Presentation on Four of the Nine Factors for the Explanatory Report as they relate to the Yegua-Jackson Aquifer presented to GMA12

February 19, 2026

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Nine Factors to be Considered

- Aquifer Uses and Conditions
- Hydrologic Conditions
- Environmental Impacts
- Subsidence
- Socioeconomic Impacts
- Private Property Right
- Feasibility
- Needs and Strategies
- Anything else

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Aquifer Uses and Conditions

- Aquifer uses and conditions within the management area, including conditions that differ substantially from one geographic area to another.

Aquifer Uses

- Municipal (public water systems, WSCs, etc…)
- Manufacturing
- Livestock
- Irrigation
- Mining (oil, gas, coal, sand, gravel, others)
- Steam-Electric

Yegua-Jackson Aquifer

- Minor Aquifer
- Present across GMA12
- Moderate historic use
- Numerous wells that tend to be of shallow to moderate depth
- Not relevant in LPGCD
- DFCs in 2021 for other GCDs

Aquifer Uses

- Primarily produced from wells less than 600 feet deep
- Primarily used for domestic, irrigation, and livestock
- Some municipal, industrial, oil/gas
- Significant users include:
  - Municipal use in Fayette County (La Grange, Schulenburg, Flatonia, Fayette WSC, etc…)
  - Golf course irrigation and some industrial use in BVGCD

2022 TWDB Pumpage Data

Pumping (ac-ft/yr)	Mid-East Texas GCD	Brazos Valley GCD	Post Oak Savannah GCD	Lost Pines GCD	Fayette County GCD
Municipal	108	23	298	27	1,387
Mining	--	--	577	370	601
Livestock	118	220	116	36	154
Irrigation	--	1,270	63	--	181
Total	**226**	**1,513**	**1,054**	**433**	**2,323**

Adopted DFC's for 2021 Joint Planning

Groundwater Conservation District	DFC 2010 through 2069 Average Drawdown (ft)
Mid-East Texas	8
Brazos Valley	67
Post Oak Savannah	61
Lost Pines	--
Fayette	81

-- Declared non-relevant for purposes of joint planning

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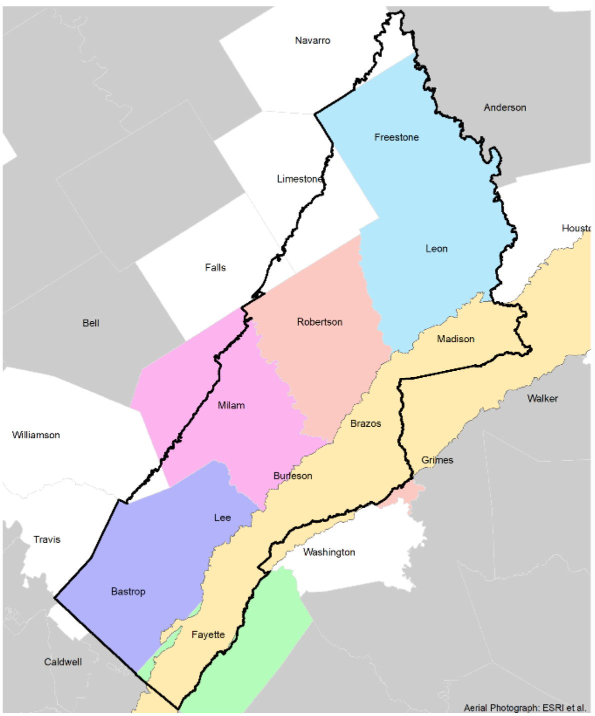
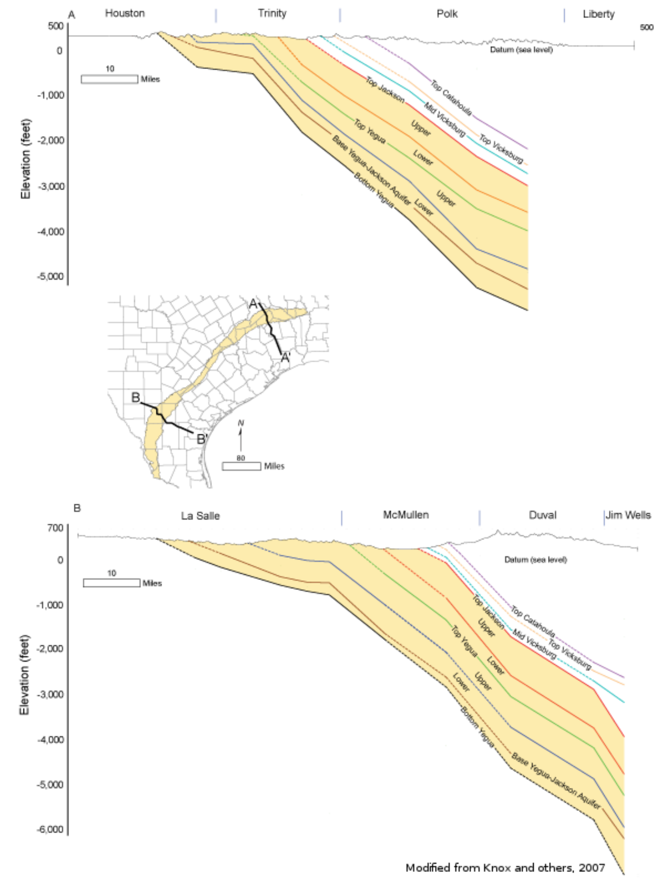
Hydrological Conditions

- Aquifer outcrop extends from NE to SW
- Dip towards the coast





Modified from Knox and others, 2007

https://www.twdb.texas.gov/groundwater/aquifer/minors/yegua-jackson.asp

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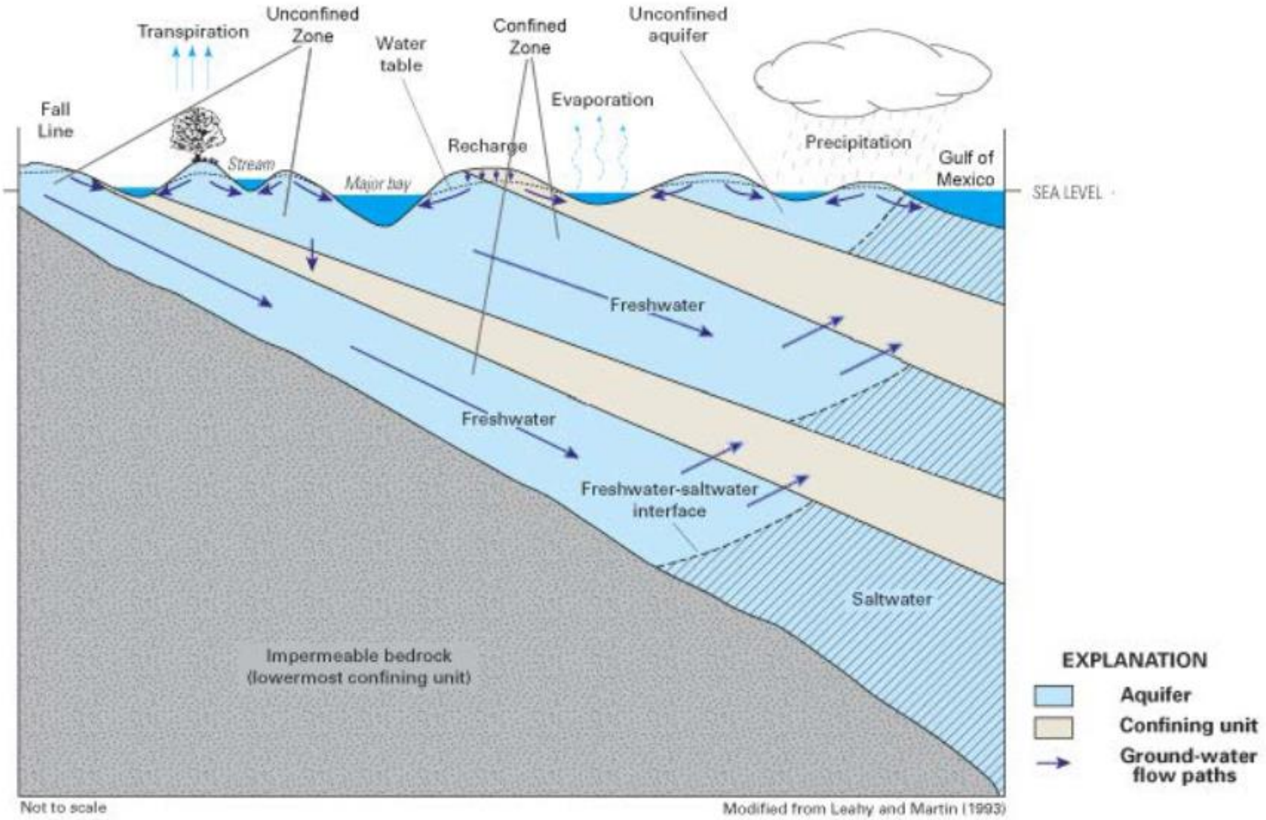
Hydrological Conditions

- Unconfined in outcrop; confined downdip
- Most pumpage and large projects are in the confined section
- Water quality transitions downdip with increase in total dissolved solids content of water
- Faults in areas

Hydrological Conditions

- Unconfined in outcrop; confined downdip



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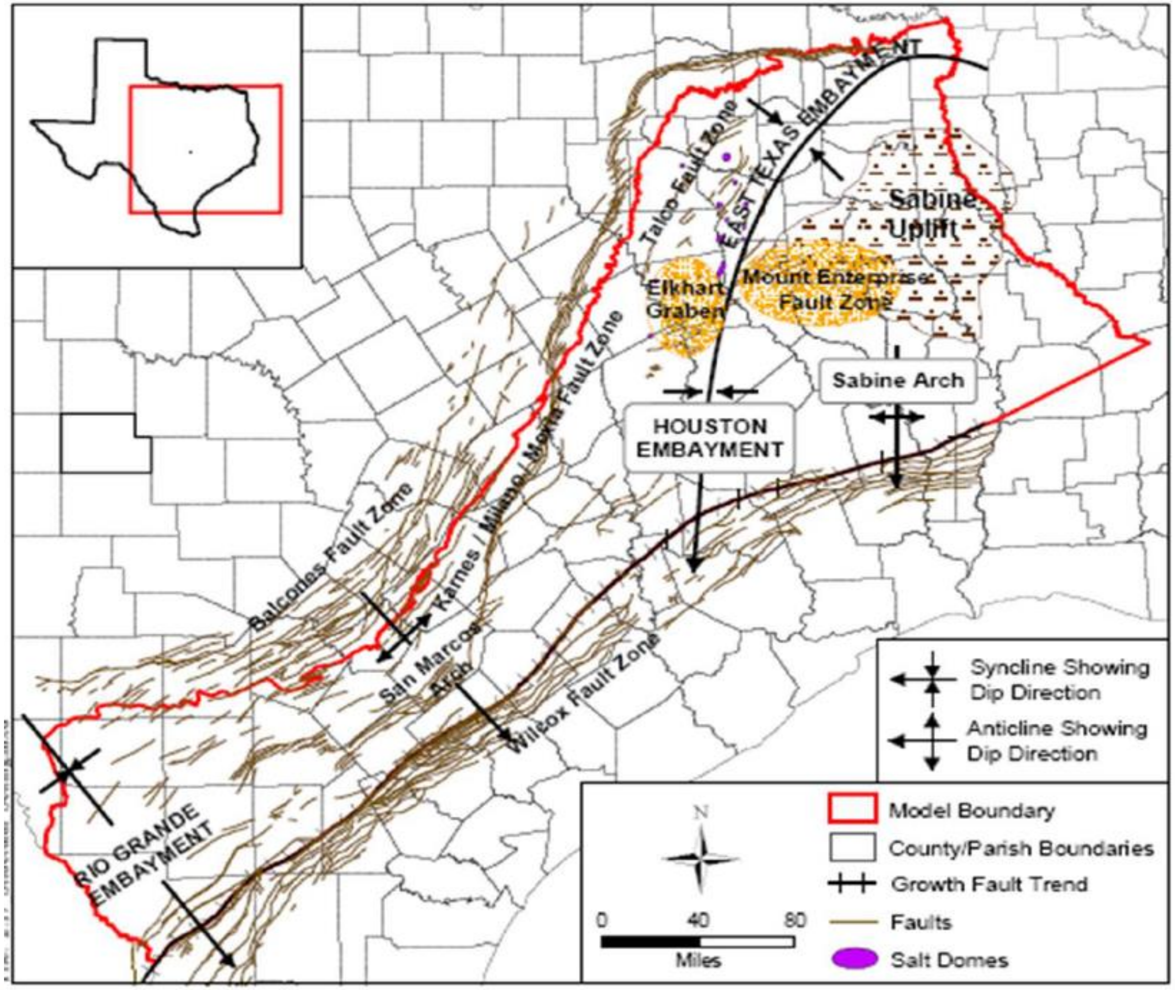
Faults

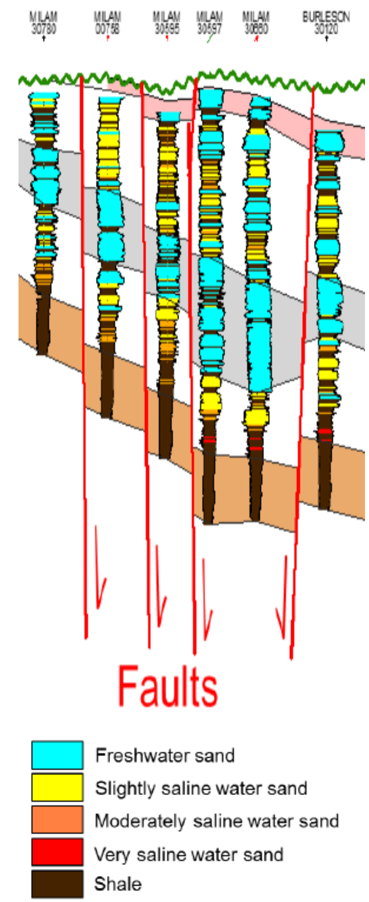
- Impact of faulting on groundwater flow in parts of GMA12 is an important consideration
- Impacts of faults on the flow system were revised in recently updated GAM
- Impacts of faults on groundwater flow much less with updated model compared to previous

Major Fault Zones



Impact of Faults on Groundwater Flow

- Mexia-Talco Fault Zone created after sediments for Sparta, Queen City, and Carrizo-Wilcox Aquifers had been deposited
- Sediment thicknesses should be comparable on both sides of a fault
- Updated model and empirical data show that the effects of faults on groundwater flow not as significant as previously estimated



Yegua-Jackson Conditions

- Water is produced from the Yegua Formation and the Jackson Group and generally treat these together as one aquifer unit
- Groundwater primarily produced from shallow wells, most <1000 feet deep
- Variable water quality due to composition of sediments in the formations
- Fairly consistent aquifer conditions across the extent of the aquifer within GMA12
- Not a highly productive aquifer anywhere within GMA12

Jackson Hydraulic Conductivity

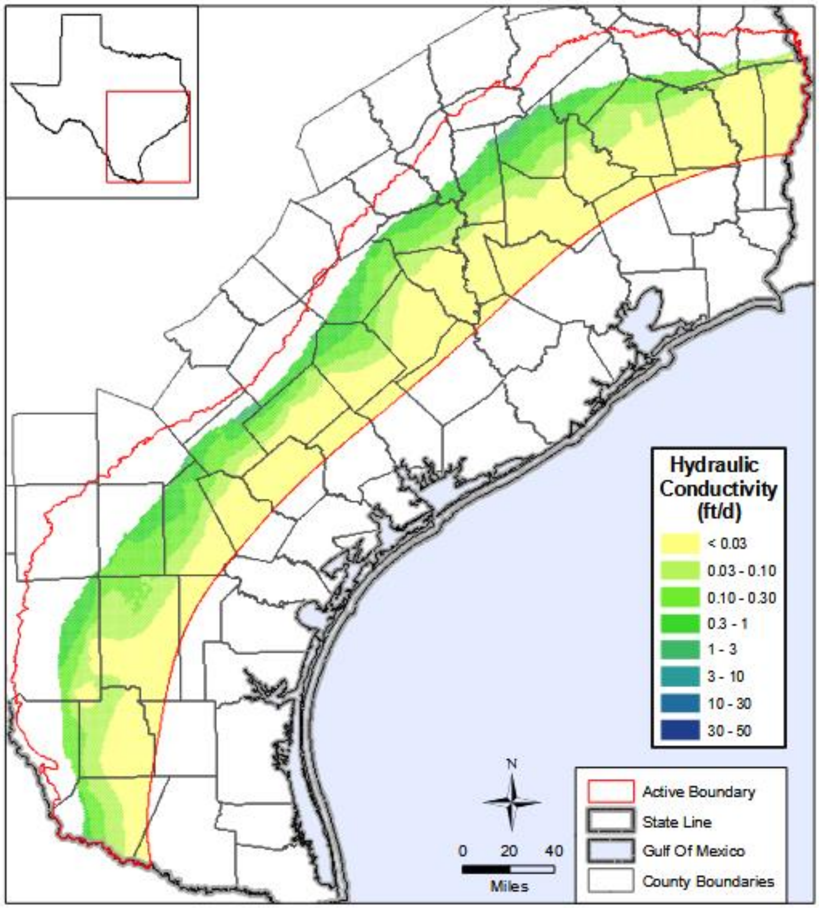


Figure 8.1.2 Horizontal hydraulic conductivity in feet per day of the Upper Jackson Unit subcrop.

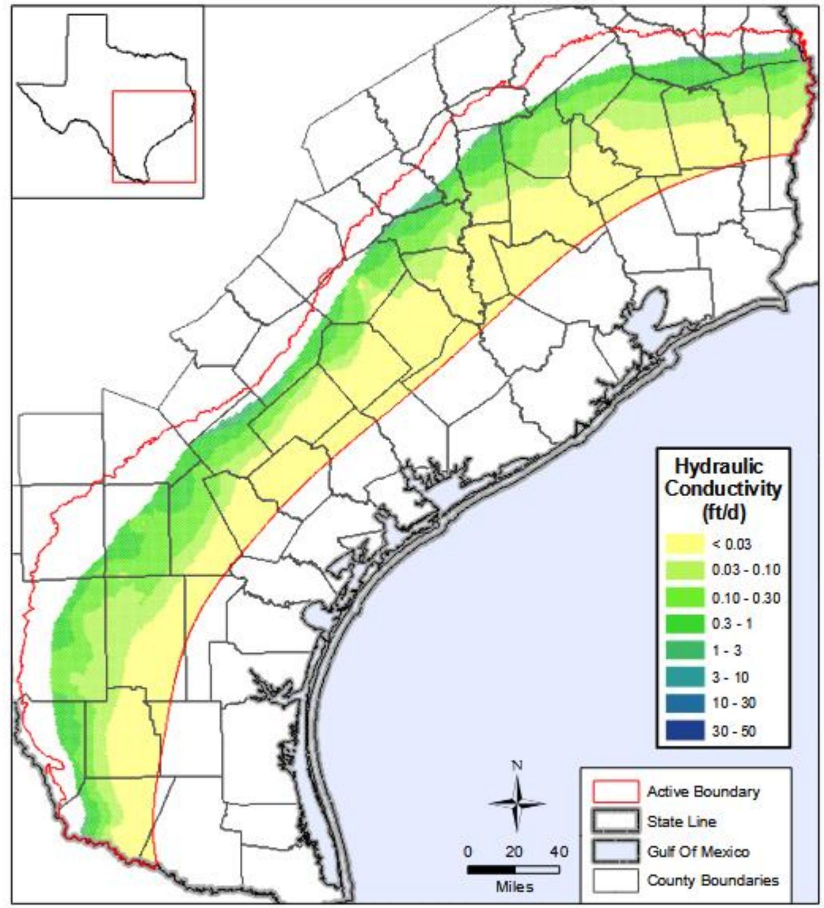


Figure 8.1.3 Horizontal hydraulic conductivity in feet per day of the Lower Jackson Unit subcrop.

Final Report, Groundwater Availability Model for the Yegua-Jackson Aquifer, INTERA, Inc. (2010)

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Yegua Hydraulic Conductivity

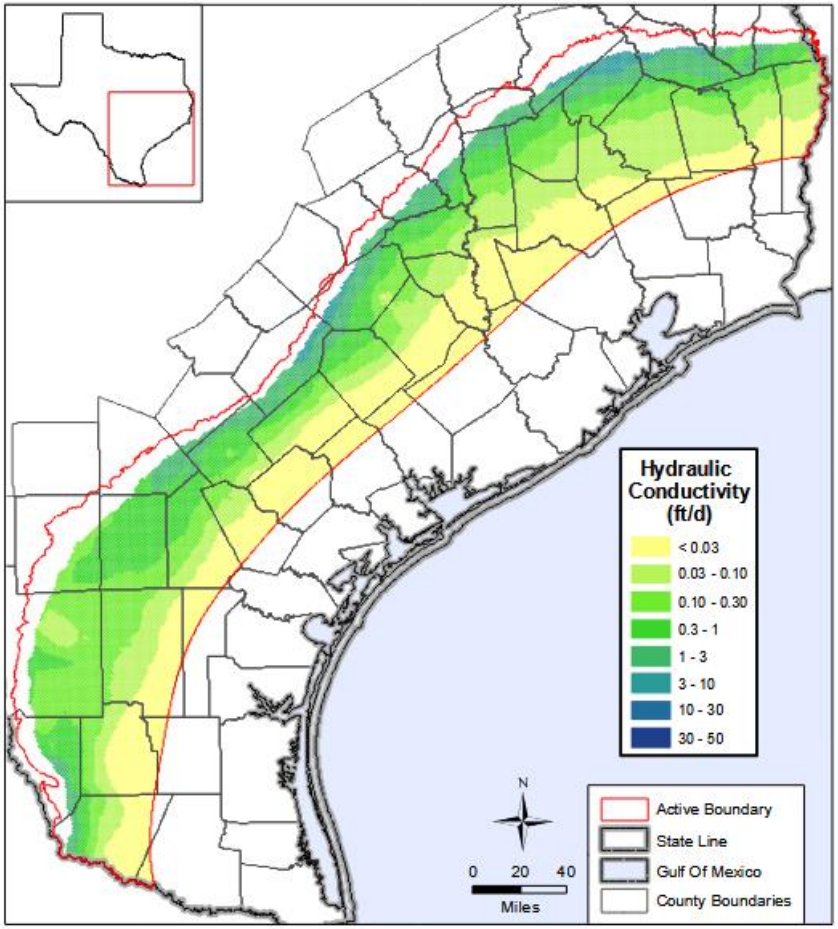


Figure 8.1.4 Horizontal hydraulic conductivity in feet per day of the Upper Yegua Unit subcrop.

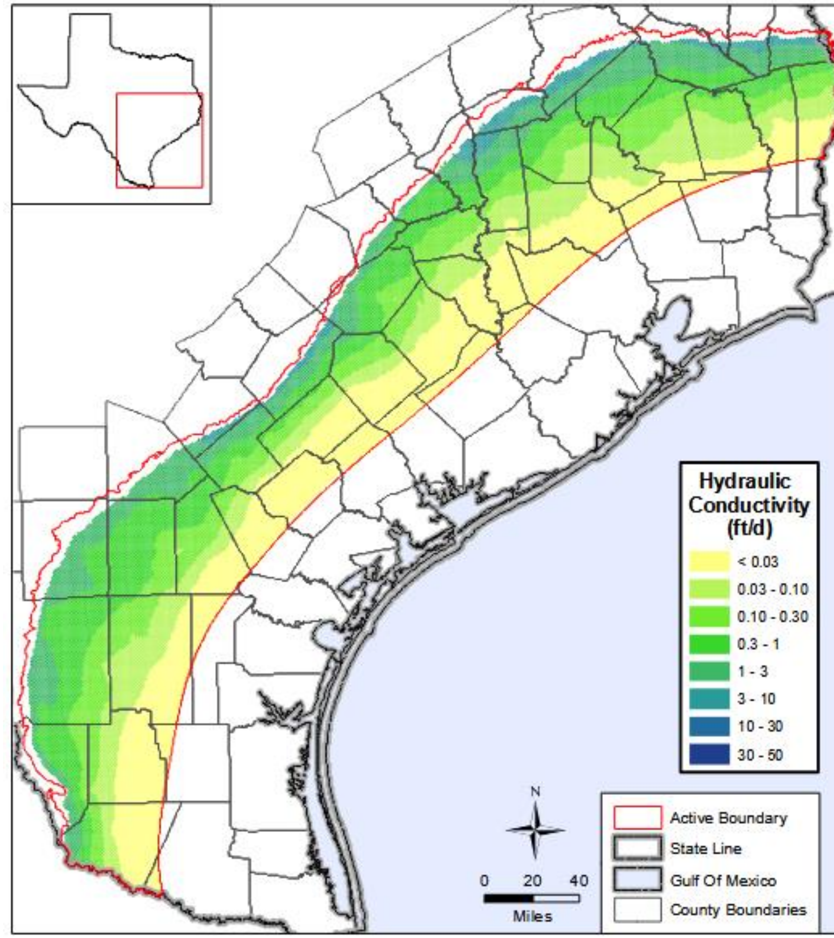


Figure 8.1.5 Horizontal hydraulic conductivity in feet per day of the Lower Yegua Unit subcrop.

Final Report, Groundwater Availability Model for the Yegua-Jackson Aquifer, INTERA, Inc. (2010)

Total Estimated Recoverable Storage (TERS)

- Required to be evaluated as part of the DFC process
- Provided by the TWDB in GAM Task 13-035 Version 2 report dated May 16, 2014
- "Recoverable" is defined as the estimated amount of groundwater that accounts for recovery scenarios that range from 25% to 75% of the total storage
- Total storage = L x W x H x Storage coefficient

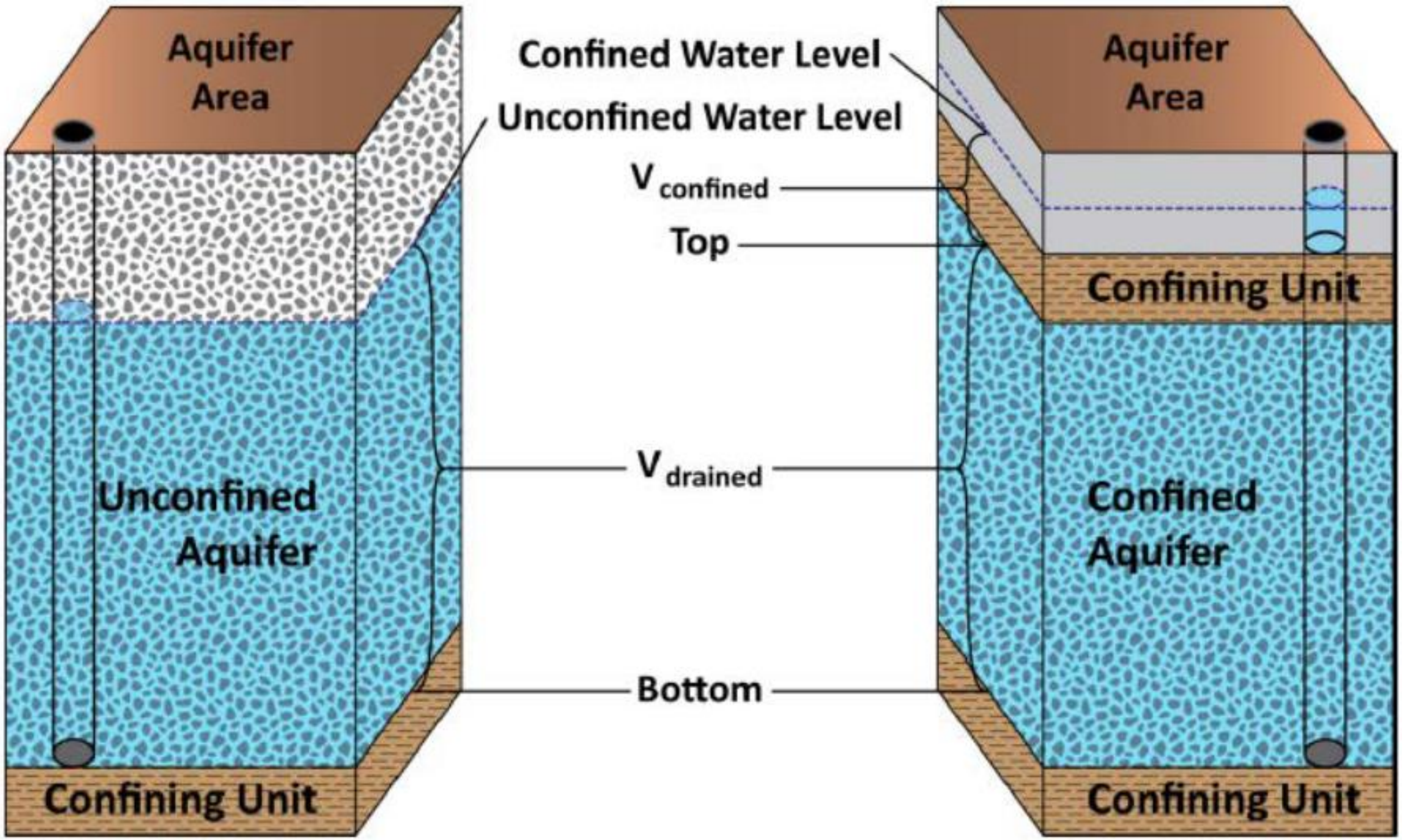


FIGURE 1. SCHEMATIC GRAPH SHOWING THE DIFFERENCE BETWEEN UNCONFINED AND CONFINED AQUIFERS.

TERS

- Estimates have been restricted based on the “official” aquifer extents per the TWDB
- Does not account for subsidence potential
- Does not account for impact on surface water
- Does not account for water quality variations

TERS

- Solely based on how much water is present and how much might be pumped out based on TWDB definition of 25% to 75%
- One-size-fits-all definition of “recoverable”. How much is actually recoverable may vary based on aquifer type
- Vast majority of water is stored in confined area of the Yegua-Jackson aquifer in GMA12

Yegua-Jackson Aquifer TERS by County

County	Total Storage (acre-feet)	25 percent of Total Storage (acre-feet)	75 percent of Total Storage (acre-feet)
Bastrop	290,000	72,500	217,500
Brazos	30,000,000	7,500,000	22,500,000
Burleson	27,000,000	6,750,000	20,250,000
Fayette	27,000,000	6,750,000	20,250,000
Lee	10,000,000	2,500,000	7,500,000
Leon	76,000	19,000	57,000
Madison	15,000,000	3,750,000	11,250,000
Total	109,366,000	27,341,500	82,024,500

Source: TWDB GAM Task 13-035 Report (Wade and Shi, 2013)

Yegua-Jackson Aquifer TERS by GCD

Groundwater Conservation District (GCD)	Total Storage (acre-feet)	25percent of Total Storage (acre-feet)	75percent of Total Storage (acre-feet)
Brazos Valley GCD	30,000,000	7,500,000	22,500,000
Fayette County GCD	27,000,000	6,750,000	20,250,000
Lost Pines GCD	10,000,000	2,500,000	7,500,000
Mid-East Texas GCD	15,000,000	3,750,000	11,250,000
Post Oak Savannah GCD	27,000,000	6,750,000	20,250,000
Total	109,000,000	27,250,000	81,750,000

Source: TWDB GAM Task 13-035 Report (Wade and Shi, 2013)

Annual Recharge, Inflows, and Discharge

- Provided by the TWDB in GAM Run reports in support of management plan development
- Fayette County GCD = GAM Run 23-008
- Lost Pines GCD = GAM Run 22-008
- Post Oak Savannah GCD = GAM Run 22-007
- Brazos Valley GCD = GAM Run 23-009
- Mid-East Texas GCD = GAM Run 24-001

Fayette County GCD

Management plan requirement	*Aquifer or confining unit*	*Results*
Estimated annual amount of recharge from precipitation to the district	Yegua-Jackson Aquifer	47,175
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Yegua-Jackson Aquifer	59,160
Estimated annual volume of flow into the district within each aquifer in the district	Yegua-Jackson Aquifer	10,032
Estimated annual volume of flow out of the district within each aquifer in the district	Yegua-Jackson Aquifer	7,063
Estimated net annual volume of flow between each aquifer in the district	From Yegua-Jackson Aquifer to Gulf Coast Aquifer	18
	From Yegua-Jackson Aquifer to Yegua-Jackson equivalent units	192

Lost Pines GCD

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Yegua-Jackson Aquifer	38,860
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Yegua-Jackson Aquifer	35,781
Estimated annual volume of flow into the district within each aquifer in the district	Yegua-Jackson Aquifer	5,882
Estimated annual volume of flow out of the district within each aquifer in the district	Yegua-Jackson Aquifer	10,154
The model assumes a no-flow boundary at the base of the Yegua-Jackson Aquifer.		

Post Oak Savannah GCD

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Yegua-Jackson Aquifer	22,416
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers.	Yegua-Jackson Aquifer	12,860
Estimated annual volume of flow into the district within each aquifer in the district	Yegua-Jackson Aquifer	3,922
Estimated annual volume of flow out of the district within each aquifer in the district	Yegua-Jackson Aquifer	8,624
Estimated net annual volume of flow between each aquifer in the district	To Yegua-Jackson Aquifer from younger units	69
	To the Yegua-Jackson Aquifer from Yegua-Jackson equivalent units	56
	To the Yegua-Jackson Aquifer from underlying units	Not applicable[1]

[1] The model assumes a no-flow boundary at the base.

Brazos Valley GCD

Management plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Yegua-Jackson Aquifer	26,560
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Yegua-Jackson Aquifer	42,656
Estimated annual volume of flow into the district within each aquifer in the district	Yegua-Jackson Aquifer	12,578
Estimated annual volume of flow out of the district within each aquifer in the district	Yegua-Jackson Aquifer	7,122
Estimated net annual volume of flow between each aquifer in the district	To Yegua-Jackson Aquifer from Yegua-Jackson equivalent units	134
	To Yegua-Jackson Aquifer from the Gulf Coast Aquifer System	17
	From Yegua-Jackson Aquifer to Brazos River Alluvium Aquifer*	2,431

* Estimated from the groundwater availability model for the Brazos River Alluvium Aquifer.

Mid-East Texas GCD

Management plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Yegua-Jackson Aquifer	31,108
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Yegua-Jackson Aquifer	43,985
Estimated annual volume of flow into the district within each aquifer in the district	Yegua-Jackson Aquifer	12,950
Estimated annual volume of flow out of the district within each aquifer in the district	Yegua-Jackson Aquifer	10,455
Estimated net annual volume of flow between each aquifer in the district	Not applicable	Not applicable

Nine Factors to be Considered

- Aquifer Uses and Conditions
- Hydrologic Conditions
- **Environmental Impacts**
- Subsidence
- Socioeconomic Impacts
- Private Property Right
- Feasibility
- Needs and Strategies
- Anything else

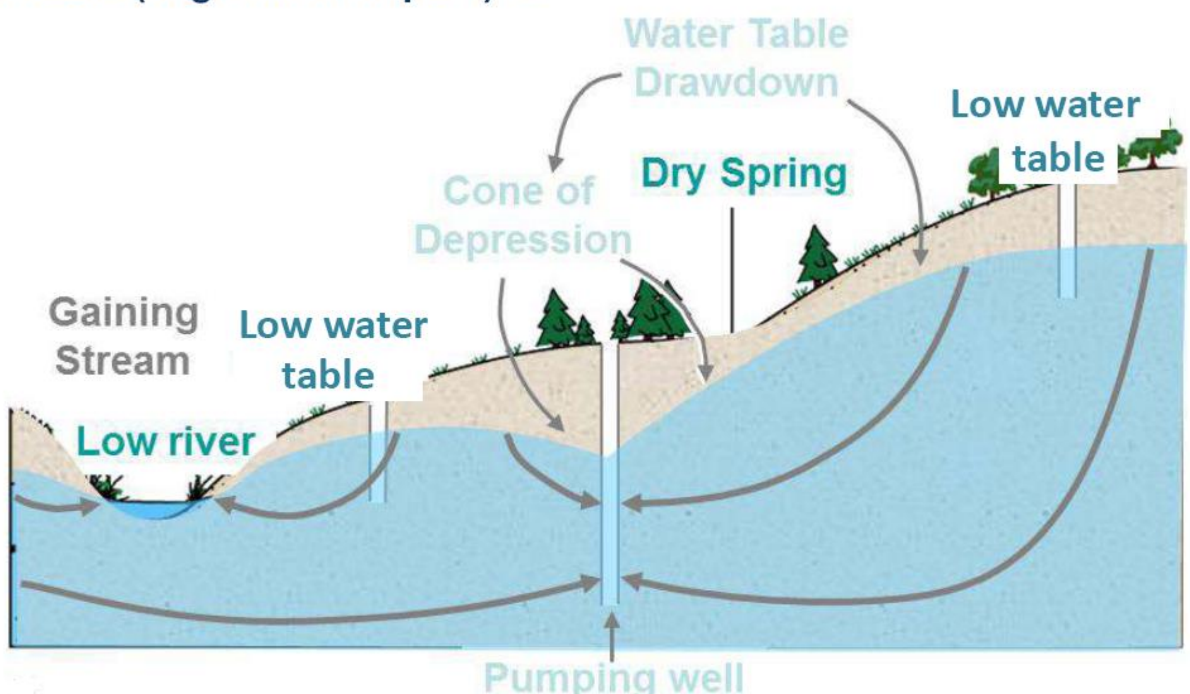
Environmental Impacts Considerations

- Introduction to Shallow Groundwater Flow Systems
  - Springs
  - GW-SW interaction
- Springs in GMA 12
- Summary of Environmental Issues or Topic

Environmental Impacts from Pumping

- Reduced flows to rivers
- Withdrawal from rivers (losing streams)
- Reduced spring flows
- Dried springs
- Lowered water table (vegetation impact)

Caused by lower of water levels



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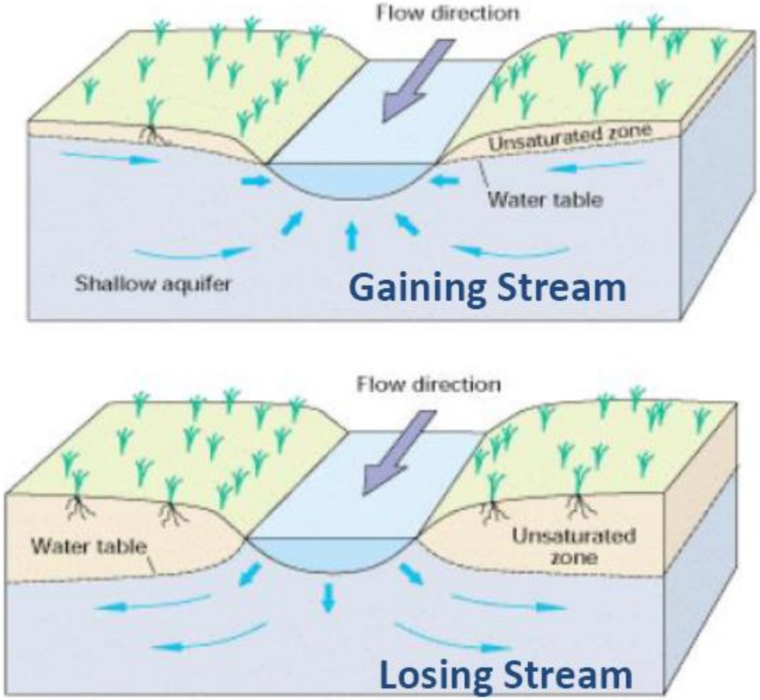
Gaining and Losing Streams

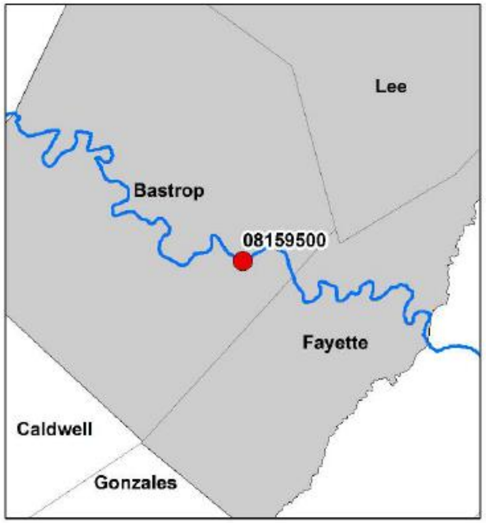


USGS Circular 1186, 1999

- Gaining:
  - Net discharge of groundwater to surface water "base flow"
- Losing:
  - Net discharge of surface water to groundwater "recharge"

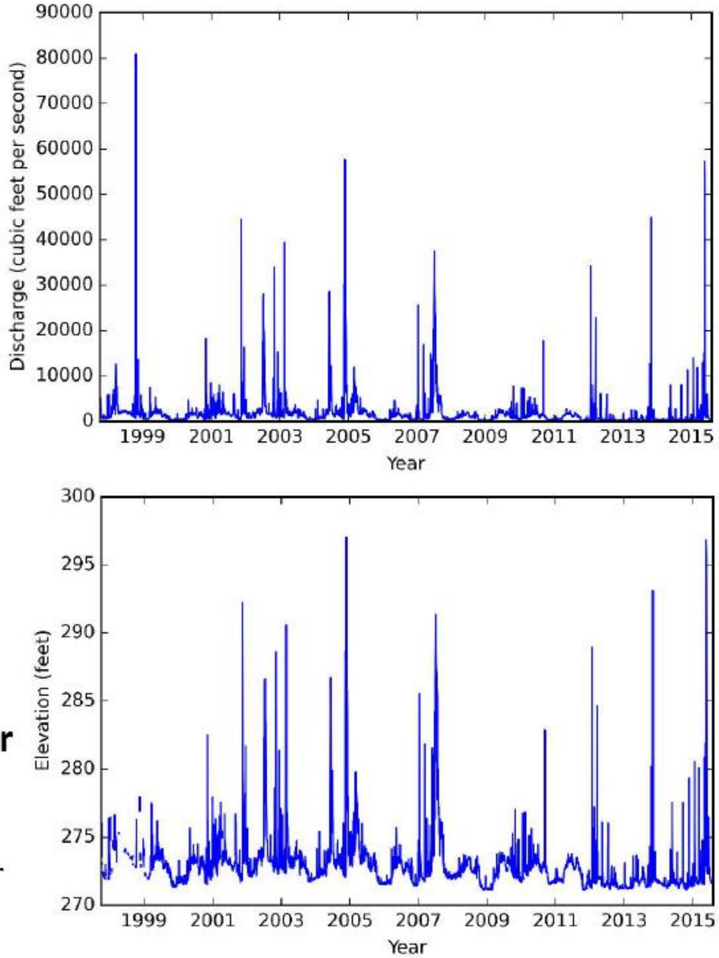
The TCEQ rules define baseflow as "*[t]he portion of streamflow uninfluenced by recent rainfall or flood runoff and is comprised of springflow, seepage, discharge from artesian wells or other groundwater sources, and the delayed drainage of large lakes and swamps.*

Stream Data from the Colorado River

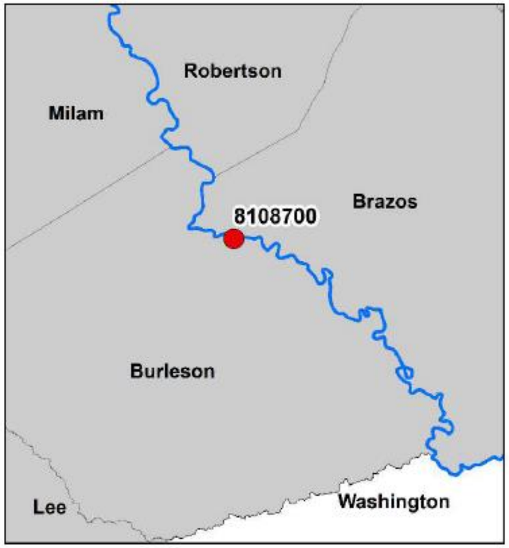


Example Gage on Colorado River

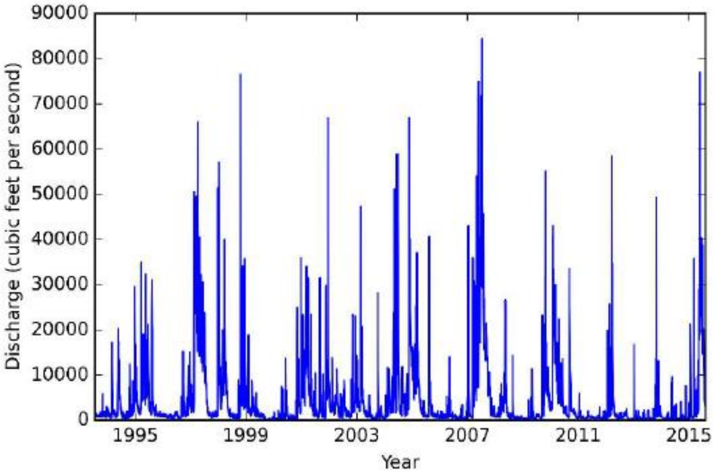
Average annual flow is 1.4 million acre-ft/yr
(~ 1,900 cfs)

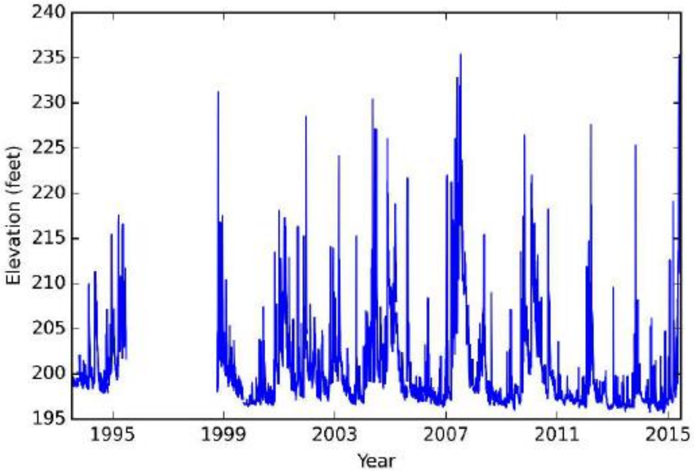


Stream Data from the Brazos River



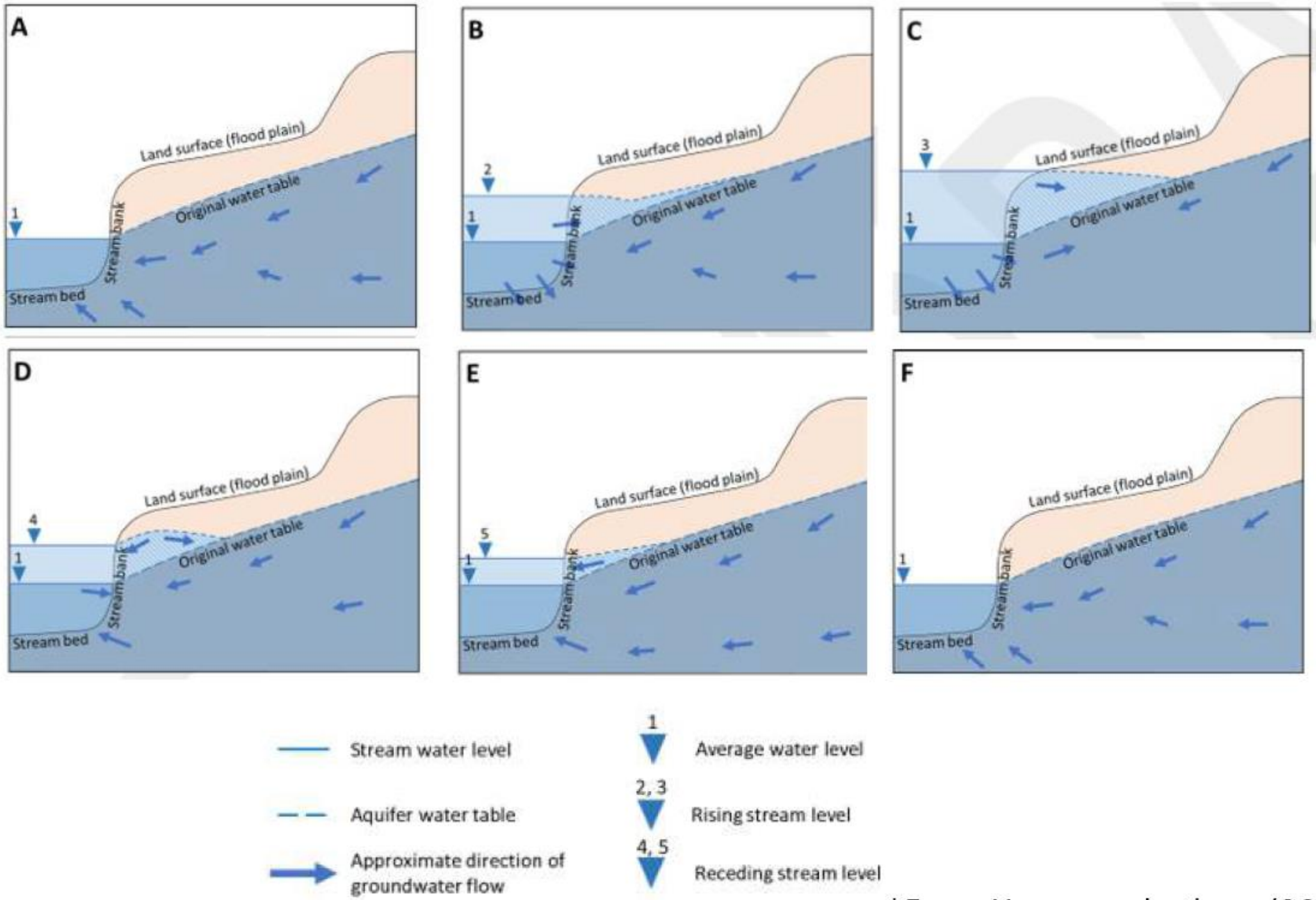
Example Gage on Brazos River





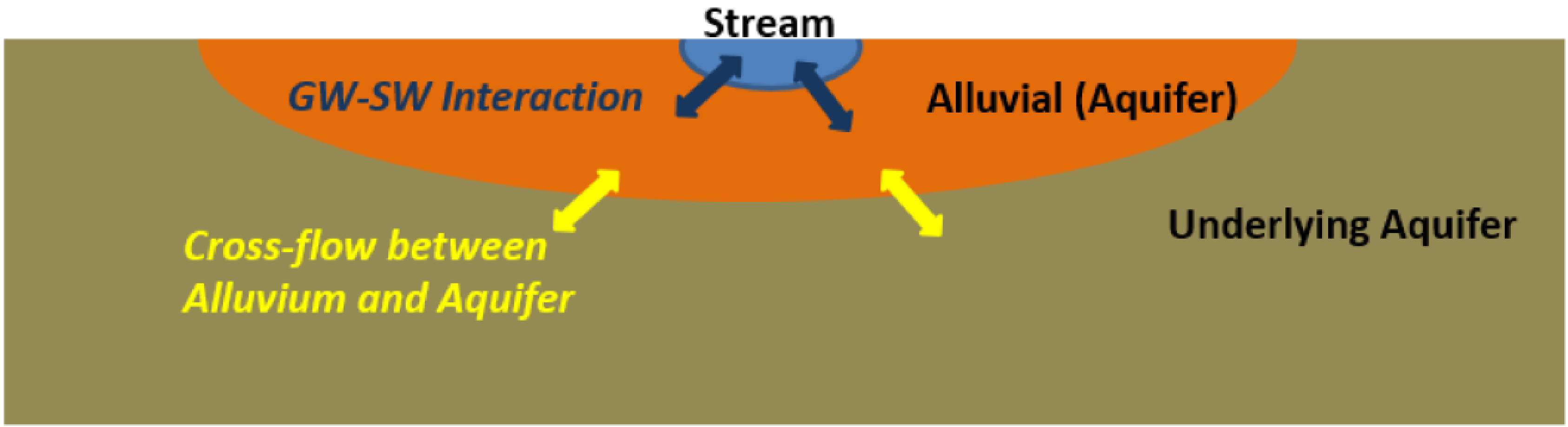
Average annual flow is 3.5 million acre-ft/yr
(~ 4,890 cfs)

Schematic of Processes Affecting Bank Storage and Bank Flow



*From Young and others (2017)

Water Budget for GW-SW Exchange that is Simulated by the GAMs



GW-SW Interaction

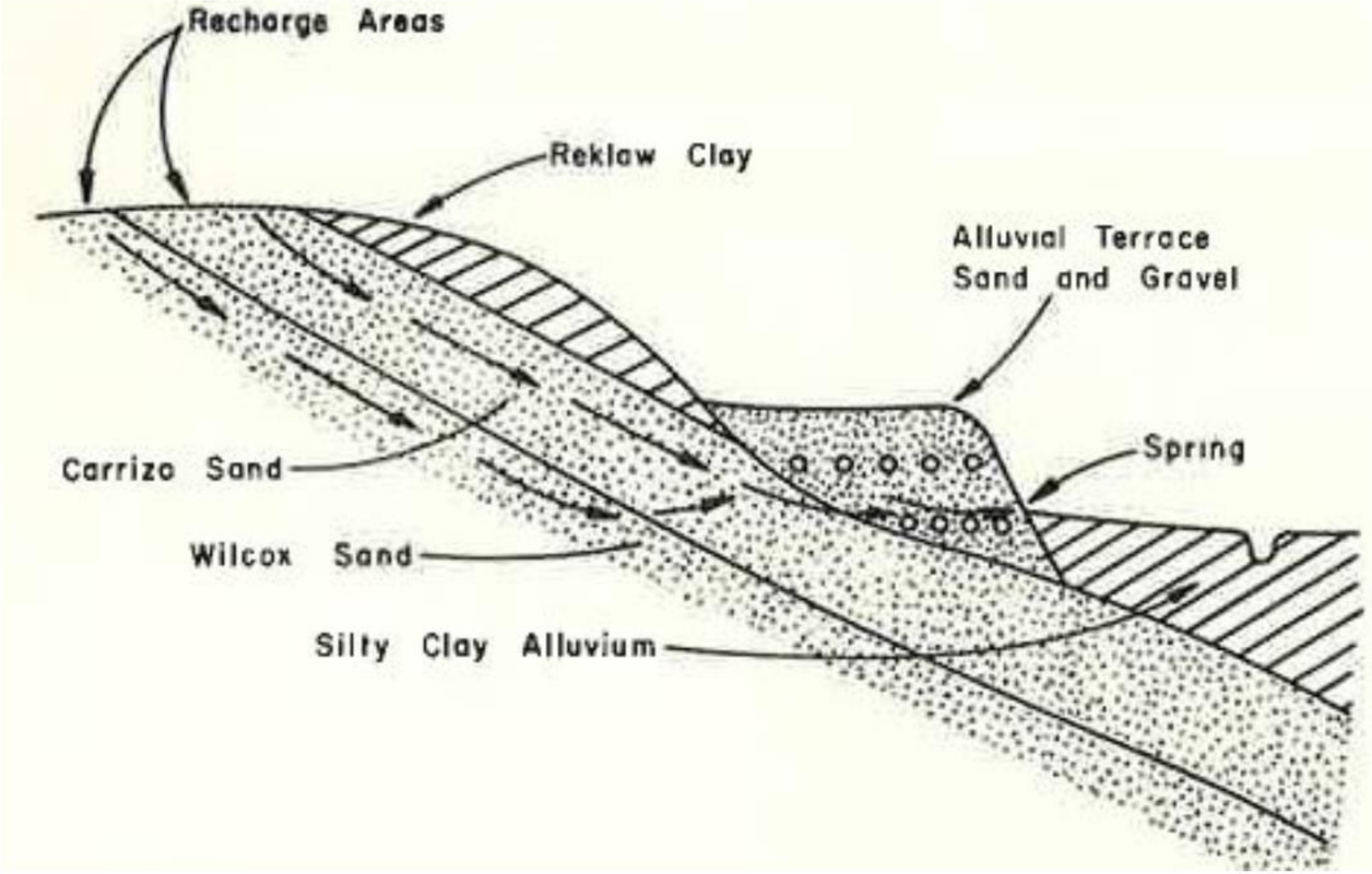
Flow from Aquifer to Stream is Negative
Flow From Stream to Aquifer is Positive

Positive Net Flow Stream Flow = Losing Stream
Negative Net Flow Stream Flow = Gaining Stream

Requirements for Springs

- Aquifer to deliver water to a spring
- Sufficiently large recharge area
- Sufficient hydraulic pressure gradient between recharge and discharge area to cause flow
- Water table intersected by ground surface

Schematic for Spring/Seep in GMA12

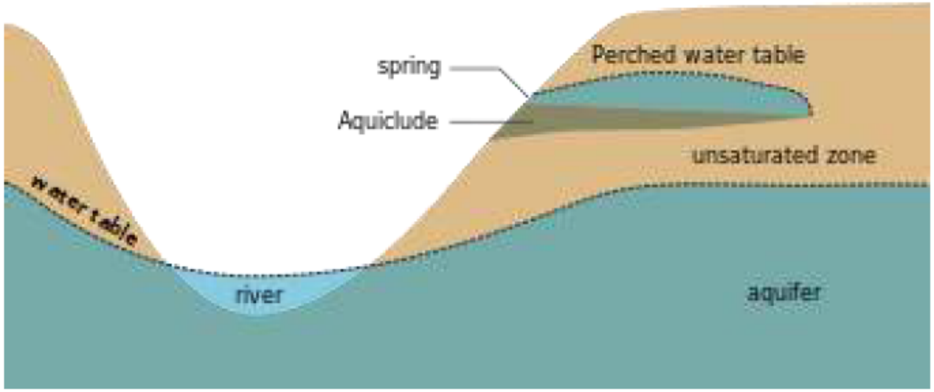


Schematic of a spring in Carrizo-Wilcox sand and terrace sand and gravel (1981, Brune)

Spring/Seep Associated with Perched Water Table

A perched water table is a water-bearing unit that occurs above the regional water table, in the unsaturated zone where there is an impermeable layer of sediment (aquiclude) above the main water table/aquifer.

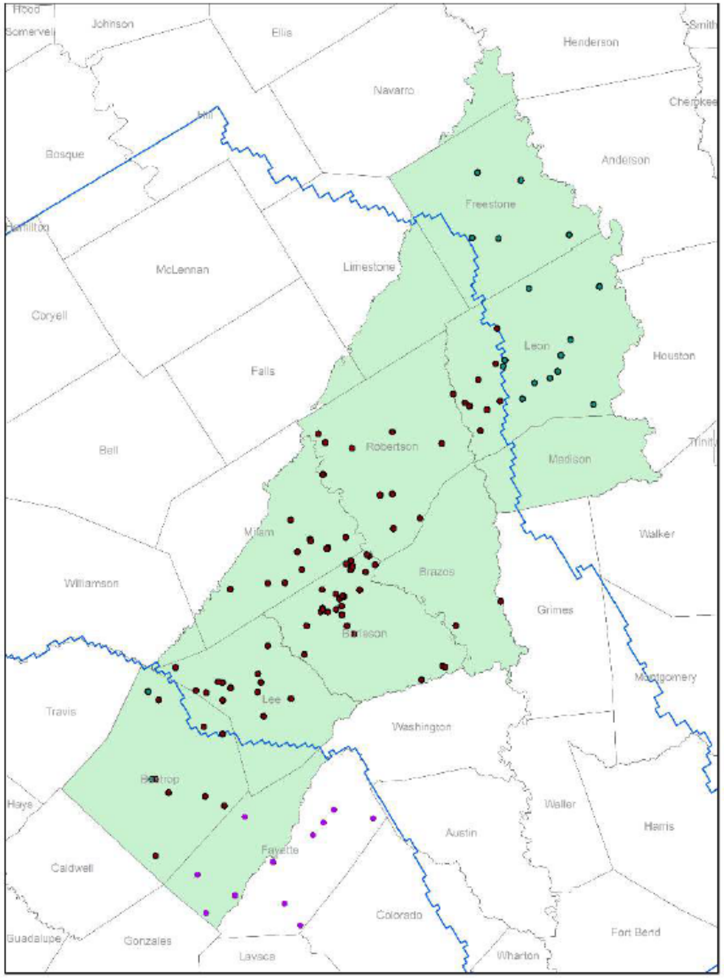
If a perched aquifer's flow intersects the Earth's dry surface, at a valley wall for example, the water is discharged as a spring



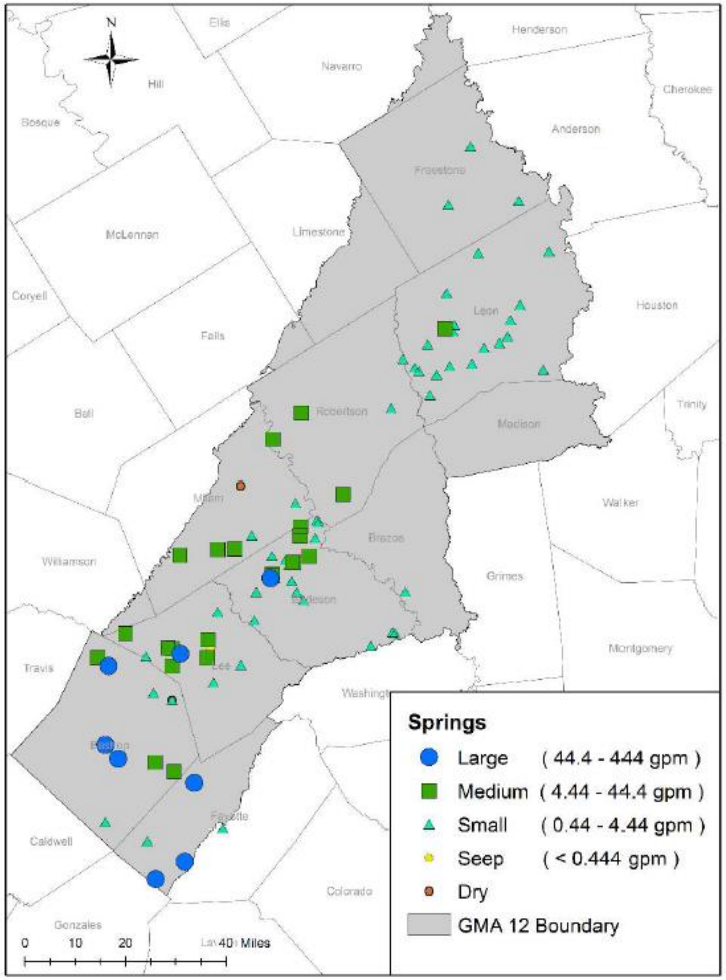
Schematic of a spring connected to a perched water table (2015,https://en.wikipedia.org/wiki/Water_table)

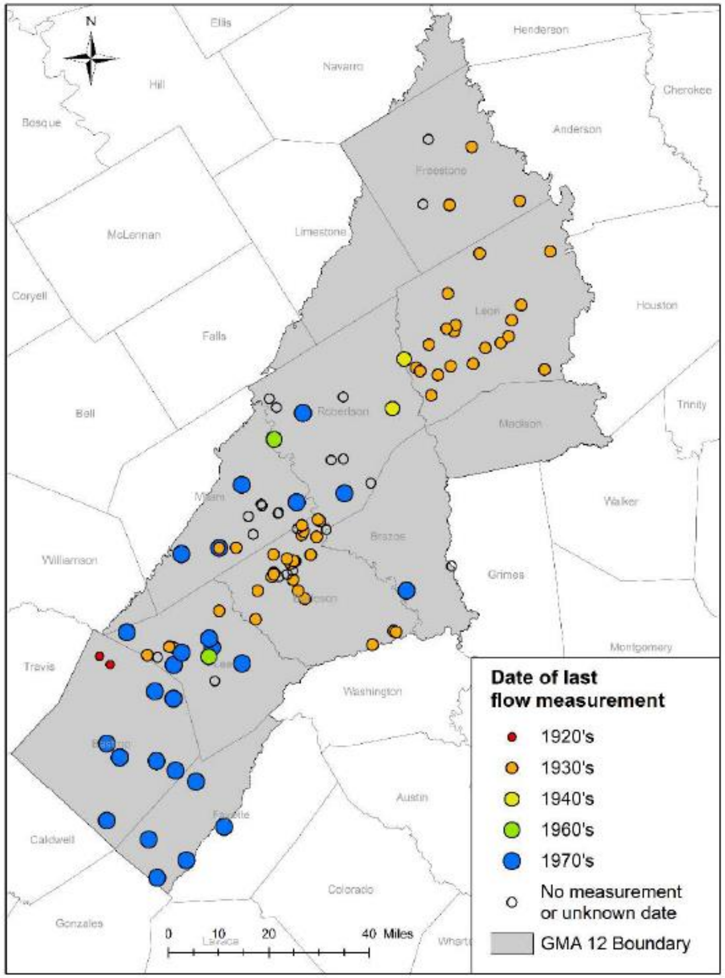
Identified Springs in GMA12

- Sources
  - Springs of Texas, Volume 1 (2002, Brune)
  - Database of historically documented springs and spring flow measurements in Texas(2003, Heitmuller and Reece)
  - No springs identified in GMA 12 that are tied to endangered species
  - TWDB Groundwater Database (March, 2014)



Identified Springs in GMA12 (cont.)





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Summary of Key Environmental Issues

- Spring flow and GW-SW interaction are two potential environmental issues of interest in GMA 12
- Springs typically controlled by local site-specific topographic, hydrologic, and geological conditions
- GW-SW interactions largely controlled by local hydraulic gradients over time scales of hours to days and in the immediately vicinity of stream/aquifer contact
- Collection of representative data on GW-SW interaction and spring flow is time consuming, relatively expensive, and difficult to perform. Very limited data exists in GMA 12.

Summary continued…

- River authorities are currently managing in-stream flows in Colorado and Brazos rivers
- River gauge hydrographs from Instream Flow program do not quantify GW flow
- Groundwater flow into streams can be an important contributor for helping river authorities maintain critical or subsistence flows

Summary of Measured Spring Flows

- Extremely limited spring flow data collected since 1970s
- GMA12 GAMs are not suitable for quantitative analysis for specific springs or for GW-SW exchange

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- Aquifer Uses and Conditions
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- Environmental Impacts
- Subsidence
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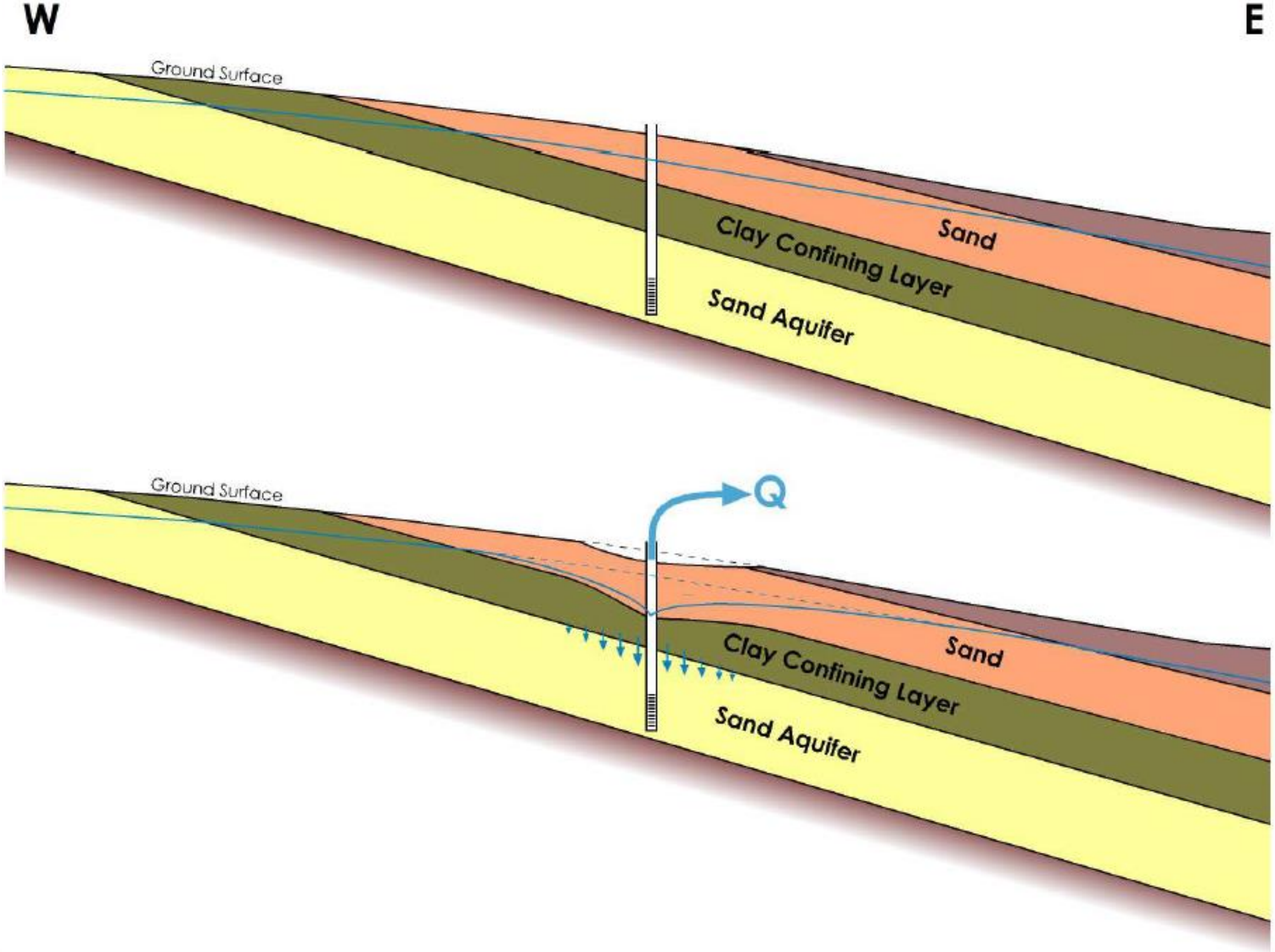
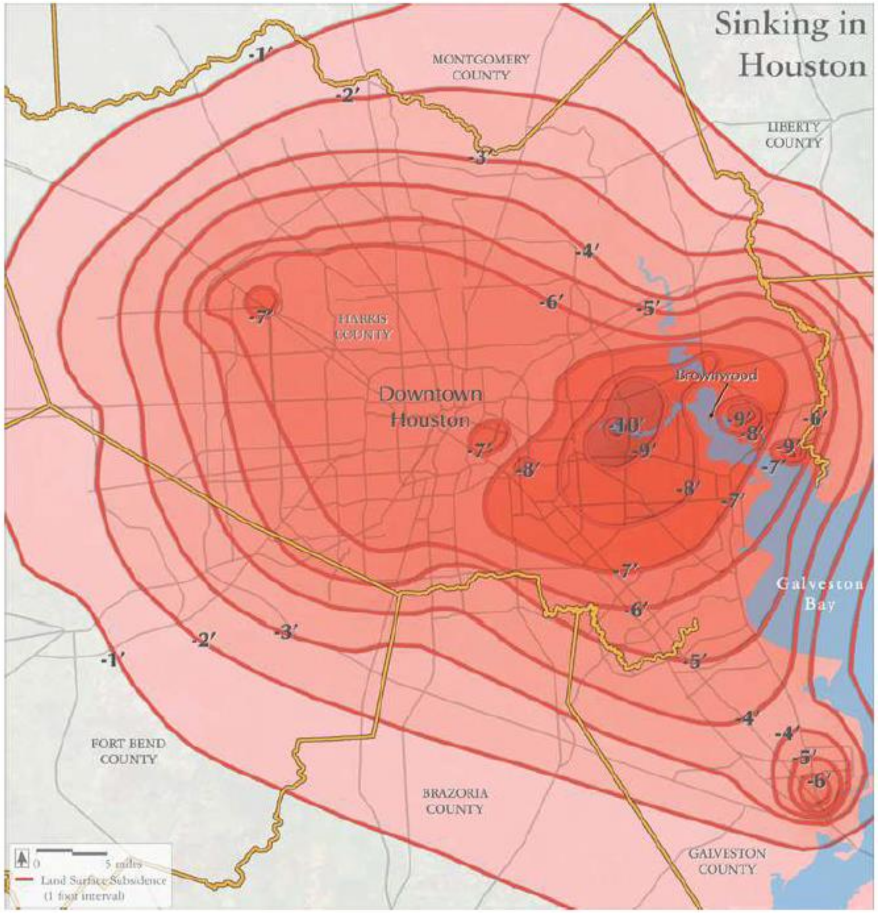
Pumping-Induced Subsidence



Subsidence in Texas

- Considerable subsidence has been observed in Harris and Galveston counties
- *No measurable subsidence observed within GMA12*
- Function of depositional setting and relative age of sediments
  - Gulf Coast (1-4 MY) still “inflated” with water
  - Yegua-Jackson clays (34+ MY) already compacted



Conclusions for Yegua-Jackson

- No observed historic subsidence
- Low risk of future subsidence

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Modeled Average Drawdown

GCD	Average Drawdown		
	Last Round (Current DFC)	AGS Calc for Last Round 2010-2069	AGS Calc for Current Round 2010-2079
Fayette	81	81	83
Brazos Valley	67	67	68
Mid-East Texas	8	8	9
Post Oak	61	61	60

END