# GMA 12

# Hydrological Conditions Consideration Discussion

by

*GMA 12 Consultant Team*

*Daniel B. Stephens & Associates*

*Intera*

*W. John Seifert*

*January 29, 2020*

# TWC Section 36.108 (d)

- Before voting on the proposed desired future conditions … the districts shall consider:
  - Aquifer uses and conditions
  - Needs and strategies
  - **Hydrologic conditions**
  - Environmental impacts
  - Subsidence
  - Socioeconomic impacts
  - Private property rights
  - Feasibility
  - Anything else

# TWC Section 36.108 (d-2)

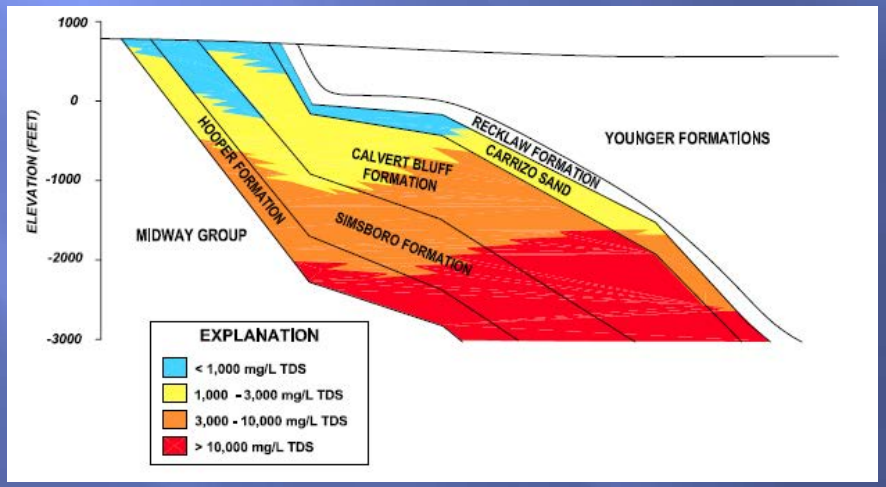
- The desired future conditions … must provide a balance between the highest practicable level of groundwater production and the conservation, preservation, protection, recharging, and prevention of waste of groundwater … in the management area.

# Consideration 3

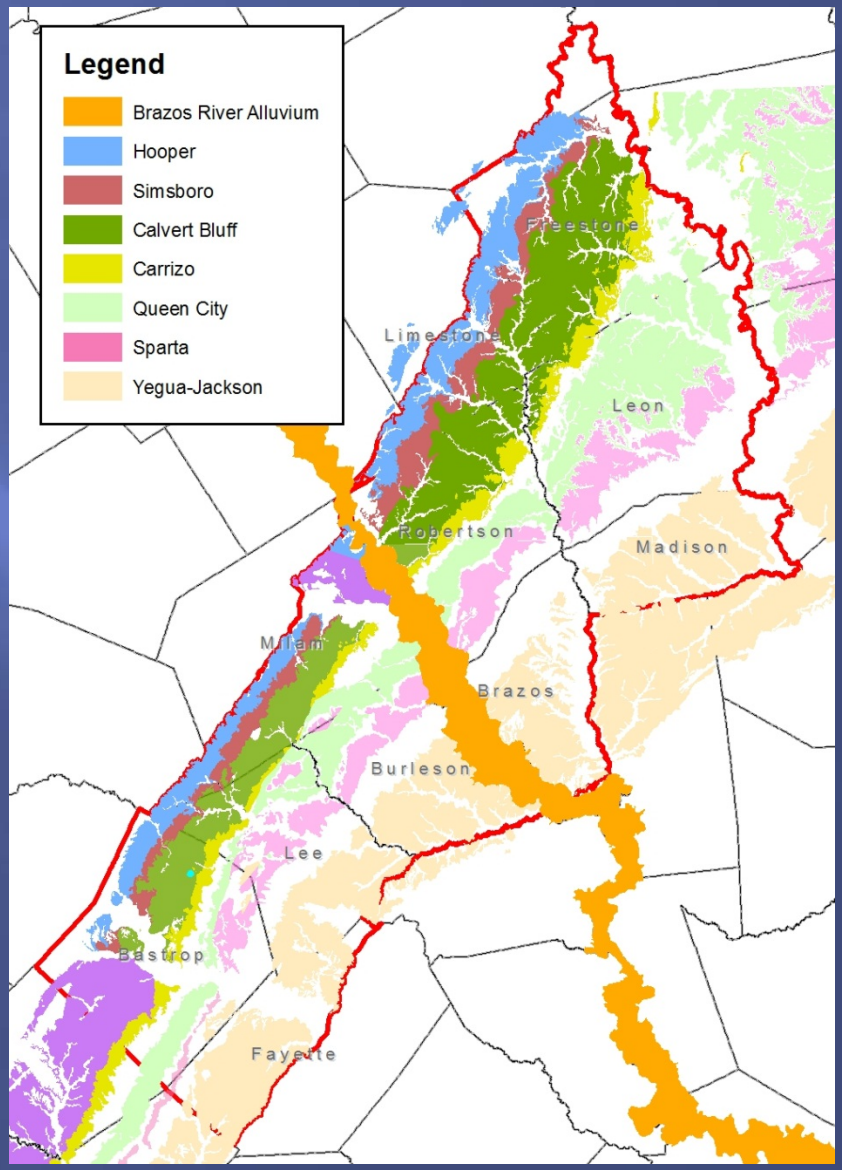
- Describe the hydrological conditions, including for each aquifer in the management area the total estimated recoverable storage (TERS) as provided by the executive administrator, and the average annual recharge, inflows, and discharge

# Hydrological Conditions

- Aquifer outcrops extend from NE to SW
- Dip towards the coast




from LBG-Guyton (2003)

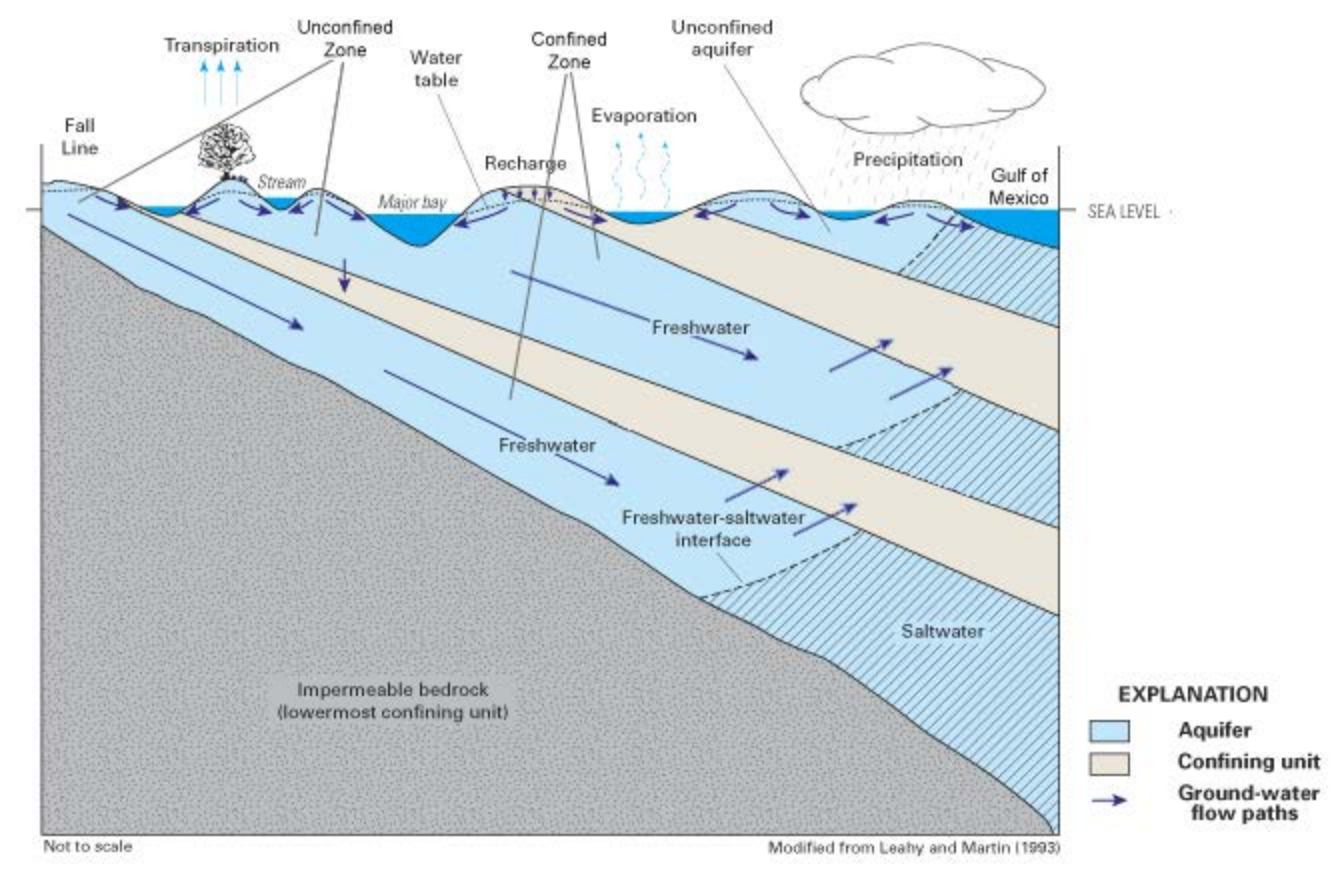


# Hydrological Conditions

- 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!

# Hydrological Conditions

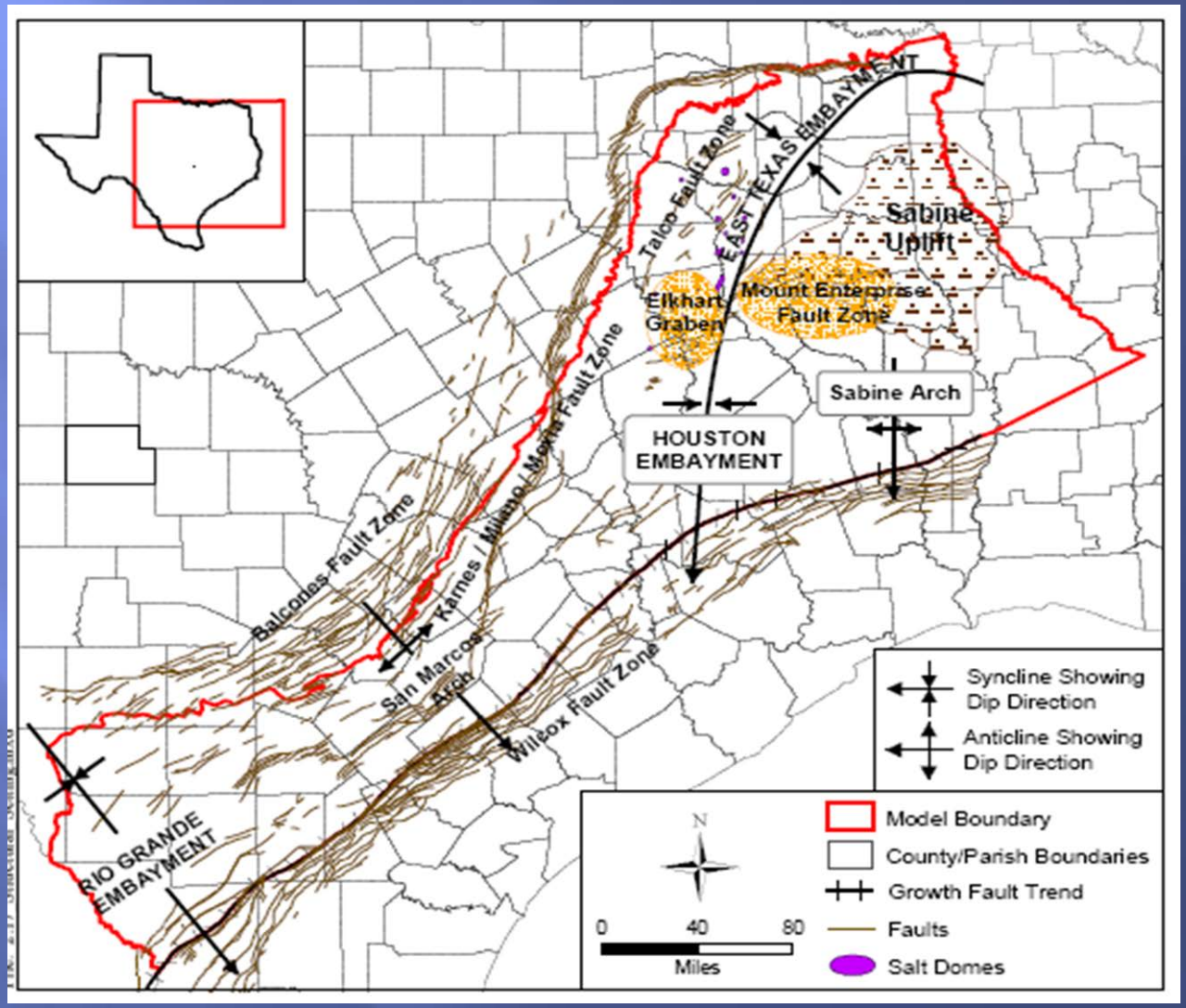
- Unconfined in outcrop, confined downdip



# Faults

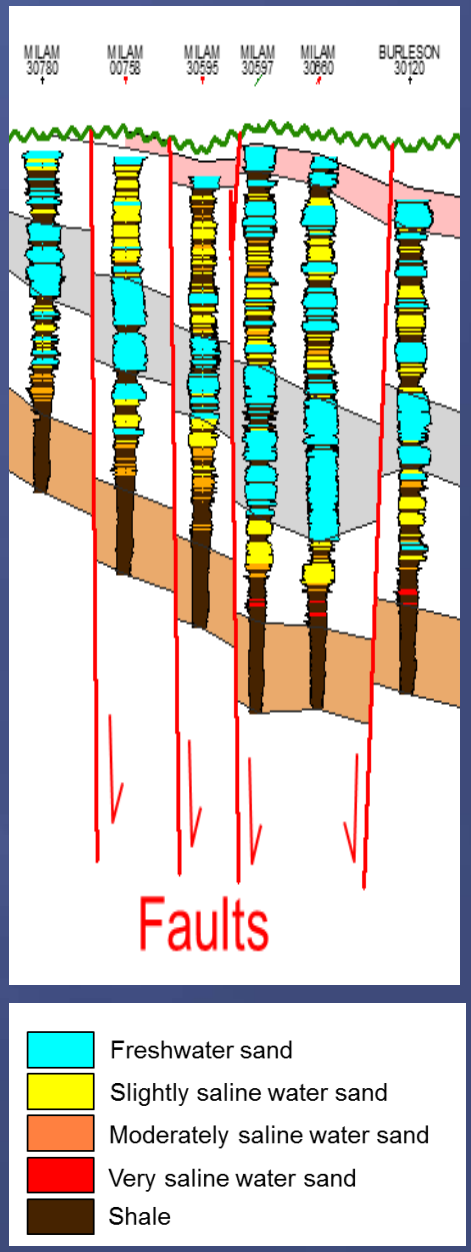
- Impact of faulting on groundwater flow in part of GMA 12 is an important consideration
- Impacts of faults on the flow system were revised in the recently updated GAM
- Impacts of faults on groundwater flow substantially less with updated model compared to previous model

# 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 GMA 12
- Not a highly productive aquifer anywhere within GMA 12

# Jackson Hydraulic Conductivity

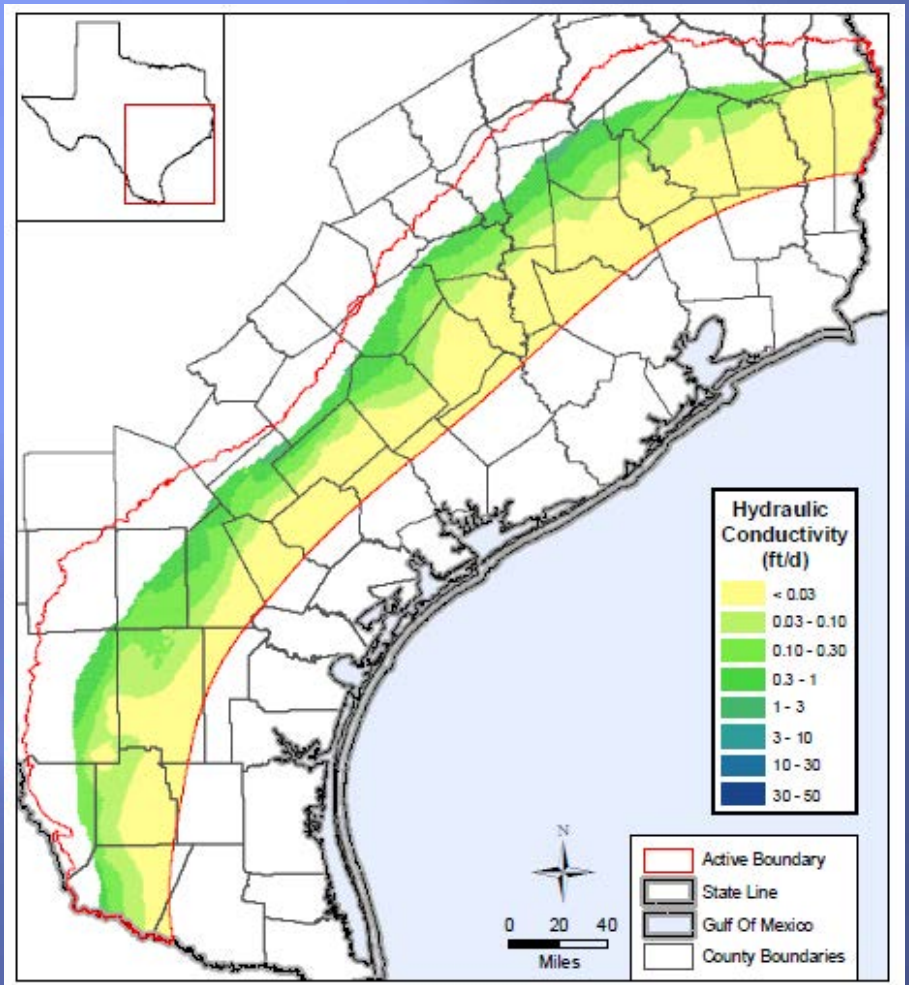



Figure 8.1.2 Horizontal hydraulic conductivity in feet per day of the Upper Jackson Unit subcrop.

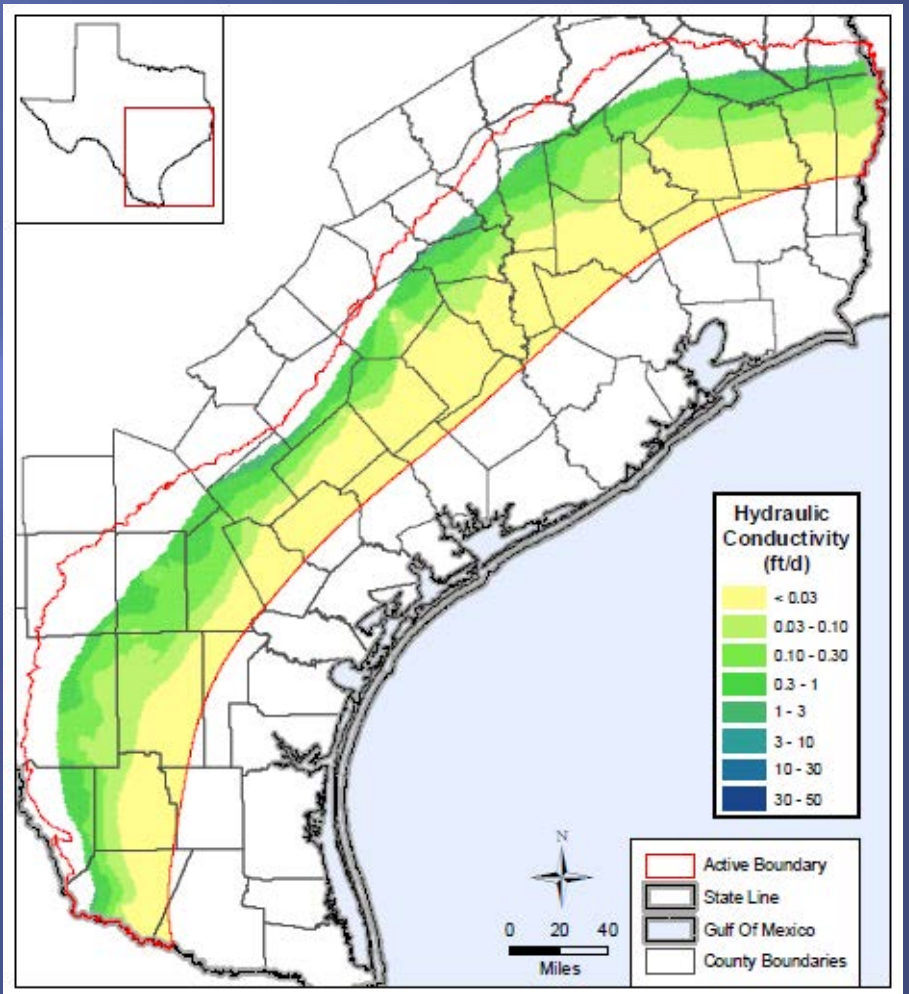



Figure 8.1.3 Horizontal hydraulic conductivity in feet per day of the Lower Jackson Unit subcrop.

# Yegua Hydraulic Conductivity

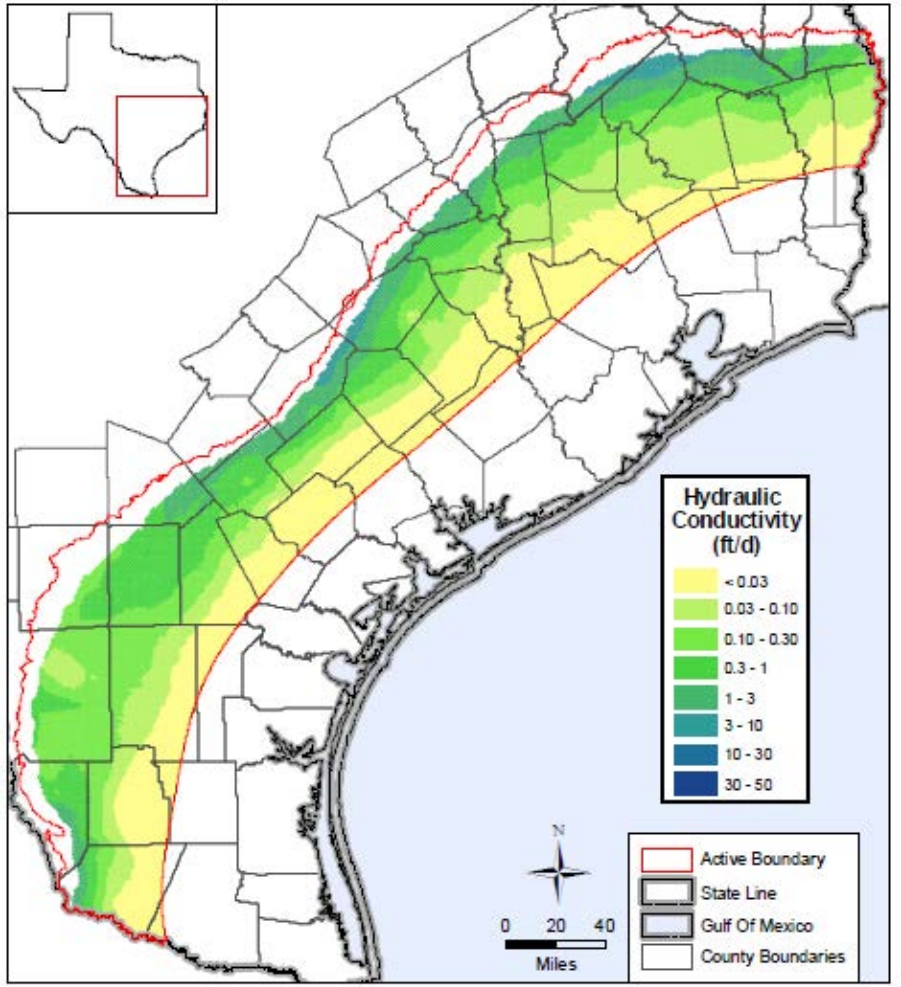



Figure 8.1.4 Horizontal hydraulic conductivity in feet per day of the Upper Yegua Unit subcrop.

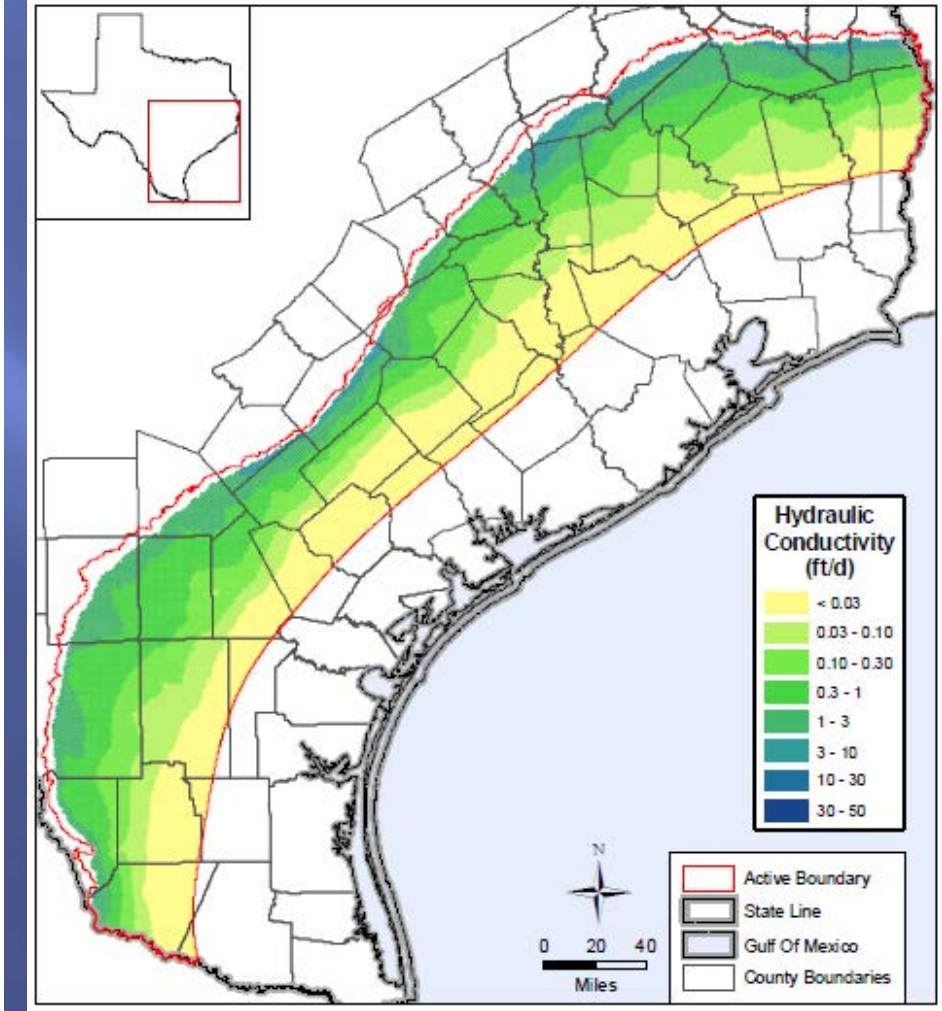
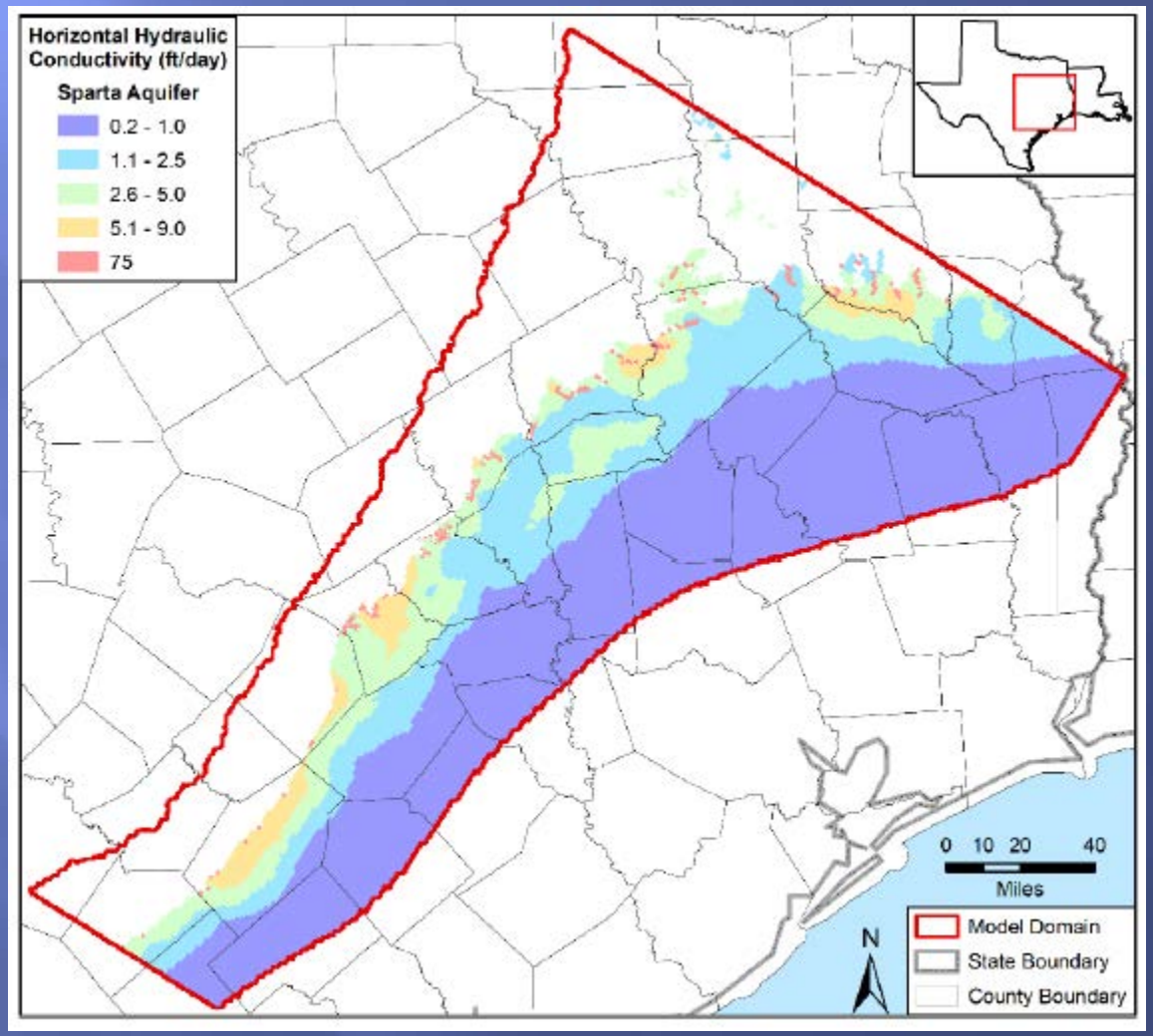



Figure 8.1.5 Horizontal hydraulic conductivity in feet per day of the Lower Yegua Unit subcrop.

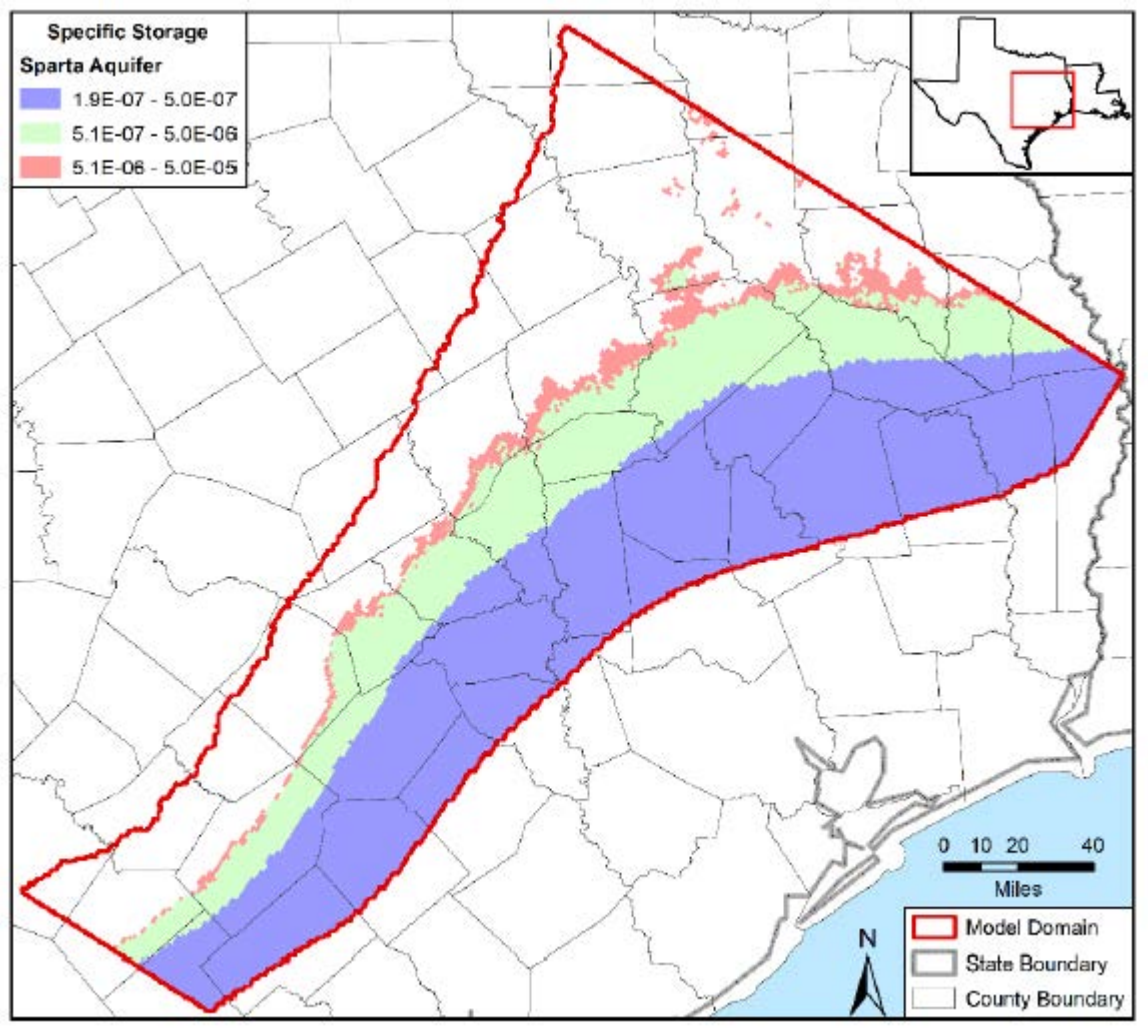
# Sparta Conditions

- Water is produced from the Sparta Formation of the Clairborne Group
- Sand-rich formation interbedded with silt and clay
- Groundwater primarily produced from shallow to moderately deep wells (most <1000 feet deep, a few up to 2,000 feet deep)
- Water quality usually fresh in and near outcrop, deteriorates downdip
- More prolific towards the northeastern parts of GMA 12
- Can produce small to moderate quantities of water in GMA 12

# Sparta Hydraulic Conductivity



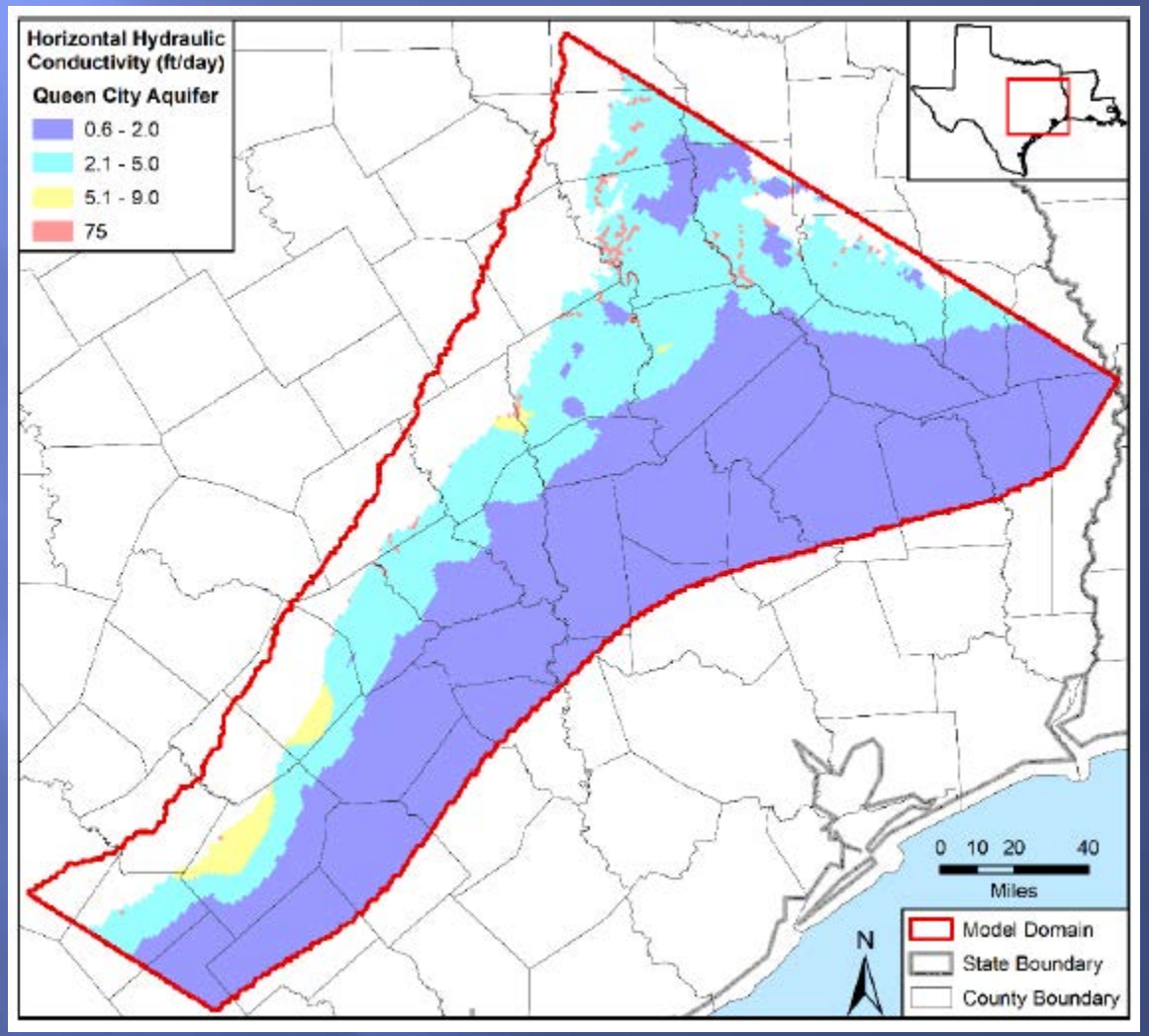
# Sparta Specific Storage



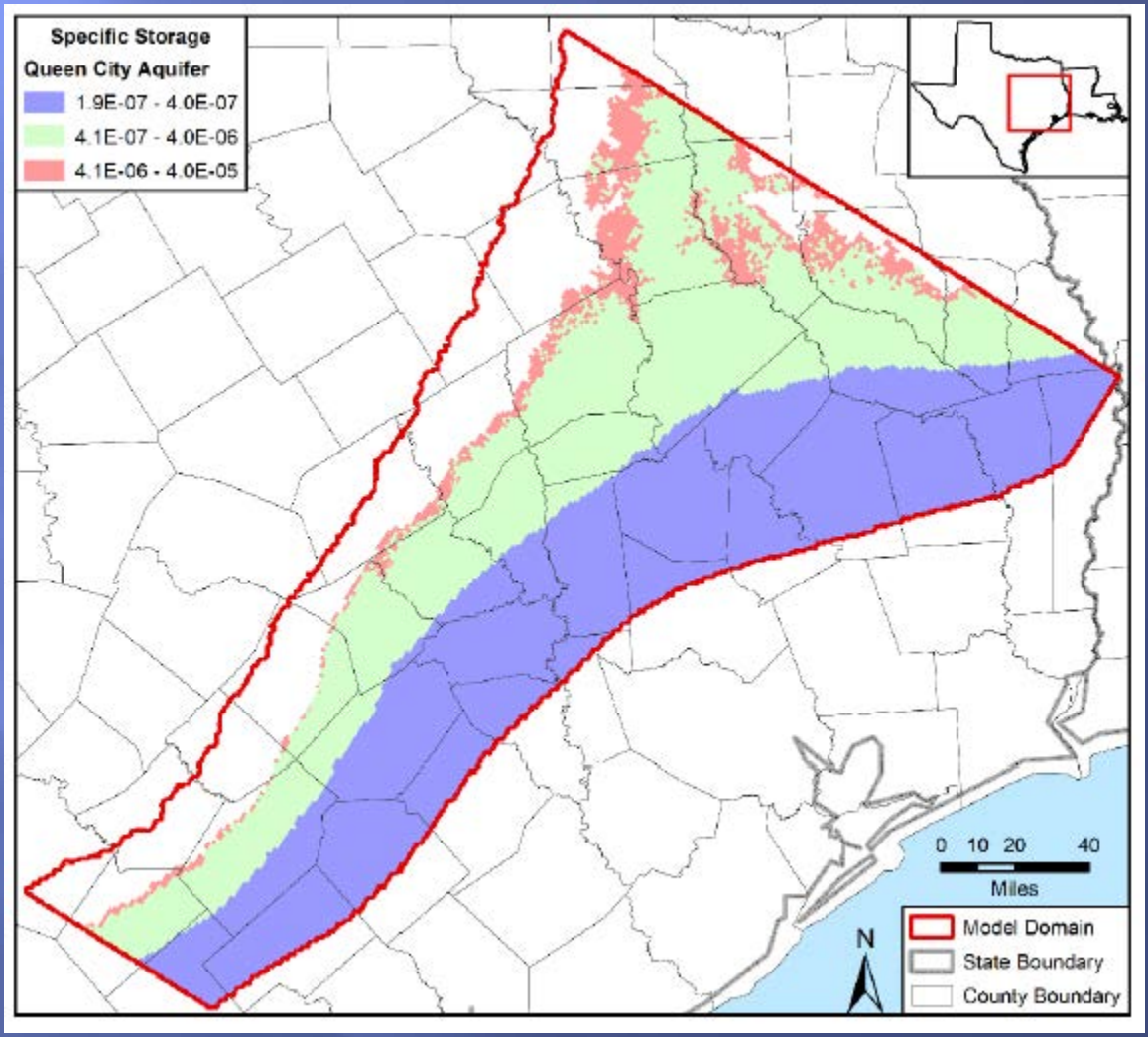
# Queen City Conditions

- Water is produced from the Queen City Formation
- Water stored in sand, loosely cemented sandstone, and interbedded clay
- Water quality generally fresh, deteriorates downdip
- Fairly consistent aquifer conditions across the extent of the aquifer within GMA 12
- Can produce small to moderate quantities of water in GMA 12

# Queen City Hydraulic Conductivity



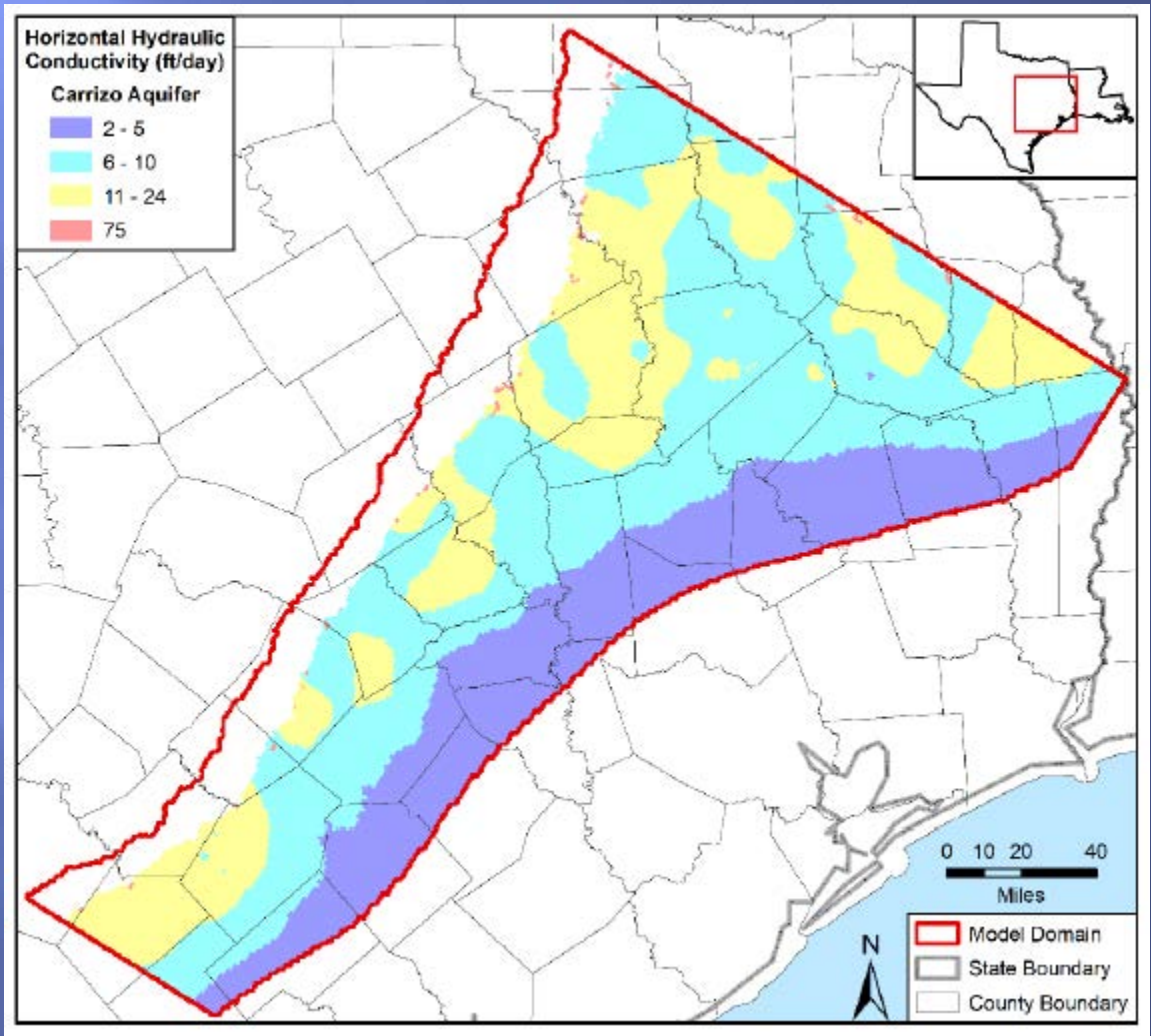
# Queen City Specific Storage



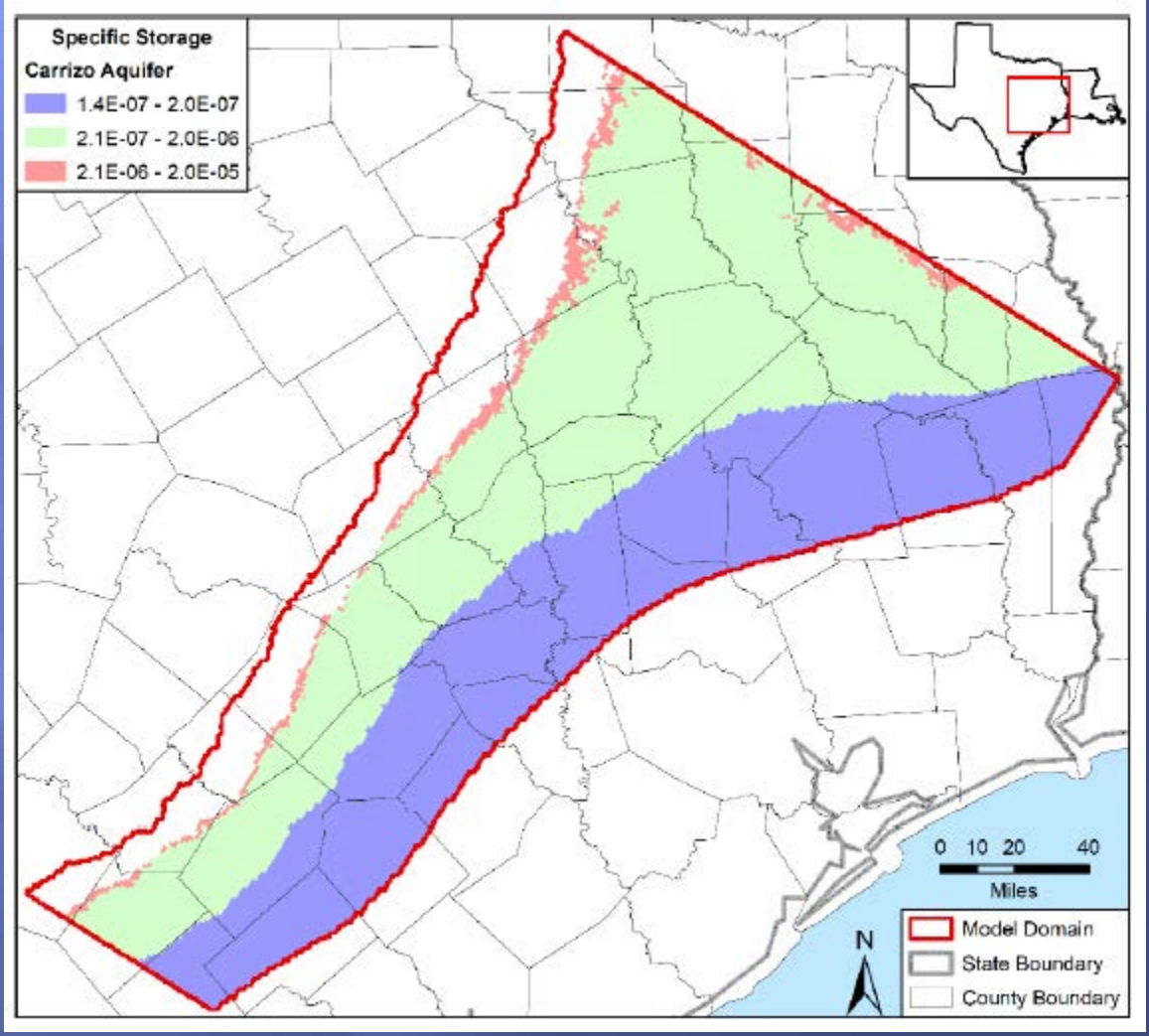
# Carrizo Conditions

- Water is produced from the Carrizo Formation, which is hydrologically connected to upper unit of Wilcox and thus is referred to as the "Carrizo-Wilcox Aquifer"
- Sand-rich formation interbedded with silt and clay. Sand thicknesses 100-200 feet and more laterally continuous.
- Water quality generally fresh, deteriorates downdip
- Is a prolific aquifer in parts of GMA 12 and less productive in other areas within GMA 12
- Extremely productive aquifer to the southwest of GMA 12 in GMA 13.

# Carrizo Hydraulic Conductivity



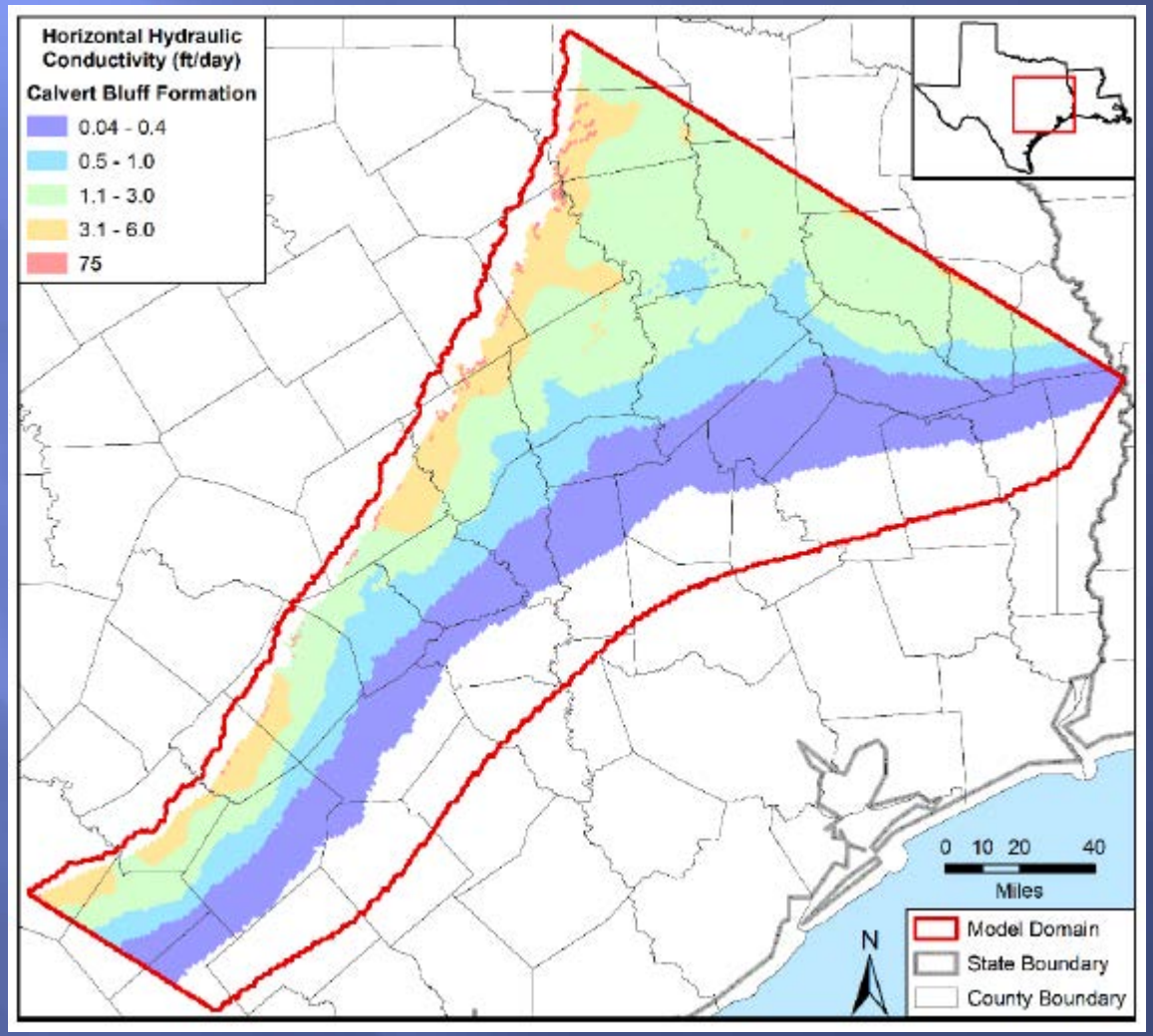
# Carrizo Specific Storage



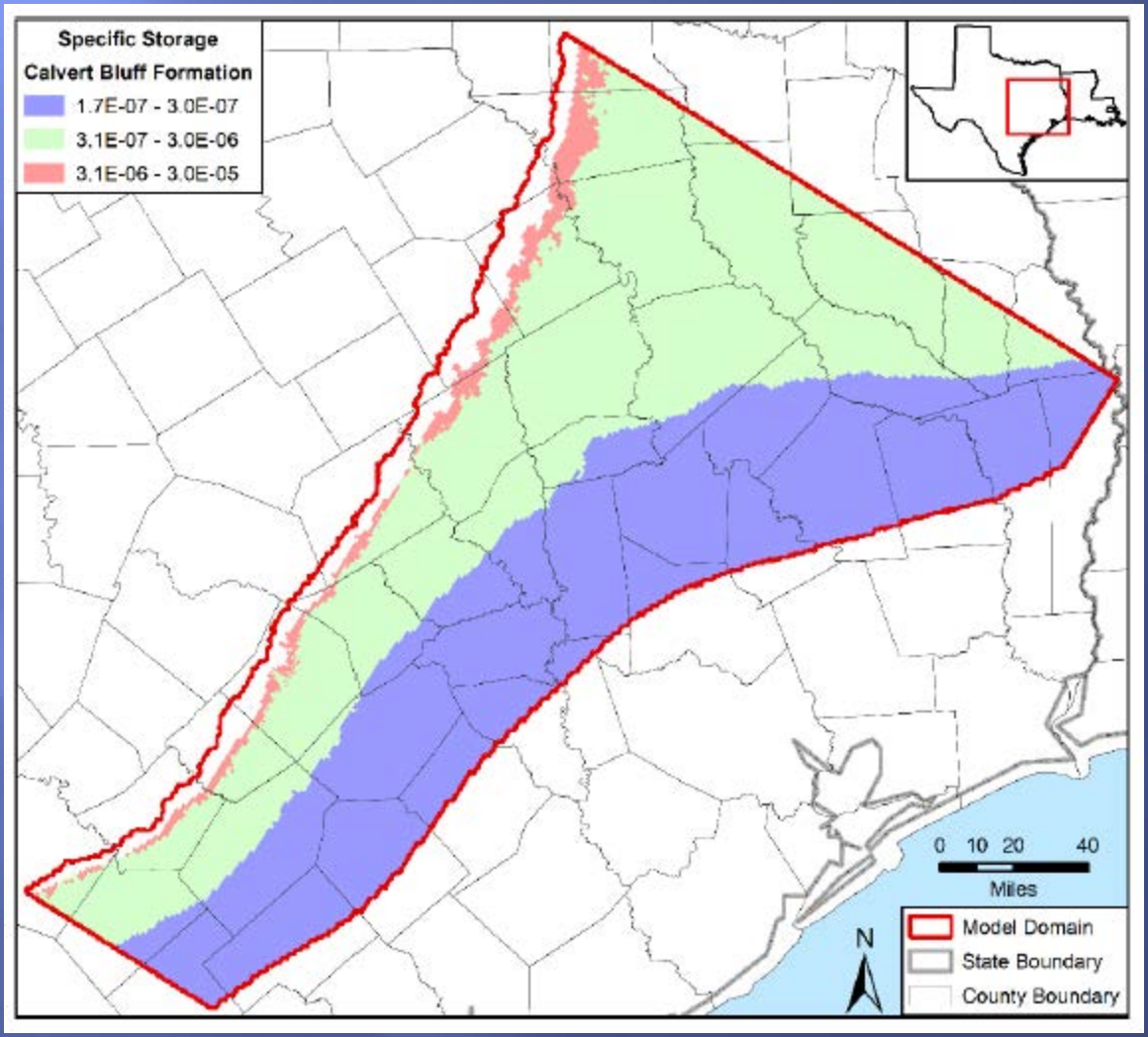
# Calvert Bluff Conditions

- Water is produced from the Calvert Bluff Formation the upper unit of the Wilcox Group
- Consists mostly of lower permeability clays and lignites. Sands, where present, can be productive. Very thick formation.
- Water quality usually fresh in and near outcrop, deteriorates downdip
- Fairly consistent across the GMA 12
- Can produce low to moderate quantities of water in GMA 12

# Calvert Bluff Hydraulic Conductivity



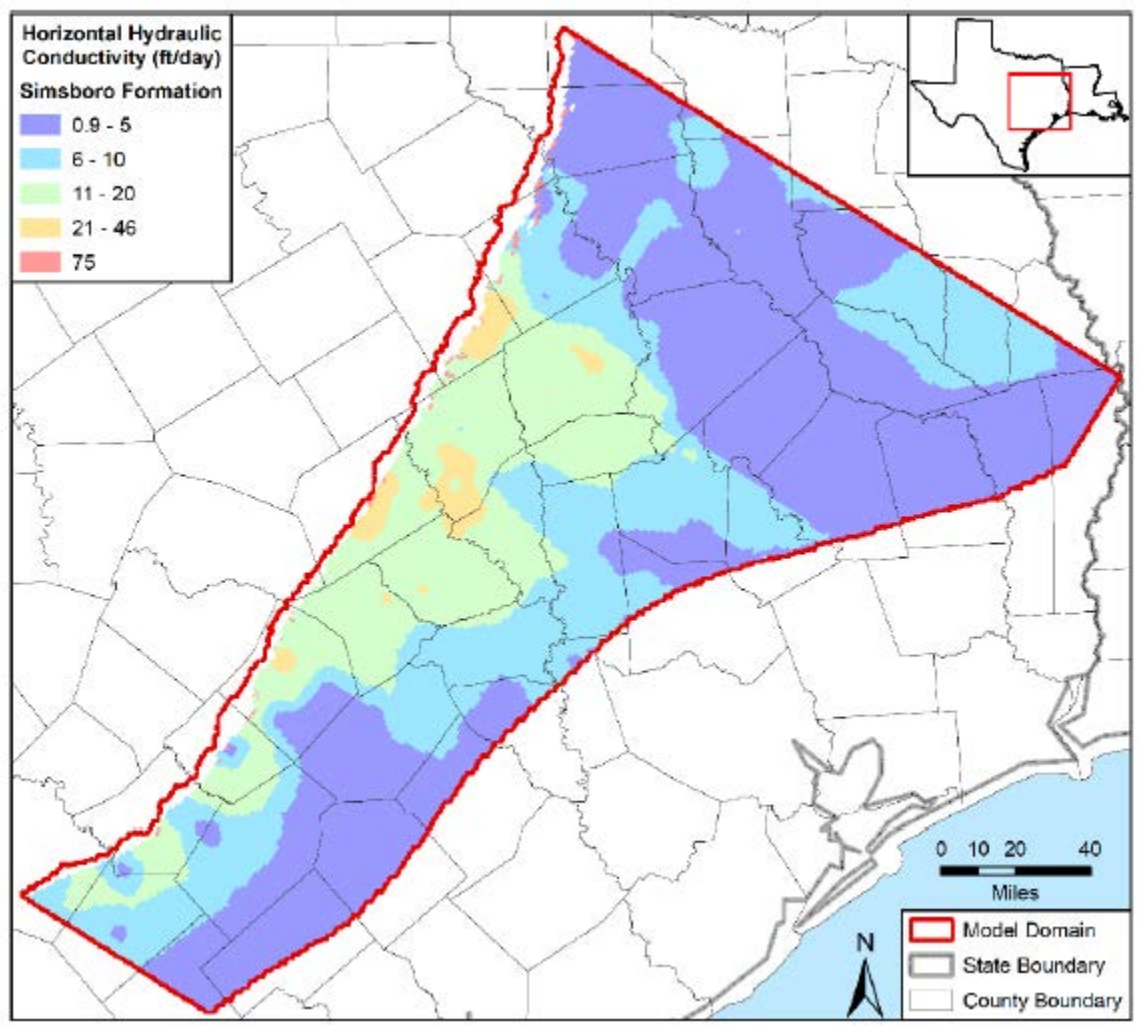
# Calvert Bluff Specific Storage



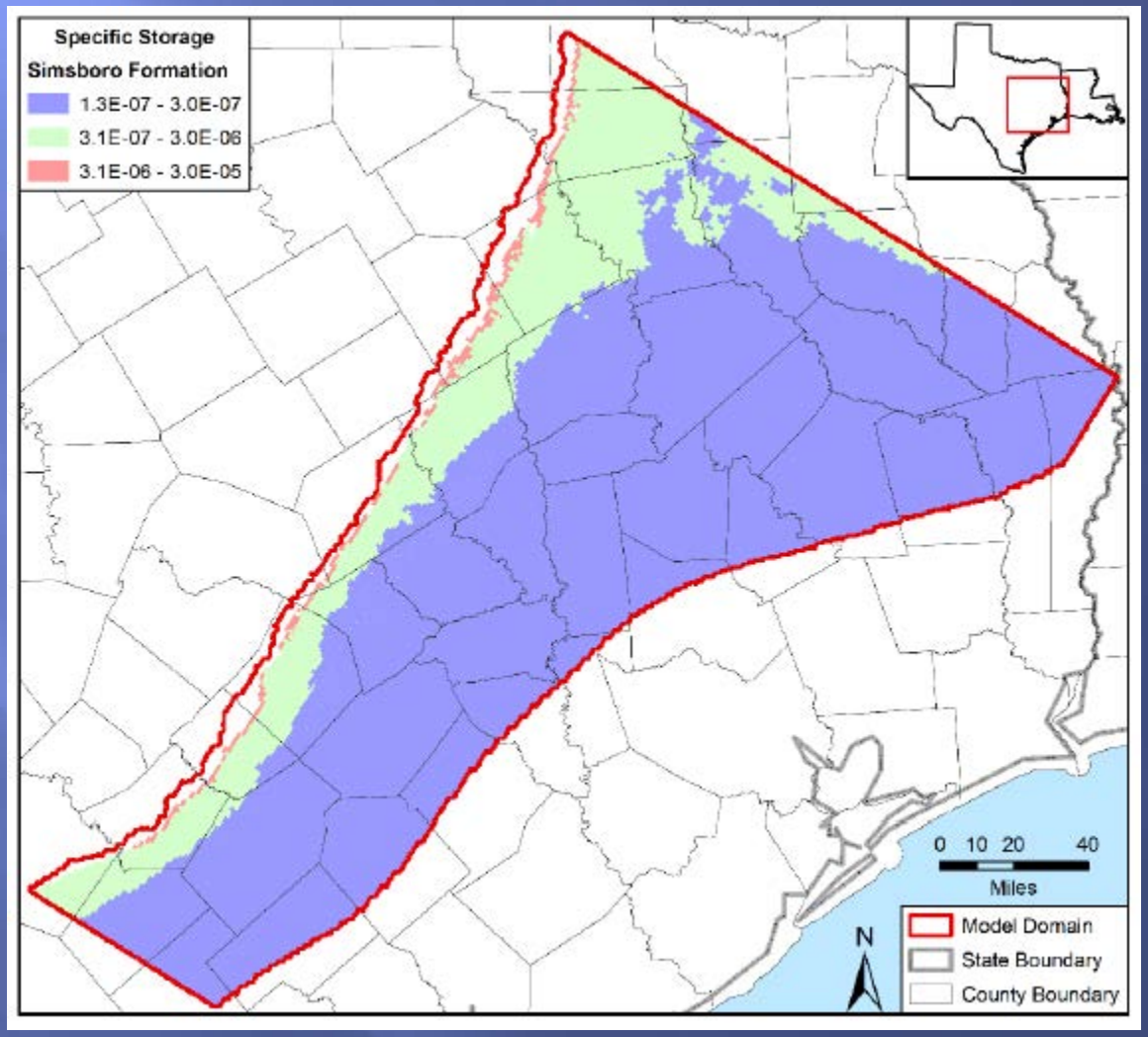
# Simsboro Conditions

- Water is produced from the Simsboro Formation, the middle unit of the Wilcox Group
- Predominantly sand-rich formation. Can have more than 500 feet of sandstone. Thick sands extend well downdip, make up 80% of the formation
- Defined as a separate unit in most of the GMA 12
- Water quality generally fresh, deteriorates farther downdip
- Presently greater utilization in the central portion of GMA 12 where it supports areas with substantial pumping
- Extremely productive aquifer within GMA 12

# Simsboro Hydraulic Conductivity



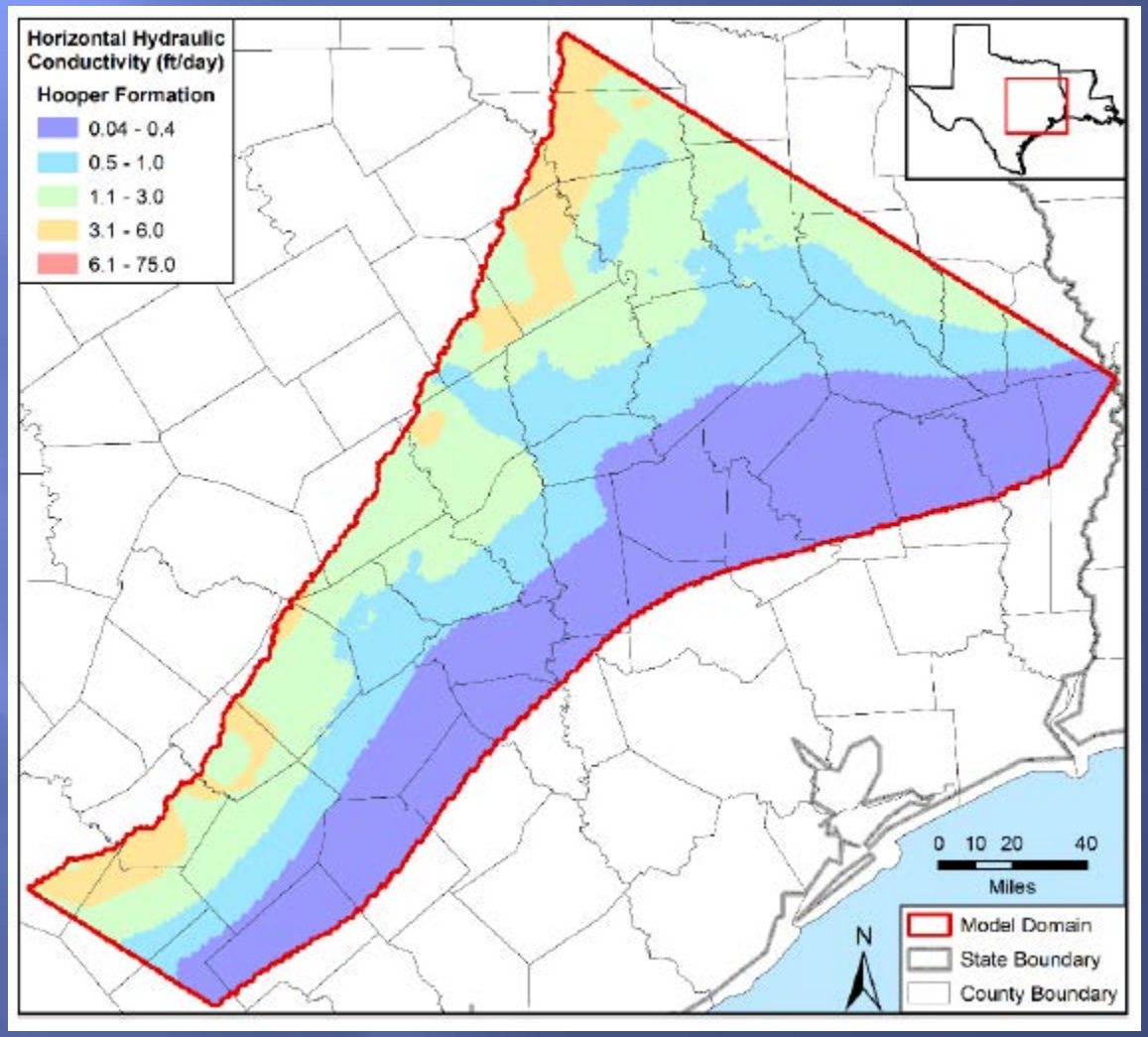
# Simsboro Specific Storage



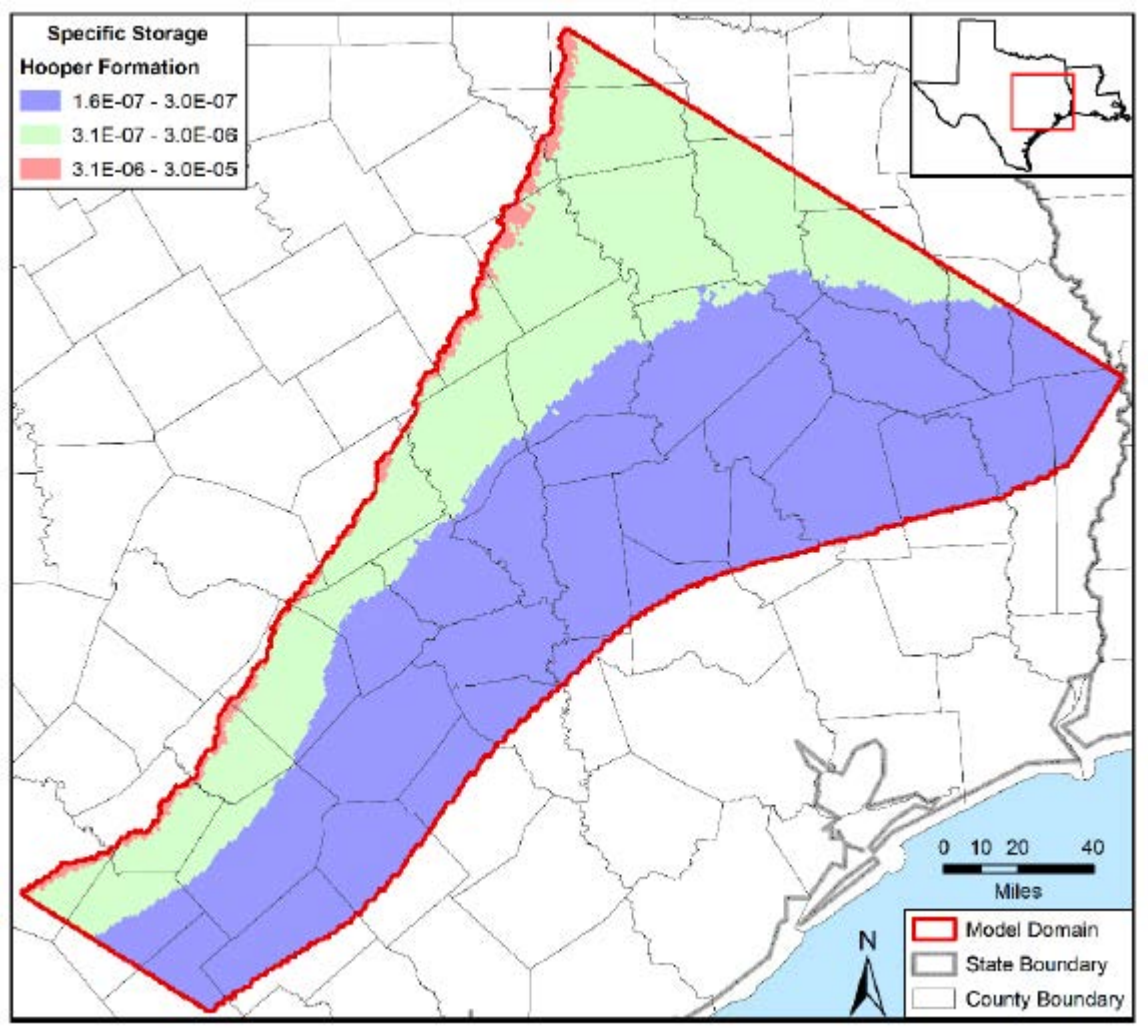
# Hooper Conditions

- Water is produced from the Hooper Formation, the lower unit of the Wilcox Group
- Made up of interbedded shales and sandstones with minor amounts of lignite, generally 20-40% sand, can be higher locally. Sand thickness limited in most of the downdip areas.
- Water quality usually fresh in and near outcrop, deteriorates downdip
- Not a highly productive aquifer in most areas of GMA 12

# Hooper Hydraulic Conductivity



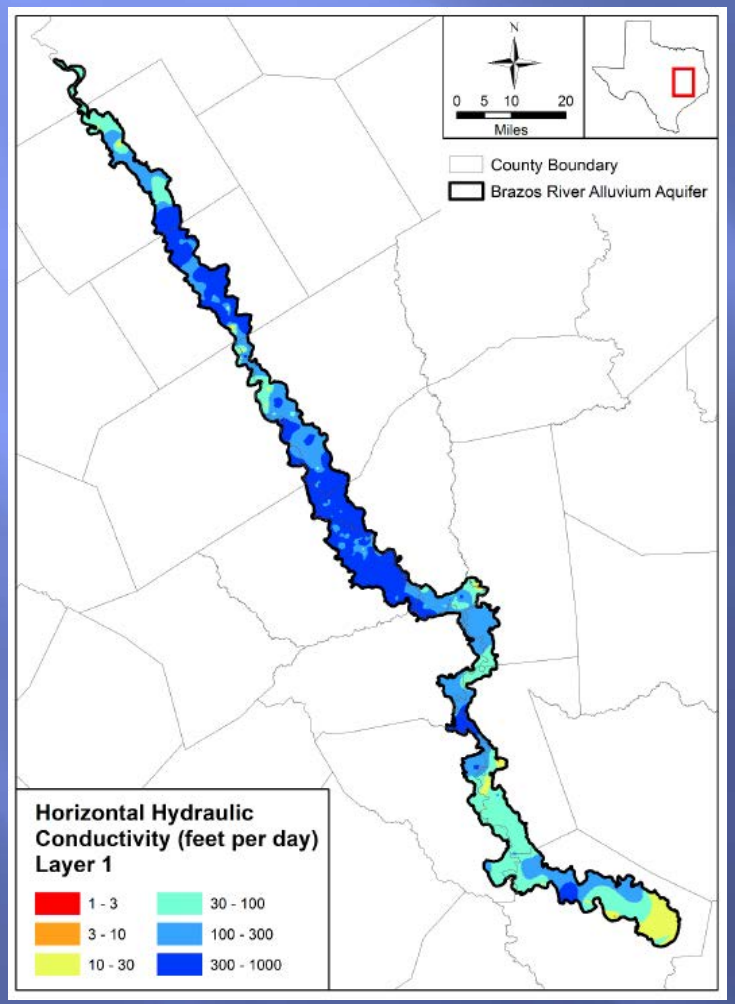
# Hooper Specific Storage

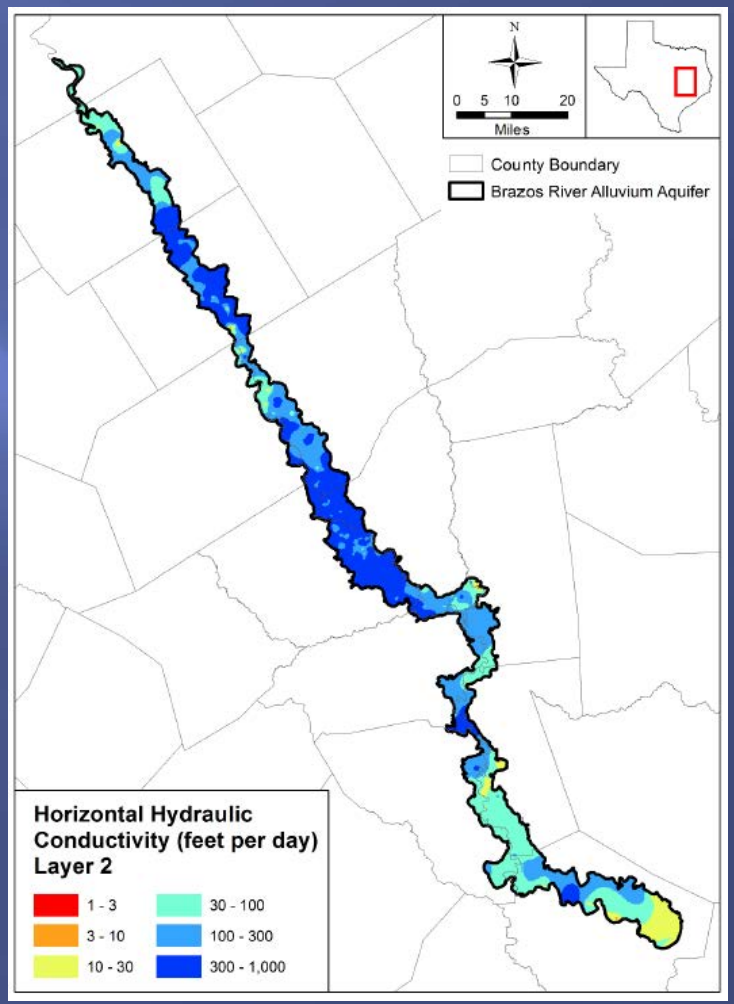


# Brazos River Alluvium Conditions

- Water is produced from the alluvium deposited by the Brazos River normally within a few miles of the river
- Wells are shallow (<100 feet)
- Water quality usually fresh, some pockets of poorer quality water exist
- Fairly consistent aquifer conditions across the extent of the aquifer within GMA 12
- Can be fairly productive
- Vast majority of water produced from the aquifer is for irrigation

# Brazos River Alluvium Hydraulic Conductivity



# 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

# Total Estimated Recoverable Storage (TERS)

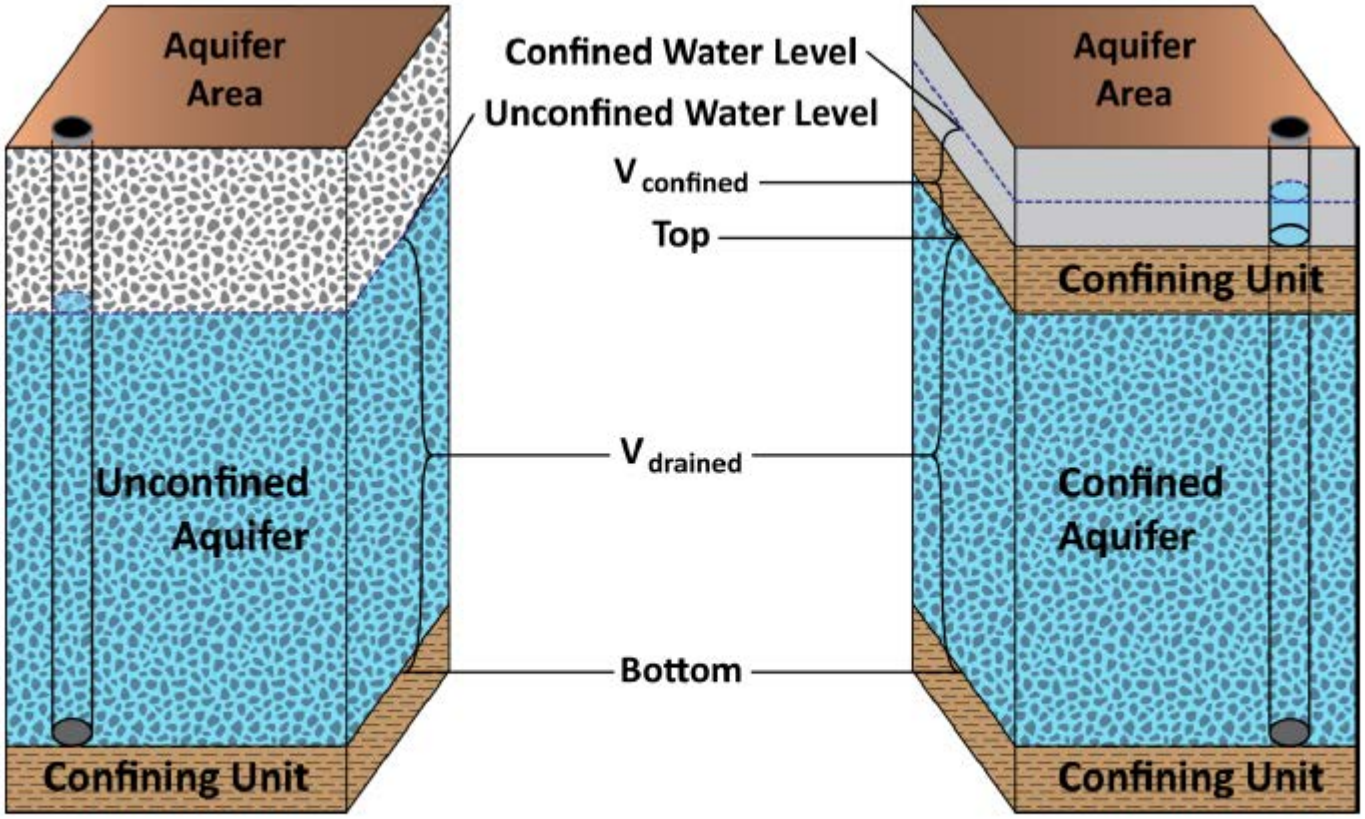



FIGURE 1. SCHEMATIC GRAPH SHOWING THE DIFFERENCE BETWEEN UNCONFINED AND CONFINED AQUIFERS.

# Total Estimated Recoverable Storage (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

# Total Estimated Recoverable Storage (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 actually vary based on aquifer type
- Vast majority of water is stored in confined areas of aquifers in GMA 12

# Trinity Aquifer TERS by County

| *County* | *Total Storage (acre-feet)* | *25 percent of Total Storage (acre-feet)* | *75 percent of Total Storage (acre-feet)* |
|---|---|---|---|
| Bastrop | 9,000,000 | 2,250,000 | 6,750,000 |
| Lee | 500,000 | 125,000 | 375,000 |
| Williamson | 1,600,000 | 400,000 | 1,200,000 |
| **Total** | **11,100,000** | **2,775,000** | **8,325,000** |

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

# Trinity Aquifer TERS by GCD

| *Groundwater Conservation District (GCD)* | *Total Storage (acre-feet)* | *25 percent of Total Storage (acre-feet)* | *75 percent of Total Storage (acre-feet)* |
|---|---|---|---|
| No District | 1,600,000 | 400,000 | 1,200,000 |
| Lost Pines GCD | 9,500,000 | 2,375,000 | 7,125,000 |
| Total | **11,100,000** | **2,775,000** | **8,325,000** |

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

# Carrizo-Wilcox Aquifer TERS by County

| County | Total Storage (acre-feet) | 25 percent of Total Storage (acre-feet) | 75 percent of Total Storage (acre-feet) |
|---|---|---|---|
| Bastrop | 98,000,000 | 24,500,000 | 73,500,000 |
| Brazos | 69,000,000 | 17,250,000 | 51,750,000 |
| Burleson | 120,000,000 | 30,000,000 | 90,000,000 |
| Falls | 820,000 | 205,000 | 615,000 |
| Fayette | 95,000,000 | 23,750,000 | 71,250,000 |
| Freestone | 46,000,000 | 11,500,000 | 34,500,000 |
| Lee | 130,000,000 | 32,500,000 | 97,500,000 |
| Leon | 180,000,000 | 45,000,000 | 135,000,000 |
| Limestone | 12,000,000 | 3,000,000 | 9,000,000 |
| Madison | 110,000,000 | 27,500,000 | 82,500,000 |
| Milam | 47,000,000 | 11,750,000 | 35,250,000 |
| Navarro | 1,000,000 | 250,000 | 750,000 |
| Robertson | 110,000,000 | 27,500,000 | 82,500,000 |
| Williamson | 500,000 | 125,000 | 375,000 |
| **Total** | 1,019,320,000 | 254,830,000 | 764,490,000 |

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

# Carrizo-Wilcox Aquifer TERS by GCD

| *Groundwater Conservation District (GCD)* | *Total Storage (acre-feet)* | *25 percent of Total Storage (acre-feet)* | *75 percent of Total Storage (acre-feet)* |
|---|---|---|---|
| No District | 14,000,000 | 3,500,000 | 10,500,000 |
| Brazos Valley GCD | 180,000,000 | 45,000,000 | 135,000,000 |
| Fayette County GCD | 95,000,000 | 23,750,000 | 71,250,000 |
| Lost Pines GCD | 220,000,000 | 55,000,000 | 165,000,000 |
| Mid-East Texas GCD | 340,000,000 | 85,000,000 | 255,000,000 |
| Post Oak Savannah GCD | 170,000,000 | 42,500,000 | 127,500,000 |
| **Total** | 1,019,000,000 | 254,750,000 | 764,250,000 |

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

# Queen City Aquifer TERS by County

| *County* | *Total Storage (acre-feet)* | *25 percent of Total Storage (acre-feet)* | *75 percent of Total Storage (acre-feet)* |
|---|---|---|---|
| Bastrop | 9,500,000 | 2,375,000 | 7,125,000 |
| Brazos | 25,000,000 | 6,250,000 | 18,750,000 |
| Burleson | 29,000,000 | 7,250,000 | 21,750,000 |
| Fayette | 19,000,000 | 4,750,000 | 14,250,000 |
| Freestone | 290,000 | 72,500 | 217,500 |
| Lee | 23,000,000 | 5,750,000 | 17,250,000 |
| Leon | 25,000,000 | 6,250,000 | 18,750,000 |
| Madison | 20,000,000 | 5,000,000 | 15,000,000 |
| Milam | 650,000 | 162,500 | 487,500 |
| Robertson | 8,800,000 | 2,200,000 | 6,600,000 |
| **Total** | 160,240,000 | 40,060,000 | 120,180,000 |

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

# Queen City Aquifer TERS by GCD

| *Groundwater Conservation District (GCD)* | *Total Storage (acre-feet)* | *25 percent of Total Storage (acre-feet)* | *75 percent of Total Storage (acre-feet)* |
|---|---|---|---|
| Brazos Valley GCD | 34,000,000 | 8,500,000 | 25,500,000 |
| Fayette County GCD | 19,000,000 | 4,750,000 | 14,250,000 |
| Lost Pines GCD | 32,000,000 | 8,000,000 | 24,000,000 |
| Mid-East Texas GCD | 45,000,000 | 11,250,000 | 33,750,000 |
| Post Oak Savannah GCD | 30,000,000 | 7,500,000 | 22,500,000 |
| **Total** | 160,000,000 | 40,000,000 | 120,000,000 |

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

# Sparta Aquifer TERS by County

| County | Total Storage (acre-feet) | 25 percent of Total Storage (acre-feet) | 75 percent of Total Storage (acre-feet) |
|---|---|---|---|
| Bastrop | 2,500,000 | 625,000 | 1,875,000 |
| Brazos | 17,000,000 | 4,250,000 | 12,750,000 |
| Burleson | 16,000,000 | 4,000,000 | 12,000,000 |
| Fayette | 12,000,000 | 3,000,000 | 9,000,000 |
| Lee | 10,000,000 | 2,500,000 | 7,500,000 |
| Leon | 4,600,000 | 1,150,000 | 3,450,000 |
| Madison | 16,000,000 | 4,000,000 | 12,000,000 |
| Robertson | 1,300,000 | 325,000 | 975,000 |
| **Total** | 79,400,000 | 19,850,000 | 59,550,000 |

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

# Sparta Aquifer TERS by GCD

| *Groundwater Conservation District (GCD)* | *Total Storage (acre-feet)* | *25 percent of Total Storage (acre-feet)* | *75 percent of Total Storage (acre-feet)* |
|---|---|---|---|
| Brazos Valley GCD | 18,000,000 | 4,500,000 | 13,500,000 |
| Fayette County GCD | 12,000,000 | 3,000,000 | 9,000,000 |
| Lost Pines GCD | 13,000,000 | 3,250,000 | 9,750,000 |
| Mid-East Texas GCD | 21,000,000 | 5,250,000 | 15,750,000 |
| Post Oak Savannah GCD | 16,000,000 | 4,000,000 | 12,000,000 |
| **Total** | 80,000,000 | 20,000,000 | 60,000,000 |

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

# 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)

# Brazos River Alluvium Aquifer TERS by County

| *County* | *Total Storage (acre-feet)* | *25 percent of Total Storage (acre-feet)* | *75 percent of Total Storage (acre-feet)* |
|---|---|---|---|
| Brazos | 290,000 | 72,500 | 217,500 |
| Burleson | 450,000 | 112,500 | 337,500 |
| Falls | 140 | 35 | 105 |
| Milam | 28,000 | 7,000 | 21,000 |
| Robertson | 270,000 | 67,500 | 202,500 |
| **Total** | 1,038,140 | 259,535 | 778,605 |

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

# Brazos River Alluvium Aquifer TERS by GCD

| *Groundwater Conservation District (GCD)* | *Total Storage (acre-feet)* | *25percent of Total Storage (acre-feet)* | *75percent of Total Storage (acre-feet)* |
|---|---|---|---|
| No district | 140 | 35 | 105 |
| Brazos Valley GCD | 560,000 | 140,000 | 420,000 |
| Post Oak Savannah GCD | 480,000 | 120,000 | 360,000 |
| **Total** | 1,040,140 | 260,035 | 780,105 |

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

# Gulf Coast Aquifer TERS by County

| County | Total Storage (acre-feet) | 25 percent of Total Storage (acre-feet) | 75 percent of Total Storage (acre-feet) |
|---|---|---|---|
| Brazos | 450,000 | 112,500 | 337,500 |
| Total | 450,000 | 112,500 | 337,500 |

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 17-019
- Lost Pines GCD = GAM Run 16-014
- Post Oak Savannah GCD = GAM Run 16-015
- Brazos Valley GCD = GAM Run 18-021
- Mid-East Texas GCD = GAM Run 18-020

# Fayette County GCD
# Sparta Aquifer

| *Management Plan requirement* | *Aquifer* | *Results* |
|---|---|---|
| Estimated annual amount of recharge from precipitation to the district | Sparta Aquifer | 382 |
| Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers | Sparta Aquifer | 0 |
| Estimated annual volume of flow into the district within each aquifer in the district | Sparta Aquifer | 516 |
| Estimated annual volume of flow out of the district within each aquifer in the district | Sparta Aquifer | 197 |
| Estimated net annual volume of flow between each aquifer in the district | From the Sparta Aquifer into the overlying younger units | 1,666 |
| | From the Weches Confining Unit into the Sparta Aquifer | 1,522 |
| | From the Sparta Aquifer into its brackish portion | 15 |

Units are in Acre Feet per Year

# Fayette County GCD
# Queen City Aquifer

| *Management Plan requirement* | *Aquifer or confining unit* | *Results* |
|---|---|---|
| Estimated annual amount of recharge from precipitation to the district | Queen City Aquifer | 0 |
| Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers | Queen City Aquifer | 0 |
| Estimated annual volume of flow into the district within each aquifer in the district | Queen City Aquifer | 1,932 |
| Estimated annual volume of flow out of the district within each aquifer in the district | Queen City Aquifer | 505 |
| Estimated net annual volume of flow between each aquifer in the district | From the Queen City Aquifer into the Weches Confining Unit | 1,417 |
| | From the Reklaw Confining Unit into the Queen City Aquifer | 181 |
| | From the Queen City Aquifer into its brackish portion | 79 |

# Fayette County GCD
# Carrizo-Wilcox Aquifer

| *Management Plan requirement* | *Aquifer or confining unit* | *Results* |
|---|---|---|
| Estimated annual amount of recharge from precipitation to the district | Carrizo-Wilcox Aquifer | 0 |
| Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers | Carrizo-Wilcox Aquifer | 0 |
| Estimated annual volume of flow into the district within each aquifer in the district | Carrizo-Wilcox Aquifer | 7,133 |
| Estimated annual volume of flow out of the district within each aquifer in the district | Carrizo-Wilcox Aquifer | 2,980 |
| Estimated net annual volume of flow between each aquifer in the district | From the Carrizo-Wilcox Aquifer into the Reklaw Confining Unit | 217 |
| | From the Carrizo-Wilcox Aquifer into its brackish portion | 4,090 |

Suggest units be in larger print size

t per year

# Fayette County GCD
# Yegua-Jackson Aquifer

| *Management Plan requirement* | *Aquifer or confining unit* | *Results* |
|---|---|---|
| Estimated annual amount of recharge from precipitation to the district | Yegua-Jackson Aquifer | 47,304 |
| 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 | 59,161 |
| Estimated annual volume of flow into the district within each aquifer in the district | Yegua-Jackson Aquifer | 9,885 |
| Estimated annual volume of flow out of the district within each aquifer in the district | Yegua-Jackson Aquifer | 7,045 |
| Estimated net annual volume of flow between each aquifer in the district | From the Yegua-Jackson Aquifer into the Catahoula Formation | 18 |
| | From the Yegua-Jackson Aquifer into its brackish portion | 193 |

Units are in acre-feet per year

# Lost Pines GCD
# Sparta Aquifer

| Management Plan requirement | Aquifer or confining unit | Results |
|---|---|---|
| Estimated annual amount of recharge from precipitation to the district | Sparta Aquifer | 10,142 |
| Estimated annual volume of water that discharges from the aquifer to springs and any surface-water body including lakes, streams, and rivers | Sparta Aquifer | 4,564 |
| Estimated annual volume of flow into the district within each aquifer in the district | Sparta Aquifer | 915 |
| Estimated annual volume of flow out of the district within each aquifer in the district | Sparta Aquifer | 593 |
| Estimated net annual volume of flow between each aquifer in the district | Flow into the Sparta Aquifer from underlying units | 957 |
| | Flow from the Sparta Aquifer into overlying units | 883 |

Units are in acre-feet per year

# Lost Pines GCD
# Queen City Aquifer

| Management Plan requirement | Aquifer or confining unit | Results |
|---|---|---|
| Estimated annual amount of recharge from precipitation to the district | Queen City Aquifer | 7,255 |
| Estimated annual volume of water that discharges from the aquifer to springs and any surface-water body including lakes, streams, and rivers | Queen City Aquifer | 5,488 |
| Estimated annual volume of flow into the district within each aquifer in the district | Queen City Aquifer | 516 |
| Estimated annual volume of flow out of the district within each aquifer in the district | Queen City Aquifer | 2,610 |
| Estimated net annual volume of flow between each aquifer in the district | Flow from the Queen City Aquifer into overlying units | 934 |
| | From Queen City Aquifer into underlying formations | 167 |

Units are in acre-feet per year

# Lost Pines GCD
# Carrizo-Wilcox Aquifer

| Management Plan requirement | Aquifer or confining unit | Results |
|---|---|---|
| Estimated annual amount of recharge from precipitation to the district | Carrizo-Wilcox Aquifer | 29,602 |
| Estimated annual volume of water that discharges from the aquifer to springs and any surface-water body including lakes, streams, and rivers | Carrizo-Wilcox Aquifer | 32,781 |
| Estimated annual volume of flow into the district within each aquifer in the district | Carrizo-Wilcox Aquifer | 12,660 |
| Estimated annual volume of flow out of the district within each aquifer in the district | Carrizo-Wilcox Aquifer | 17,538 |
| Estimated net annual volume of flow between each aquifer in the district | Flow into the Carrizo-Wilcox Aquifer from overlying units | 1,313 |
| | Flow to underlying formations | NA[2] |

Units are in acre-feet per year

# Lost Pines GCD
# Trinity Aquifer

| Management Plan requirement | Aquifer or confining unit | Results |
|---|---|---|
| Estimated annual amount of recharge from precipitation to the district | Trinity Aquifer | 0 |
| Estimated annual volume of water that discharges from the aquifer to springs and any surface-water body including lakes, streams, and rivers | Trinity Aquifer | 0 |
| Estimated annual volume of flow into the district within each aquifer in the district | Trinity Aquifer | 355 |
| Estimated annual volume of flow out of the district within each aquifer in the district | Trinity Aquifer | 136 |
| Estimated net annual volume of flow between each aquifer in the district | Flow from the Trinity Aquifer into overlying units | 2 |
| | Flow to underlying formations | NA[1] |

Units are in acre-feet per year

# Lost Pines GCD
# Yegua-Jackson Aquifer

| 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 |
| Estimated net annual volume of flow between each aquifer in the district | Flow to underlying formations | NA[3] |

Units are in acre-feet per year

# Post-Oak Savannah GCD Trinity Aquifer

| Management Plan requirement | Aquifer or confining unit | Results |
|---|---|---|
| Estimated annual amount of recharge from precipitation to the district | Trinity Aquifer | 0 |
| Estimated annual volume of water that discharges from the aquifer to springs and any surface-water body including lakes, streams, and rivers | Trinity Aquifer | 0 |
| Estimated annual volume of flow into the district within each aquifer in the district | Trinity Aquifer | 740 |
| Estimated annual volume of flow out of the district within each aquifer in the district | Trinity Aquifer | 382 |
| Estimated net annual volume of flow between each aquifer in the district | | NA[1] |

Units are in acre-feet per year

# Post-Oak Savannah GCD Sparta Aquifer

| Management Plan requirement | Aquifer or confining unit | Results |
|---|---|---|
| Estimated annual amount of recharge from precipitation to the district | Sparta Aquifer | 7,423 |
| Estimated annual volume of water that discharges from the aquifer to springs and any surface-water body including lakes, streams, and rivers | Sparta Aquifer | 4,808 |
| Estimated annual volume of flow into the district within each aquifer in the district | Sparta Aquifer | 763 |
| Estimated annual volume of flow out of the district within each aquifer in the district | Sparta Aquifer | 1,228 |
| Estimated net annual volume of flow between each aquifer in the district | Weches Confining Unit and adjacent underlying areas into the Sparta Aquifer | 1,583 |

Units are in acre-feet per year

# Post-Oak Savannah GCD Queen City Aquifer

| Management Plan requirement | Aquifer or confining unit | Results |
|---|---|---|
| Estimated annual amount of recharge from precipitation to the district | Queen City Aquifer | 8,811 |
| Estimated annual volume of water that discharges from the aquifer to springs and any surface-water body including lakes, streams, and rivers | Queen City Aquifer | 12,030 |
| Estimated annual volume of flow into the district within each aquifer in the district | Queen City Aquifer | 1,343 |
| Estimated annual volume of flow out of the district within each aquifer in the district | Queen City Aquifer | 965 |
| Estimated net annual volume of flow between each aquifer in the district | Queen City Aquifer into the Overlying Weches Confining Unit | 1,448 |
| | Reklaw Confining Unit and adjacent underlying areas into the Queen City Aquifer | 866 |

Units are in acre-feet per year

# Post-Oak Savannah GCD Carrizo-Wilcox Aquifer

| Management Plan requirement | Aquifer or confining unit | Results |
|---|---|---|
| Estimated annual amount of recharge from precipitation to the district | Carrizo-Wilcox Aquifer | 26,266 |
| Estimated annual volume of water that discharges from the aquifer to springs and any surface-water body including lakes, streams, and rivers | Carrizo-Wilcox Aquifer | 29,010 |
| Estimated annual volume of flow into the district within each aquifer in the district | Carrizo-Wilcox Aquifer | 19,237 |
| Estimated annual volume of flow out of the district within each aquifer in the district | Carrizo-Wilcox Aquifer | 25,823 |
| Estimated net annual volume of flow between each aquifer in the district | Carrizo-Wilcox Aquifer into the overlying Reklaw Confining Unit | 237 |

Units are in acre-feet per year

# Post-Oak Savannah GCD Yegua-Jackson Aquifer

| Management Plan requirement | Aquifer or confining unit | Results |
|---|---|---|
| Estimated annual amount of recharge from precipitation to the district | Yegua-Jackson Aquifer | 22,459 |
| 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 | 13,932 |
| Estimated annual volume of flow into the district within each aquifer in the district | Yegua-Jackson Aquifer | 5,087 |
| Estimated annual volume of flow out of the district within each aquifer in the district | Yegua-Jackson Aquifer | 8,690 |
| Estimated net annual volume of flow between each aquifer in the district | Yegua-Jackson Aquifer | NA[2] |

Units are in acre-feet per year

# Post-Oak Savannah GCD
# Brazos River Alluvium Aquifer

| Management Plan requirement | Aquifer or confining unit | Results |
|---|---|---|
| Estimated annual amount of recharge from precipitation to the district | Brazos River Alluvium Aquifer | 15,510 |
| Estimated annual volume of water that discharges from the aquifer to springs and any surface-water body including lakes, streams, and rivers | Brazos River Alluvium Aquifer | 25,447 |
| Estimated annual volume of flow into the district within each aquifer in the district | Brazos River Alluvium Aquifer | 15,181 |
| Estimated annual volume of flow out of the district within each aquifer in the district | Brazos River Alluvium Aquifer | 19,706 |
| Estimated net annual volume of flow between each aquifer in the district | Flow into the Brazos River Alluvium Aquifer from underlying formations and geological units | 9,532 |

Units are in acre-feet per year

# Brazos Valley GCD
# Carrizo-Wilcox Aquifer

| Management Plan requirement | Aquifer or confining unit | Results |
|---|---|---|
| Estimated annual amount of recharge from precipitation to the district | Carrizo-Wilcox Aquifer | 47,122 |
| Estimated annual volume of water that discharges from the aquifer to springs and any surface-water body including lakes, streams, and rivers | Carrizo-Wilcox Aquifer | 54,520 |
| Estimated annual volume of flow into the district within each aquifer in the district | Carrizo-Wilcox Aquifer | 32,600 |
| Estimated annual volume of flow out of the district within each aquifer in the district | Carrizo-Wilcox Aquifer | 10,109 |
| Estimated net annual volume of flow between each aquifer in the district | Flow into the Carrizo-Wilcox Aquifer from downdip Carrizo-Wilcox units | 2,537 |
| | Flow from the Carrizo-Wilcox Aquifer into the overlying Reklaw Confining Unit | 1,951 |
| | Flow into the Queen City Aquifer from the Carrizo-Wilcox Aquifer | 95 |
| | Flow from the Carrizo-Wilcox Aquifer into the Brazos River Alluvium Aquifer[1] | 2,290 |

Units are in acre-feet per year

# Brazos Valley GCD
# Queen City Aquifer

| Management Plan requirement | Aquifer or confining unit | Results |
|---|---|---|
| Estimated annual amount of recharge from precipitation to the district | Queen City Aquifer | 10,391 |
| Estimated annual volume of water that discharges from the aquifer to springs and any surface-water body including lakes, streams, and rivers | Queen City Aquifer | 11,123 |
| Estimated annual volume of flow into the district within each aquifer in the district | Queen City Aquifer | 3,046 |
| Estimated annual volume of flow out of the district within each aquifer in the district | Queen City Aquifer | 1,211 |
| Estimated net annual volume of flow between each aquifer in the district | Flow into the Queen City Aquifer from the Carrizo-Wilcox Aquifer | 95 |
| | Flow into the Queen City Aquifer from the underlying Reklaw Confining Unit | 1,896 |
| | Flow into the Queen City Aquifer from downdip Queen City units | 30 |
| | Flow from the Queen City Aquifer into the overlying Weches Confining Unit | 2,818 |
| | Flow from the Queen City Aquifer into the Sparta Aquifer | 205 |
| | Flow from the Queen City Aquifer into the Brazos River Alluvium Aquifer[2] | 6,288 |

Units are in acre-feet per year

# Brazos Valley GCD
# Sparta Aquifer

| Management Plan requirement | Aquifer or confining unit | Results |
|---|---|---|
| Estimated annual amount of recharge from precipitation to the district | Sparta Aquifer | 8,568 |
| Estimated annual volume of water that discharges from the aquifer to springs and any surface-water body including lakes, streams, and rivers | Sparta Aquifer | 12,874 |
| Estimated annual volume of flow into the district within each aquifer in the district | Sparta Aquifer | 1,415 |
| Estimated annual volume of flow out of the district within each aquifer in the district | Sparta Aquifer | 347 |
| Estimated net annual volume of flow between each aquifer in the district | Flow from the Queen City Aquifer into the Sparta Aquifer | 205 |
| | Flow into the Sparta Aquifer from the underlying Weches Confining Unit | 2,542 |
| | Flow from the Sparta Aquifer into downdip Sparta units | 8 |
| | Flow from the Sparta Aquifer into overlying units | 149 |
| | Flow from the Sparta Aquifer into the Brazos River Alluvium Aquifer[3] | 3,870 |

Units are in acre-feet per year

# Brazos Valley GCD
# Yegua-Jackson Aquifer

| Management Plan requirement | Aquifer or confining unit | Results |
|---|---|---|
| Estimated annual amount of recharge from precipitation to the district | Yegua-Jackson Aquifer | 26,512 |
| 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 | 39,287 |
| Estimated annual volume of flow into the district within each aquifer in the district | Yegua-Jackson Aquifer | 12,069 |
| Estimated annual volume of flow out of the district within each aquifer in the district | Yegua-Jackson Aquifer | 9,923 |
| Estimated net annual volume of flow between each aquifer in the district | Flow into the Yegua-Jackson Aquifer from the Catahoula and younger units | 17 |
| | Flow from the confined portion of the Yegua and Jackson groups into the Yegua-Jackson Aquifer | 134 |
| | Flow from the Yegua-Jackson Aquifer into the Brazos River Alluvium Aquifer[4] | 2,399 |

Units are in acre-feet per year

# Brazos Valley GCD
# Brazos River Alluvium Aquifer

| Management Plan requirement | Aquifer or confining unit | Results |
|---|---|---|
| Estimated annual amount of recharge from precipitation to the district | Brazos River Alluvium Aquifer | 23,333 |
| Estimated annual volume of water that discharges from the aquifer to springs and any surface-water body including lakes, streams, and rivers | Brazos River Alluvium Aquifer | 33,859 |
| Estimated annual volume of flow into the district within each aquifer in the district | Brazos River Alluvium Aquifer | 24,447 |
| Estimated annual volume of flow out of the district within each aquifer in the district | Brazos River Alluvium Aquifer | 20,432 |
| Estimated net annual volume of flow between each aquifer in the district | Flow from the Carrizo-Wilcox Aquifer into the Brazos River Alluvium Aquifer | 2,290 |
| | Flow from the Queen City Aquifer into the Brazos River Alluvium Aquifer | 6,288 |
| | Flow from the Sparta Aquifer into the Brazos River Alluvium Aquifer | 3,870 |
| | Flow from the Yegua-Jackson Aquifer into the Brazos River Alluvium Aquifer | 2,399 |
| | Flow from the Gulf Coast Aquifer System into the Brazos River Alluvium | 2,154 |

Units are in acre-feet per year

# Brazos Valley GCD
# Gulf Coast Aquifer

| Management Plan requirement | Aquifer or confining unit | Results |
|---|---|---|
| Estimated annual amount of recharge from precipitation to the district | Gulf Coast Aquifer System | 40 |
| Estimated annual volume of water that discharges from the aquifer to springs and any surface-water body including lakes, streams, and rivers | Gulf Coast Aquifer System | 255 |
| Estimated annual volume of flow into the district within each aquifer in the district | Gulf Coast Aquifer System | 332 |
| Estimated annual volume of flow out of the district within each aquifer in the district | Gulf Coast Aquifer System | 48 |
| Estimated net annual volume of flow between each aquifer in the district | Flow into the Catahoula unit from the Jasper Aquifer[5] | 46 |
| | Flow from the Gulf Coast Aquifer System into the Brazos River Alluvium[6] | 2,154 |

Units are in acre-feet per year

# Mid-East Texas GCD Carrizo-Wilcox Aquifer

| Management Plan requirement | Aquifer or confining unit | Results |
|---|---|---|
| Estimated annual amount of recharge from precipitation to the district | Carrizo-Wilcox Aquifer | 105,777 |
| Estimated annual volume of water that discharges from the aquifer to springs and any surface-water body including lakes, streams, and rivers | Carrizo-Wilcox Aquifer | 113,293 |
| Estimated annual volume of flow into the district within each aquifer in the district | Carrizo-Wilcox Aquifer | 17,377 |
| Estimated annual volume of flow out of the district within each aquifer in the district | Carrizo-Wilcox Aquifer | 20,772 |
| Estimated net annual volume of flow between each aquifer in the district | Flow from the Carrizo-Wilcox Aquifer into downdip Carrizo-Wilcox units | 523 |
| | Flow into the Carrizo-Wilcox Aquifer from the overlying Reklaw Confining Unit | 1,491 |
| | Flow into the Queen City Aquifer from the Carrizo-Wilcox Aquifer | 1,394 |

Units are in acre-feet per year

# Mid-East Texas GCD
# Queen City Aquifer

| Management Plan requirement | Aquifer or confining unit | Results |
|---|---|---|
| Estimated annual amount of recharge from precipitation to the district | Queen City Aquifer | 69,600 |
| Estimated annual volume of water that discharges from the aquifer to springs and any surface-water body including lakes, streams, and rivers | Queen City Aquifer | 74,582 |
| Estimated annual volume of flow into the district within each aquifer in the district | Queen City Aquifer | 4,417 |
| Estimated annual volume of flow out of the district within each aquifer in the district | Queen City Aquifer | 3,886 |
| Estimated net annual volume of flow between each aquifer in the district | Flow into the Queen City Aquifer from the Carrizo-Wilcox Aquifer | 1,394 |
| | Flow into the Queen City Aquifer from the underlying Reklaw Confining Unit | 445 |
| | Flow into the Queen City Aquifer from downdip Queen City units | 11 |
| | Flow from the Queen City Aquifer into the overlying Weches Confining Unit | 872 |
| | Flow into the Queen City Aquifer from the Sparta Aquifer | 802 |

Units are in acre-feet per year

# Mid-East Texas GCD
# Sparta Aquifer

| Management Plan requirement | Aquifer or confining unit | Results |
|---|---|---|
| Estimated annual amount of recharge from precipitation to the district | Sparta Aquifer | 21,332 |
| Estimated annual volume of water that discharges from the aquifer to springs and any surface-water body including lakes, streams, and rivers | Sparta Aquifer | 24,201 |
| Estimated annual volume of flow into the district within each aquifer in the district | Sparta Aquifer | 1,459 |
| Estimated annual volume of flow out of the district within each aquifer in the district | Sparta Aquifer | 1,513 |
| Estimated net annual volume of flow between each aquifer in the district | Flow into the Queen City Aquifer from the Sparta Aquifer | 725 |
| | Flow into the Sparta Aquifer from the underlying Weches Confining Unit | 949 |
| | Flow from the Sparta Aquifer into overlying units | 850 |

Units are in acre-feet per year

# Mid-East Texas GCD Carrizo-Wilcox Aquifer

| Management Plan requirement | Aquifer or confining unit | Results |
|---|---|---|
| Estimated annual amount of recharge from precipitation to the district | Yegua-Jackson Aquifer | 31,137 |
| 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 | 46,448 |
| Estimated annual volume of flow into the district within each aquifer in the district | Yegua-Jackson Aquifer | 15,344 |
| Estimated annual volume of flow out of the district within each aquifer in the district | Yegua-Jackson Aquifer | 10,411 |
| Estimated net annual volume of flow between each aquifer in the district | Yegua-Jackson Aquifer | 0[1] |

Units are in acre-feet per year

# *QUESTIONS?*

# Tentative GMA 12 Schedule

- **Tentative GMA 12 schedule for the GMA to consider**
- January 29, 2020- Additional Y-J and BRA GAM runs and discussion; begin discussion of nine factors (hydrologic conditions); get direction on Carrizo-Wilcox model runs; discuss draft White Paper regarding groundwater management/planning;
- April, 2020- Continue discussion of nine factors (Supplies/Needs/WMS; Aquifer Uses & Conditions; Subsidence); present and discuss results of any new modeling scenarios; get direction on new modeling scenarios; discuss potential DFCs for certain aquifers;

# Tentative GMA 12 Schedule

- July, 2020- Continue discussion of nine factors (socioeconomic and environmental considerations; private property rights); present and discuss results of any new modeling scenarios; get direction on new modeling scenarios if needed; discuss potential DFCs;
- Fall 2020- Discuss and finalize proposed DFCs, discuss DFC feasibility factor (have to have specific proposed DFCs to complete this factor analysis);
- Winter 2020-2021- Individual GCDs meet, discuss, and formally approve/adopt proposed DFCs;

# Tentative GMA 12 Schedule

- Spring 2021- GMA 12 meeting to discuss outcome of individual GCD meetings and potentially adopt proposed DFCs
- Mid-April, 2021- GMA 12 meeting to adopt proposed DFCs if not done previously
- May 1, 2021- Deadline for proposed DFC submittal to TWDB (this is a Saturday, so plan on submitting by Friday, April 30, 2021)
- Summer 2021- GCDs receive public comments and hold public hearings
- Fall 2021- GMA 12 meets and reviews and discusses public comment received

# Tentative GMA 12 Schedule

- Winter 2021- GMA 12 meeting to adopt final DFCs, discuss draft Explanatory Report
- Jan. 5, 2022- Deadline for final DFC adoption
- Spring 2022- Adopt final Explanatory Report