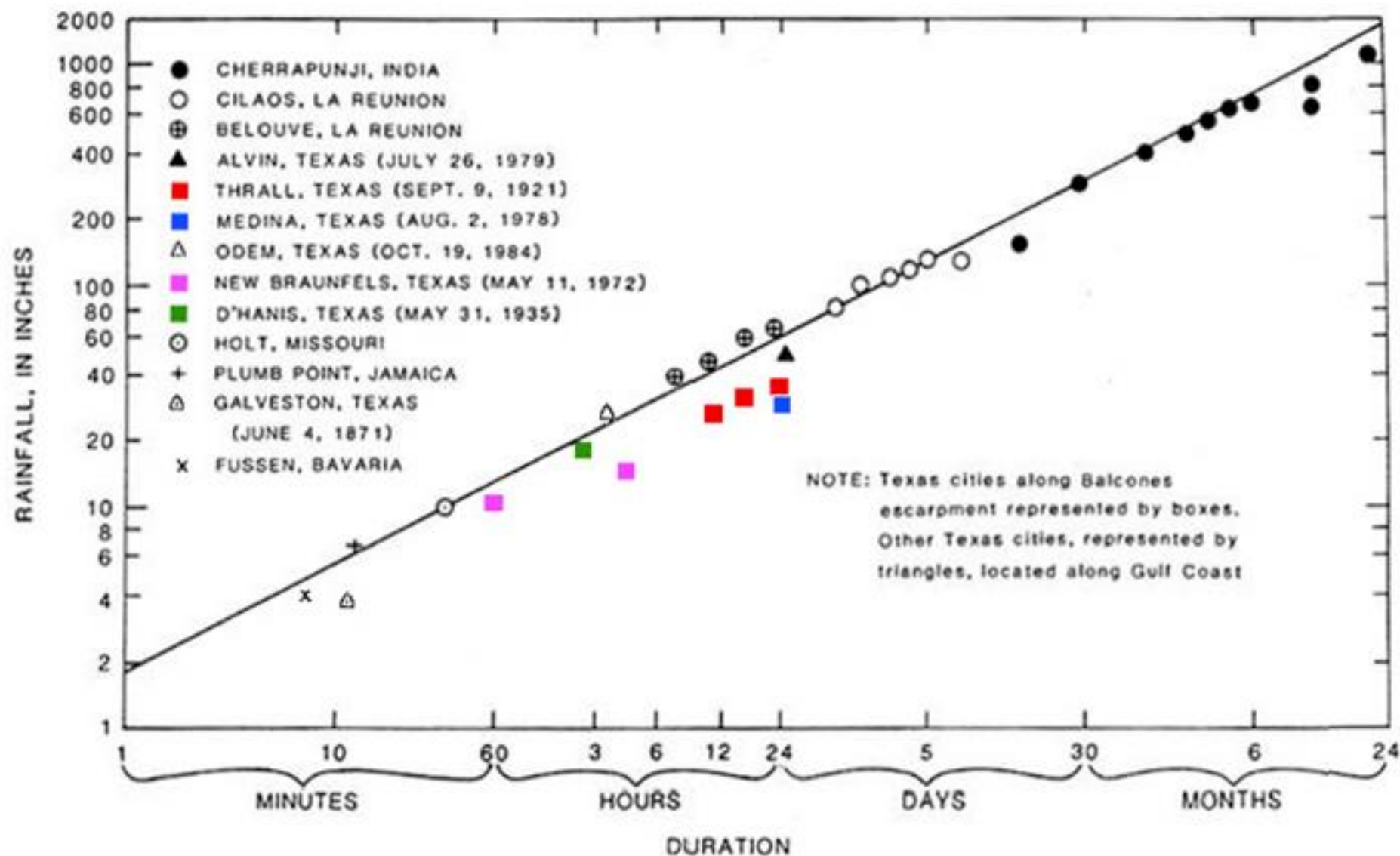
Colorado River at Austin, 1935



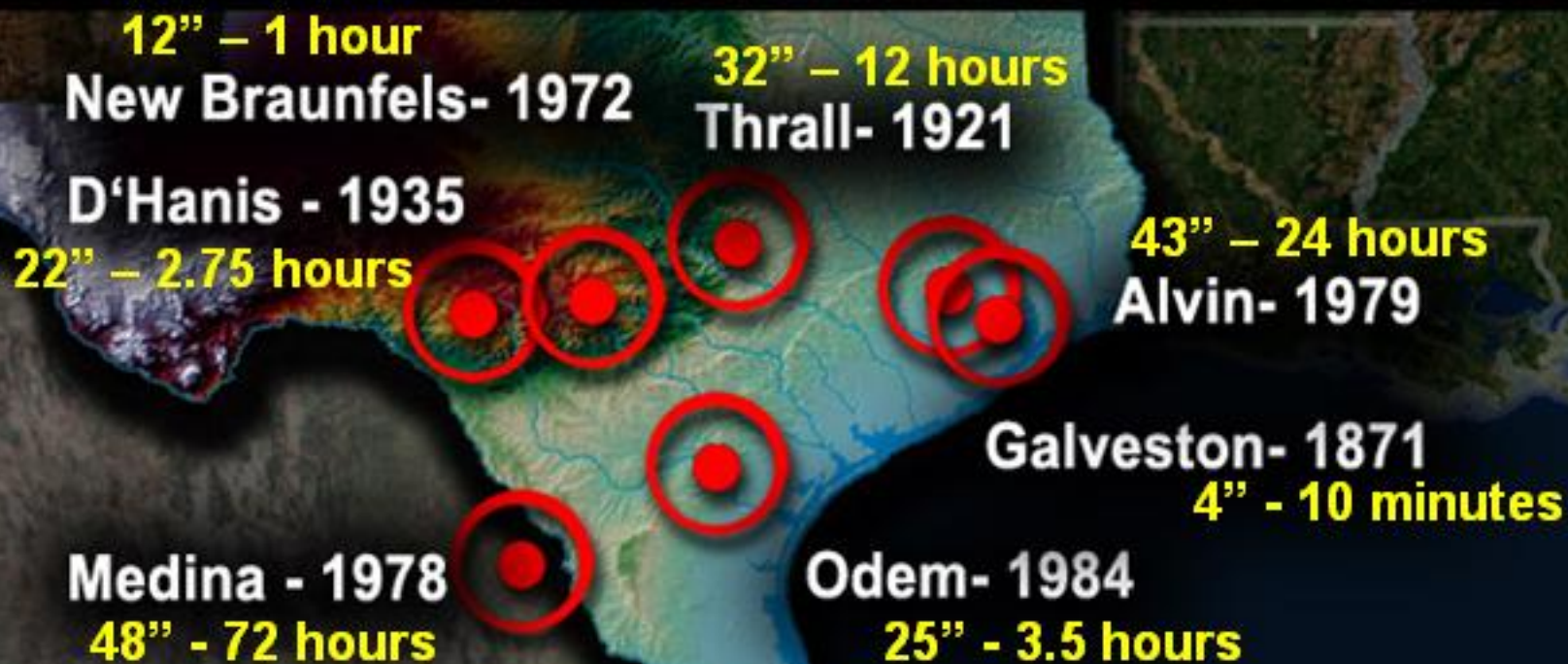


Texas topography and principal sources of moisture

Record Rainfall Rates for Various Durations – The World and Texas

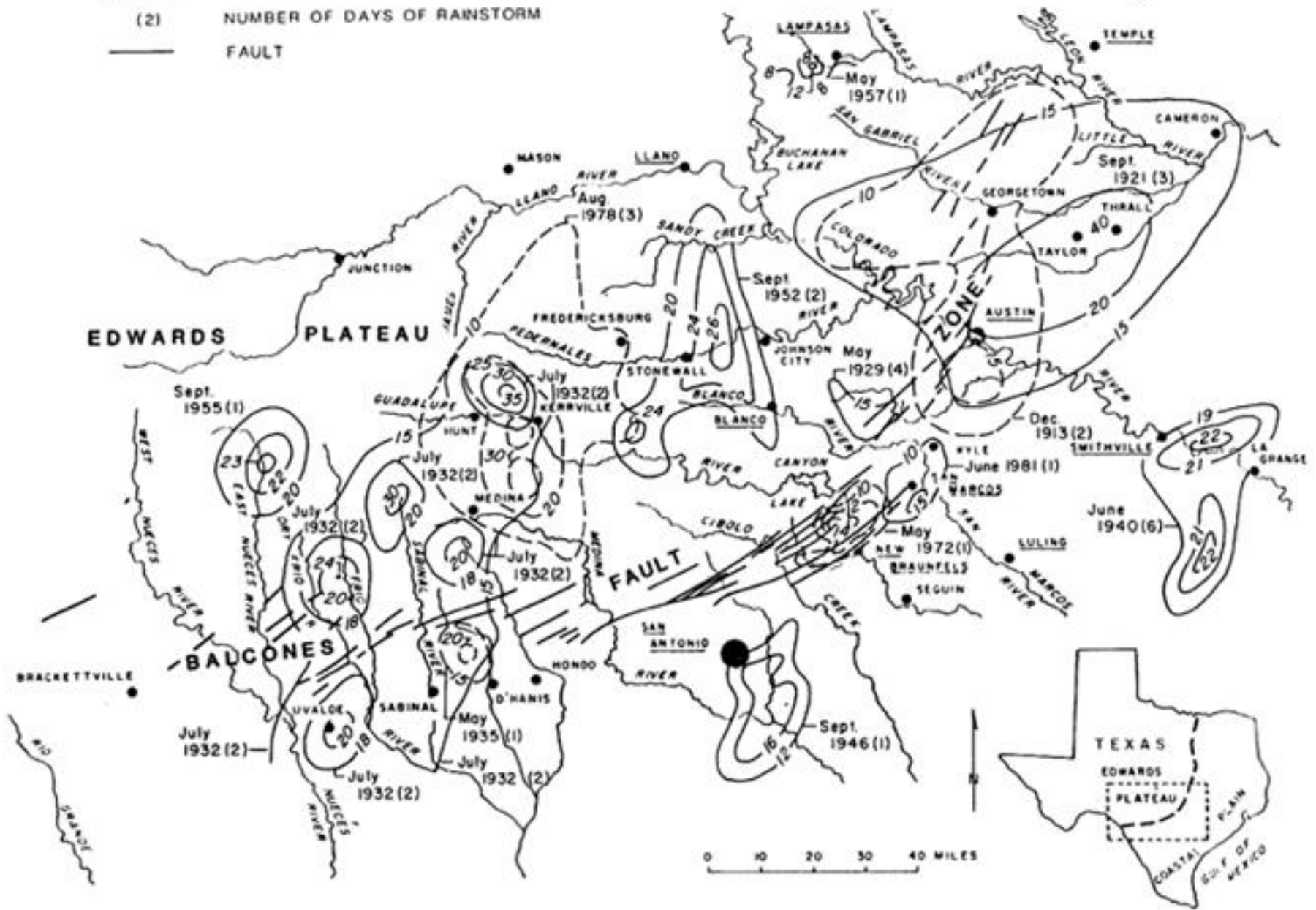


Texas World Record Rainfall Rates (for rains in 48-hours or less)



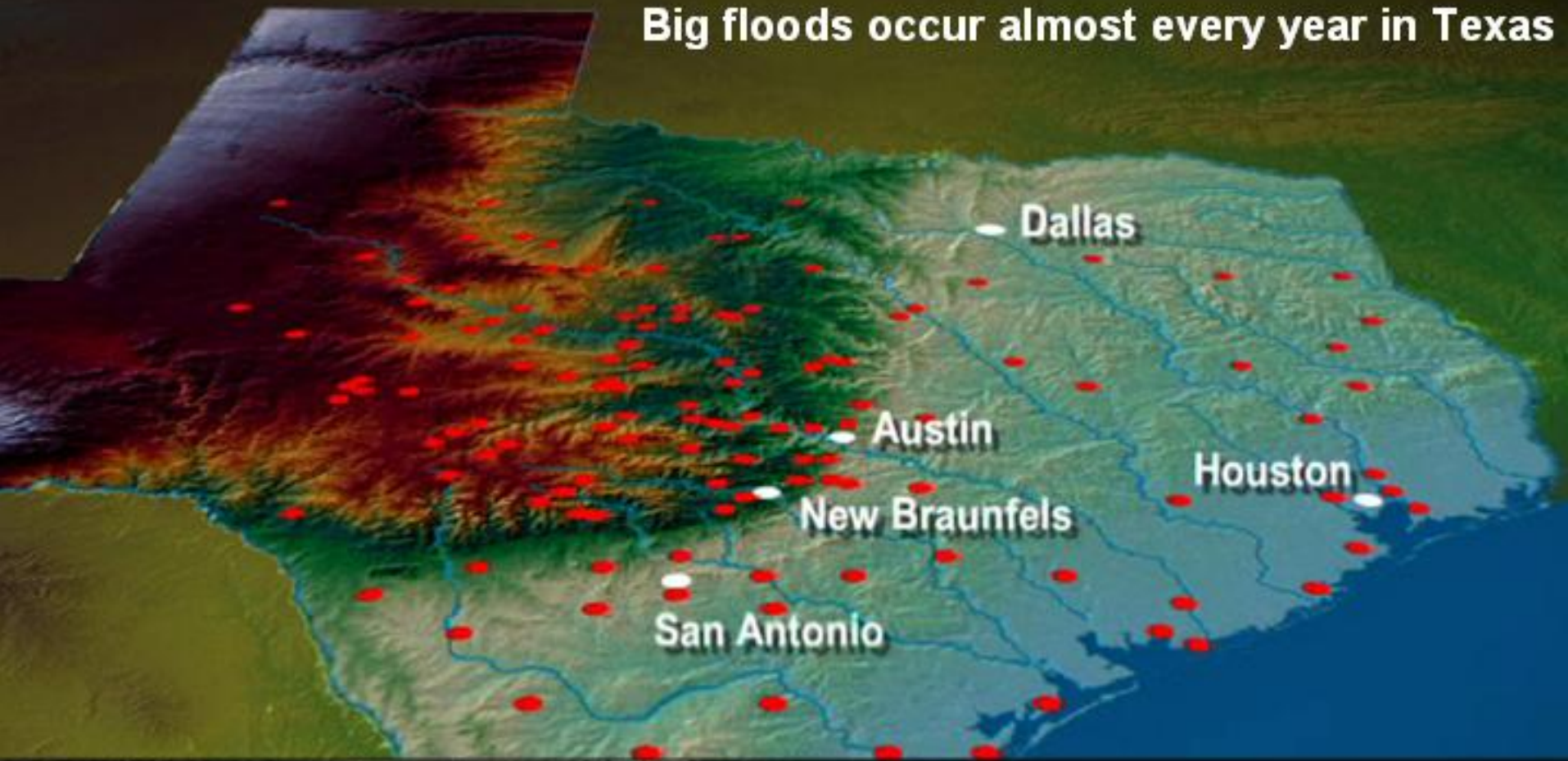
Major storms along the Balcones Escarpment

EDWARDS PLATEAU



Location map

Big floods occur almost every year in Texas



House boat(?) going over Austin Dam (Tom Miller) in 1935



Colorado River At Wharton, 1935




Colorado River at Austin, 1936



LOOKING NORTH FROM SOUTH CONGRES
SEPT. 28, 1936

Colorado River at Wharton 1938



COLORADO RIVER AT
WHARTON, TEX. JULY 1938
Peak discharge 156,000 sec-ft.
Greater floods occurred in
1869 and 1913

Austin, May 24-25, 1981- Shoal Creek Floodplain



After 1981 Austin flood...



Mayor Carole McClellan has asked city staff members to find out what is necessary to keep residents informed on flood control work.

Mayor wants city to tell residents about flood threat

By JANET WILSON

American-Statesman Staff

Mayor Carole McClellan wants more than 7,000 families notified that they live on the city's 100-year flood plain.

The 100-year flood plain is the area near creeks and rivers that would be flooded in storms with a 1 percent probability of occurring in any given year. McClellan has asked the city staff to determine what it would take to notify the residents and keep them informed about maintenance work to control floods.

The city has undertaken an extensive project of dredging and widening channels of flood-prone creeks after devastating floods on Memorial Day 1981 took the city by surprise.

Thirteen people were killed and millions of dollars in damage were caused by the flooding, primarily along Shoal Creek.

Deputy City Manager Jorge Carrasco said there is a notification procedure for people who live on the flood plain.



Houston, 1994

Tropical Storm Allison, June 2001

23 deaths

\$5 billion damages



Canyon Dam Spillway, July 9, 2002



Texas Flood data and information

- **Next 3 slides**

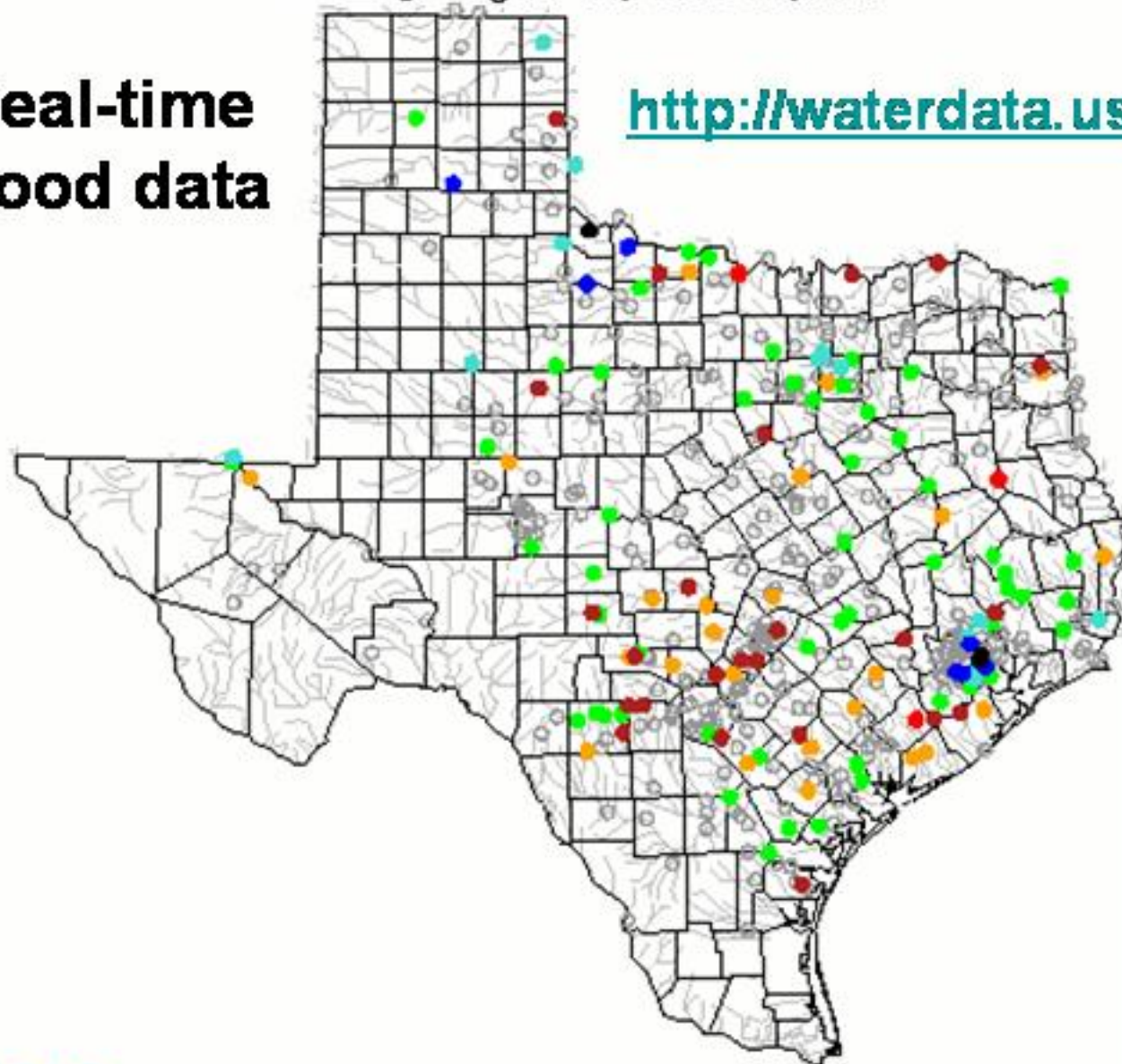
Daily Streamflow Conditions

Select a site to retrieve data and station information.

Thursday, August 24, 2006 02:20ET

**Real-time
flood data**

<http://waterdata.usgs.gov/tx/nwis/rt>



Explanation

- High
- ≥ 90 th percentile
- 75th - 89th percentile
- 25th - 74th percentile
- 10th - 24th percentile
- < 10 th percentile
- Low
- Not ranked

"Flash Flood Alley" Quicktime Movie Player

[Return to Main Menu](#)

[Chapter Summary](#)

[Behind the Scenes](#)



Flash Flood Alley

Introduction



Chapter 1: - 10 min

The 1998 Flood



Chapter 2: - 10 min

Texas Flood
History



Chapter 3: - 15 min

Rebuilding in the
Floodplain



Chapter 4: - 15 min

The 2002 Repeat
Flood

These chapter links only available on the "Flash Flood Alley" DVD-ROM.



Major and Catastrophic Storms and Floods in Texas

215 major and 41 catastrophic events from 1853 to September 1, 2002

By Raymond M. Slade, Jr., and John Patton U.S. Geological Survey Open-File Report 03-193

[Opening Page](#)

[Report Guide](#)

[Glossary](#)

[Introduction](#) ▶

[View Storm Lists by:](#) ▶

[Substantial Flood Peaks](#) ▶

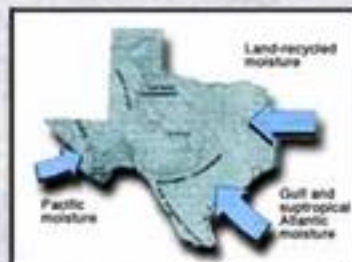
[Selected WWW Resources](#)

[Related Documents](#) ▶

[Bibliography](#)

[Dedication and Credits](#)

Prepared by the U.S. Geological Survey in cooperation with the Lower Colorado River Authority, Federal Emergency Management Agency, and Guadalupe-Blanco River Authority



Reports

Featuring:



Interactive Maps for Locating Storm Centers and Annual Peak Discharges at USGS Gages



Photographs

Location: Tarrant and Dallas Counties
Date: May 5, 1995
Description: Damages caused by wind speeds up to 70 miles per hour, softball-sized hail, and high-intensity rain cause this storm to be deemed as the "costliest thunderstorm event in history" by the National Weather Service. The maximum rainfall intensity was almost 3 inches in 30 minutes.
109 people were injured by hail.
Deaths and damages:
20 lives and \$2 billion

Storm Summaries



Related Documents

Produced by:
FloodSafety.com



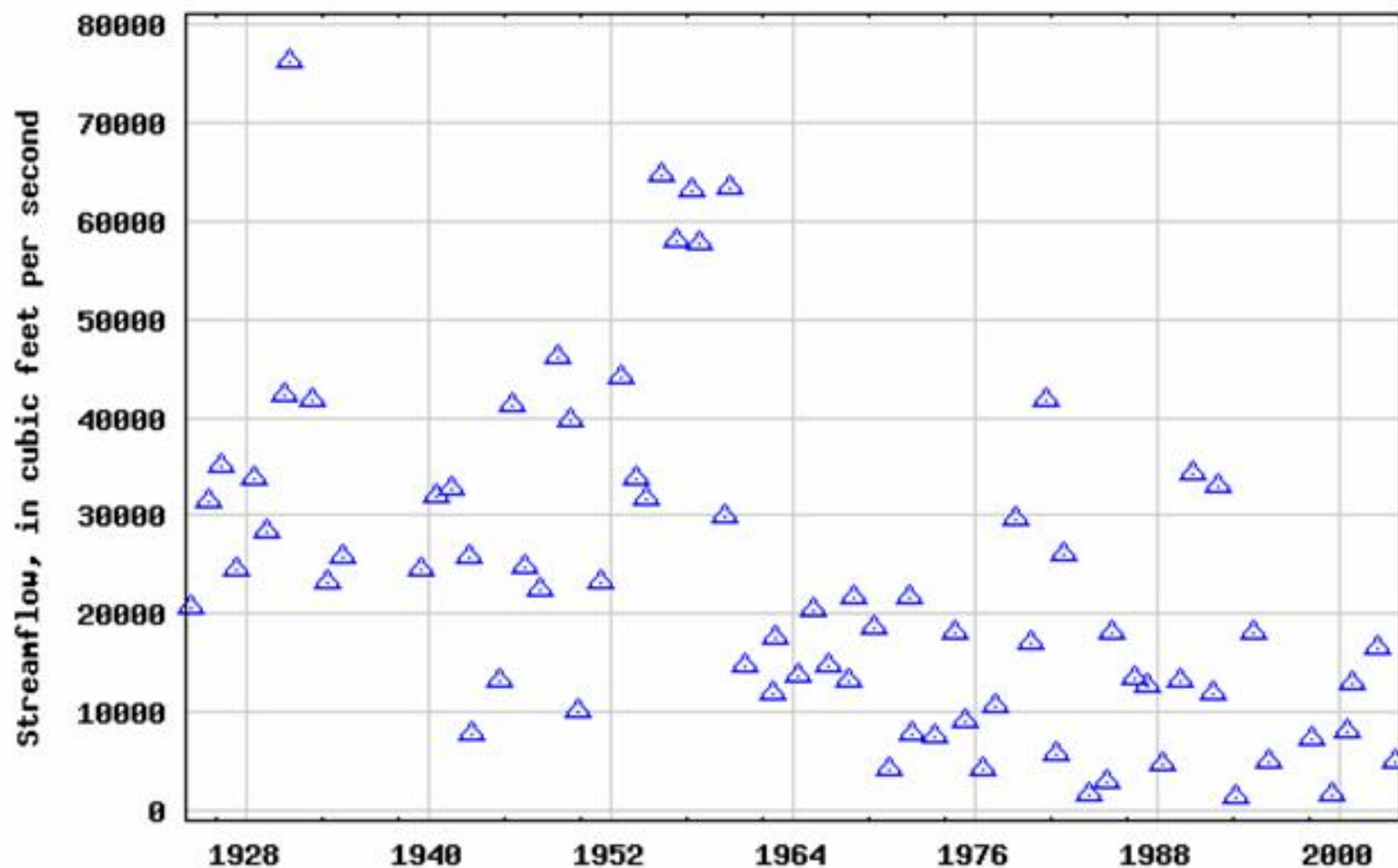
Sponsors:
U.S. Geological Survey (USGS)
Lower Colorado River Authority (LCRA)
Federal Emergency Management Agency (FEMA)
Guadalupe-Blanco River Authority (GBRA)



Why do people get flooded

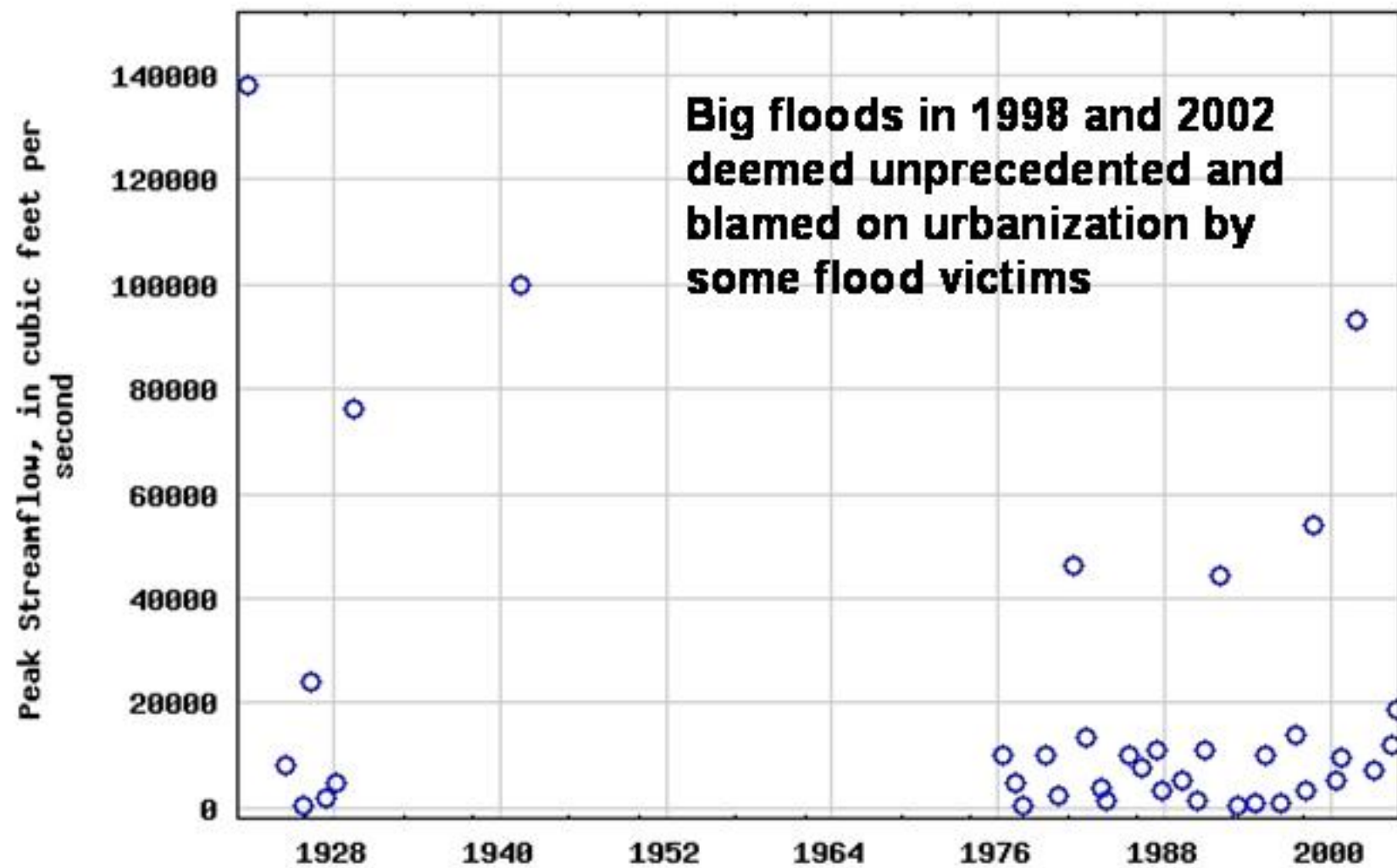
- **Timing of big floods (next 2 slides)**

USGS 08138000 Colorado Rv at Winchell, TX



Big floods can be clustered in time

USGS 08159000 Onion Ck at US Hwy 183, Austin, TX



Flood history often ignored

Flood Plain Problems

Why do people and property flood

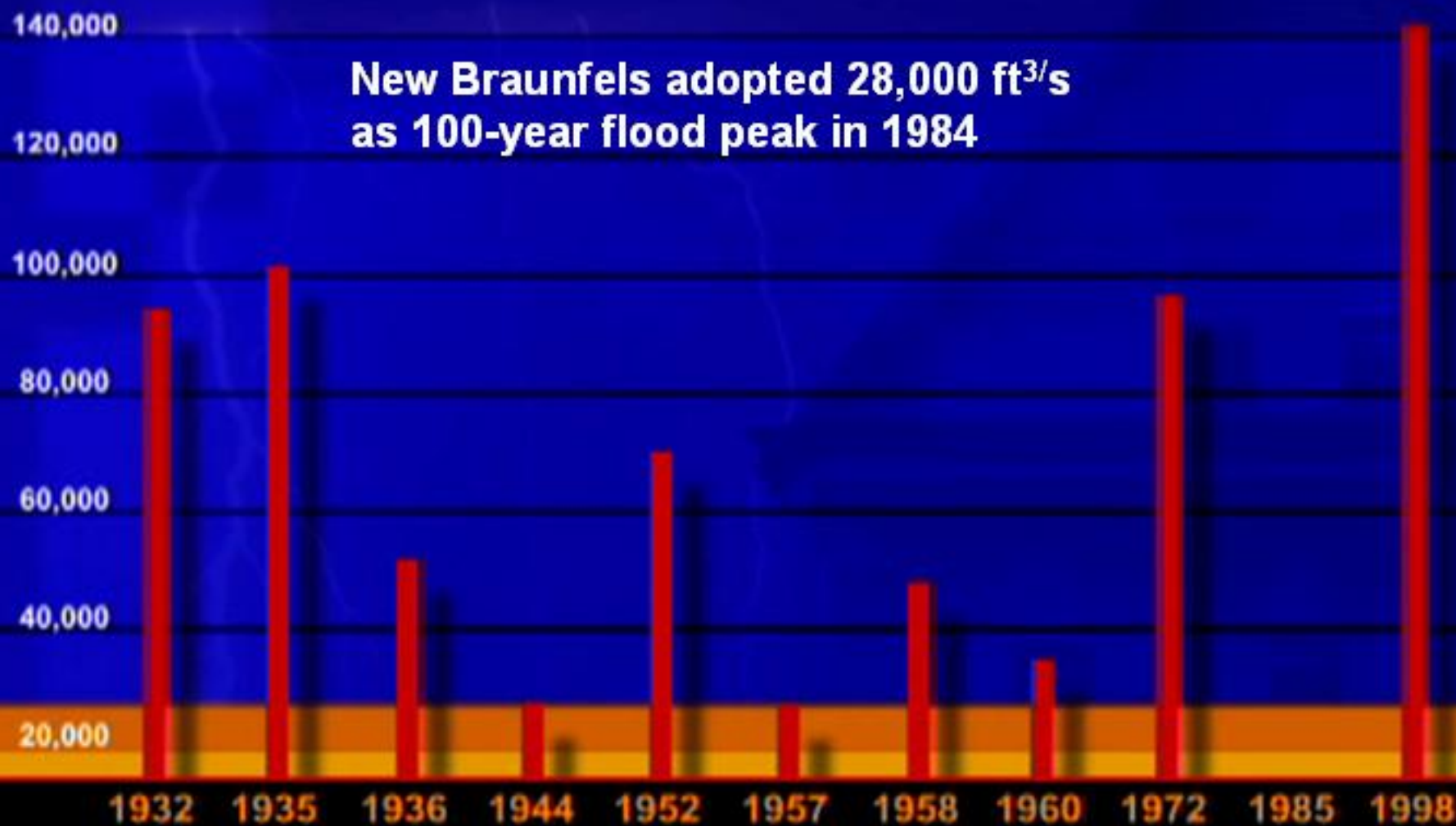
Texas leads Nation in annual deaths and damages

100-year flood plain – mapped on most large streams

- **Some floods exceed 100-year peak**
- **Some flood plains incorrect - lack of data**
- **Flood plain encroachment increases after last big flood**
- **Some development allowed in flood plains**
- **Urbanization & land cover change increases flood plain**
- **Dams provide false security**
- **Fallible early warning flood prediction models**
- **Low flood plains adopted by some communities**

Example of low flood plain

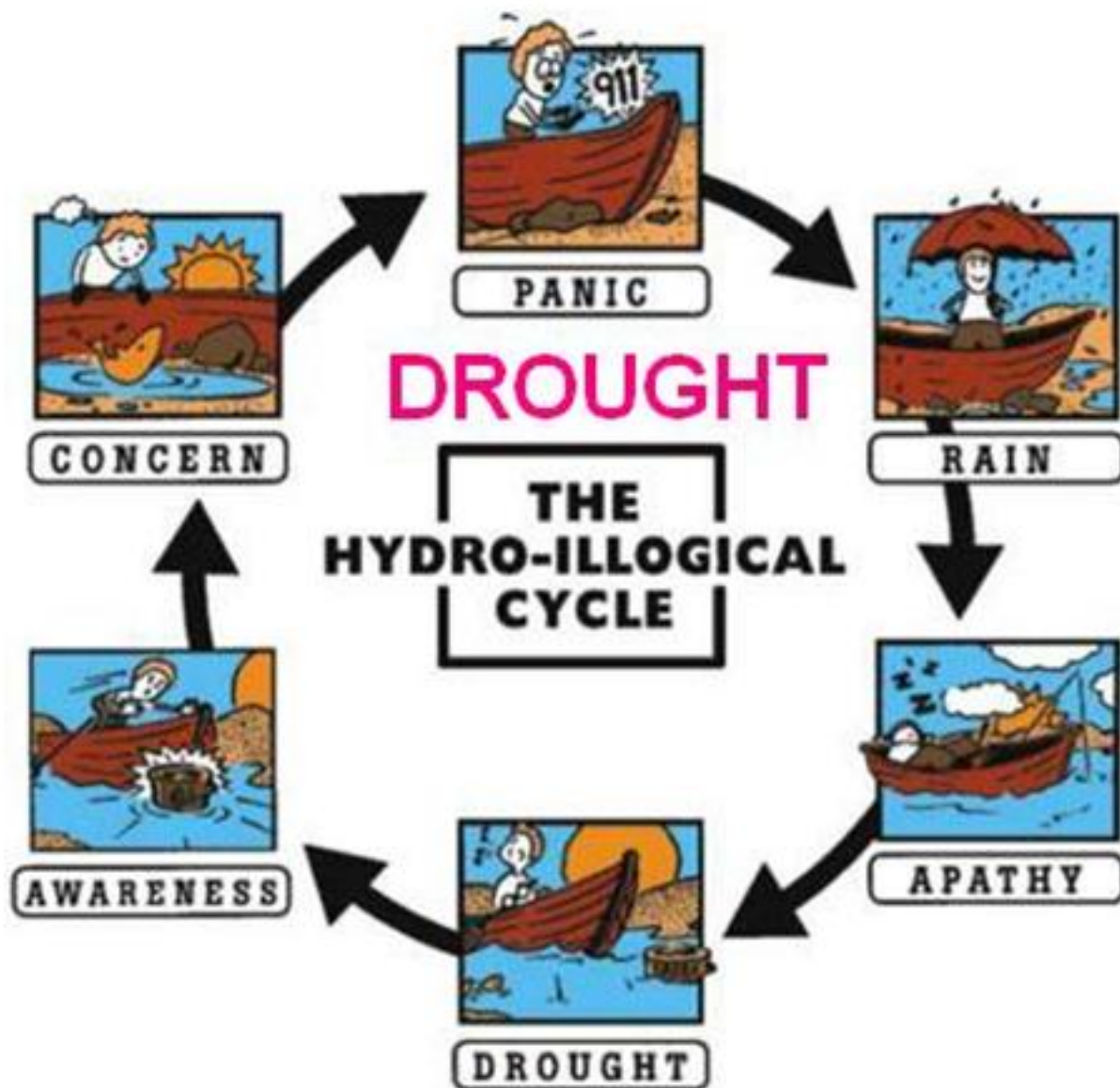
USGS Flood Peaks at New Braunfels



Year and associated flood peak in ft^3/s

4. Droughts





“We know the value of water when the well runs dry”



Drought Definitions

- What is a drought?
 - meteorologic
 - agricultural
 - water supply availability
 - When does a drought begin?
 - What area does a drought cover?
 - When does a drought end?
 - How do you evaluate drought severity?
 - Must be based on beginning date and defined area
- (next 3 slides)

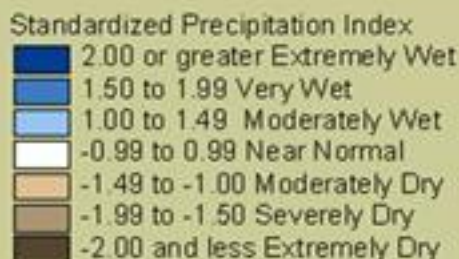
Evaluate drought severity: Precipitation data



Standardized Precipitation Index (SPI) through the end of July, 2006

Data Courtesy of Western Regional Climate Center
Desert Research Institute
Reno, Nevada

Provisional Data Provided by
NOAA/NWS/CPC and
NOAA/NESDIS/NCDC



08/08/06

<http://www.wrcc.dri.edu/spi/spi.html>

Texas Water
Development
Board presents
precipitation
indices

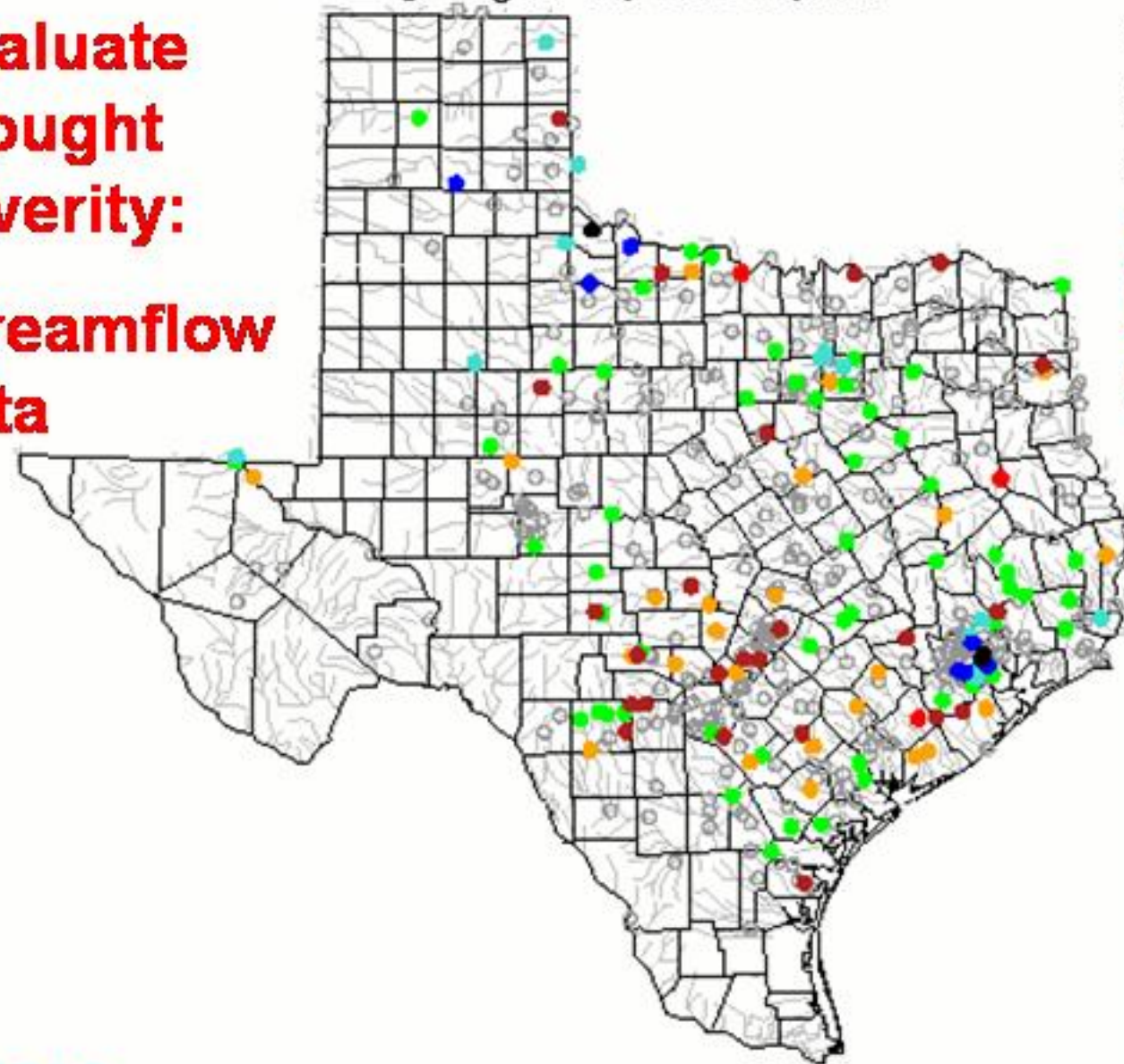
[http://www.txwin.net/
Monitoring/Meteorolo
gical/Drought/spi.htm](http://www.txwin.net/Monitoring/Meteorological/Drought/spi.htm)

Daily Streamflow Conditions

Select a site to retrieve data and station information.

Thursday, August 24, 2006 02:20ET

**Evaluate
drought
severity:
Streamflow
data**



The U.S. Geological Survey presents streamflow data

<http://waterdata.usgs.gov/tx/nwis/rt>

Explanation

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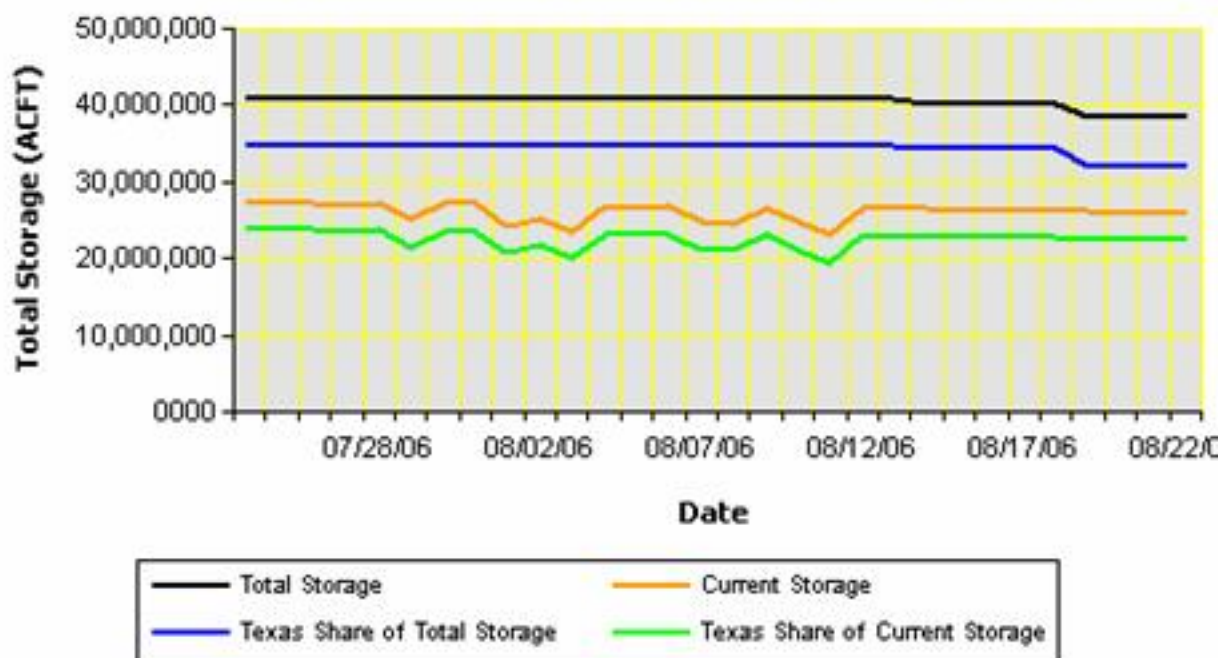
Evaluate drought severity:

Reservoir levels and groundwater levels

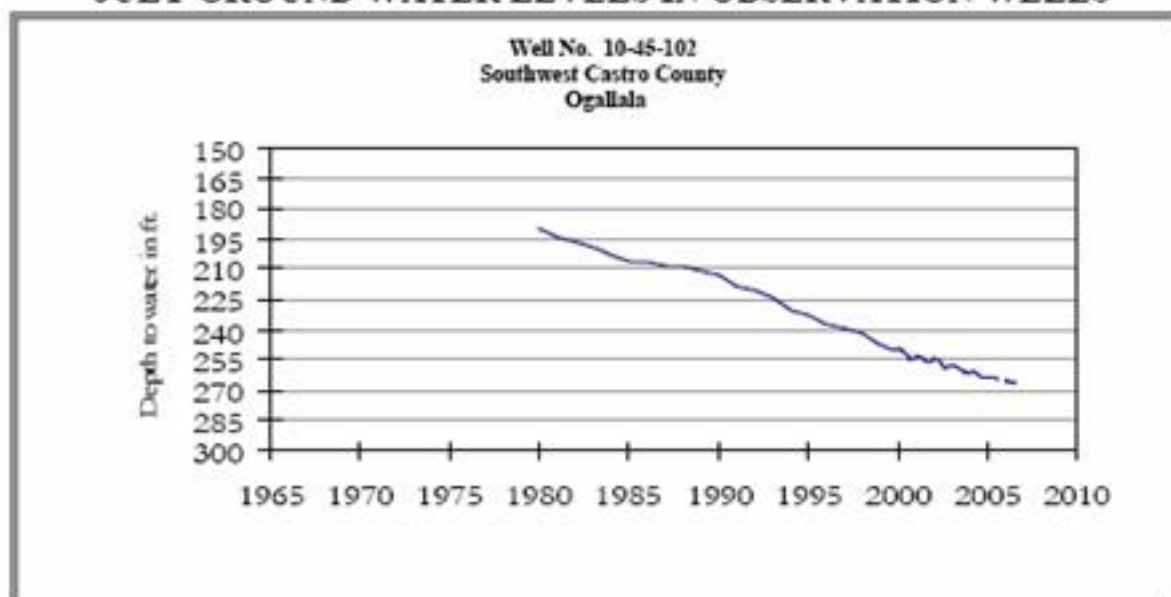
Texas Water Development Board presents reservoir and groundwater levels

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

Reservoir Storage for Texas



JULY GROUND WATER LEVELS IN OBSERVATION WELLS



Drought severity evaluated by hydrologic and meteorologic data

Data Summary

Worst drought ever

100-year drought

10-year drought

1-year drought

If you are without water

To bad--so is everybody else

Find emergency water--won't happen often

You are in trouble—better find additional water

Move or steal water with gun or legislation

**If water shortage “worse” than drought severity:
not enough water initially or water use has increased**

Drought identified water dilemmas

Conserve water, export water, limit growth?

Looking for water in Hays County

Drought and growth blamed for lack of groundwater.

By [Miguel Liscano](#)
AMERICAN-STATESMAN STAFF
Friday, June 30, 2006

HAYS COUNTY — When Wayland Clark decided to build a home in northern Hays County 26 years ago, a local well driller gave him some advice about rural water.

"Water is kind of like love," Clark recalled the old-timer saying. "It's where you find it."

NEWS

HOME: JUNE 2, 2000: NEWS

High and Dry

LCRA Approves Controversial Pipeline to Dripping Springs

BY ROB D'AMICO

The Lower Colorado River Authority (LCRA) continues to proclaim that it is fulfilling its mission as an environmental steward by offering an

Wimberley water conference addresses dry wells

As population grows, will groundwater be plentiful?

By [Asher Price](#)
AMERICAN-STATESMAN STAFF
Thursday, August 17, 2006

Wimberley Valley Watershed Association NEWS AND EVENTS

Hays County seeks to offset development with land buys

Hays County seeks to offset development with land buys
Purchases of pools and land intended to balance development.

By [Asher Price](#)
AMERICAN-STATESMAN STAFF
Wednesday, January 18, 2006

Texas Water Development Board Drought Page

- What Drought is and How it is Measured
- Drought Conditions
- Current Drought Monitoring
- Outlook
- Historical Data
- Mitigating Drought
- Drought Related Links

[http://www.twdb.state.tx.us/data/DROUGHT/
drought_toc.asp](http://www.twdb.state.tx.us/data/DROUGHT/drought_toc.asp)

5. Water quality contamination



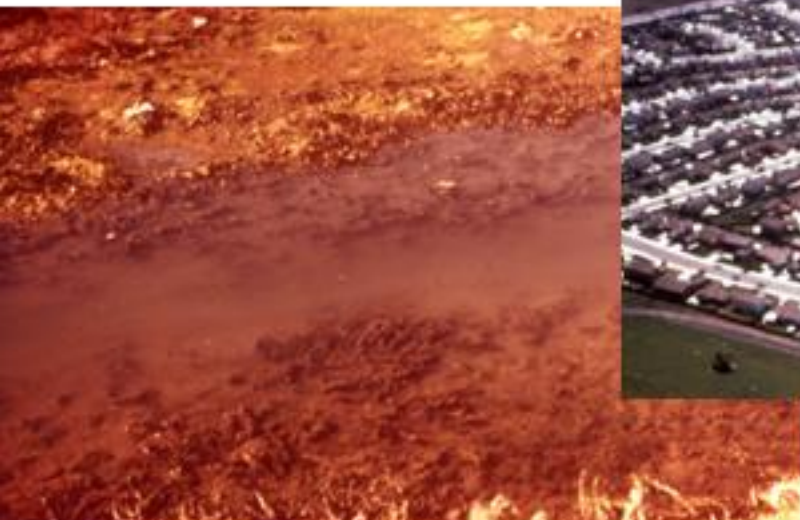
**Toxic chemicals
taint Barton waters**

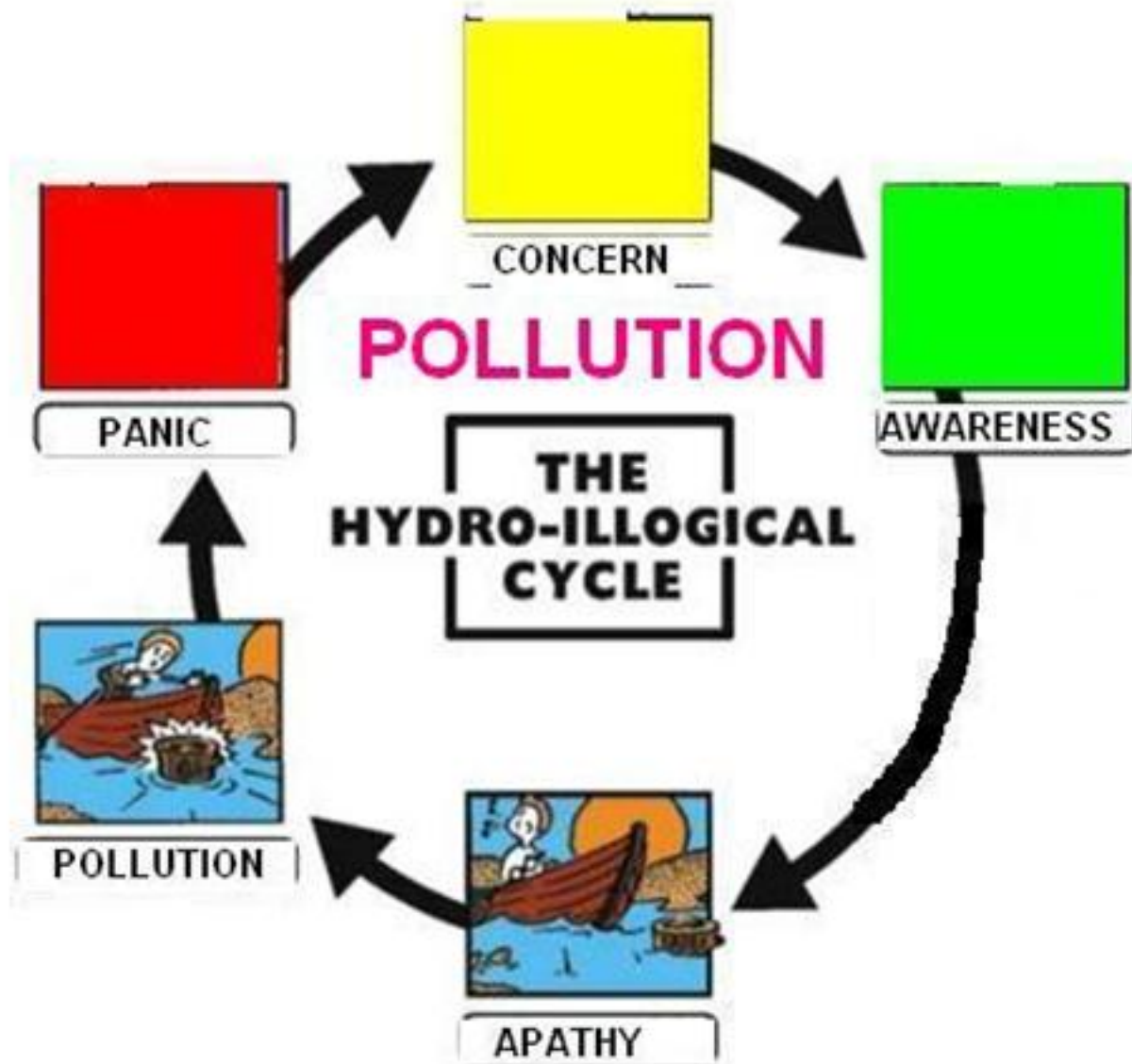
TOXIC WATERS
AN AUSTIN TREASURE AT RISK

Decades-old fuel waste
cited as possible source

**City closes
Barton pool**

POOL, OTHER CITY CREEKS MAY POSE HEALTH RISK





Point Sources

Discharges from businesses, industry, mining

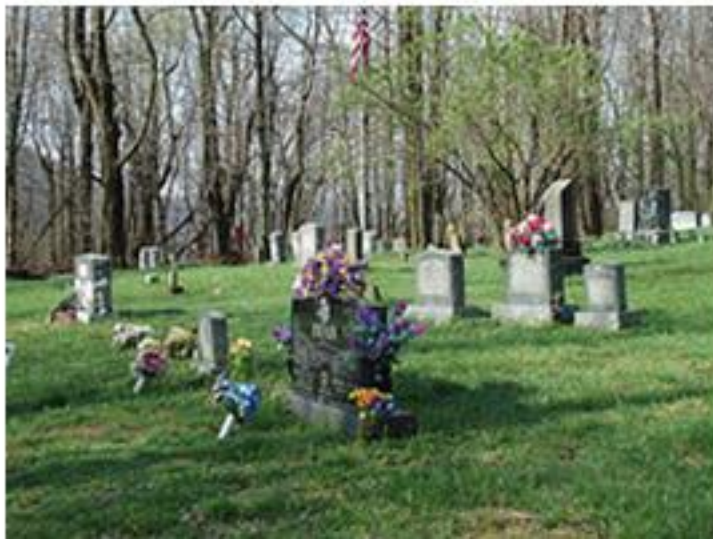
Permitted – sewage & industry effluent discharges (liquid or solid)

Non-permitted – leaking storage tanks, spills, dumps



Point Sources (cont)

- **Other sources** – construction activities, waste dumps, cemeteries



Point Sources (cont)

- **Petroleum wells** – salinity and organic carbon



Pump jack



**Oil and brine
Separator**



Brine disposal

**Dead cotton crop land due to
brine seeps and leaks**



More saline brine seeps



Non-Point Sources

- **Urban development** — construction, sewage, autos, parking-lot sealants, pesticides, fertilizers, industry, pets



Non-Point Sources (cont)

- **Ranching and farming practices** – pesticides, animal wastes
- **Land-use or land-cover changes** – construction activities



Urban water quality degradation

Median water-quality concentrations for rural and urban basins,
for samples collected in Austin during rising stream stages

<u>Water-quality constituent</u>	<u>Median value for rural basins</u>	<u>Median value for urban basins</u>	<u>Percent change in median concentration from rural to urban basin</u>
<u>dissolved solids</u>	245	130	47 % decrease
<u>suspended solids</u>	6.0	410	6700 % increase
<u>biochemical oxygen demand</u>	0.95	6.0	530 % increase
<u>total organic carbon</u>	4.0	18	350 % increase
<u>total nitrogen</u>	0.5	2.15	330 % increase
<u>total phosphorus</u>	0.02	0.45	2150 % increase
<u>fecal coliform</u>	1,000	42,000	4100 % increase
<u>fecal streptococci</u>	1,200	75,000	6150 % increase

Best Management Practices to mitigate water quality degradation



Pervious parking lot



Sand filter



Infiltration basin



Wet pond or wetland

Sedimentation fence



Grass swell



Sand filter pond at Barton Creek Mall



Degradation of Hill Country Streams



Green Hole on Lick Creek, west Travis County, Summer 2003

**Green Hole on July 27, 2004,
after rainfall caused overflow
from the West Cypress Hills
subdivision detention pond for
development construction**



Degradation of Hill Country Streams (cont.)



Dead Mans Hole on Dead Mans Creek, east Hays County, before construction of a small dam in the watershed



Dead Mans Hole after construction of the dam

Managing Water Quality

http://www.tceq.state.tx.us/nav/eq/eq_water.htm

- **Water Quality Advisory Groups**
- **Drinking Water and Water Availability**
- **Water Quality Management**
 - Groundwater Planning and Assessment**
 - Nonpoint Source Program**
- **Water Quality Planning**
 - Texas Clean Rivers Program**
 - Texas Surface Water Quality Standards**

Texas Water Issues In Conclusion...

Water Quantity

- **“The frog does not drink up the pond in which he lives.”**
 - American Indian proverb
quoted in Water Wasteland by David
Zwick & Marcy Benstock, 1971

Water Quality

- **“Filthy water cannot be washed.”**
 - West African proverb