A Cross Section of Texas Springs

Cold Spring on Town Lake in Austin

We wish he was Gunnar Brune, but instead…

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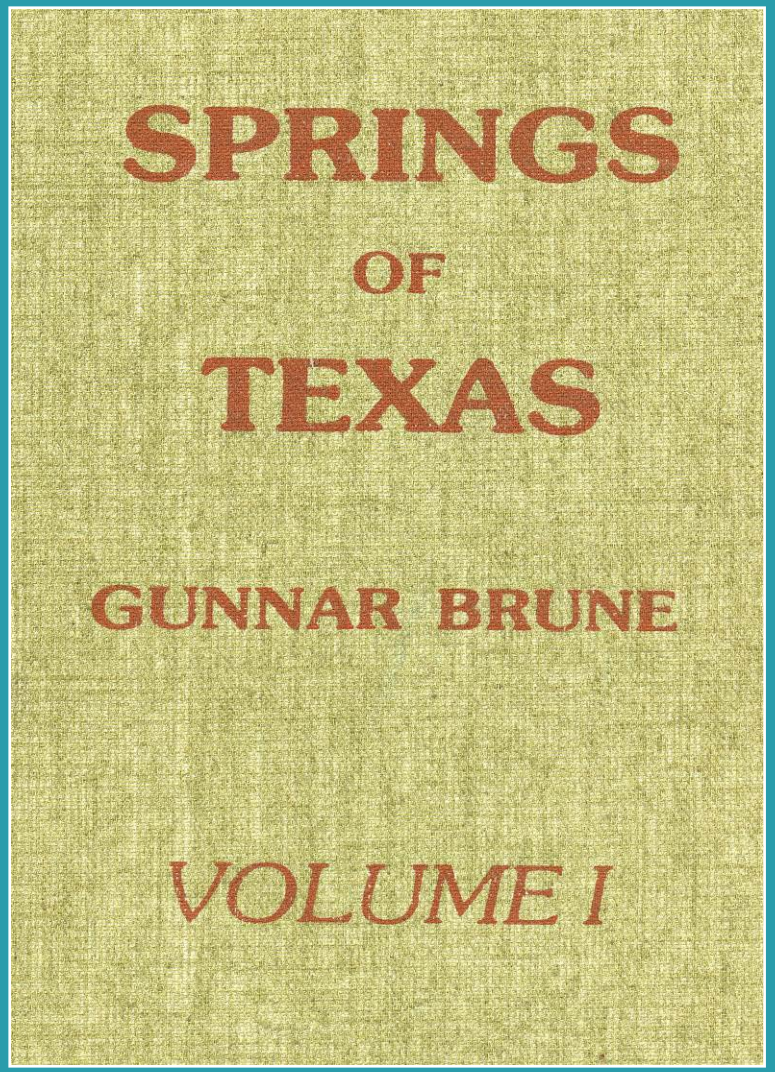
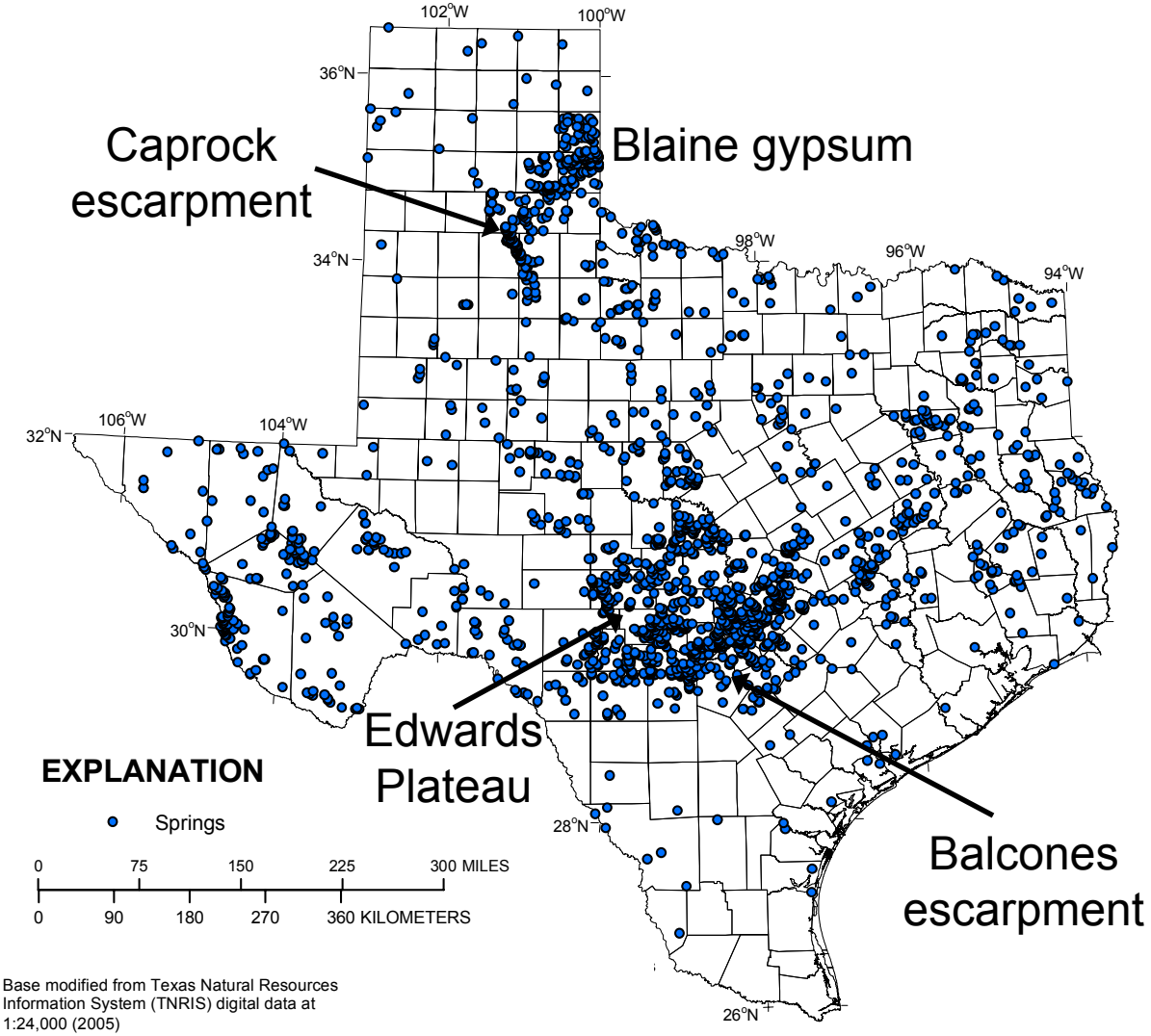
USGS science for a changing world

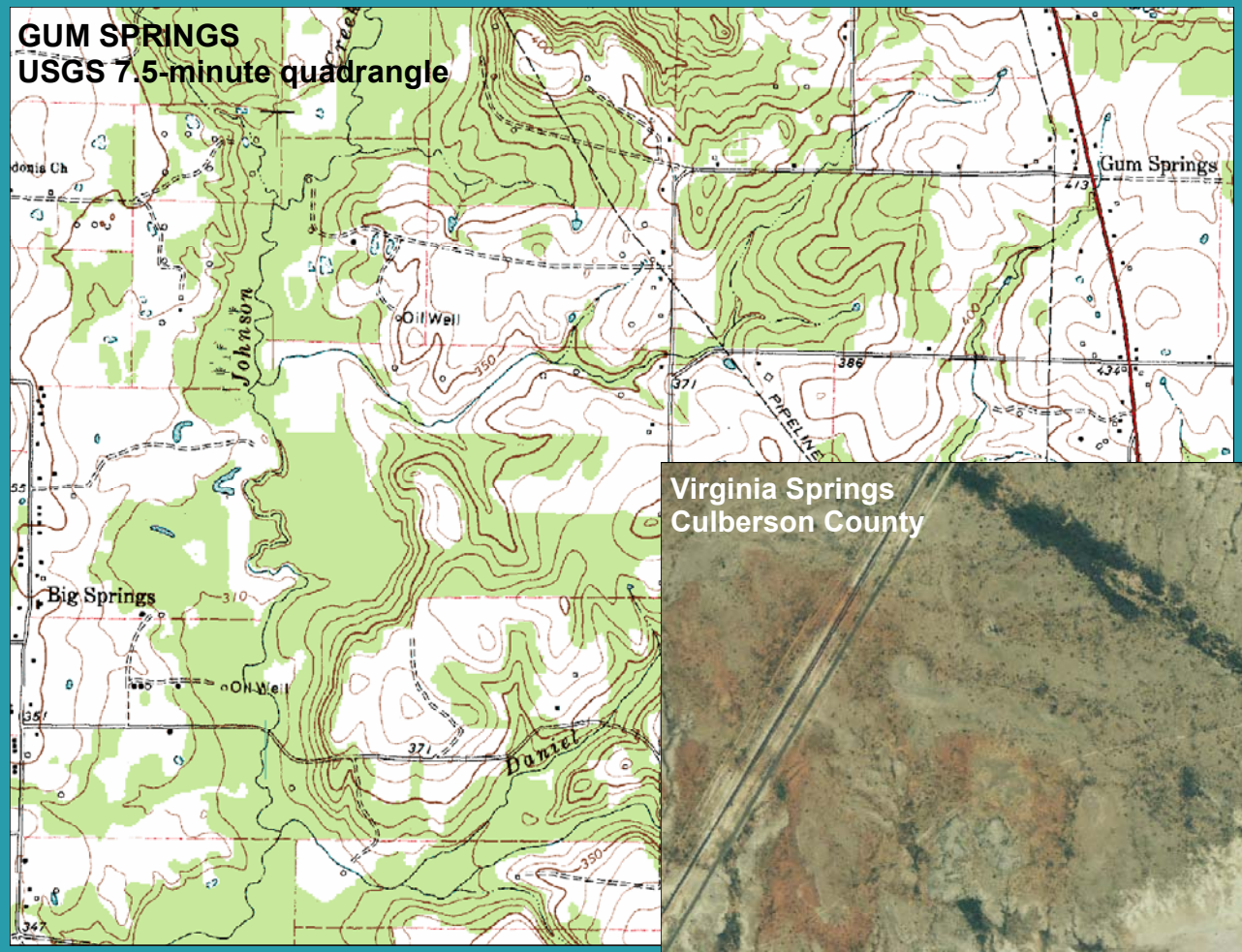
Who's Gunnar Brune?



- Worked on an inventory of Texas springs, spring-flow and water-quality measurements, and historical importance in the 1970s and 1980s
- Springs of Texas: Volume 1 – Refer to if you want a highly detailed "cross section" of Texas springs; 183 Texas counties
- Springs of Texas: Volume 2 – Currently being worked on by Helen Besse; 71 remaining counties

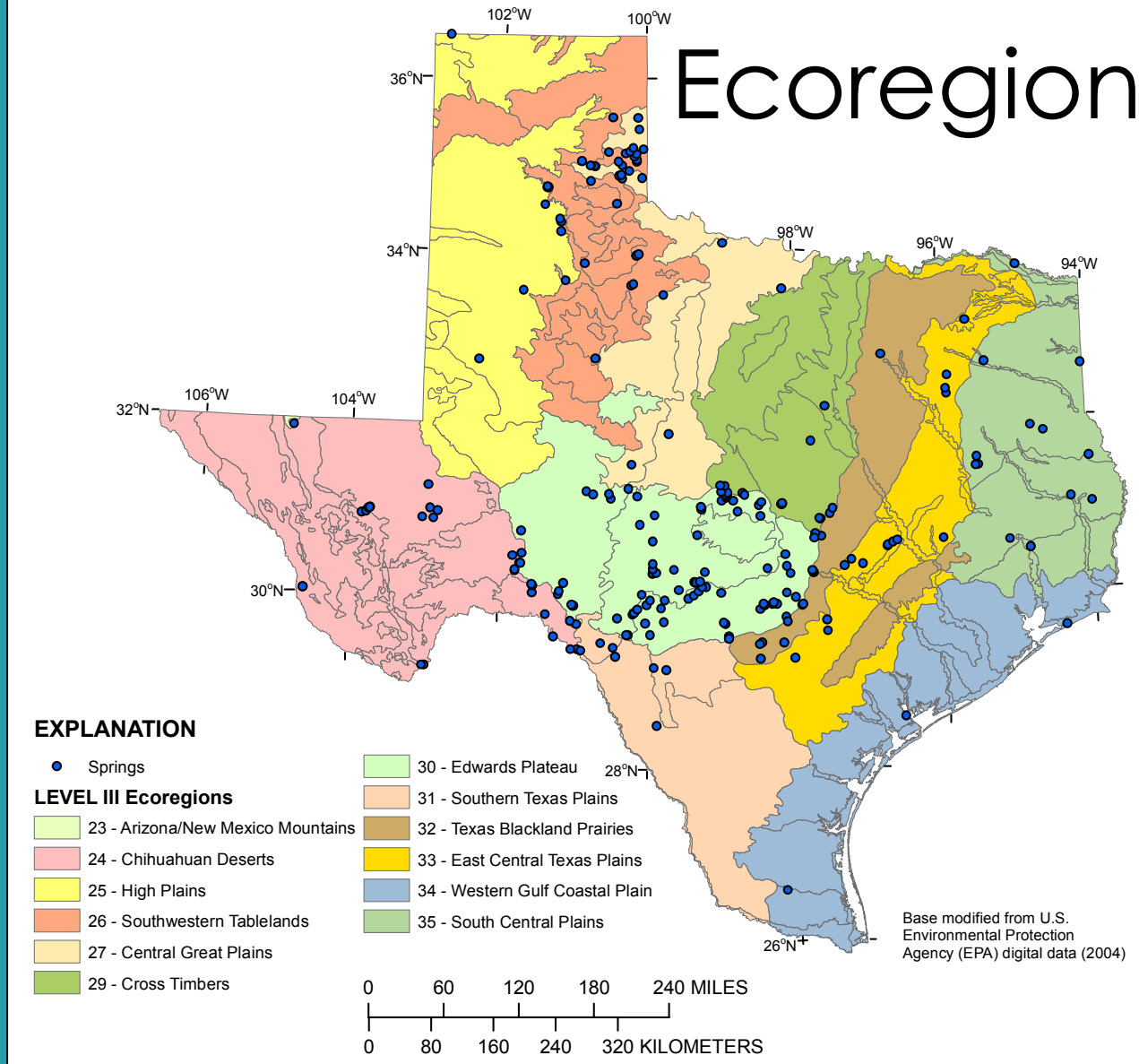
Brune, Gunnar, 1981, Springs of Texas—Volume 1: Fort Worth, Tex., Branch-Smith, Inc., 566 p.


Caprock escarpment
Blaine gypsum
Edwards Plateau
Balcones escarpment
102°W
100°W
98°W
96°W
94°W
106°W
104°W
36°N
34°N
32°N
30°N
28°N
26°N
EXPLANATION
Springs
0 75 150 225 300 MILES
0 90 180 270 360 KILOMETERS
Base modified from Texas Natural Resources Information System (TNRIS) digital data at 1:24,000 (2005)

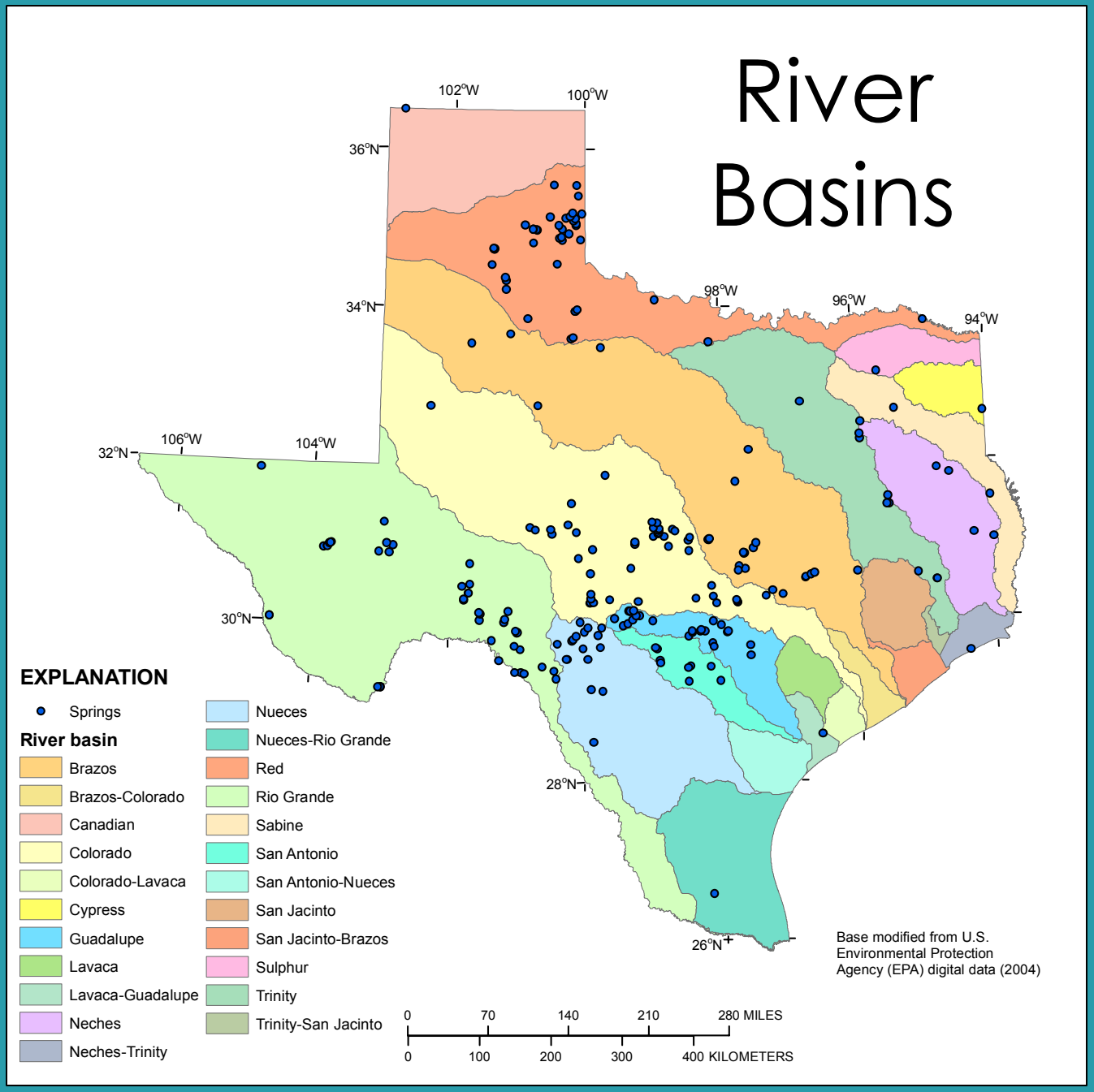

GUM SPRINGS
USGS 7.5-minute quadrangle
Gum Springs
Oil Well
Johnson
PIPELINE
Big Springs
Oil Well
Daniel


Virginia Springs
Culberson County

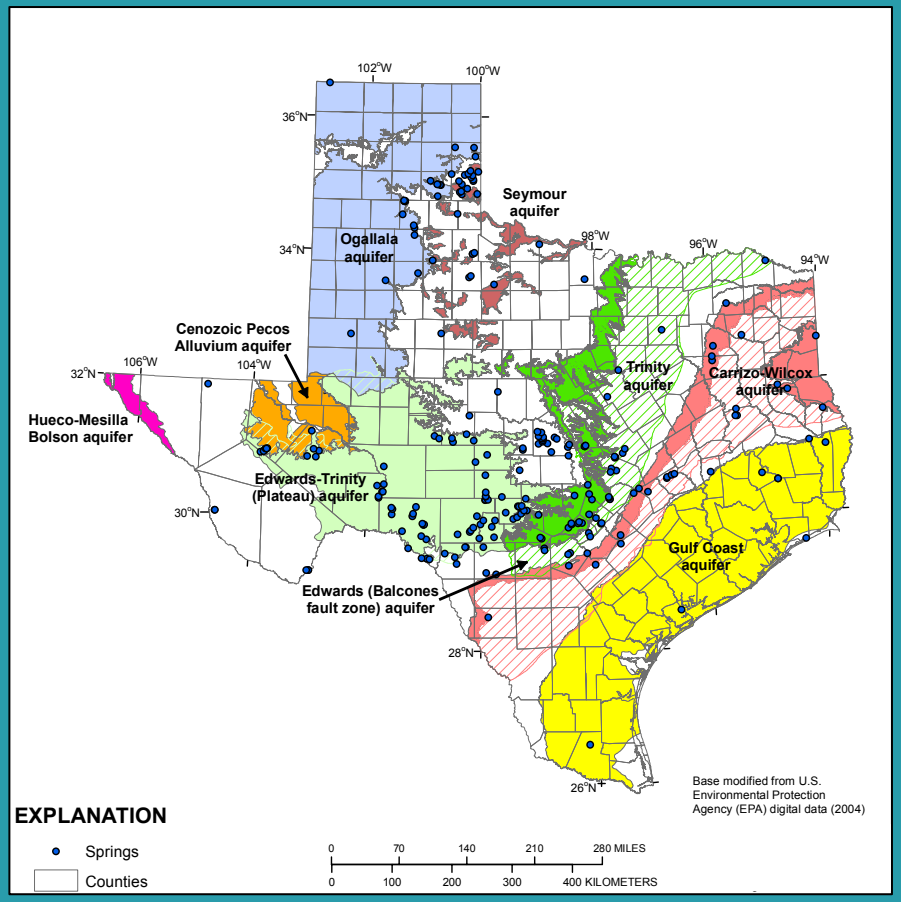
Ecoregions

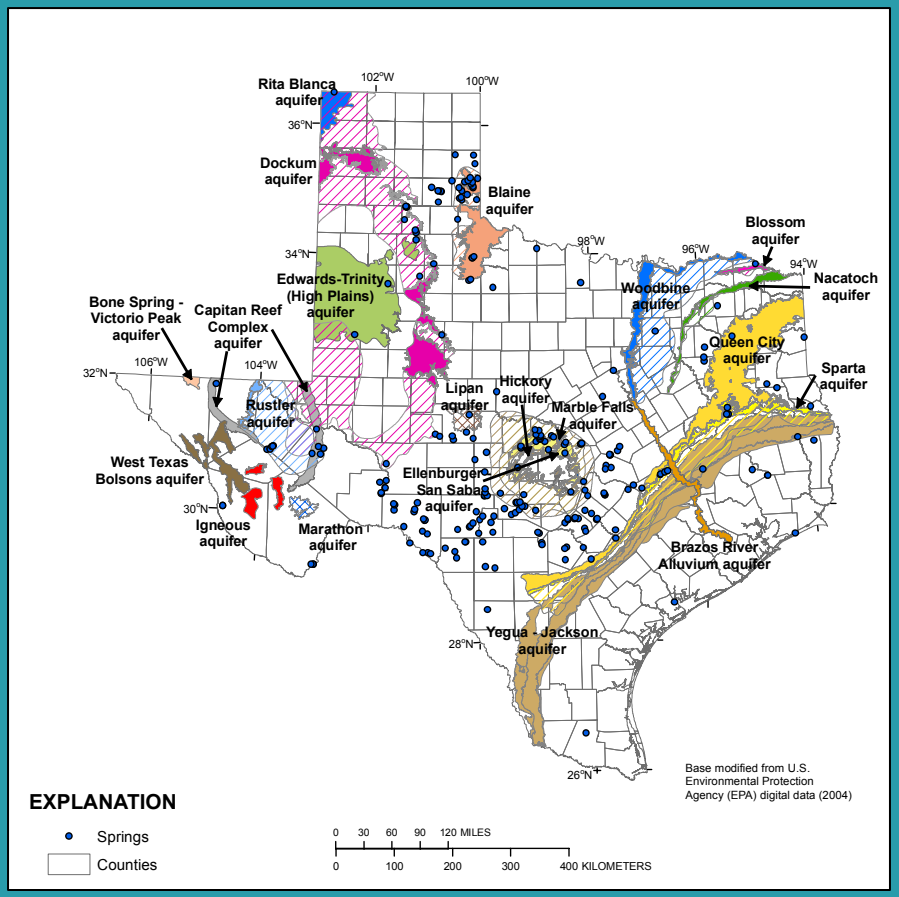

102°W
100°W
36°N
34°N
98°W
96°W
94°W
106°W
104°W
32°N
30°N
28°N
26°N
EXPLANATION
Springs
LEVEL III Ecoregions
23 - Arizona/New Mexico Mountains
24 - Chihuahuan Deserts
25 - High Plains
26 - Southwestern Tablelands
27 - Central Great Plains
29 - Cross Timbers
30 - Edwards Plateau
31 - Southern Texas Plains
32 - Texas Blackland Prairies
33 - East Central Texas Plains
34 - Western Gulf Coastal Plain
35 - South Central Plains
0 60 120 180 240 MILES
0 80 160 240 320 KILOMETERS
Base modified from U.S. Environmental Protection Agency (EPA) digital data (2004)

River Basins



Major and Minor Aquifers





What is a Spring?

- "Natural features in the bedrock or soil that function as discrete or clustered outlets to convey ground water to the surface" (Heitmuller and Williams, 2006)
- "Issues through a natural opening in the rock or soil, or may result from the coalescence of a large number of seeps', 'the spillways through which the overflow or surplus ground water passes" (Brune, 1981)
- "Can be permanent or ephemeral" (Fetter, 1994)
- Spring / seep threshold – 1 pint/minute

Brune, Gunnar, 1981, Springs of Texas—Volume 1: Fort Worth, Tex., Branch-Smith, Inc., 566 p.

Fetter, C.W., 1994, Applied hydrogeology—Third edition: Upper Saddle River, N.J., Prentice Hall, 691 p.

Heitmuller, F.T., and Williams, I.P., 2006, Compilation of historical water-quality data for selected springs in Texas, by ecoregion: U.S. Geological Survey Data Series 230, 32 p.

Types of Springs

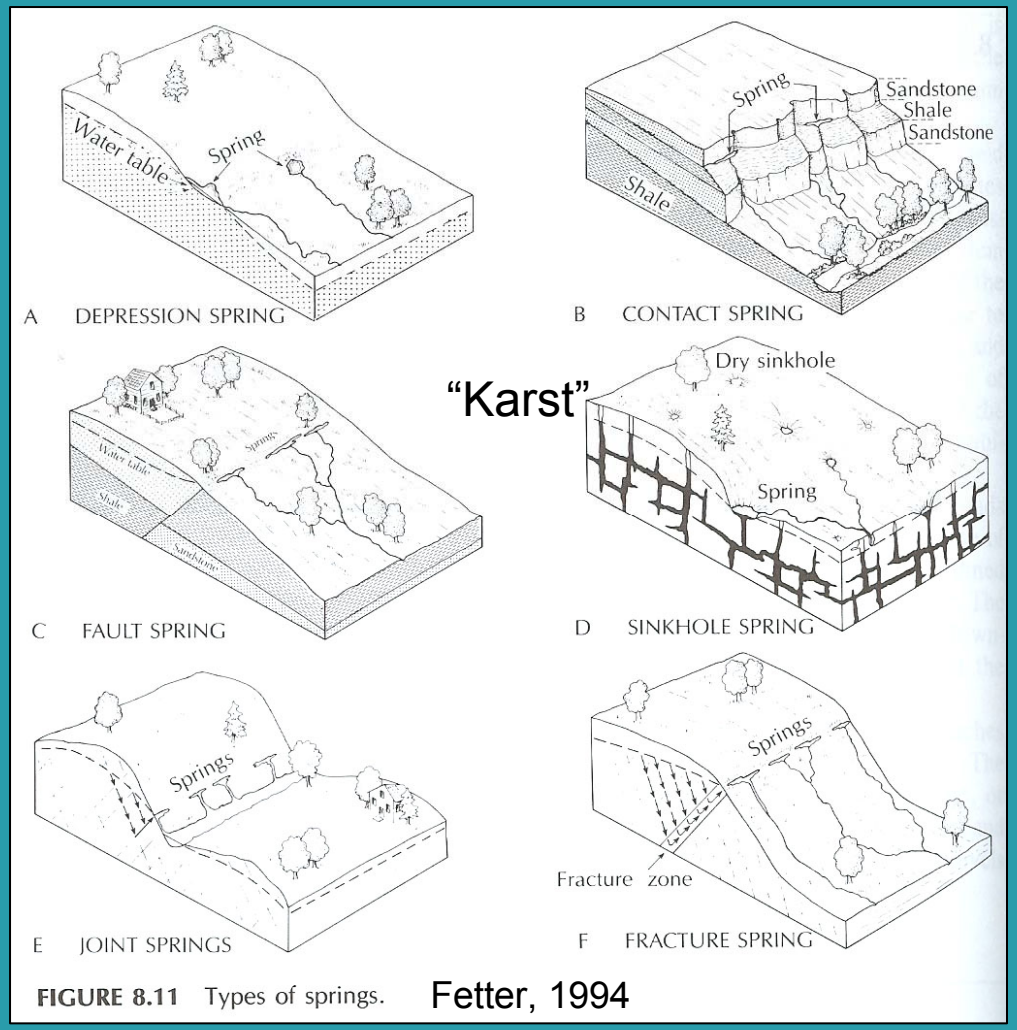


FIGURE 8.11 Types of springs. Fetter, 1994

"Karst"

- Influence #1 – gravity
- Influence #2 – porosity and permeability
- Influence #3 – artesian pressure
- Influence #4 – thermal pressure

Fetter, C.W., 1994, Applied hydrogeology—Third edition: Upper Saddle River, N.J., Prentice Hall, 691 p.

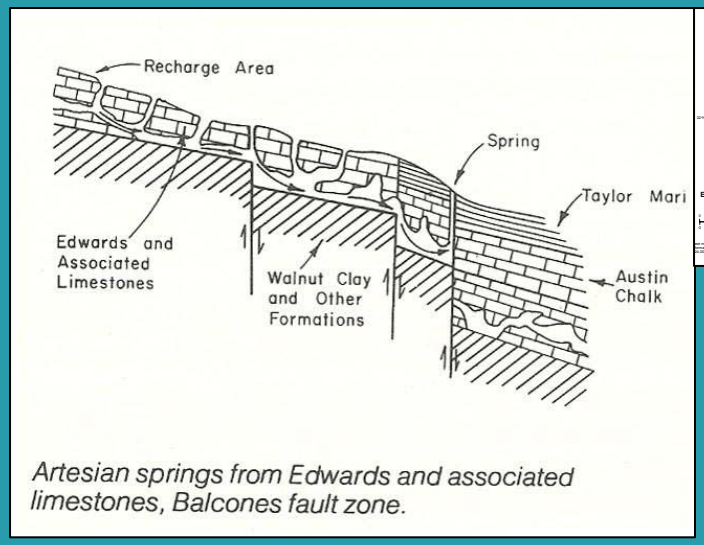
Combinations of Spring Types

Depression-type (gravity) spring along a joint (in soluble limestone)

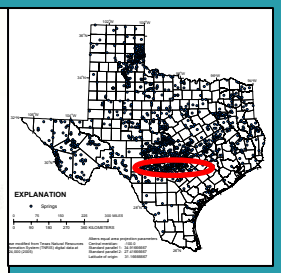
Near Canyon Dam, Comal County

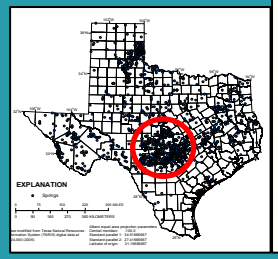
Types of Texas Springs - Conduits

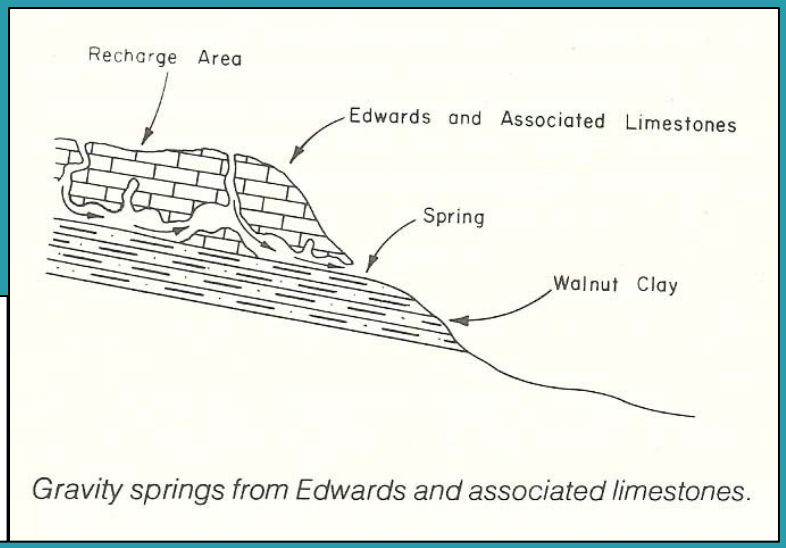
From Brune,1981



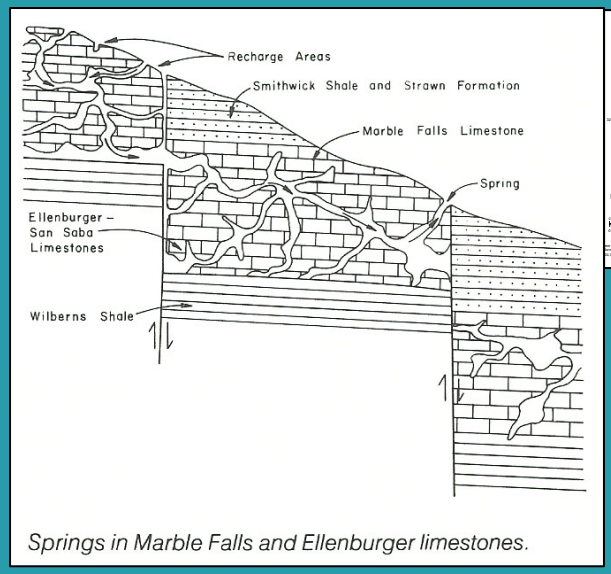
Artesian springs from Edwards and associated limestones, Balcones fault zone.



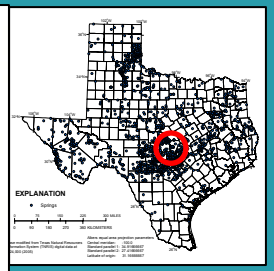


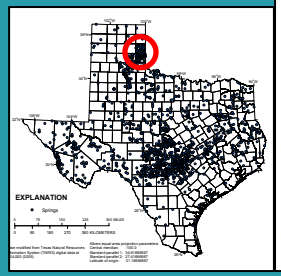


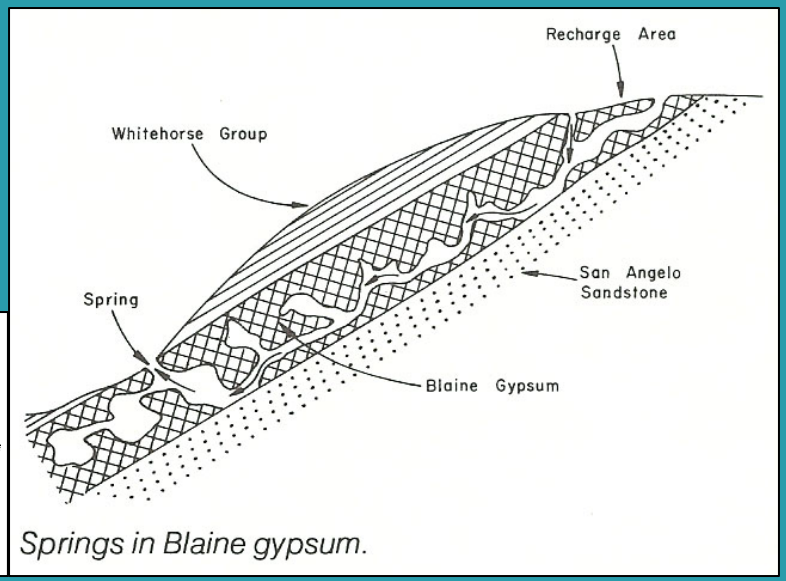
Gravity springs from Edwards and associated limestones.



Springs in Marble Falls and Ellenburger limestones.



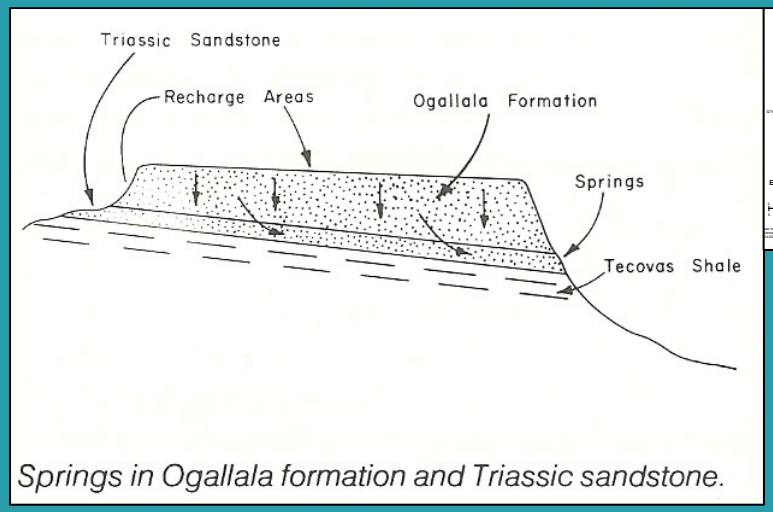




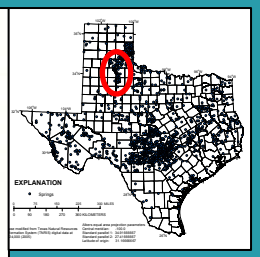
Springs in Blaine gypsum.

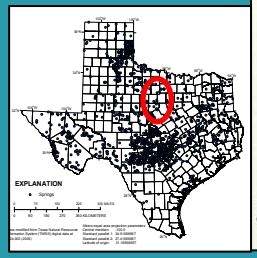
Types of Texas Springs - Diffuse

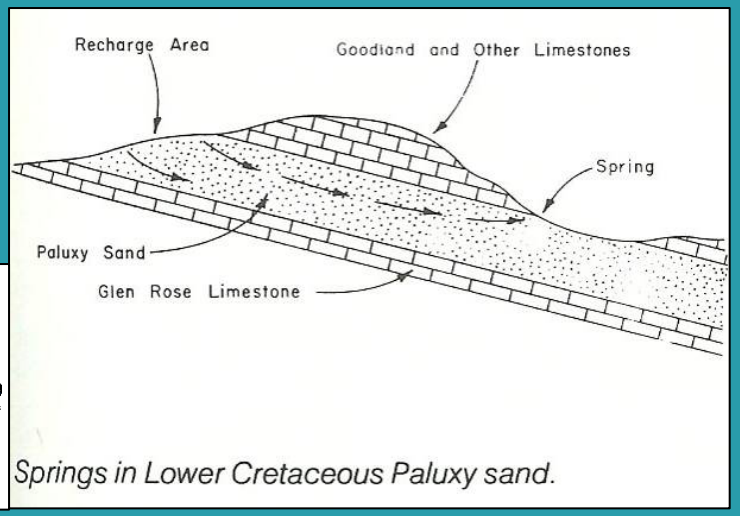
From Brune,1981



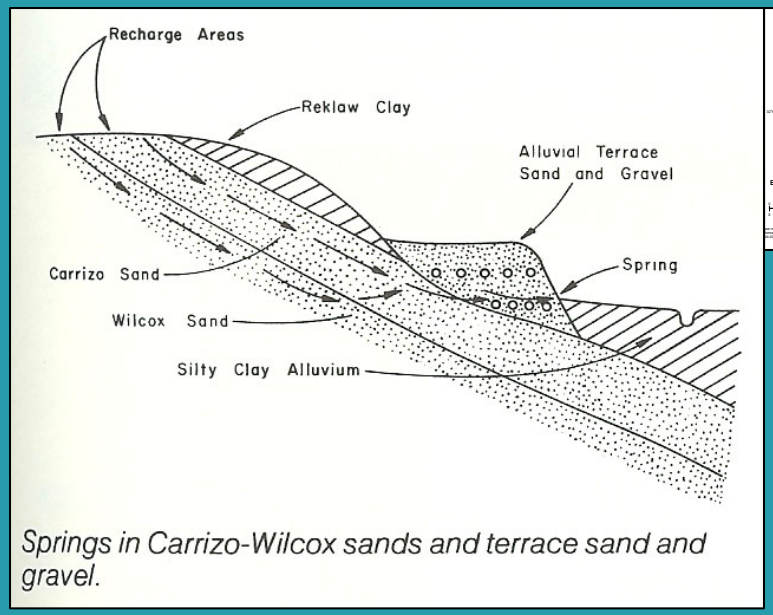
Springs in Ogallala formation and Triassic sandstone.



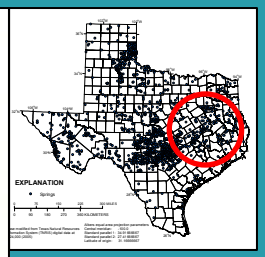


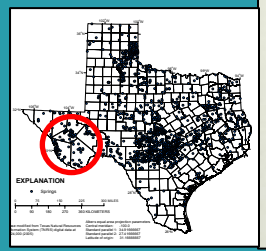


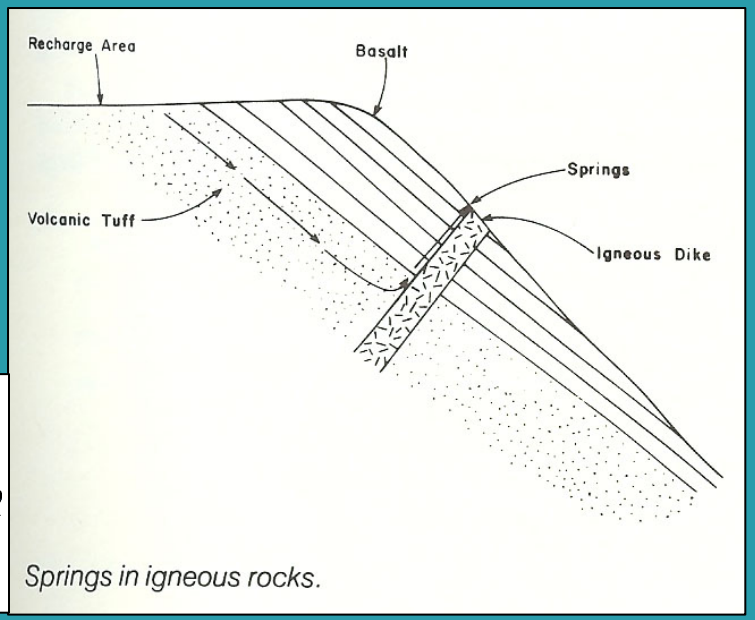
Springs in Lower Cretaceous Paluxy sand.



Springs in Carrizo-Wilcox sands and terrace sand and gravel.

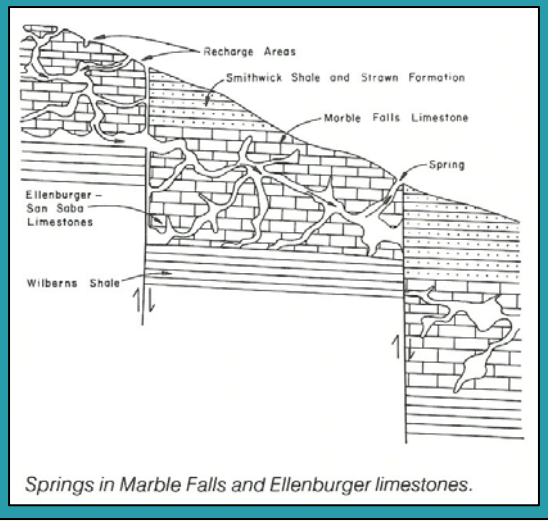




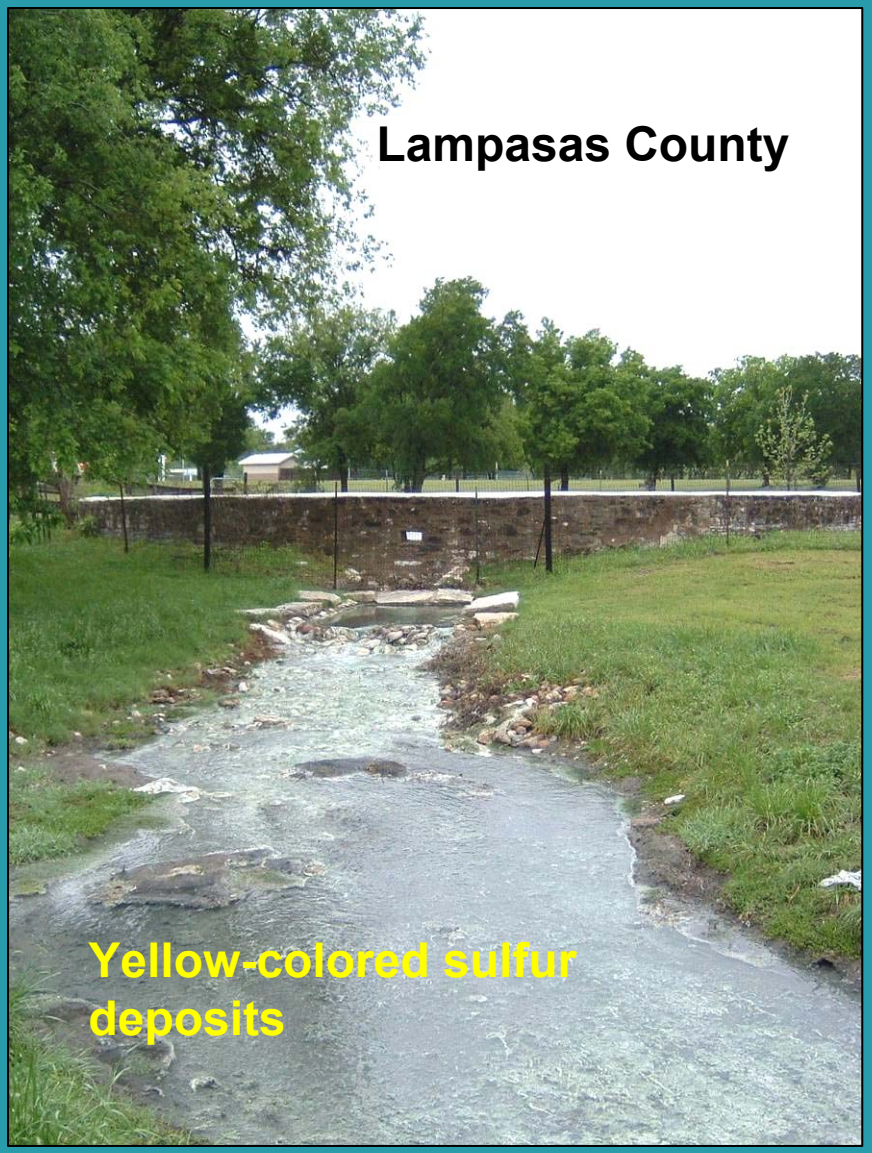


Springs in igneous rocks.

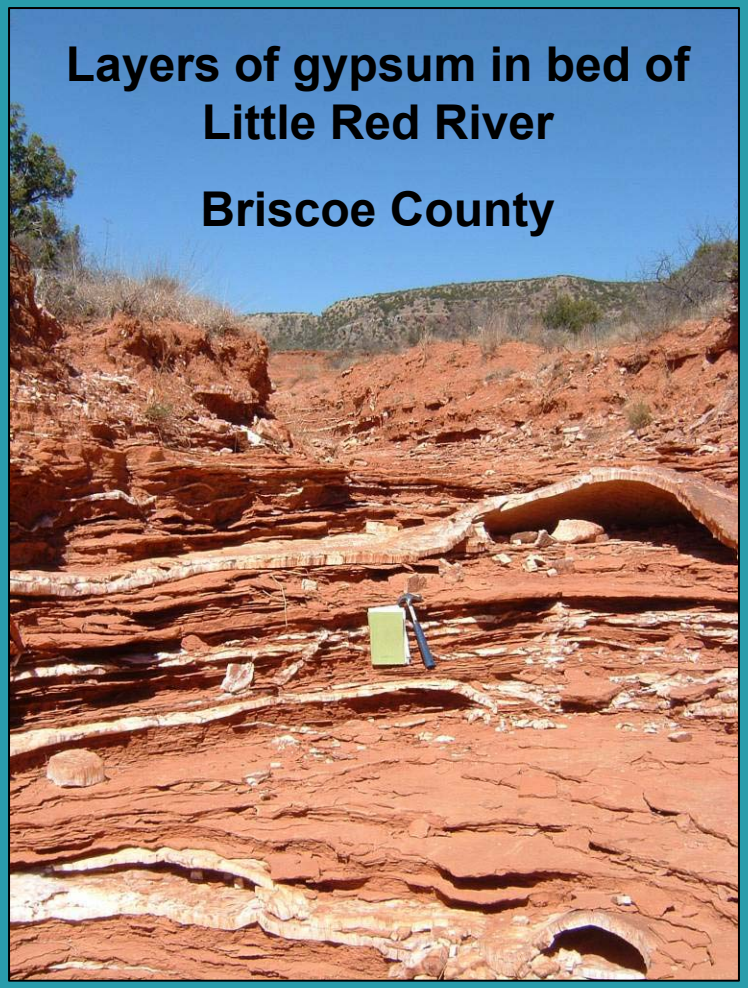
Hannah Spring

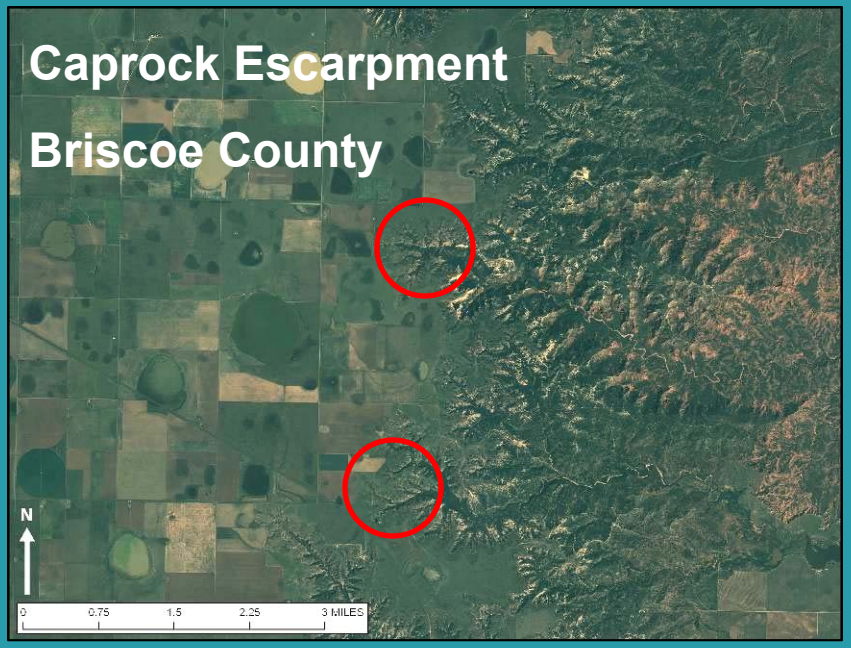


Springs in Marble Falls and Ellenburger limestones.



Ogallala and "gyp" springs



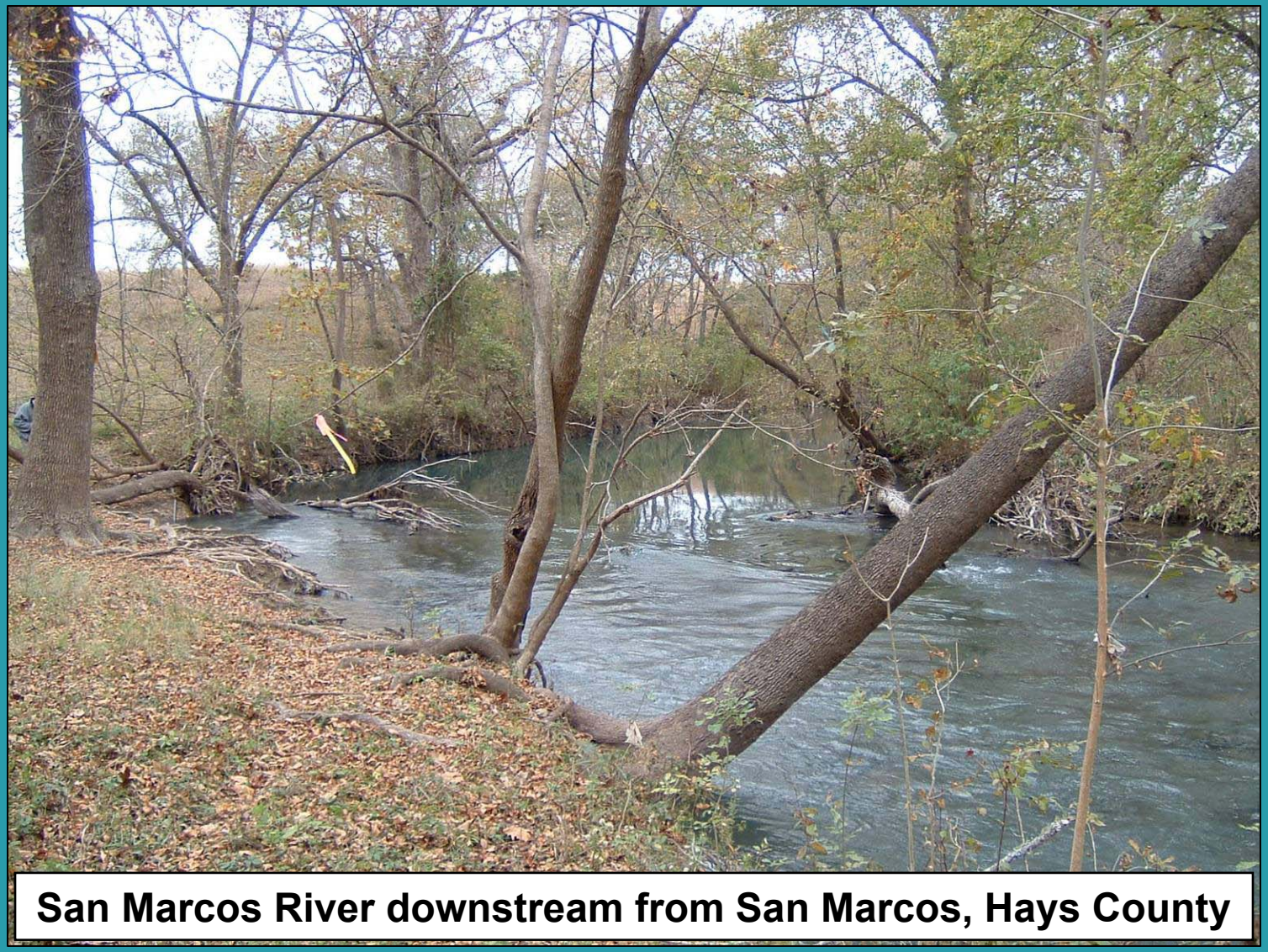


Importance of Texas Springs

- Discrete connections between ground water and surface water; water budget studies; education
- Maintain base flow for numerous perennial streams in Texas
- Form unique habitats for a variety of species, including rare, threatened, and endangered species
- Recreation
- Historical or cultural significance
- Municipal or industrial water supply
- Unique features in their own right; aesthetic value

Hancock Springs in Lampasas

Contribution to Surface Water



San Marcos River downstream from San Marcos, Hays County

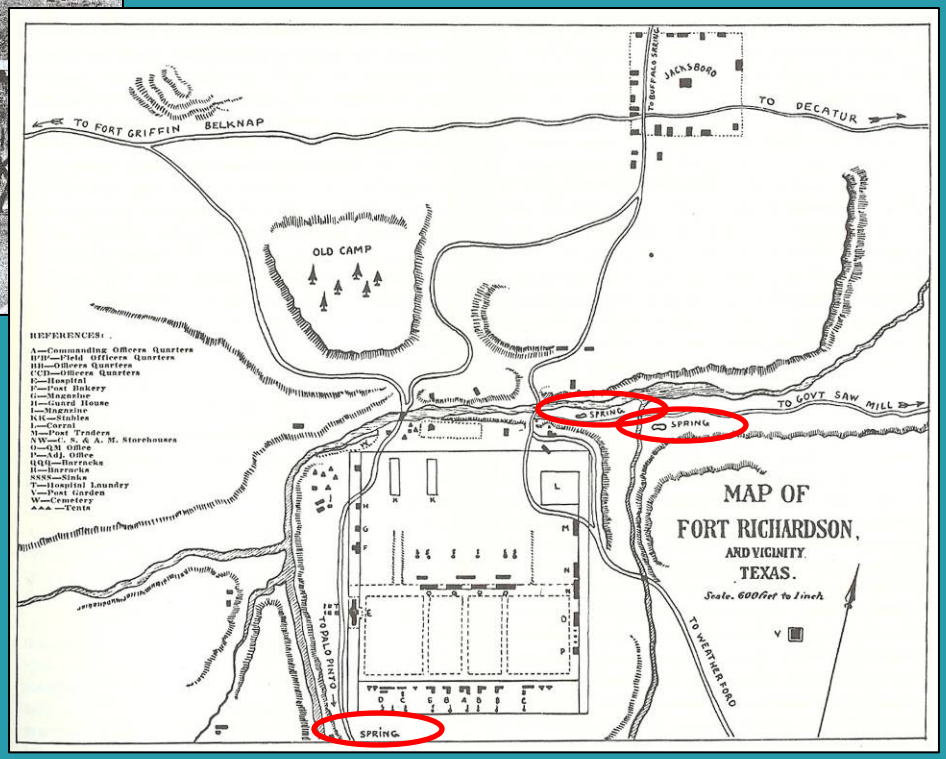
Unique Habitats

Cienaga downstream from San Solomon Spring, Reeves County

Historical and Cultural Importance

Old advertisement for Sutherland Springs, Wilson County; Image courtesy of Chad Norris (TPWD)

Old map of Fort Richardson and Jacksboro, Jack County; source (Brune, 1981)



History of Assessment in Texas

- **USGS monitoring began in 1894 – Barton Springs in Austin (Comal, San Felipe, and Las Moras followed in 1895)**
- **Meinzer (1927) – called attention to large springs in the U.S. and proposed a magnitude classification system**
- **Texas Board of Water Engineers (TBWE) and Texas Water Commission (TWC) county records of wells and springs – 1930s-60s**
- **Texas Water Development Board (TWDB)**
- **Gunnar Brune (1970s)**

Meinzer, O.E., 1927, Large springs in the United States: U.S. Geological Survey Water-Supply Paper 557, 94 p.

Photo provided by George Ozuna, USGS

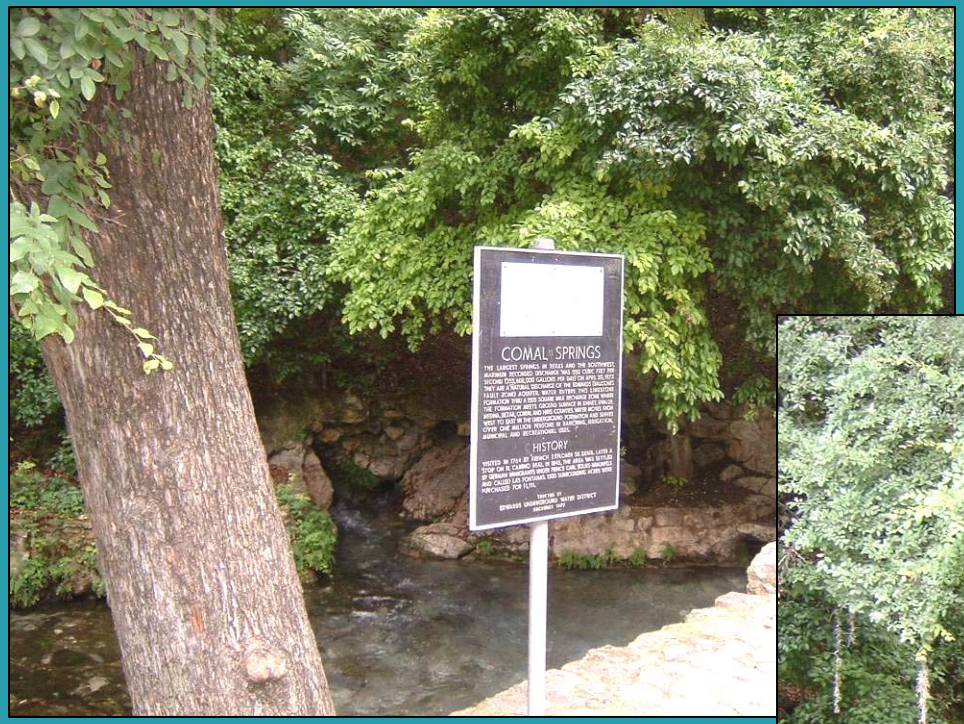
Landa Lake in Landa Park, New Braunfels, TX; formed by Comal Springs; July 1956

Ten Largest Texas Springs

Station number	Spring	County	Level III ecoregion	Period of record or year visited	Mean spring flow (ft^3/s)
08168710	**Comal Springs**	Comal	32	1932–2004	288[1]
08170000	**San Marcos Springs**	Hays	32	1956–2004	174[1]
08448500[2]	**Goodenough Springs**	Val Verde	24	1921–68	146[3]
08452800	**San Felipe Springs**	Val Verde	31	1889, 1895–1939, 1952–1971, 1997	86.8
08155500	**Barton Springs**	Travis	32	1978–2004	65.0[1]
08177818	**San Antonio Springs**	Bexar	32	1895–1963, 1970–2004	44.7
08168000	**Hueco Springs**	Comal	30	1924, 1928–1929, 1937, 1944–2003	41.3
08427500	**San Solomon Spring**	Reeves	24	1900, 1904, 1919–25, 1931–36, 1941–86, 1990, 1997, 2001–04	30.6
08444500[4]	**Comanche Springs**	Pecos	24	1899, 1904, 1919–25, 1932–84, 1992	28.3[5]
301619099523801	**Big Paint Springs**	Edwards	30	1939, 1955, 1962	23.7[6]

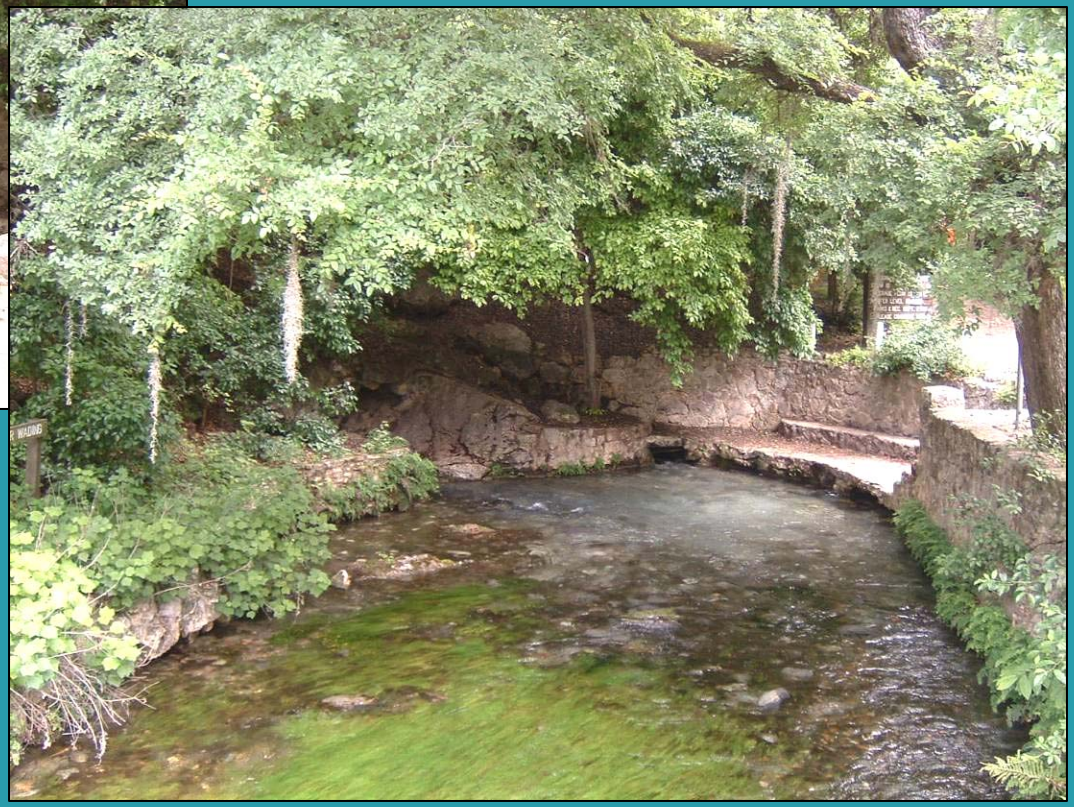
[1]Computed from continuous daily spring flow.
[2]Beneath the surface of Lake Amistad since 1968.
[3]Mean spring flow computed from monthly mean spring flow for period of record.
[4]Now generally dry.
[5]Mean spring flow includes numerous zero flow measurements.
[6]Mean spring flow based on only three measurements.

Comal Springs

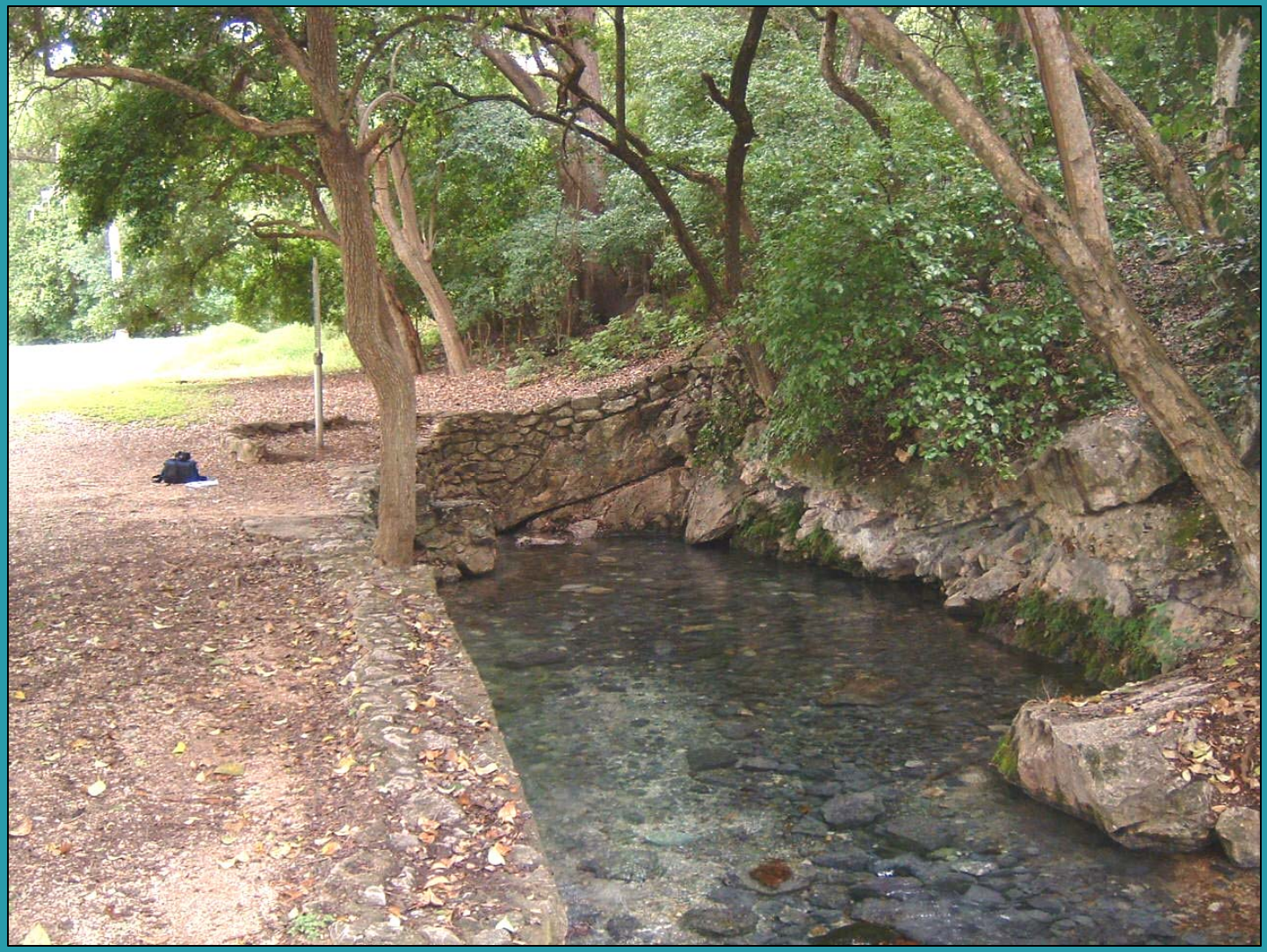


Edwards (Balcones fault zone) aquifer

Comal County



Comal Springs



San Marcos Springs

Edwards (Balcones fault zone) aquifer

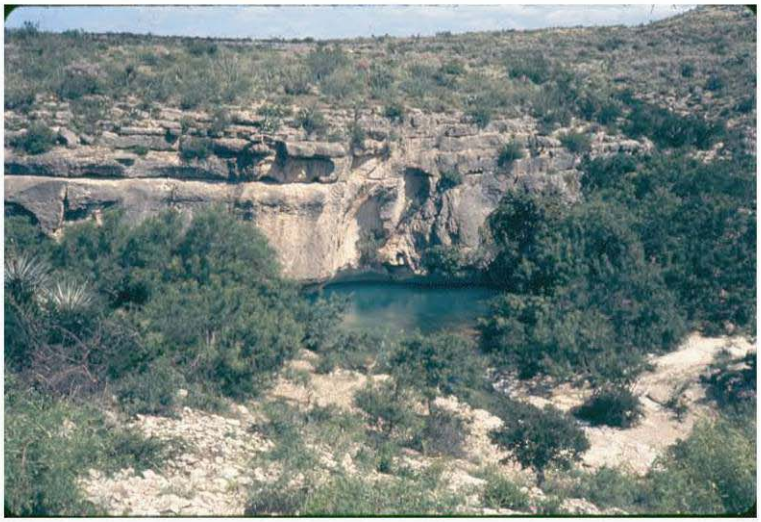
Hays County

Photo courtesy of Robin Gary (USGS)

Goodenough Springs

Goodenough Springs
Val Verde County, Tex.

Dec 1964



Goodenough Springs
last picture lake already over spring
Val Verde County, Tex.

July 1968

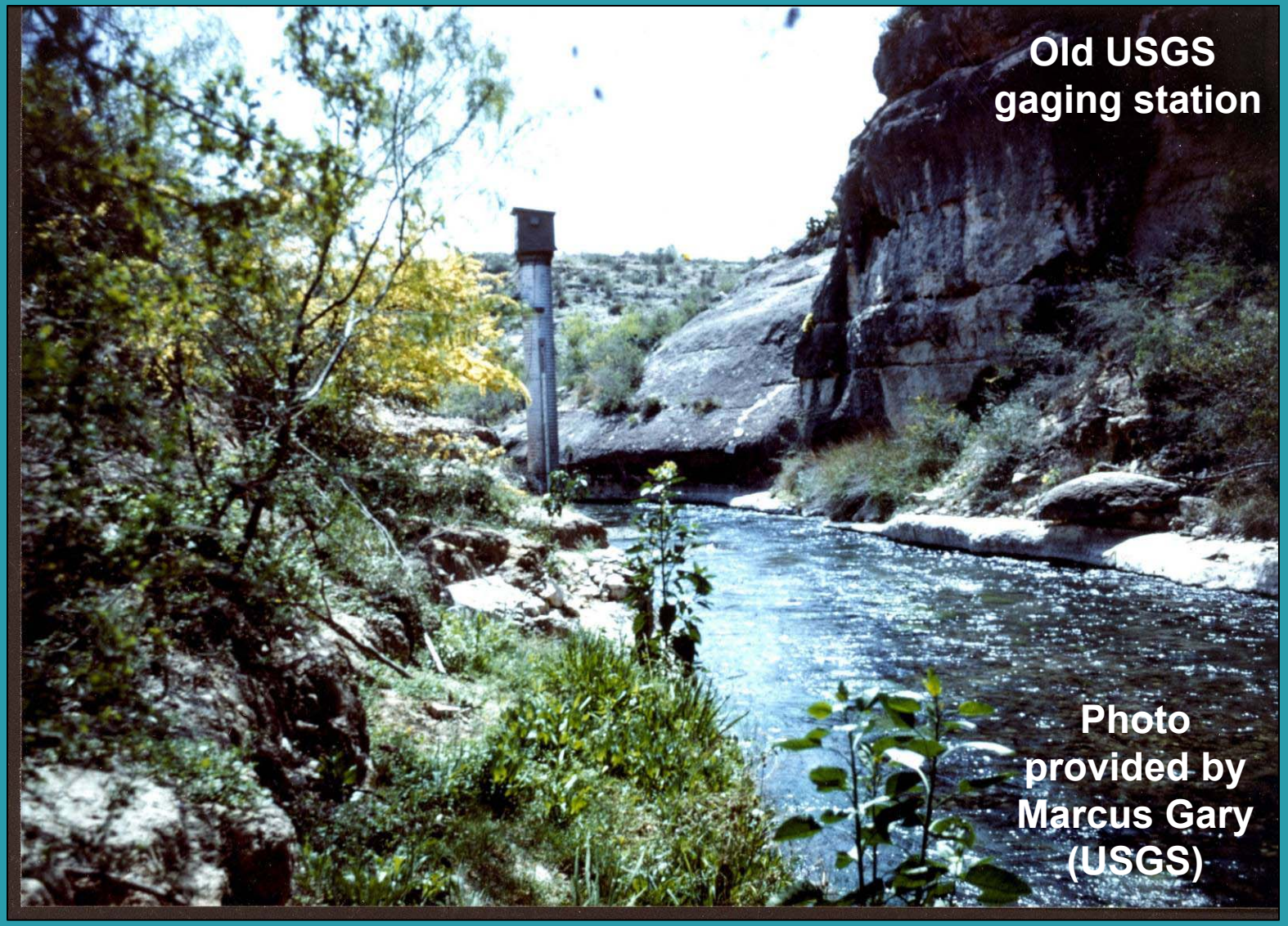
Edwards-Trinity (Plateau) aquifer?

Val Verde County

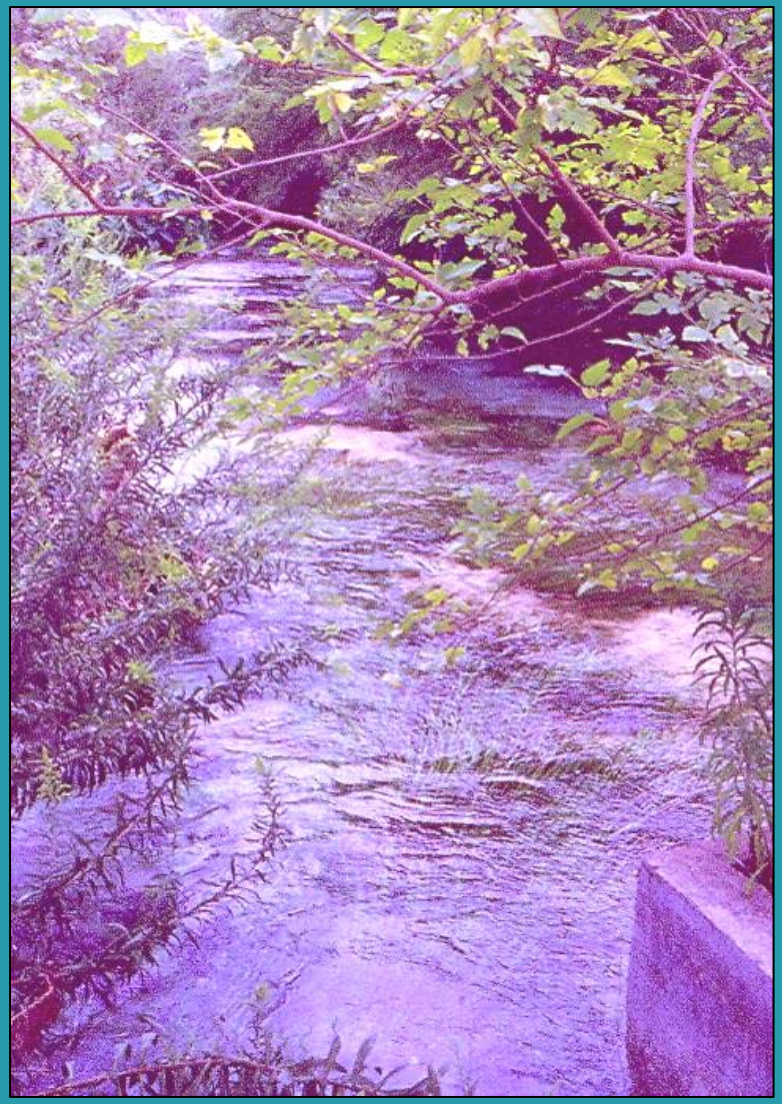
Impounded by Lake Amistad in 1968

Photos courtesy of Ted Small (former USGS) and Laura Coplin (USGS)

Goodenough Springs



San Felipe Springs

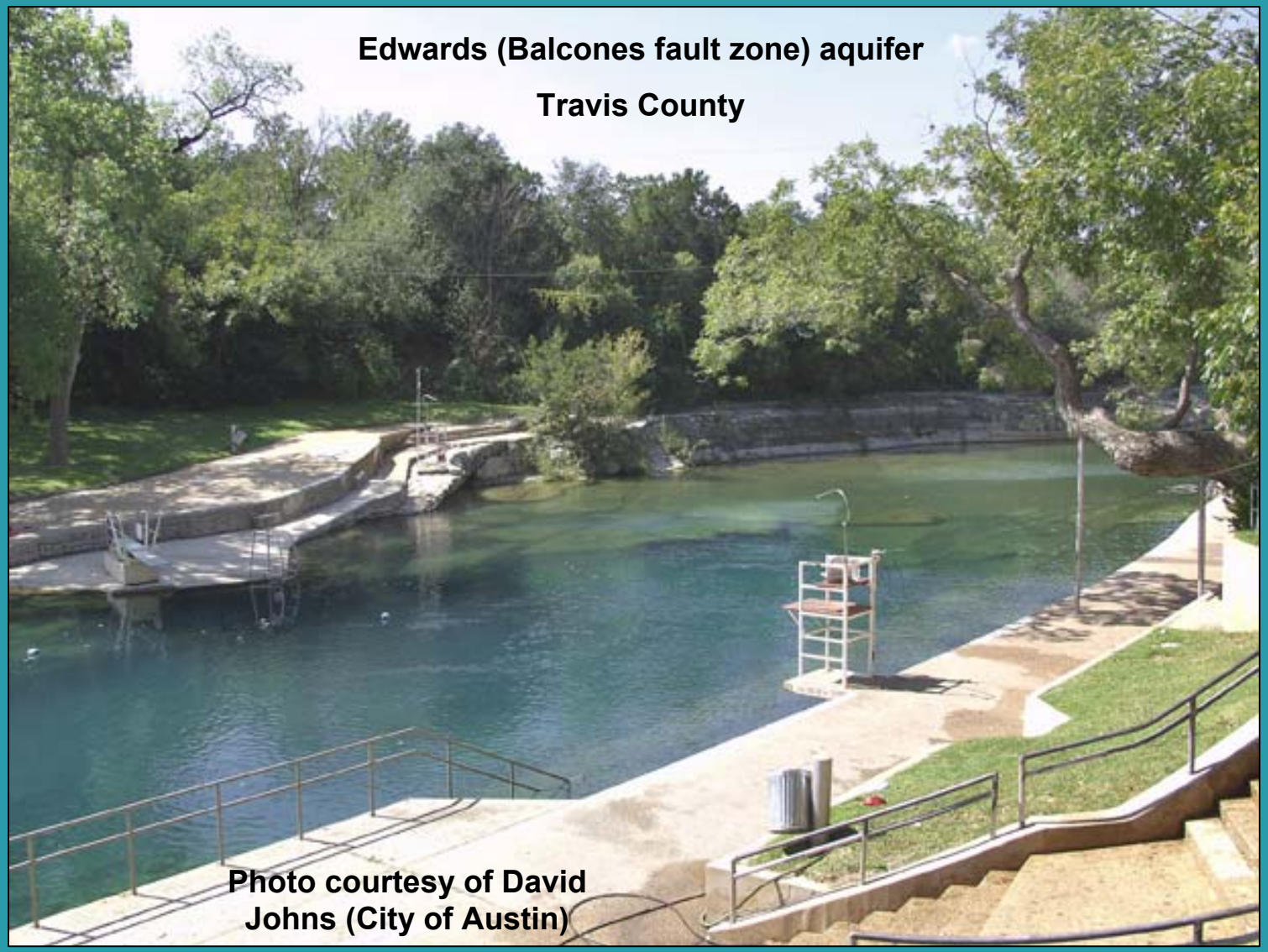


Edwards (Balcones fault zone) aquifer

Val Verde County

City of Del Rio water supply

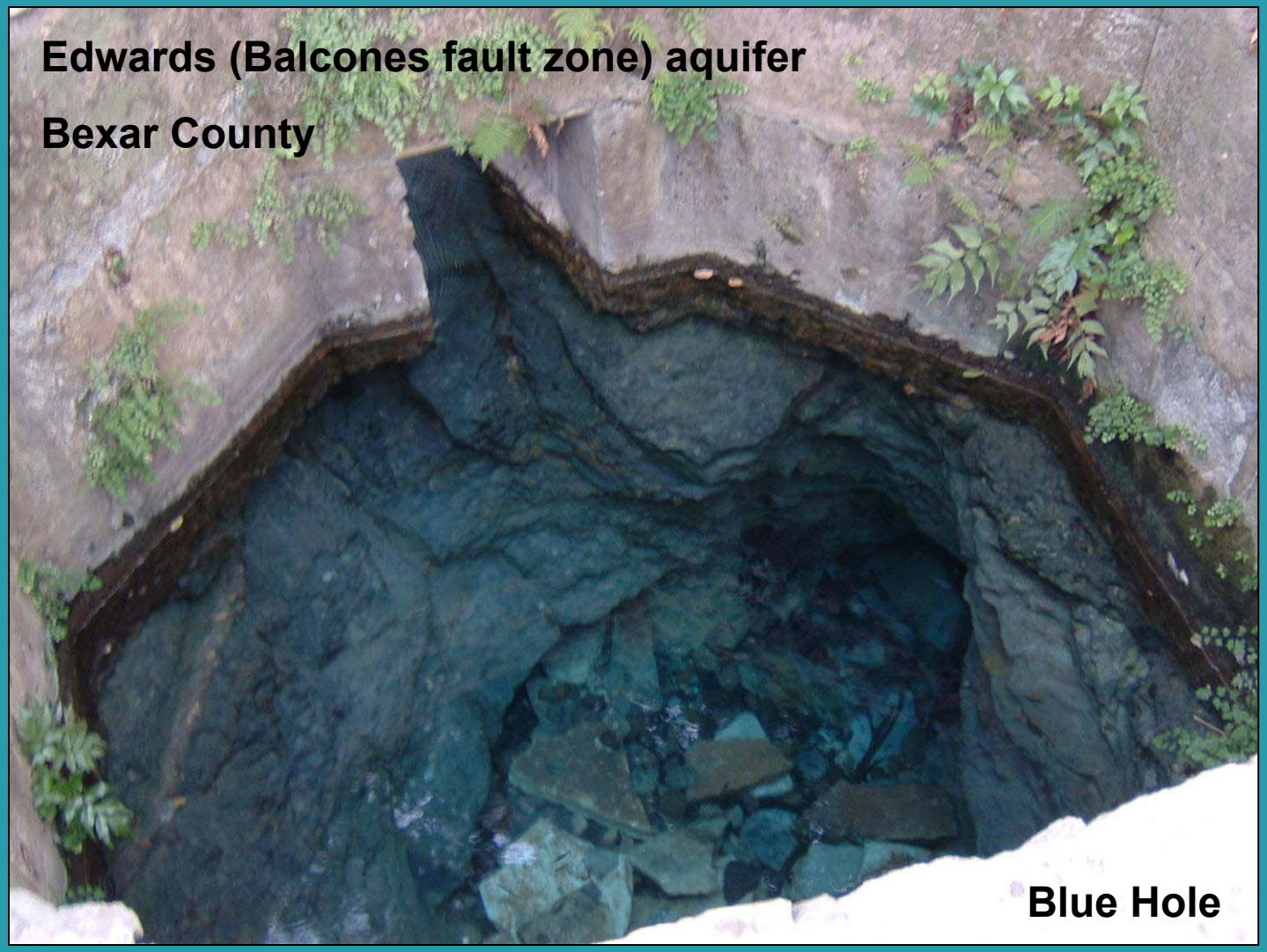
Barton Springs



Barton Springs

Photo courtesy of David Johns (City of Austin)

San Antonio Springs



Hueco Springs

San Solomon Spring

Edwards-Trinity (Plateau) aquifer

Reeves County

USGS-Monitored Springs in Texas

- **CONTINUOUSLY MONITORED**
  - 08155500 Barton Springs
  - 08168000 Hueco Springs
  - 08168710 Comal Springs
  - 08170000 San Marcos Springs
  - 08170990 Jacobs Well Spring
  - 08427000 Giffin Springs
  - 08456300 Las Moras Springs

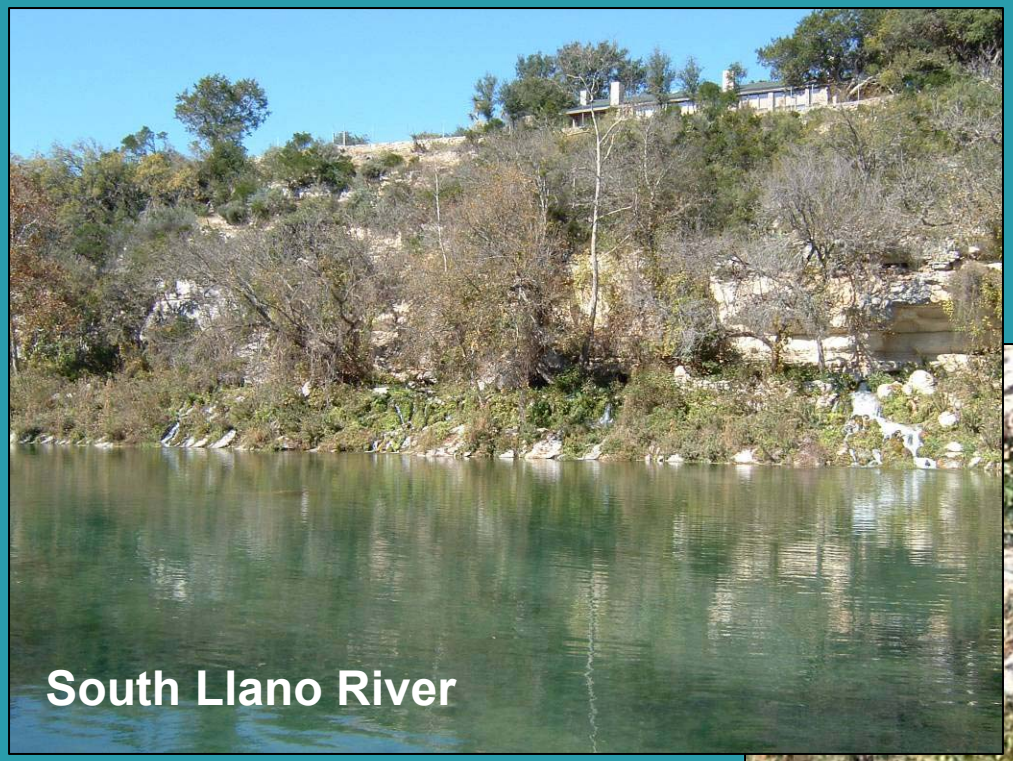
- **DISCRETE VISITS**
  - 08155395 Upper Barton Springs (QW only)
  - 08155501 Eliza Spring (QW only)
  - 08155503 Old Mill Spring (QW only)
  - 08129500 Dove Creek Spring
  - 08143900 Springs at Fort McKavett
  - 08146500 San Saba Springs
  - 08149500 Seven Hundred Springs
  - 08149395 Tanner Springs
  - 08177818 San Antonio Springs
  - 08178090 San Pedro Springs
  - 08425500 Phantom Lake Spring
  - 08427500 San Solomon Spring

Las Moras Springs

Edwards (Balcones Fault Zone) aquifer

Kinney County

Seven Hundred Springs



South Llano River

Edwards-Trinity (Plateau) aquifer

Edwards County

Headwaters of the South Llano River

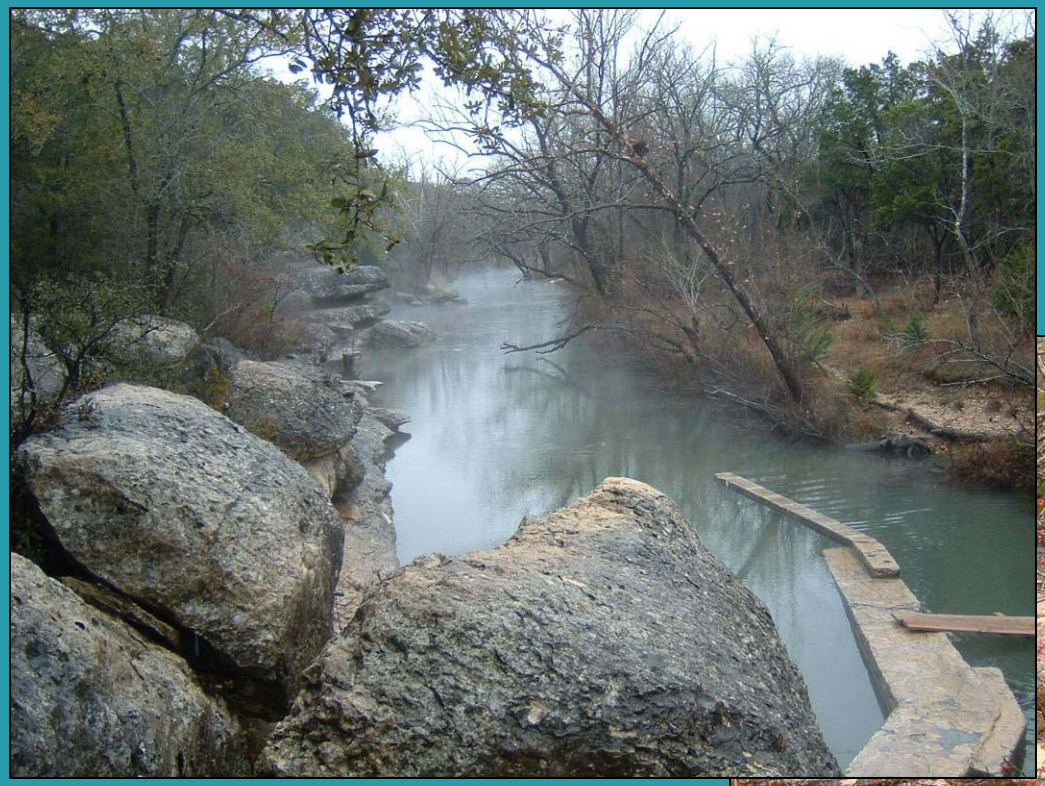
Springs near Fort McKavett

Edwards-Trinity (Plateau) aquifer

Menard County

Headwaters of the San Saba River

Jacobs Well Spring

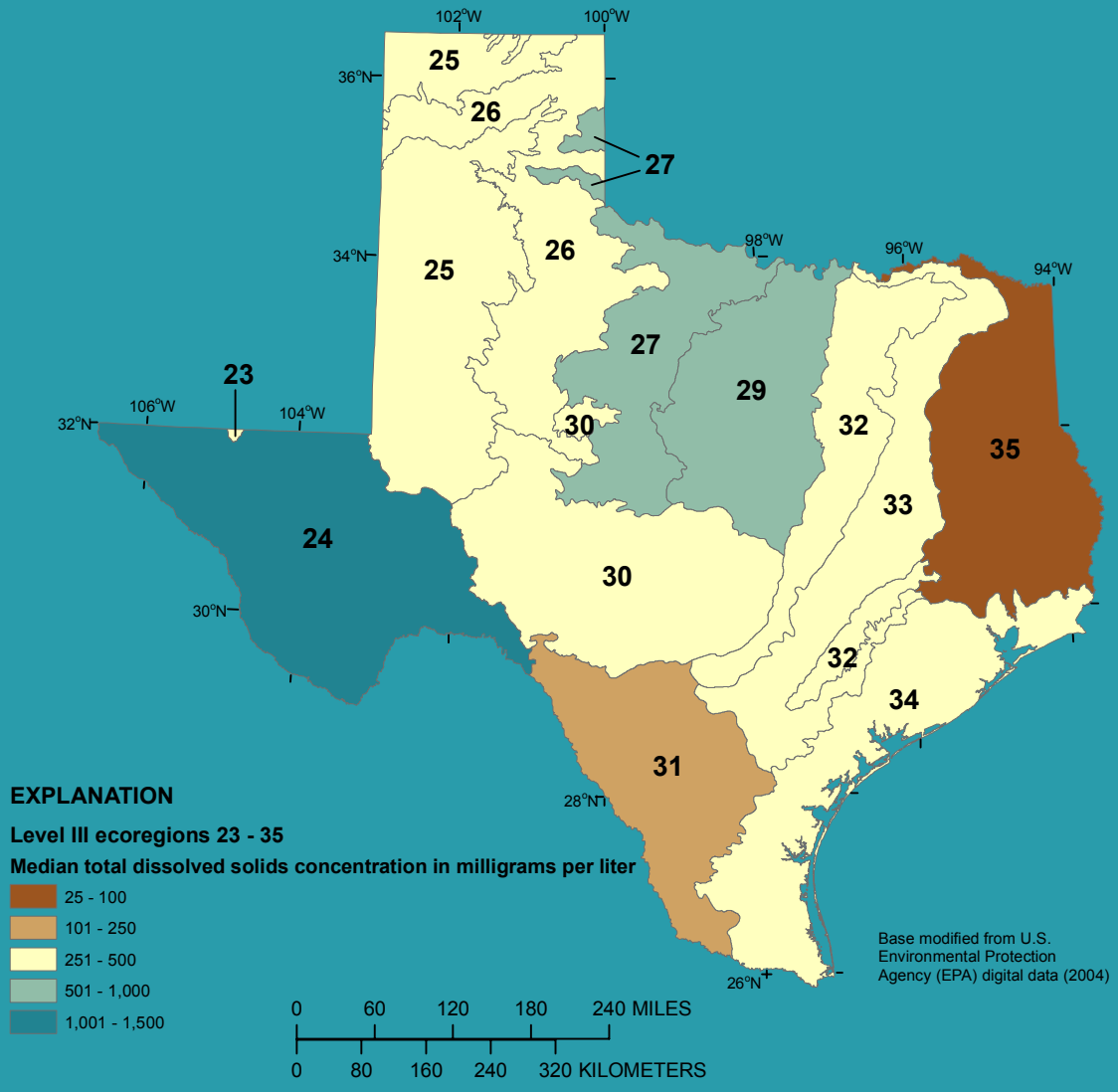


Trinity aquifer

Hays County

Headwaters of Cypress Creek

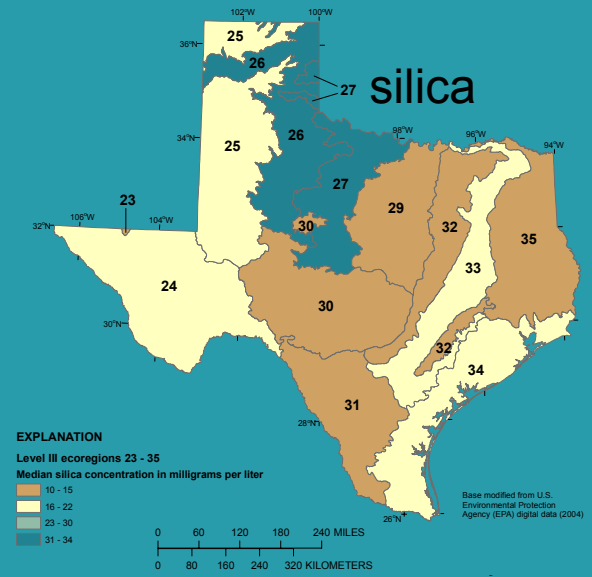
Spring-Water-Quality Synthesis

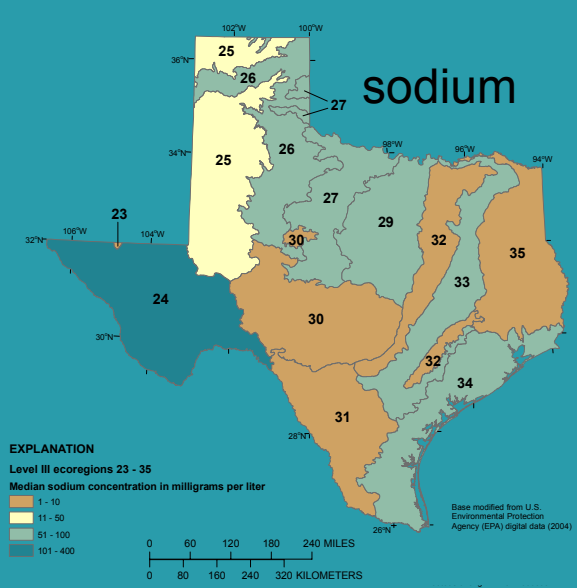


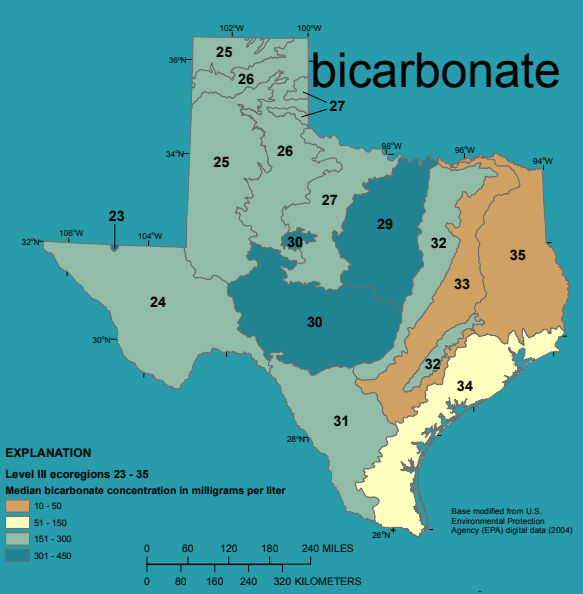
Mean dissolved solids

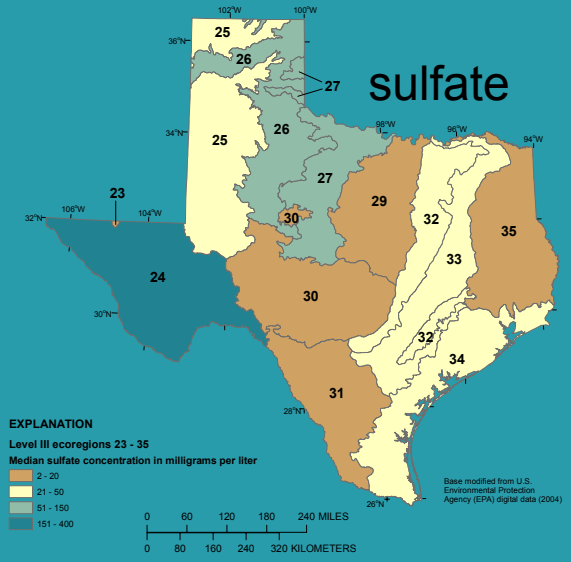
- Low in East Texas (water-bottling companies)
- High in West Texas (long, deep flow paths)

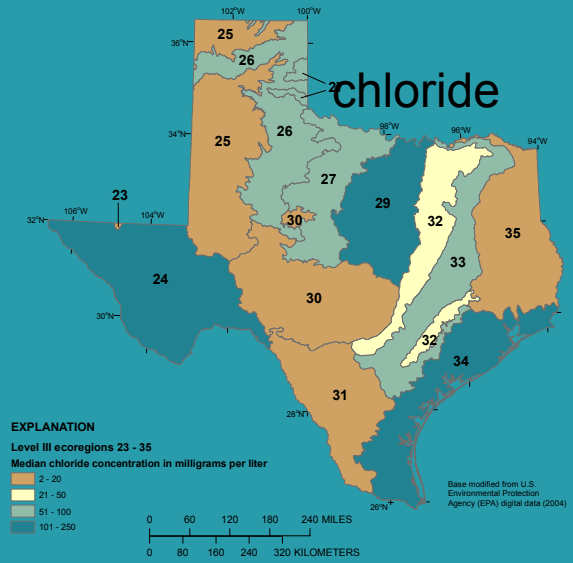
Spring-Water-Quality Synthesis

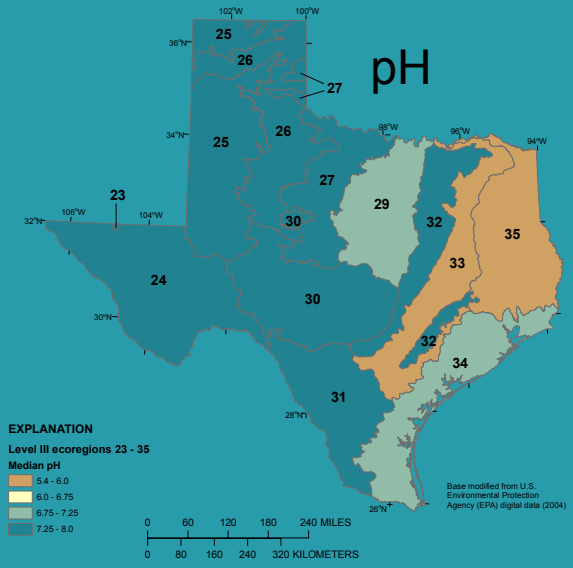












USGS Links for Texas Springs

Real-time streamflow (spring-flow) data:

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

Database (geodatabase) of Texas springs:

http://pubs.water.usgs.gov/ofr03315

Database of water quality for selected Texas springs:

http://pubs.water.usgs.gov/ds230

While you're here today, check out the USGS poster by MaryLynn Musgrove on work at Barton Springs!

THANK YOU ENVIRONMENTAL DEFENSE &

THE LADY BIRD JOHNSON WILDFLOWER CENTER!

Questions?

USGS science for a changing world