GMA 12

Hydrological Conditions Consideration Discussion

by

GMA 12 Consultant Team

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)

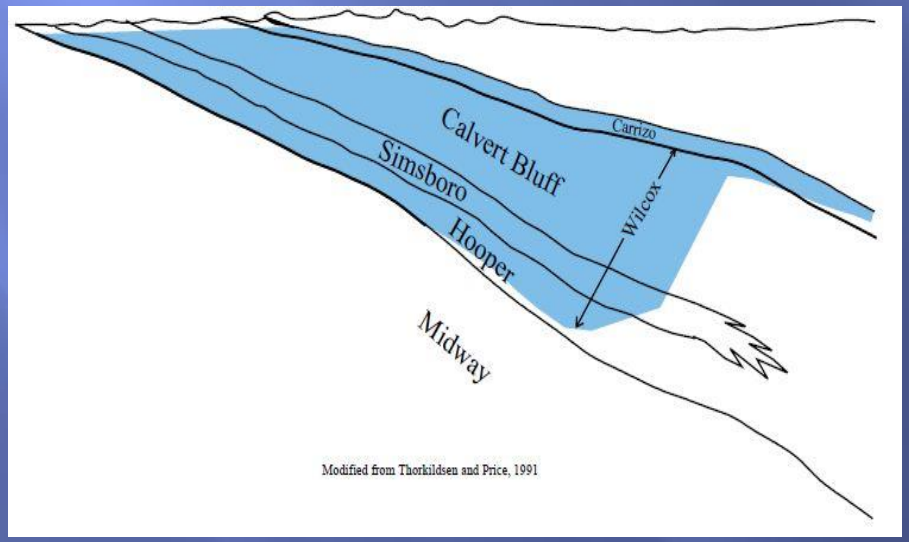
- The desired future conditions … must provide a balance between the highest practicable level of groundwater production and the conservation, preservation, protection, recharging, and prevention of waste of groundwater … in the management area.

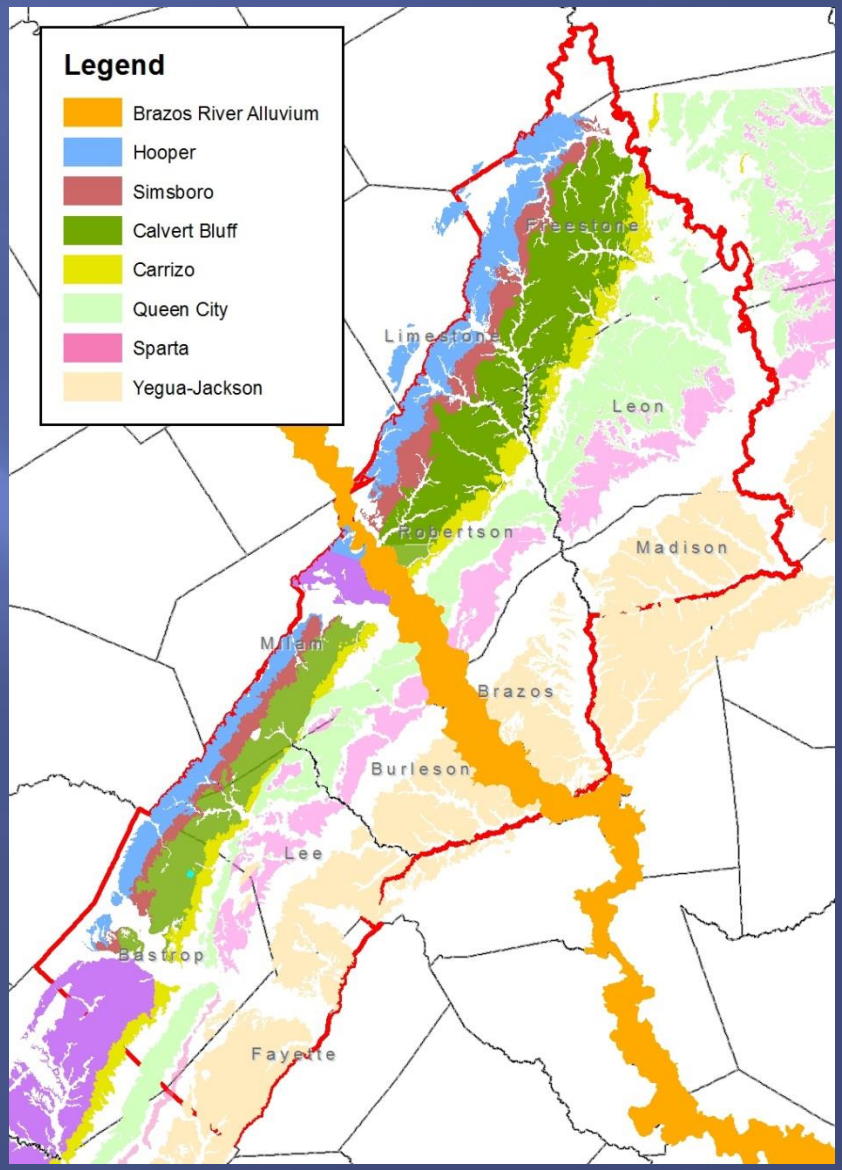
Consideration 3

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

Hydrological Conditions

- Aquifers outcrop from SW to NE
- Dip towards the coast



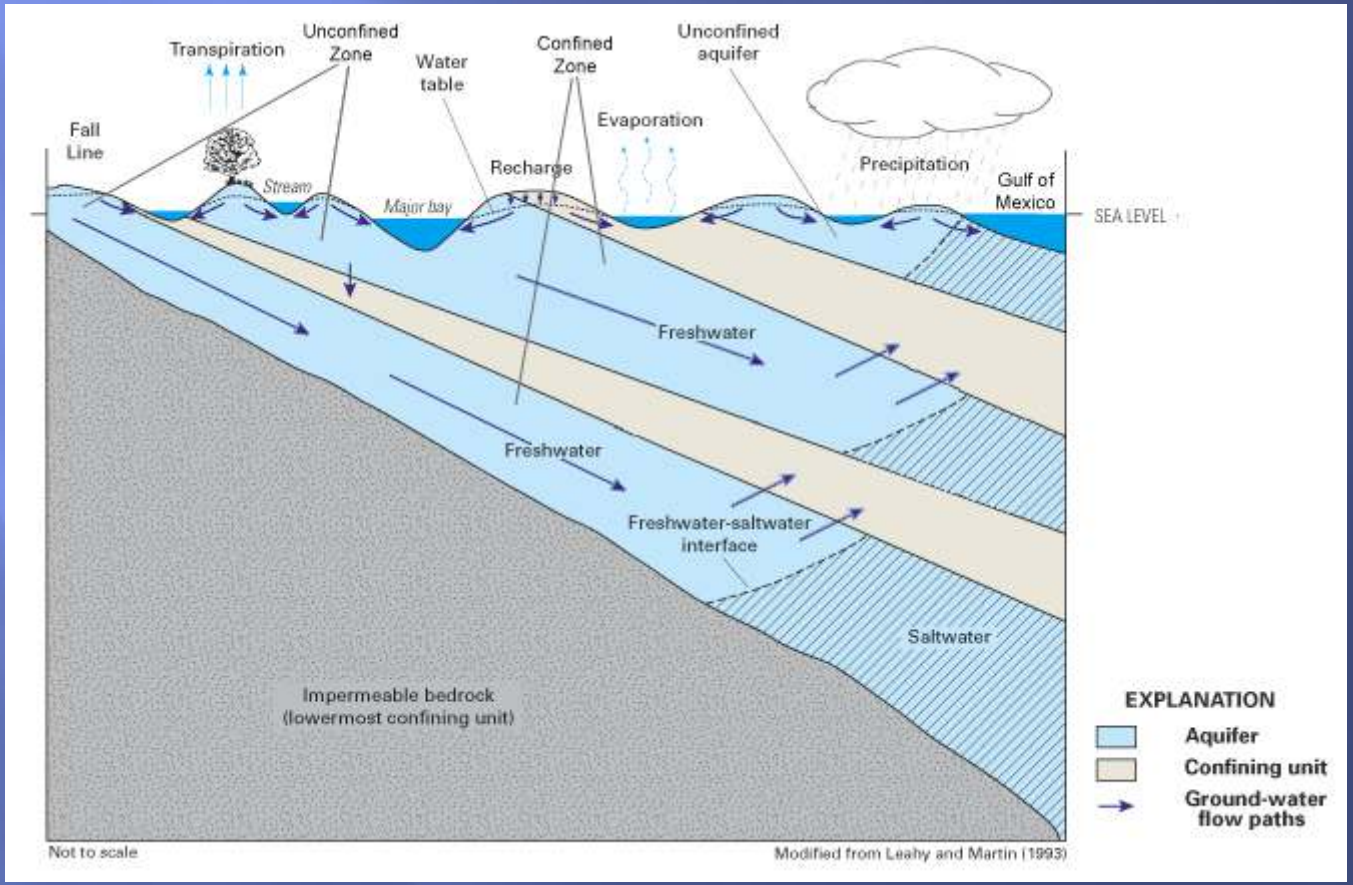


Hydrological Conditions

- Unconfined in outcrop, confined downdip
- Most pumpage and large projects are in the confined section
- Faults!!!!!

Hydrological Conditions

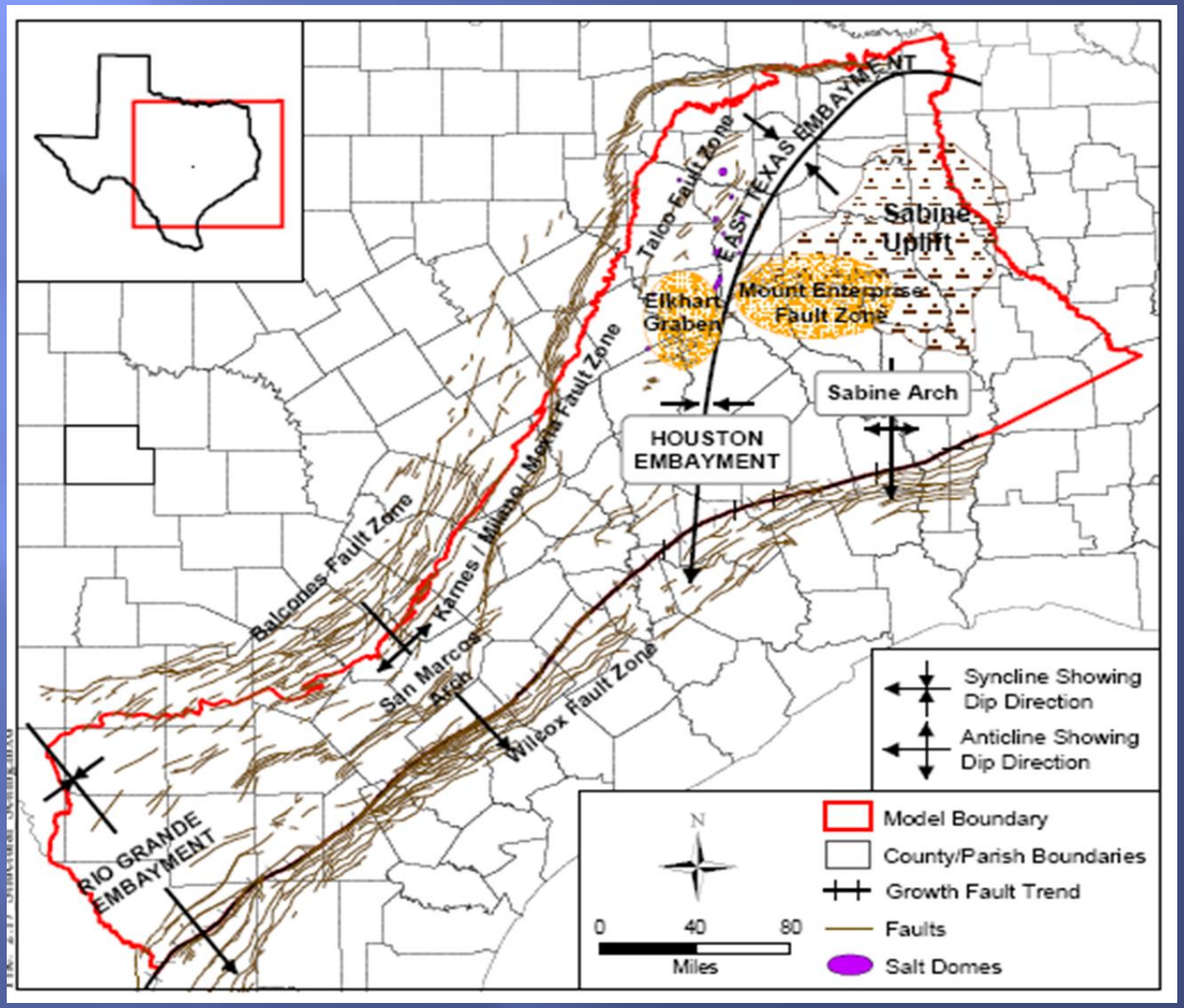
- Unconfined in outcrop, confined downdip



Faults

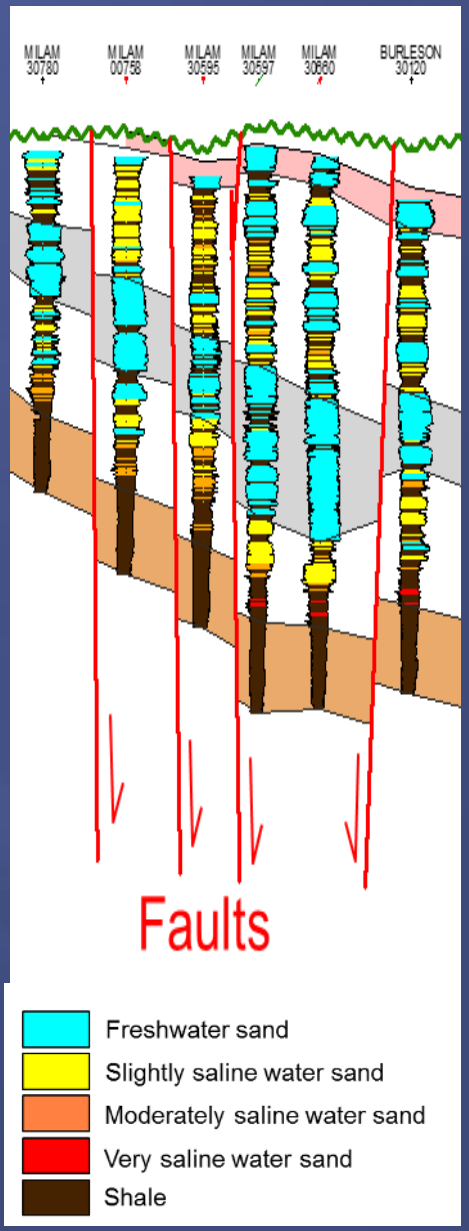
- Impact of faulting on groundwater flow in much of GMA 12 is an important consideration
- Many of the faults included in the GAM are "sealing" faults, allowing little water to move across them
- Unsure of real impact of faults on groundwater flow
- Impact of faults on the flow system is about to be re-evaluated in an updated GAM

Major Fault Zones

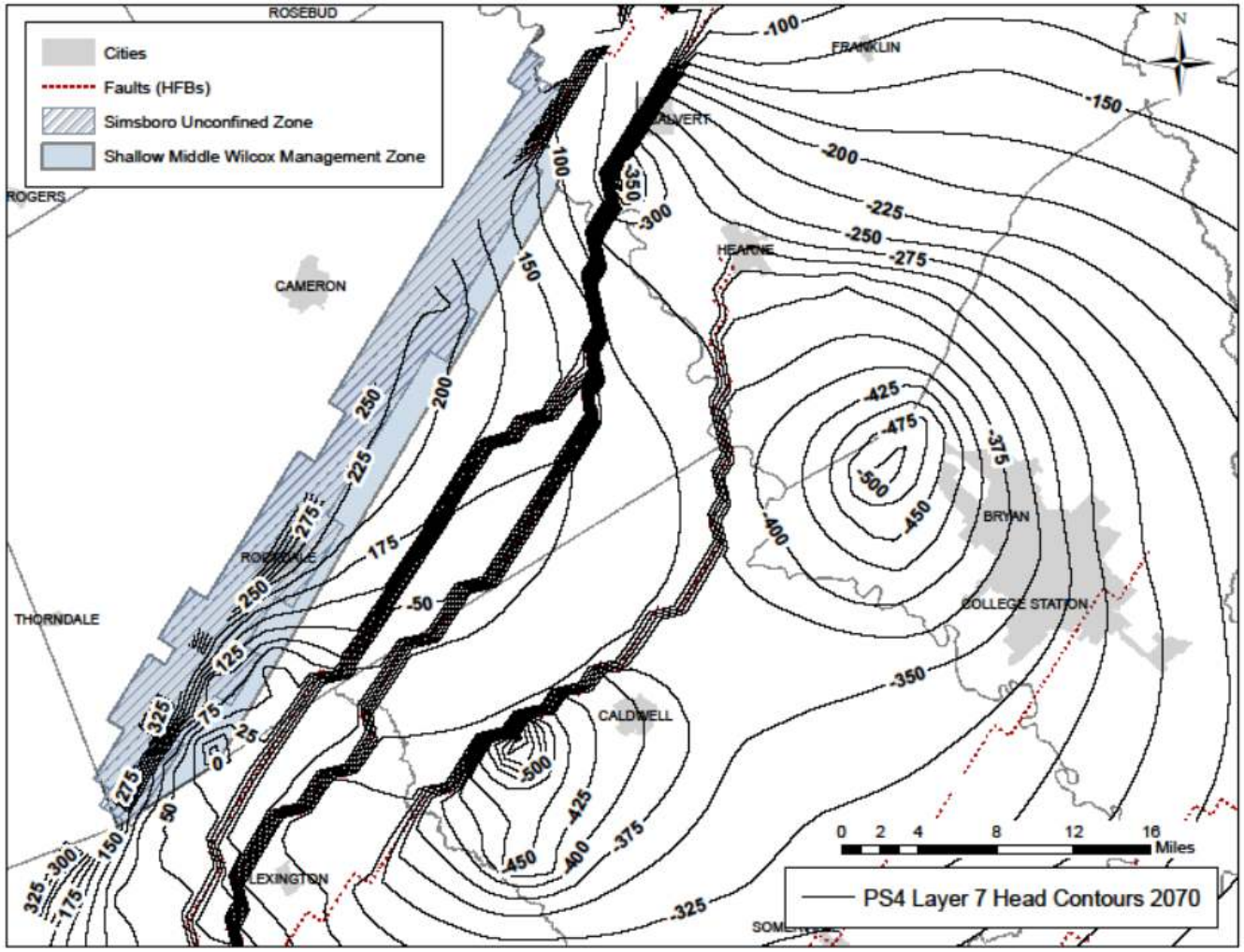


Impact of Faults on Groundwater Flow

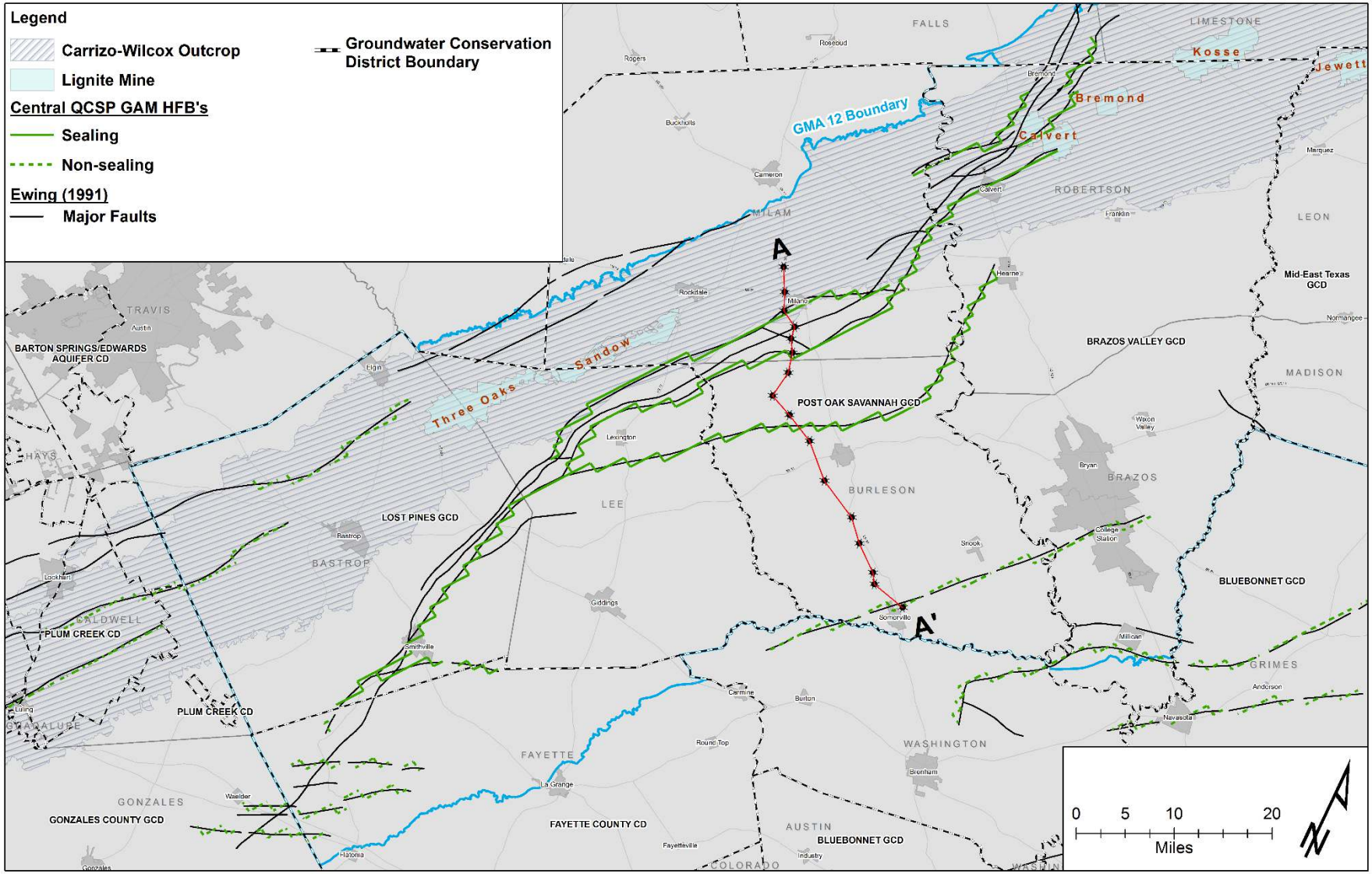
- Mexia-Talco Fault Zone created after sediments for Sparta, Queen City, and Carrizo-Wilcox Aquifers had been deposited
- Sediment thicknesses should be comparable on both sides of a fault
- Existing GAM classifies fault as either
  - Sealing (major impedance to groundwater flow)
  - Non-sealing (minor impact on groundwater flows)



Effects of Sealing Faults



Comparison of Simsboro Faults in Ewing (1991) and in GAM

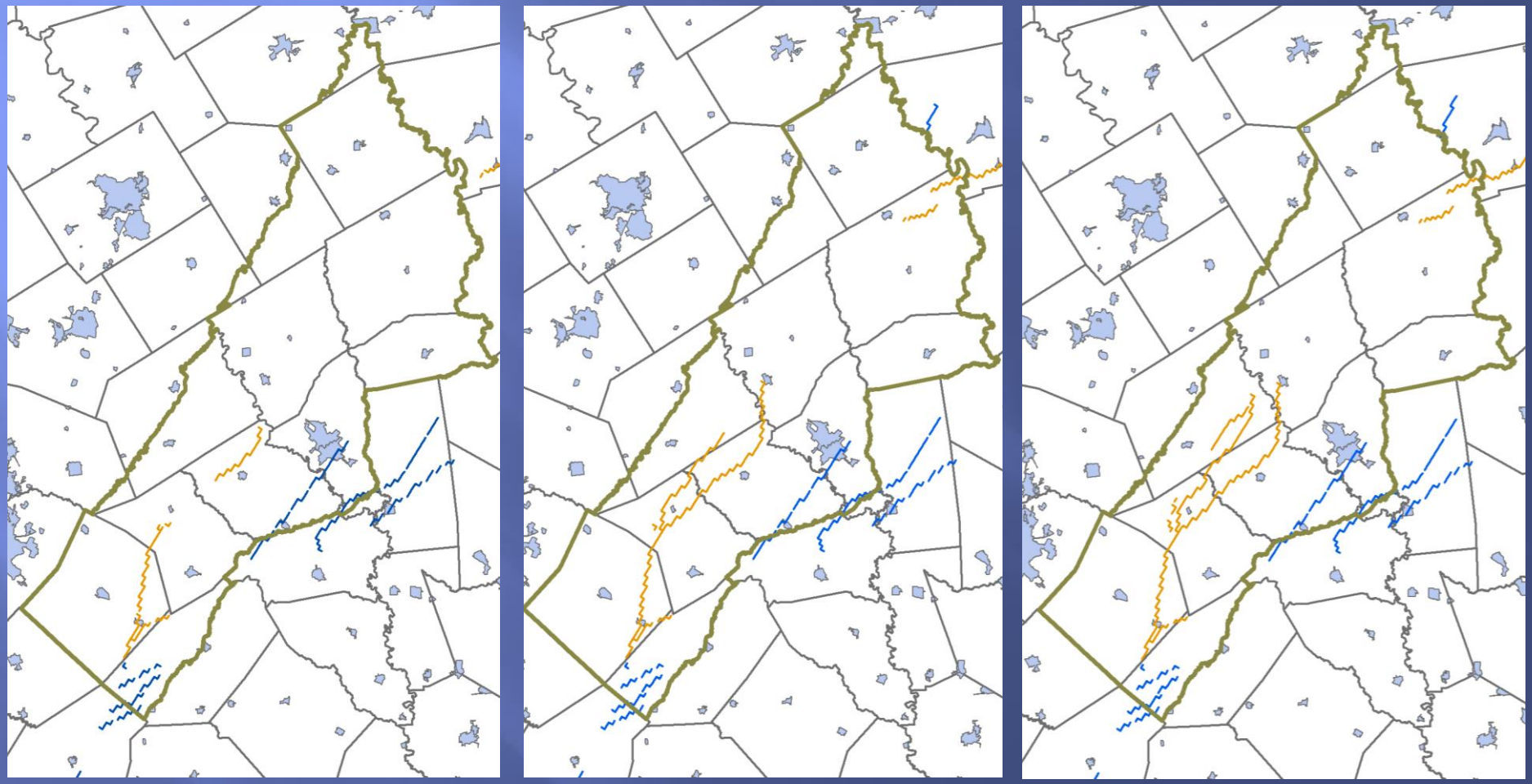


Fault Locations in GAM

Sparta

Queen City

Carrizo



Sealing Faults

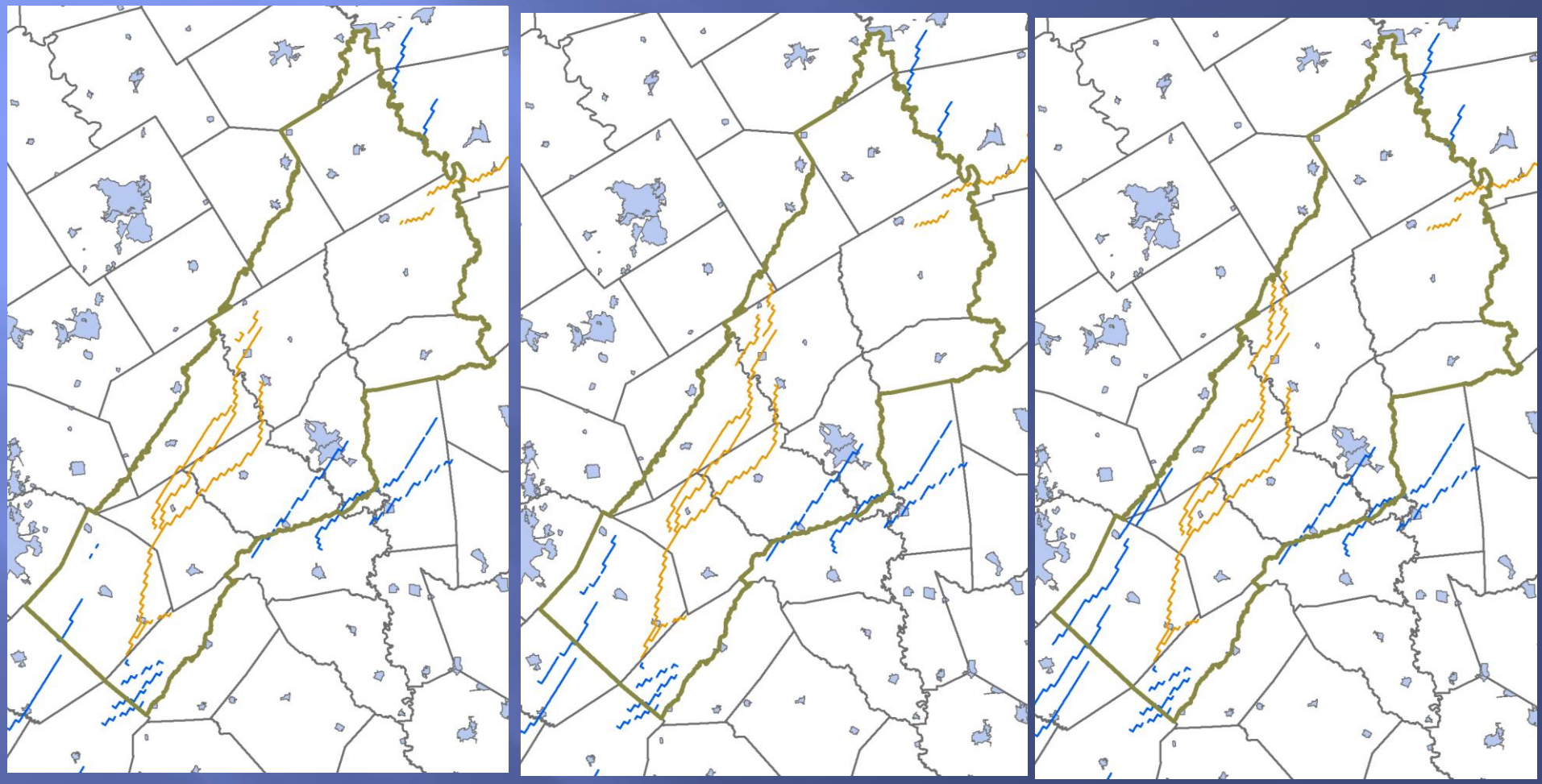
Non-Sealing Faults

Fault Locations in GAM

Calvert Bluff

Simsboro

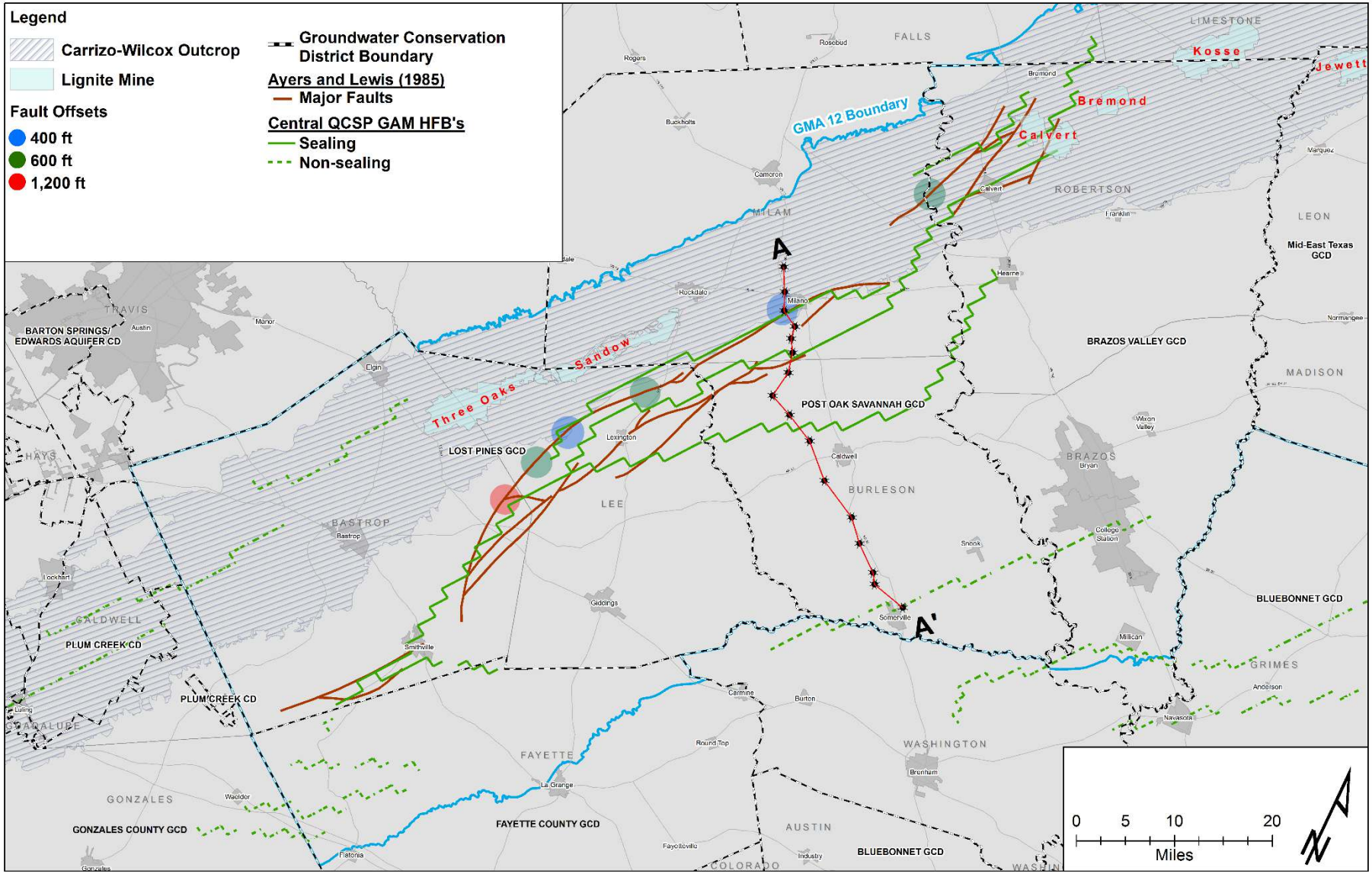
Hooper



Sealing Faults

Non-Sealing Faults

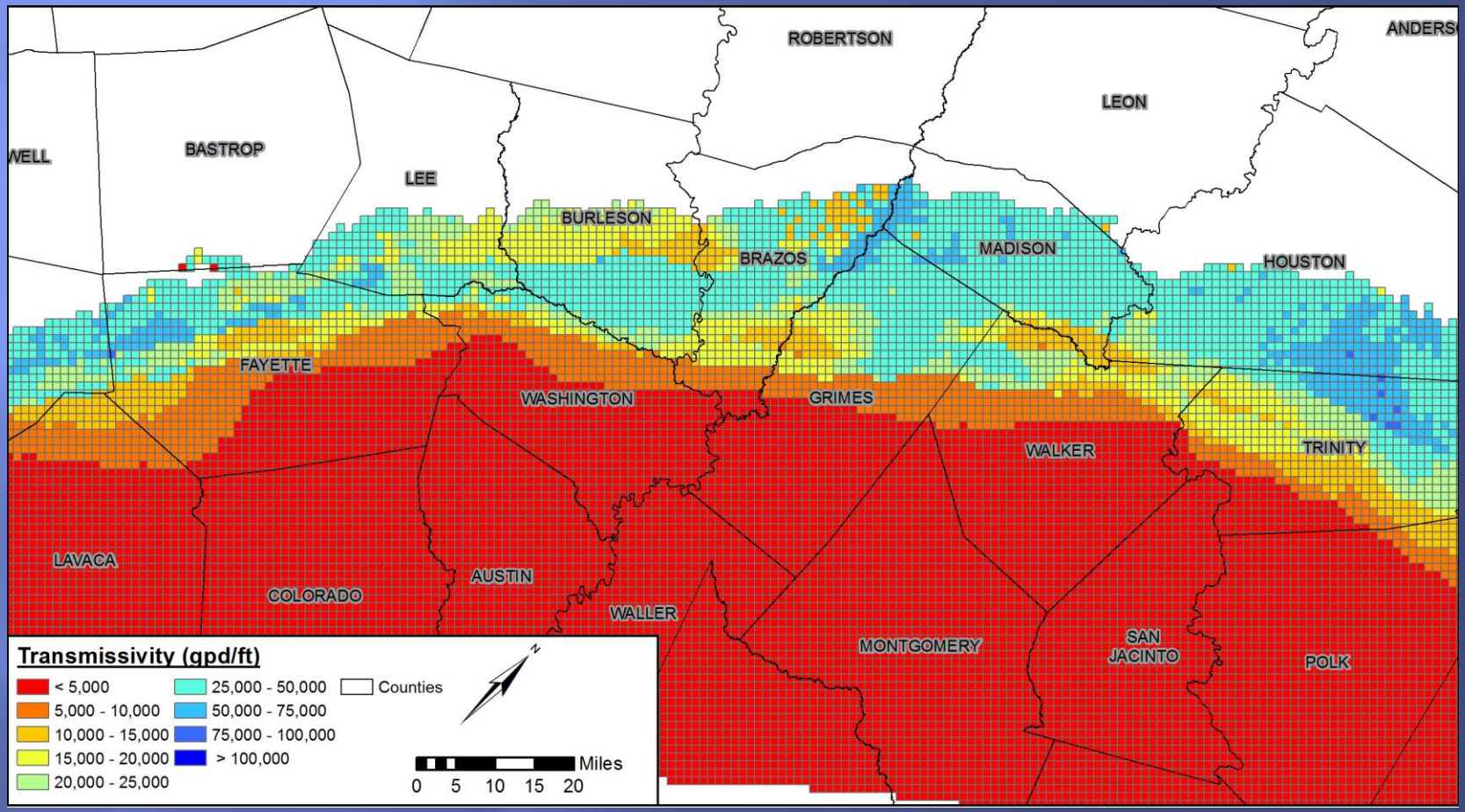
Comparison of Simsboro Faults in Ayers (1985) and in QCSP GAM



Yegua-Jackson Conditions

- Water is produced from the Yegua Formation and the Jackson Group, generally treat these together as one aquifer unit
- Groundwater primarily produced from shallow wells, most <1000'
- 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

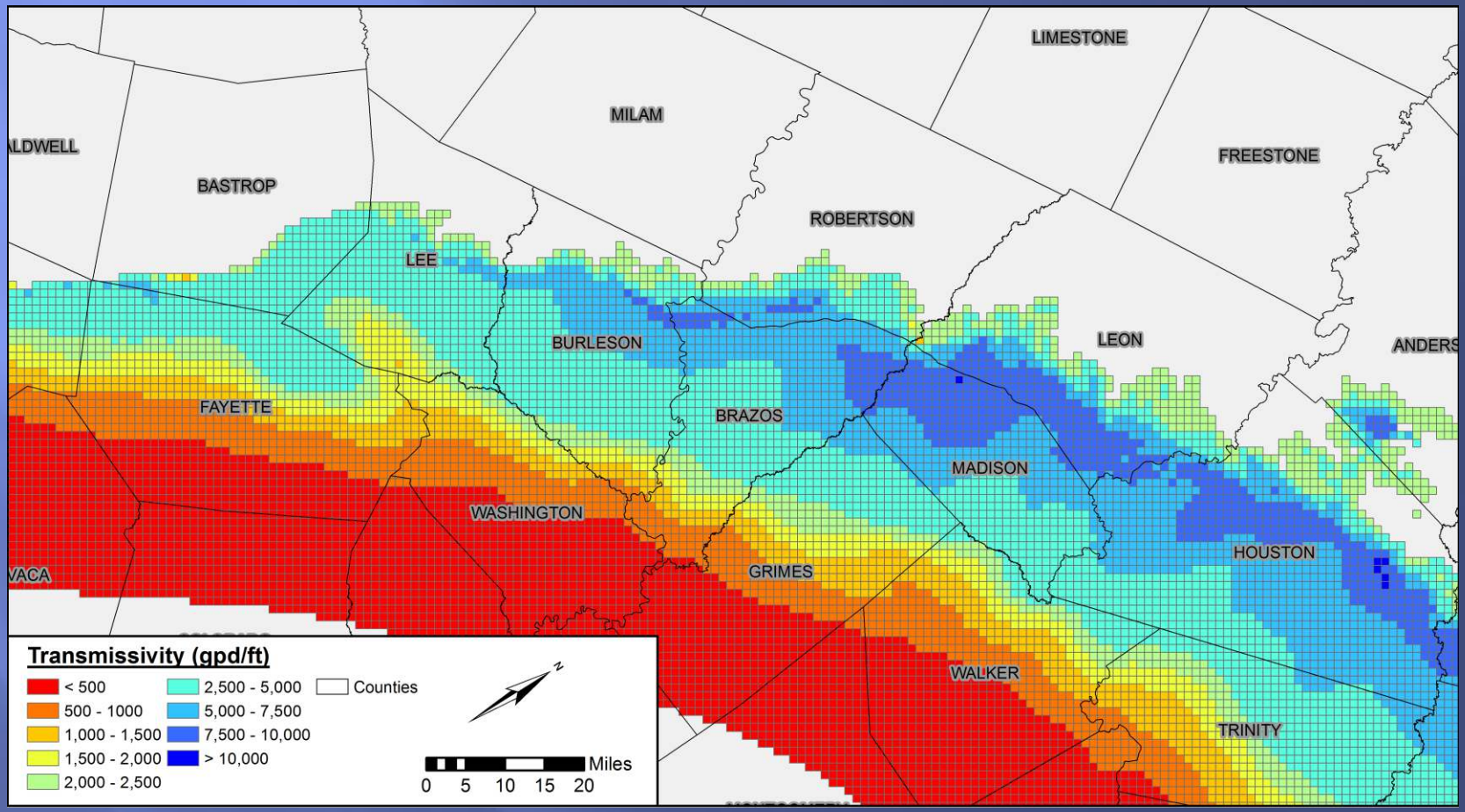
Yegua-Jackson Transmissivity



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', a few up to 2,000')
- Water quality usually fresh in and near outcrop, deteriorates downdip
- More prolific towards the northeastern portions of GMA 12
- Can produce small to moderate quantities of water in GMA 12

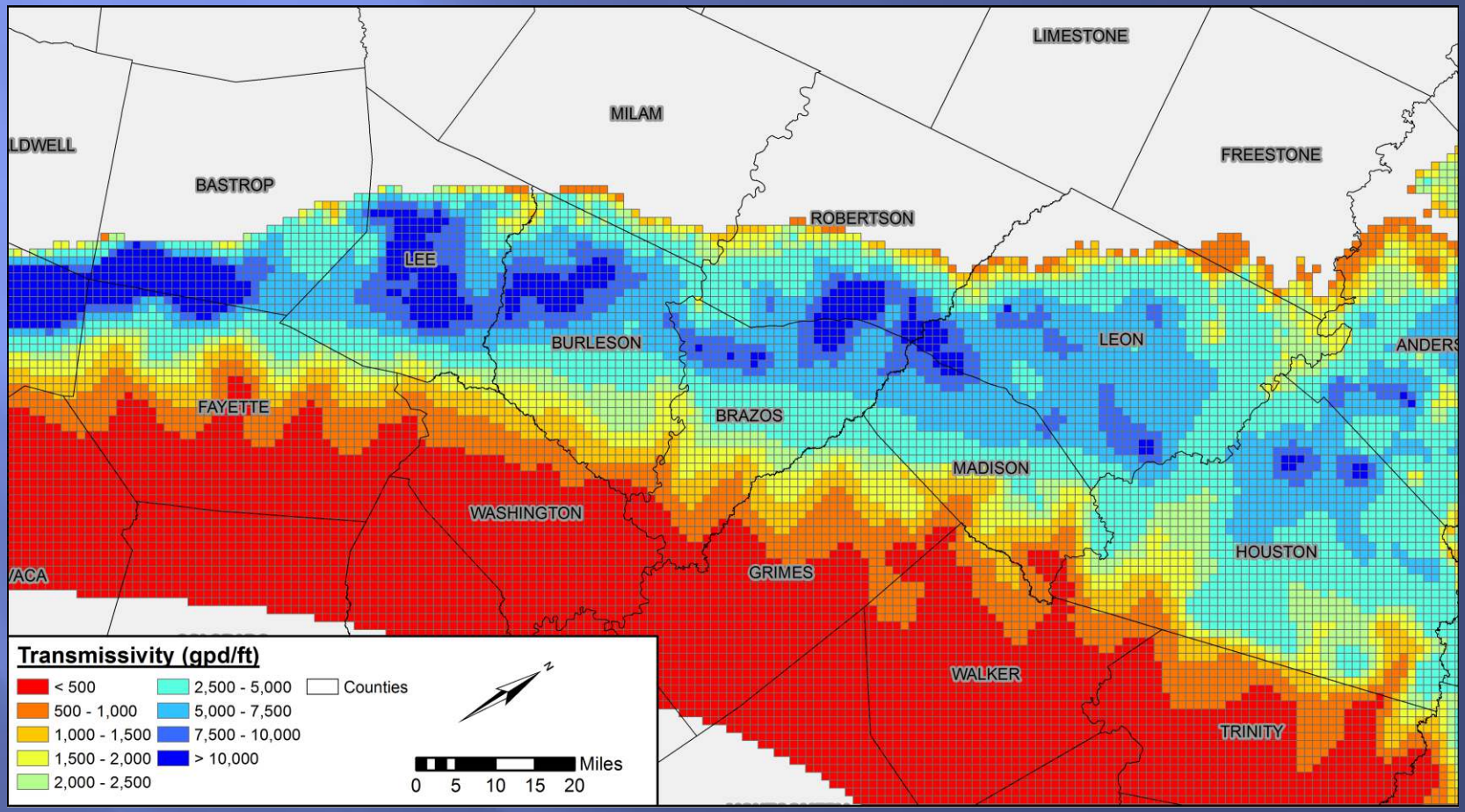
Sparta Transmissivity



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

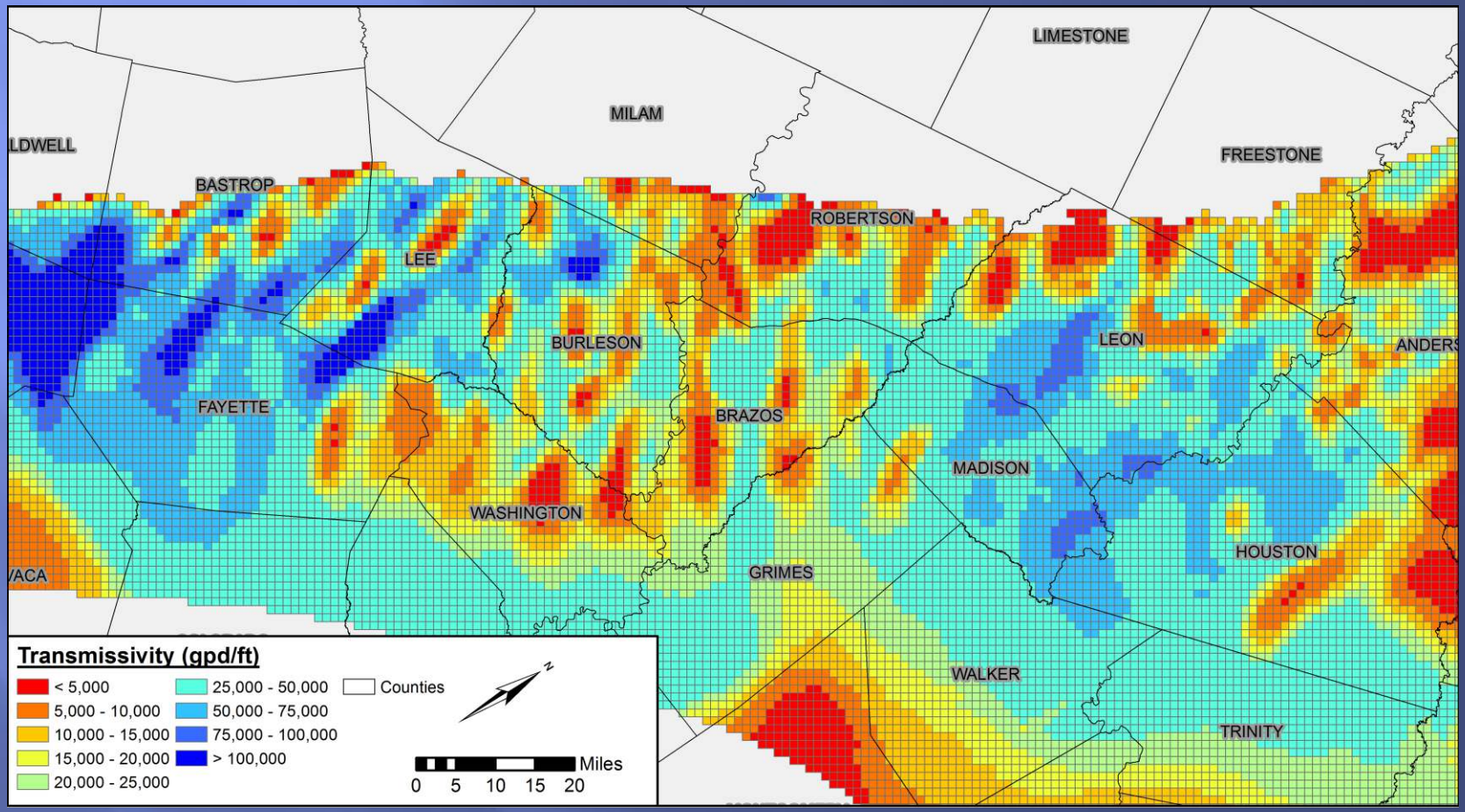
Queen City Transmissivity



Carrizo Conditions

- Water is produced from the Carrizo Formation, which is hydrologically connected to Wilcox and thus 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
- Becomes more prolific to the southeast, especially in GMA 13.
- Can be a very productive aquifer within GMA 12. Extremely productive aquifer in GMA 13.

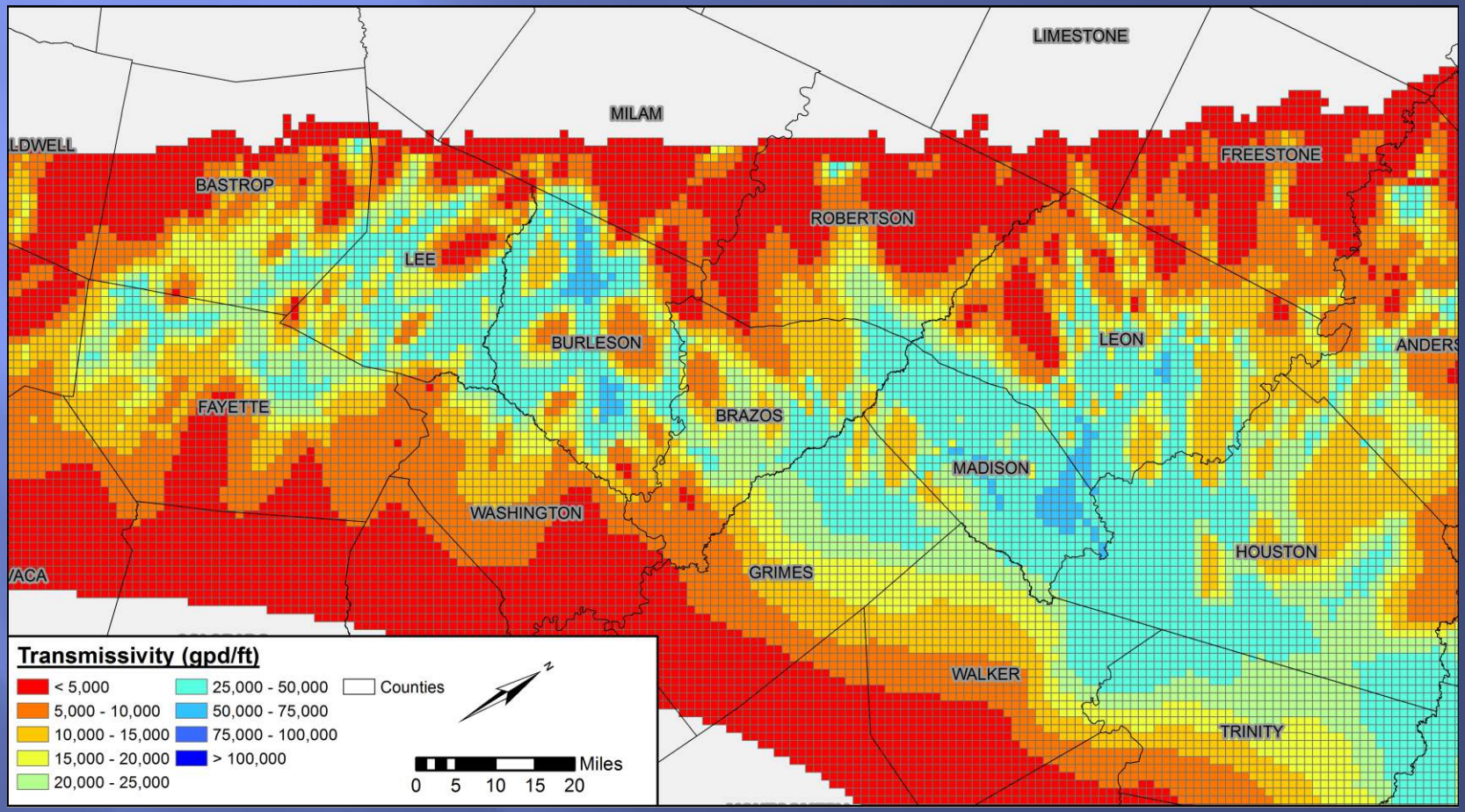
Carrizo Transmissivity



Calvert Bluff Conditions

- Water is produced from the Calvert Bluff Formation 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
- Can produce low to moderate quantities of water in GMA 12

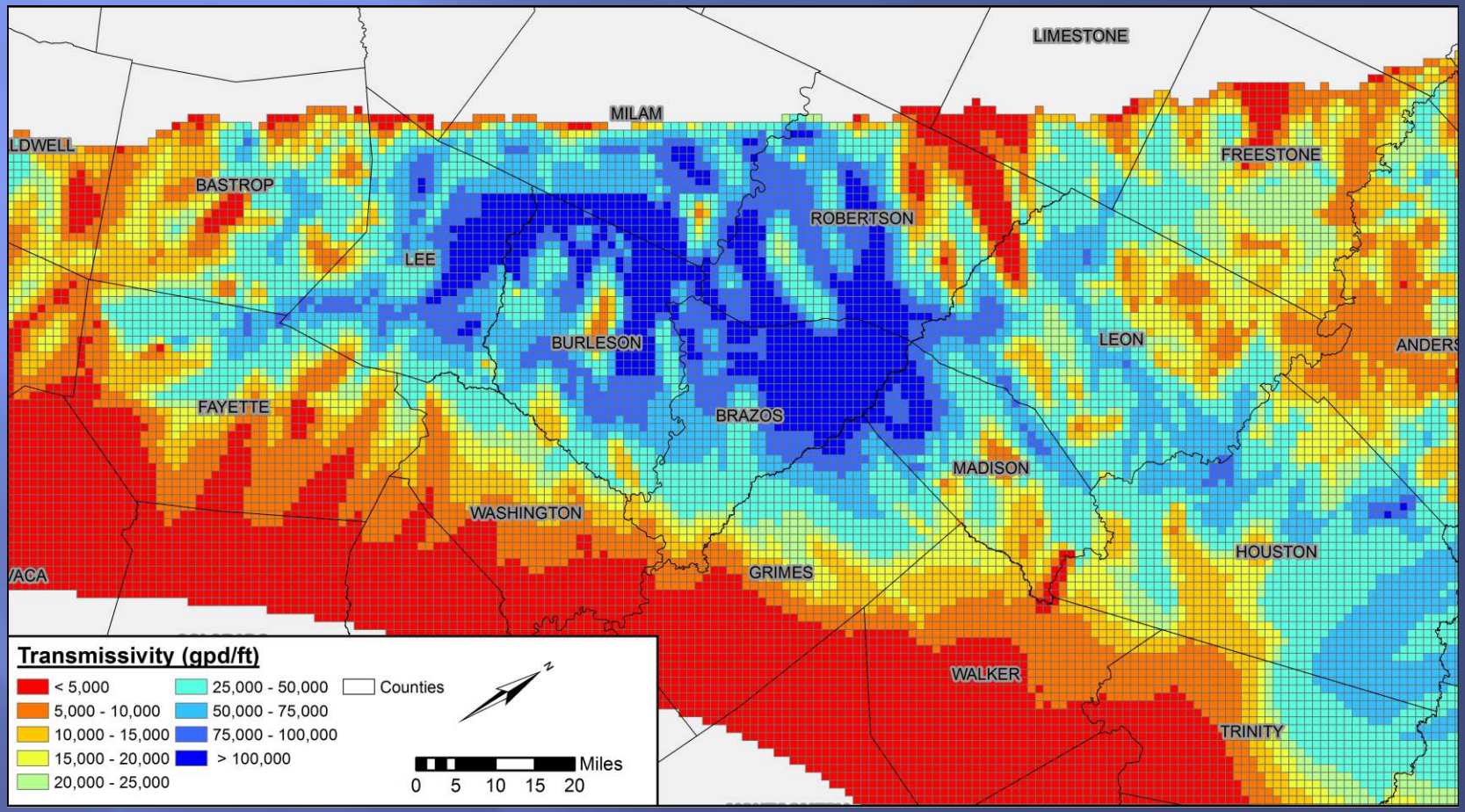
Calvert Bluff Transmissivity



Simsboro Conditions

- Water is produced from the Simsboro Formation 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
- Water quality generally fresh, deteriorates farther downdip
- More productive in the central portion of the GMA
- Extremely productive aquifer within GMA 12

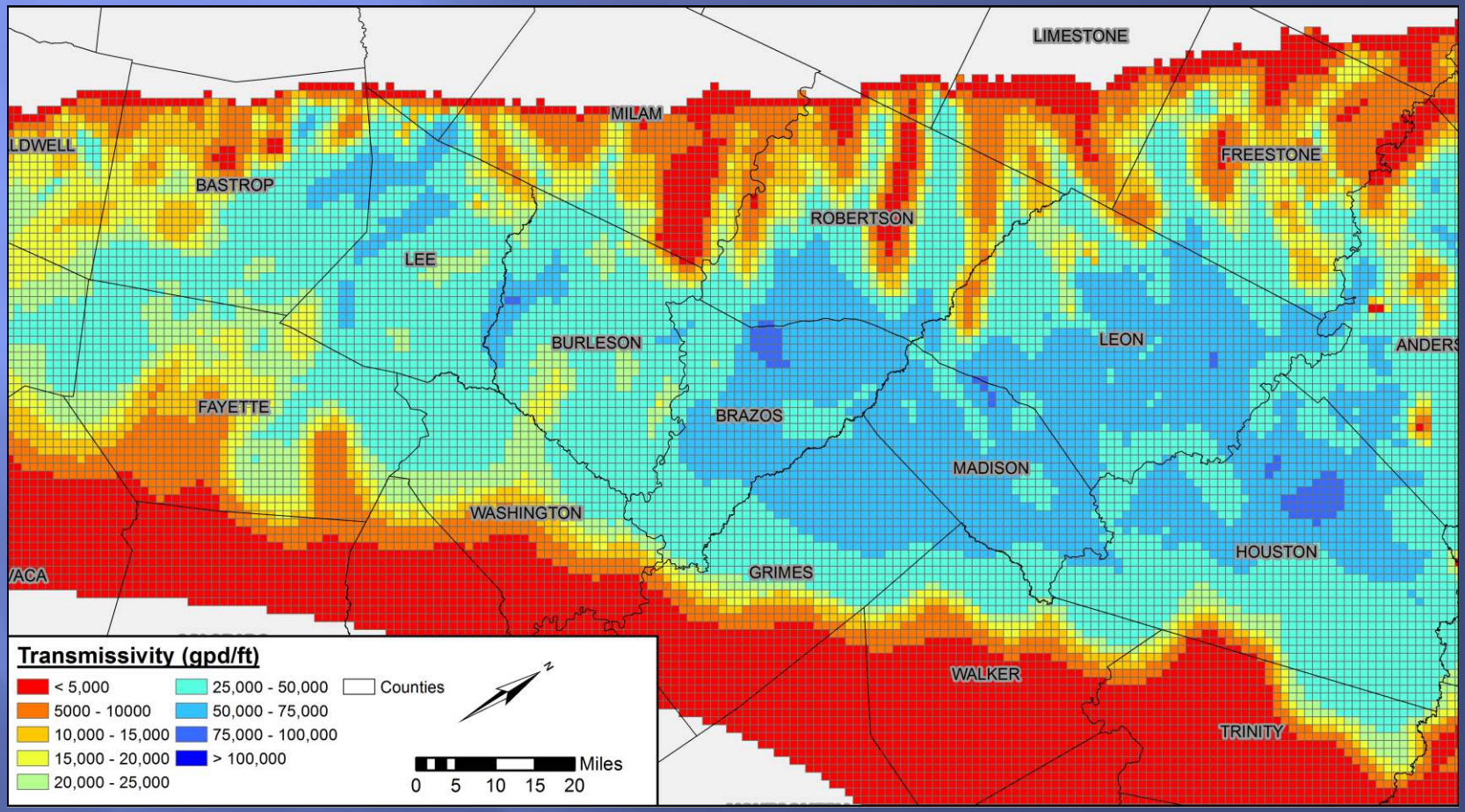
Simsboro Transmissivity



Hooper Conditions

- Water is produced from the Hooper Formation 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 thicknesses thin to near zero 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 Transmissivity



Brazos River Alluvium Conditions

- Water is produced from the alluvium deposited by the Brazos River
- Wells are very shallow (<100 feet)
- Water quality usually fresh, some pockets of poorer quality water
- Fairly consistent aquifer conditions across the extent of the aquifer within GMA 12
- Can be fairly productive

Total Estimated Recoverable Storage (TERS)

- Required to be evaluated as part of the DFC process
- Provided by the TWDB in GAM Task 13-035 report dated August 30, 2013
- "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)

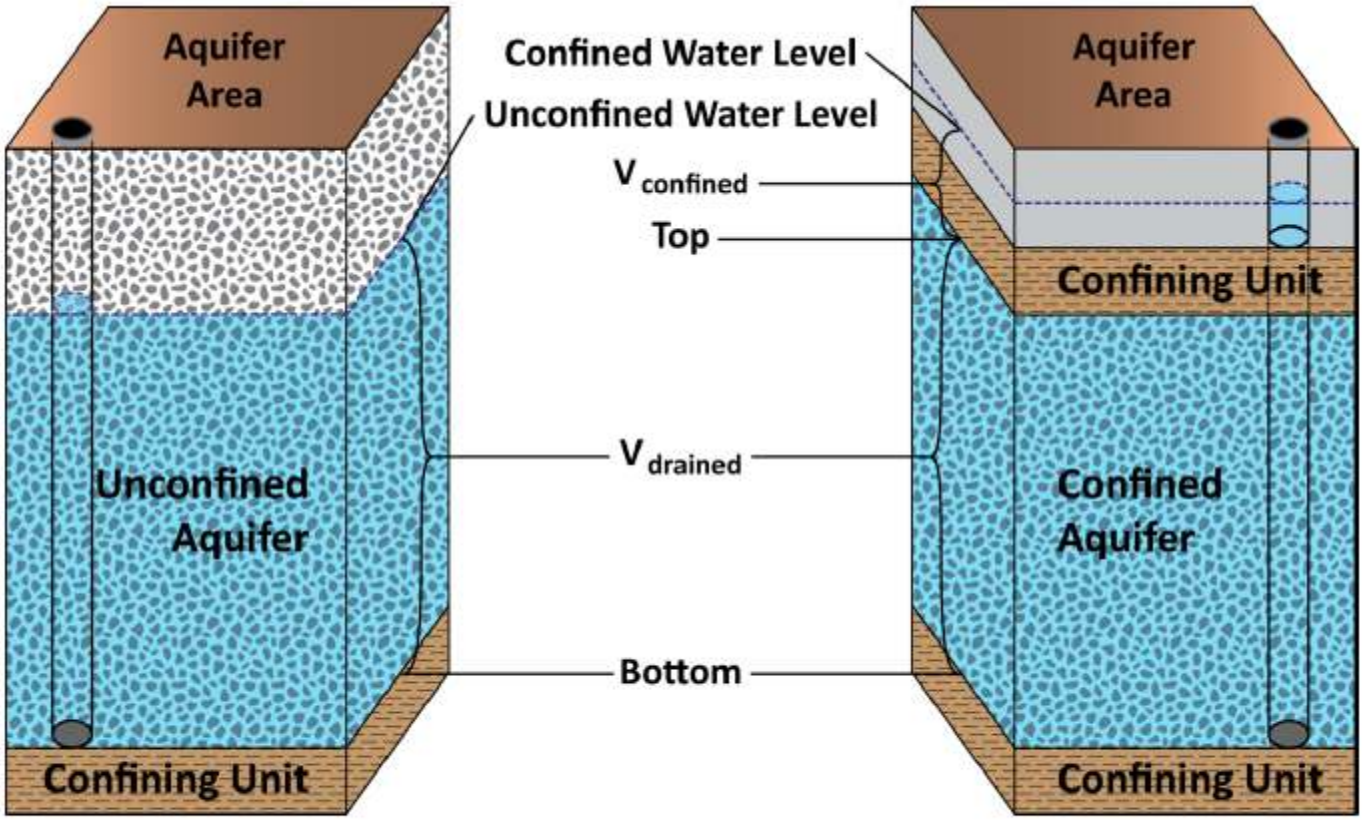


FIGURE 1. SCHEMATIC GRAPH SHOWING THE DIFFERENCE BETWEEN UNCONFINED AND CONFINED AQUIFERS.

Total Estimated Recoverable Storage (TERS)

- Does not account for water quality
- 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

Total Estimated Recoverable Storage (TERS)

- Solely based on how much water is present and how much can 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 in unconfined storage

Trinity Aquifer TERS

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

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

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

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

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

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

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

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

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

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

County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Brazos	180,000	45,000	135,000
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	928,140	232,035	696,105

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

Brazos River Alluvium Aquifer TERS

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	450,000	112,500	337,500
Post Oak Savannah GCD	480,000	120,000	360,000
Total	930,140	232,535	697,605

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

Annual Recharge, Inflows, and Discharge

- Required to be evaluated as part of the DFC process
- Provided by the TWDB in GAM Run reports in support of management plan development
- Fayette County GCD = GAM Run 13-002
- Lost Pines GCD = GAM Run 10-014
- Post Oak Savannah GCD = GAM Run 10-029
- Brazos Valley GCD = GAM Run 14-005
- Mid-East Texas GCD = GAM Run 13-024
- No values for Brazos River Alluvium

Fayette County GCD
Sparta Aquifer

Management Plan requirement	*Aquifer or confining unit*	*Results*
Estimated annual amount of recharge from precipitation to the district	Sparta Aquifer	379
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	514
Estimated annual volume of flow out of the district within each aquifer in the district	Sparta Aquifer	178
Estimated net annual volume of flow between each aquifer in the district	From the Sparta Aquifer into younger overlying units	1,656
	From the Weches Formation confining unit into the Sparta Aquifer	1,534
	From Sparta Aquifer to brackish Sparta	38

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	1,935
Estimated annual volume of flow out of the district within each aquifer in the district	Queen City Aquifer	499
Estimated net annual volume of flow between each aquifer in the district	From the Queen City Aquifer into the Weches Formation confining unit.	1,430
	From the Reklaw Formation confining unit into the Queen City Aquifer	198
	From the Queen City Aquifer to the brackish Queen City	87

Units are in acre-feet per year

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	7,134
Estimated annual volume of flow out of the district within each aquifer in the district	Carrizo-Wilcox Aquifer	2,966
Estimated net annual volume of flow between each aquifer in the district	From the Carrizo-Wilcox Aquifer into the Reklaw confining unit.	231
	From the Carrizo-Wilcox Aquifer to the brackish Carrizo-Wilcox	4,115

Units are in acre-feet 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	59,160
Estimated annual volume of flow into the district within each aquifer in the district	Yegua-Jackson Aquifer	9,849
Estimated annual volume of flow out of the district within each aquifer in the district	Yegua-Jackson Aquifer	6,492
Estimated net annual volume of flow between each aquifer in the district	From Yegua-Jackson Aquifer to brackish Yegua-Jackson	728
	From the Catahoula and overlying units into the Yegua-Jackson Aquifer	599

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	1,299
Estimated annual volume of flow out of the district within each aquifer in the district	Sparta Aquifer	733
Estimated net annual volume of flow between each aquifer in the district	Weches Confining Unit into the Sparta Aquifer	970

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	7,256
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	670
Estimated annual volume of flow out of the district within each aquifer in the district	Queen City Aquifer	3,354
Estimated net annual volume of flow between each aquifer in the district	Queen City Aquifer into the Weches Confining Unit	946
	Queen City Aquifer into the Reklaw Confining Unit	179

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	29,604
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	32,780
Estimated annual volume of flow into the district within each aquifer in the district	Carrizo-Wilcox Aquifer	14,023
Estimated annual volume of flow out of the district within each aquifer in the district	Carrizo-Wilcox Aquifer	19,713
Estimated net annual volume of flow between each aquifer in the district	Reklaw Confining Unit into the Carrizo-Wilcox Aquifer	1,309

Units are in acre-feet per year

Lost Pines GCD
Trinity Aquifer

Management Plan requirement	Aquifer	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	517
Estimated annual volume of flow out of the district within each aquifer in the district	Trinity Aquifer	661
Estimated net annual volume of flow between each aquifer in the district	Not applicable	Not Applicable

Units are in acre-feet per year

Lost Pines GCD
Yegua-Jackson Aquifer

Management Plan requirement	Aquifer	Results
Estimated annual amount of recharge from precipitation to the district	Yegua-Jackson Aquifer	38,859
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	35,780
Estimated annual volume of flow into the district within each aquifer in the district	Yegua-Jackson Aquifer	5,883
Estimated annual volume of flow out of the district within each aquifer in the district	Yegua-Jackson Aquifer	10,155
Estimated net annual volume of flow between each aquifer in the district	Not applicable	Not applicable

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	423
Estimated annual volume of flow out of the district within each aquifer in the district	Trinity Aquifer	678
Estimated net annual volume of flow between each aquifer in the district	Not applicable	Not applicable

Units are in acre-feet per year

Post-Oak Savannah GCD Sparta Aquifer

Management Plan requirement	Aquifer	Results
Estimated annual amount of recharge from precipitation to the district	Sparta Aquifer	7,424
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Sparta Aquifer	4,807
Estimated annual volume of flow into the district within each aquifer in the district	Sparta Aquifer	739
Estimated annual volume of flow out of the district within each aquifer in the district	Sparta Aquifer	1,226
Estimated net annual volume of flow between each aquifer in the district	Weches Confining Unit and adjacent underlying areas into the Sparta Aquifer	1,569

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	8,812
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	12,028
Estimated annual volume of flow into the district within each aquifer in the district	Queen City Aquifer	1,316
Estimated annual volume of flow out of the district within each aquifer in the district	Queen City Aquifer	947
Estimated net annual volume of flow between each aquifer in the district	Queen City Aquifer into the overlying Weches Confining Unit	1,435
	Reklaw Confining Unit and adjacent underlying areas into the Queen City Aquifer	861

Units are in acre-feet per year

Post-Oak Savannah GCD Carrizo Formation

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Carrizo Aquifer	4,018
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Carrizo Aquifer	1,964
Estimated annual volume of flow into the district within each aquifer in the district	Carrizo Aquifer	3,810
Estimated annual volume of flow out of the district within each aquifer in the district	Carrizo Aquifer	2,424
Estimated net annual volume of flow between each aquifer in the district	Carrizo Aquifer into the overlying Reklaw Confining Unit	233
	Carrizo Aquifer into the underlying Upper Wilcox Aquifer (Calvert Bluff Formation)	317

Units are in acre-feet per year

Post-Oak Savannah GCD Calvert Bluff Formation

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Upper Wilcox Aquifer (Calvert Bluff Formation)	7,330
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Upper Wilcox Aquifer (Calvert Bluff Formation)	7,995
Estimated annual volume of flow into the district within each aquifer in the district	Upper Wilcox Aquifer (Calvert Bluff Formation)	2,416
Estimated annual volume of flow out of the district within each aquifer in the district	Upper Wilcox Aquifer (Calvert Bluff Formation)	2,000
Estimated net annual volume of flow between each aquifer in the district	Carrizo Aquifer into the underlying Upper Wilcox Aquifer (Calvert Bluff Formation)	317
	Upper Wilcox Aquifer (Calvert Bluff Formation) into the underlying Middle Wilcox Aquifer (Simsboro Formation)	3,451

Units are in acre-feet per year

Post-Oak Savannah GCD Simsboro Formation

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Middle Wilcox Aquifer (Simsboro Formation)	12,540
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Middle Wilcox Aquifer (Simsboro Formation)	18,827
Estimated annual volume of flow into the district within each aquifer in the district	Middle Wilcox Aquifer (Simsboro Formation)	10,804
Estimated annual volume of flow out of the district within each aquifer in the district	Middle Wilcox Aquifer (Simsboro Formation)	18,025
Estimated net annual volume of flow between each aquifer in the district	Upper Wilcox Aquifer (Calvert Bluff Formation) into the underlying Middle Wilcox Aquifer (Simsboro Formation)	3,451
	Lower Wilcox Aquifer (Hooper Formation) into the overlying Middle Wilcox Aquifer (Simsboro Formation)	1,537

Units are in acre-feet per year

Post-Oak Savannah GCD Hooper Formation

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Lower Wilcox Aquifer (Hooper Formation)	2,391
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Lower Wilcox Aquifer (Hooper Formation)	1,748
Estimated annual volume of flow into the district within each aquifer in the district	Lower Wilcox Aquifer (Hooper Formation)	3,572
Estimated annual volume of flow out of the district within each aquifer in the district	Lower Wilcox Aquifer (Hooper Formation)	3,232
Estimated net annual volume of flow between each aquifer in the district	Lower Wilcox Aquifer (Hooper Formation) into the overlying Middle Wilcox Aquifer (Simsboro Formation)	1,537

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	13,923
Estimated annual volume of flow into the district within each aquifer in the district	Yegua-Jackson Aquifer	4,436
Estimated annual volume of flow out of the district within each aquifer in the district	Yegua-Jackson Aquifer	8,017
Estimated net annual volume of flow between each aquifer in the district	Not applicable	Not applicable

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	26,906
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	16,869
Estimated annual volume of flow into the district within each aquifer in the district	Carrizo-Wilcox Aquifer	17,840
Estimated annual volume of flow out of the district within each aquifer in the district	Carrizo-Wilcox Aquifer	10,051
Estimated net annual volume of flow between each aquifer in the district	To the Carrizo-Wilcox Aquifer from the Reklaw Formation confining unit	62
	To the Carrizo-Wilcox Aquifer from the down-dip portions of the equivalent formations	10,962

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	6,091
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	11,902
Estimated annual volume of flow into the district within each aquifer in the district	Queen City Aquifer	1,865
Estimated annual volume of flow out of the district within each aquifer in the district	Queen City Aquifer	815
Estimated net annual volume of flow between each aquifer in the district	To the Queen City Aquifer from the Weches Formation confining unit	209
	To the Queen City Aquifer from the Reklaw Formation confining unit	148
	From the Queen City Aquifer to the down-dip portion of the Queen City Formation	83

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	9,970
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Sparta Aquifer	1,861
Estimated annual volume of flow into the district within each aquifer in the district	Sparta Aquifer	617
Estimated annual volume of flow out of the district within each aquifer in the district	Sparta Aquifer	496
Estimated net annual volume of flow between each aquifer in the district	To the Sparta Aquifer from overlying stratigraphic units	714
	From the Sparta Aquifer to the Weches Formation confining unit	599
	From the Sparta Aquifer to the down-dip portion of the Sparta Formation	76

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	12,029
Estimated annual volume of flow out of the district within each aquifer in the district	Yegua-Jackson Aquifer	9,921
Estimated net annual volume of flow between each aquifer in the district	To the Yegua-Jackson Aquifer from the confined portion of the Yegua and Jackson groups	178

Units are in acre-feet per year

Mid-East Texas GCD Yegua-Jackson Aquifer

Management Plan requirement	*Aquifer or confining unit*	*Results*
Estimated annual amount of recharge from precipitation to the groundwater resources within the district	Yegua-Jackson Aquifer	31,137
Estimated annual volume of water that discharges from the aquifer to springs and any surface water bodies, 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	16,334
Estimated annual volume of flow out of the district within each aquifer in the district	Yegua-Jackson Aquifer	11,401
Estimated net annual volume of flow between each aquifer in the district	Yegua-Jackson Aquifer	0[1]

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 groundwater resources within the district	Sparta Aquifer	15,100
Estimated annual volume of water that discharges from the aquifer to springs and any surface water bodies, including lakes, streams, and rivers	Sparta Aquifer	3,702
Estimated annual volume of flow into the district within each aquifer in the district	Sparta Aquifer	1,135
Estimated annual volume of flow out of the district within each aquifer in the district	Sparta Aquifer	914
Estimated net annual volume of flow between each aquifer in the district	From the Sparta Aquifer to overlying stratigraphic Unit	445
	From the Sparta Aquifer to the Weches Confining Unit	1,121
	From the Sparta Aquifer to down-dip parts of the Sparta Formation	86

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 groundwater resources within the district	Queen City Aquifer	26,645
Estimated annual volume of water that discharges from the aquifer to springs and any surface water bodies, including lakes, streams, and rivers	Queen City Aquifer	16,399
Estimated annual volume of flow into the district within each aquifer in the district	Queen City Aquifer	2,000
Estimated annual volume of flow out of the district within each aquifer in the district	Queen City Aquifer	2,294
Estimated net annual volume of flow between each aquifer in the district	To the Queen City Aquifer from the Weches Confining Unit	2,126
	To the Queen City Aquifer from the Reklaw Confining Unit	150
	From the Queen City Aquifer to down-dip parts of the Queen City Formation	130

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 groundwater resources within the district	Carrizo-Wilcox Aquifer	48,603
Estimated annual volume of water that discharges from the aquifer to springs and any surface water bodies, including lakes, streams, and rivers	Carrizo-Wilcox Aquifer	35,855
Estimated annual volume of flow into the district within each aquifer in the district	Carrizo-Wilcox Aquifer	10,474
Estimated annual volume of flow out of the district within each aquifer in the district	Carrizo-Wilcox Aquifer	21,365
Estimated net annual volume of flow between each aquifer in the district	To the Carrizo-Wilcox Aquifer from the Reklaw Confining Unit	29
	To the Carrizo-Wilcox Aquifer from down-dip stratigraphic units	4,184

Units are in acre-feet per year

PS-4 Budgets

- Current simulation PS-4 is an "anticipated use" model run
- Budgets extracted from results for 2070
- Important to note that storage is part of the budget as a source of water. Removing water from storage means water levels are declining.

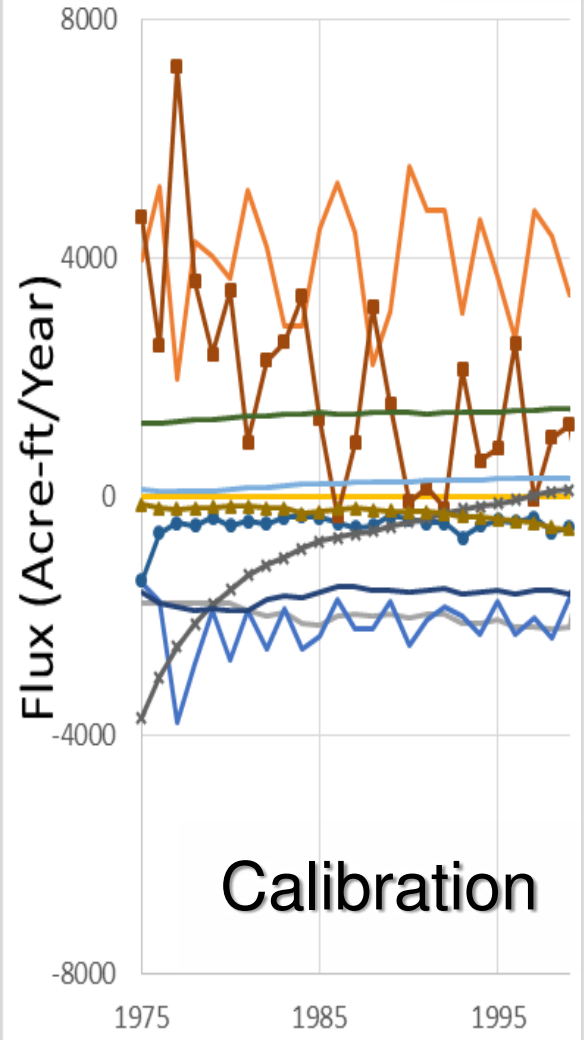
Water Budget Charts for GMA 12 GCDs

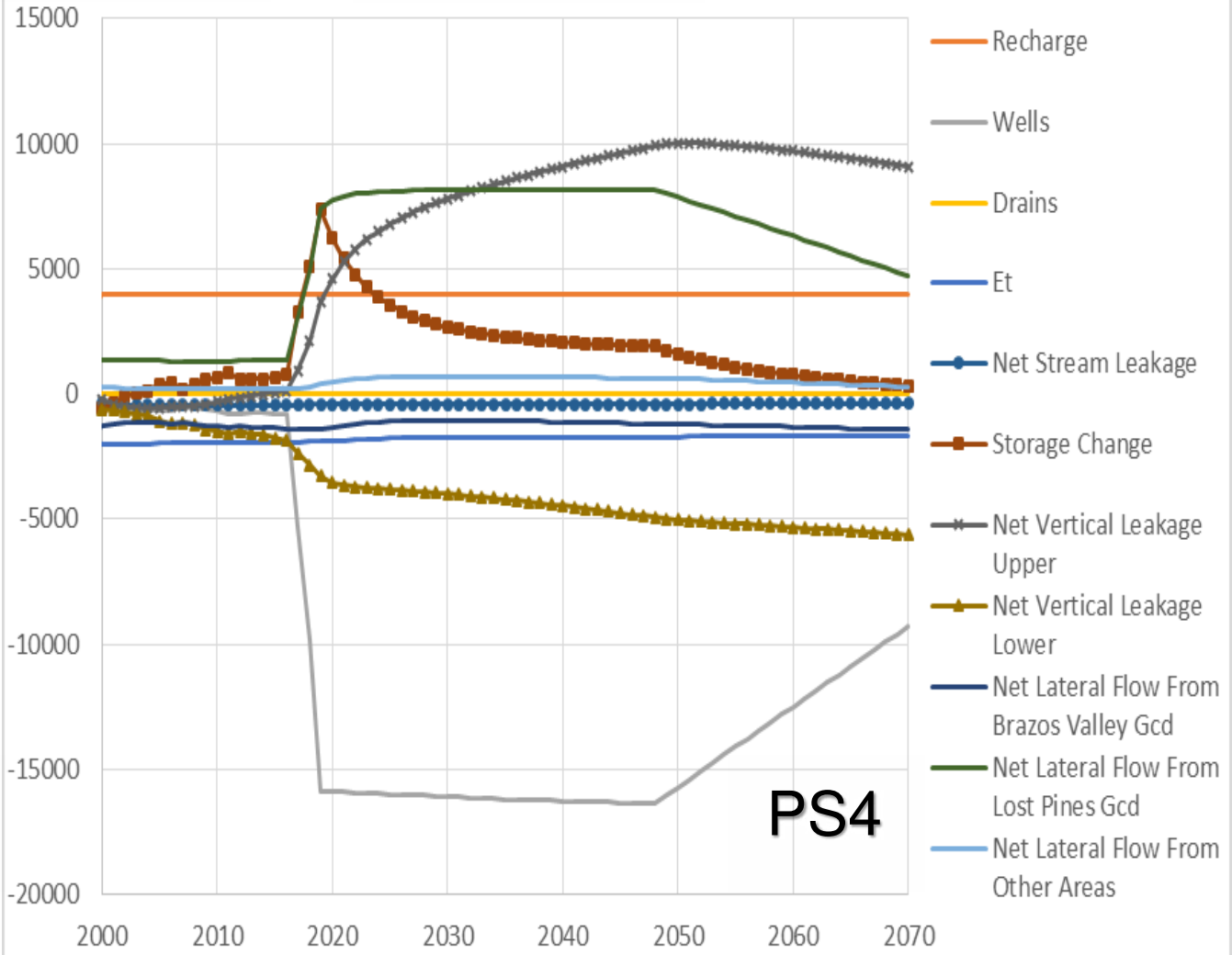
- Five GMA 12 GCDs
- Charts for Carrizo and Simsboro Aquifers and for all eight model layers
- 1975 – 1999 based on GAM model report
- 2000 to 2070 based on PS 4 simulation
- Water Budget Calculations performed using a version of the USGS code Zone Budget

POSGCD: Carrizo

+ Aquifer Gains

- Aquifer Losses

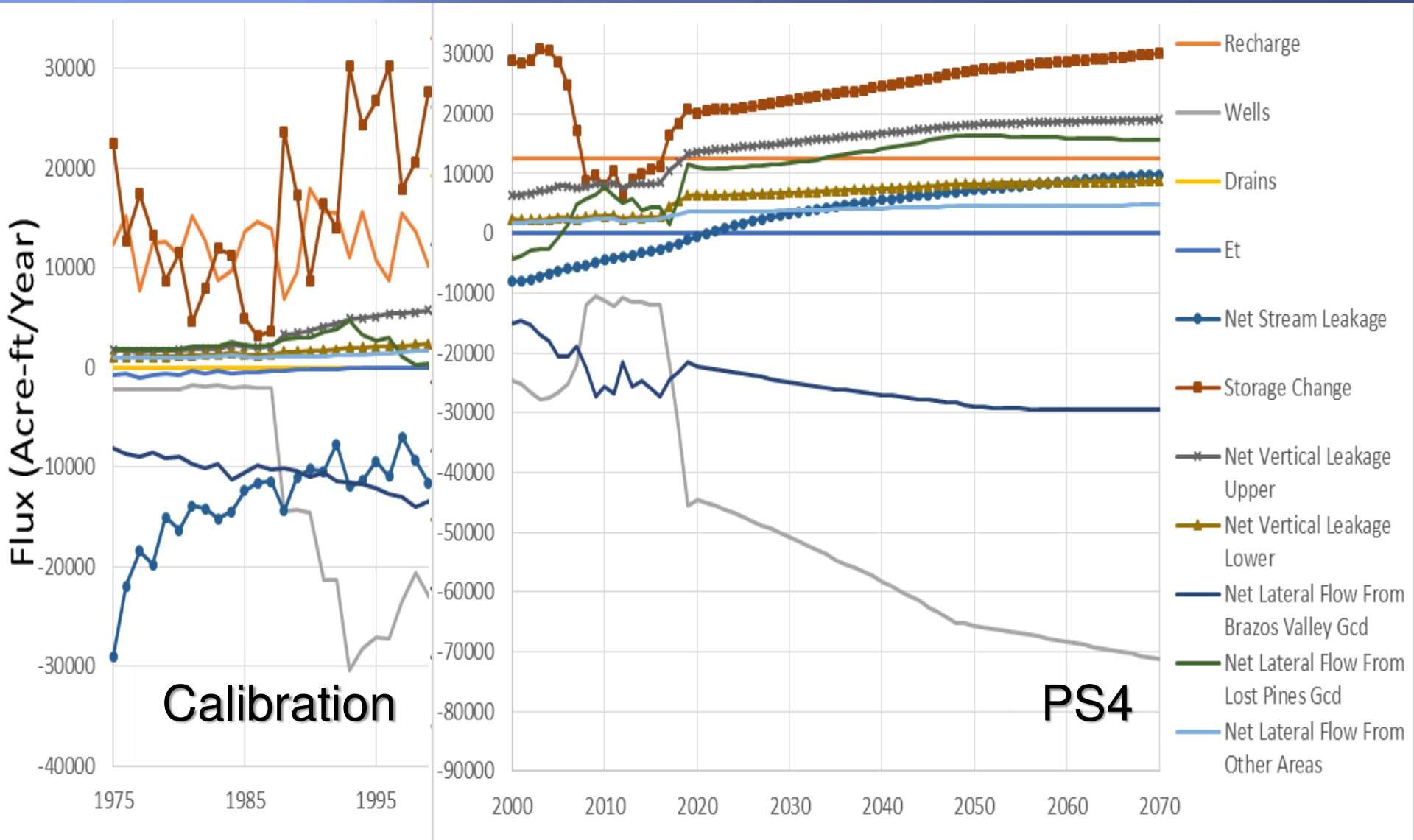




POSGCD: Simsboro

+ Aquifer Gains

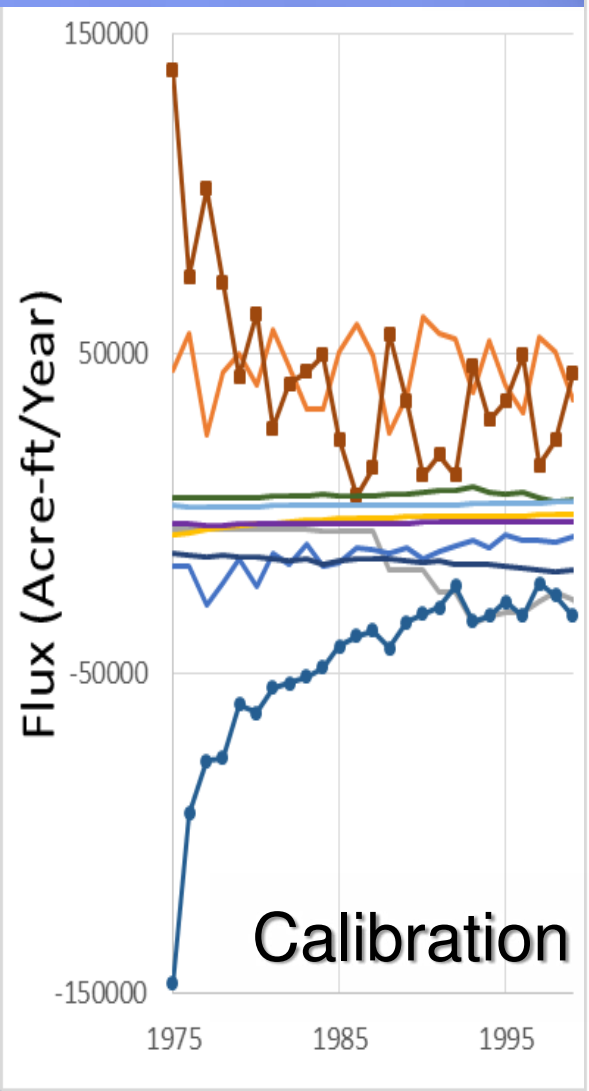
- Aquifer Losses

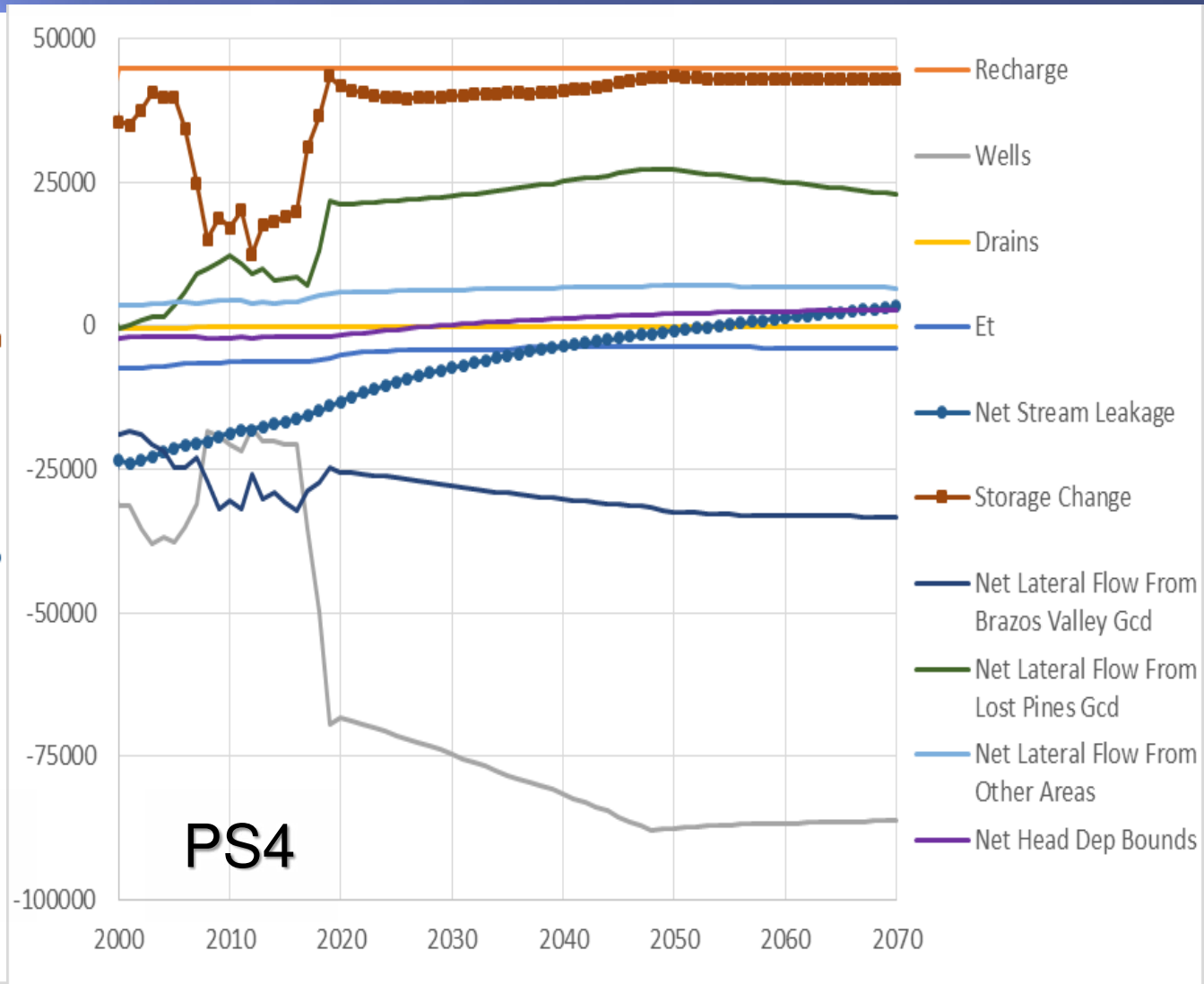


POSGCD: Overall

+ Aquifer Gains

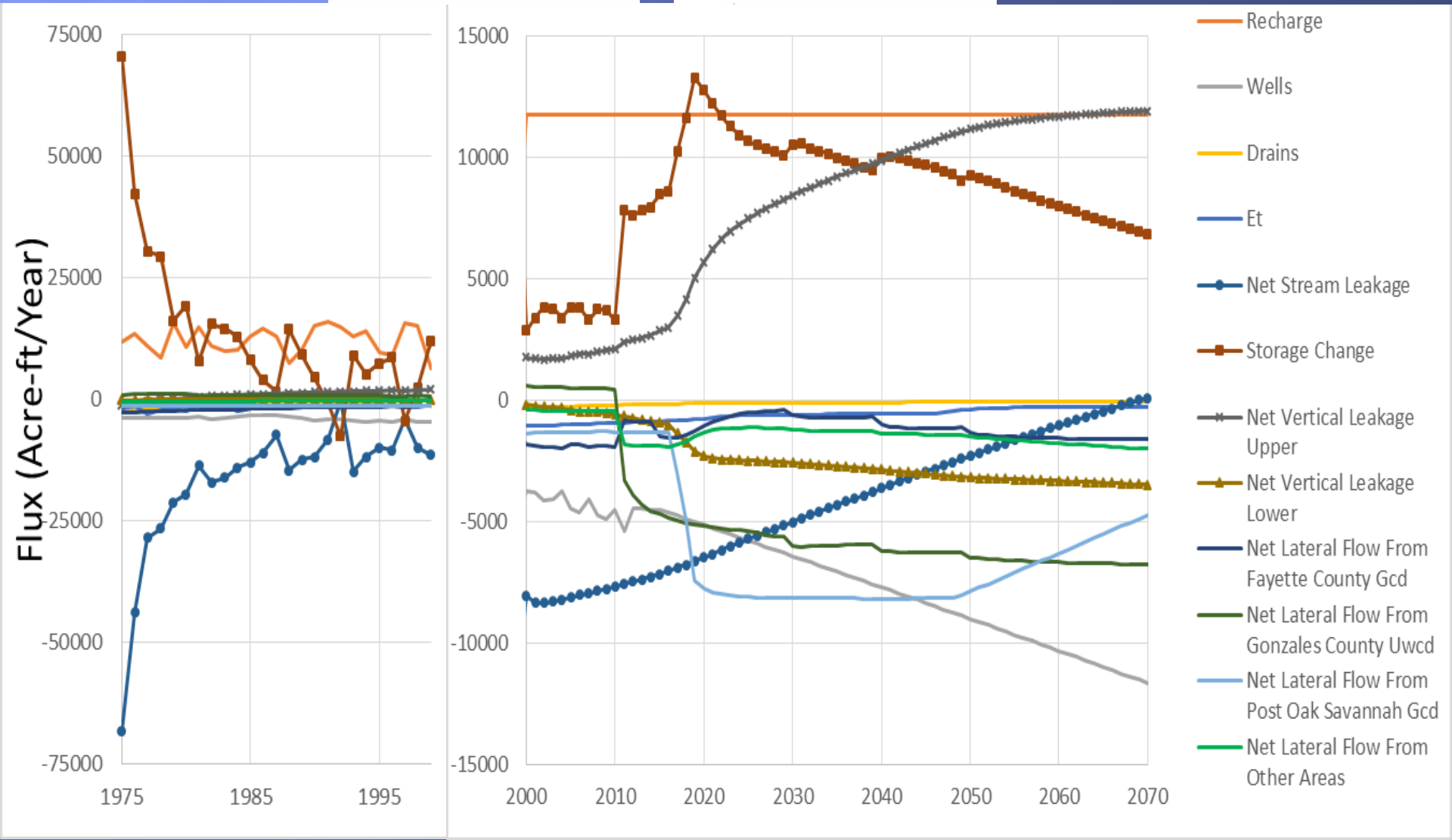
- Aquifer Losses





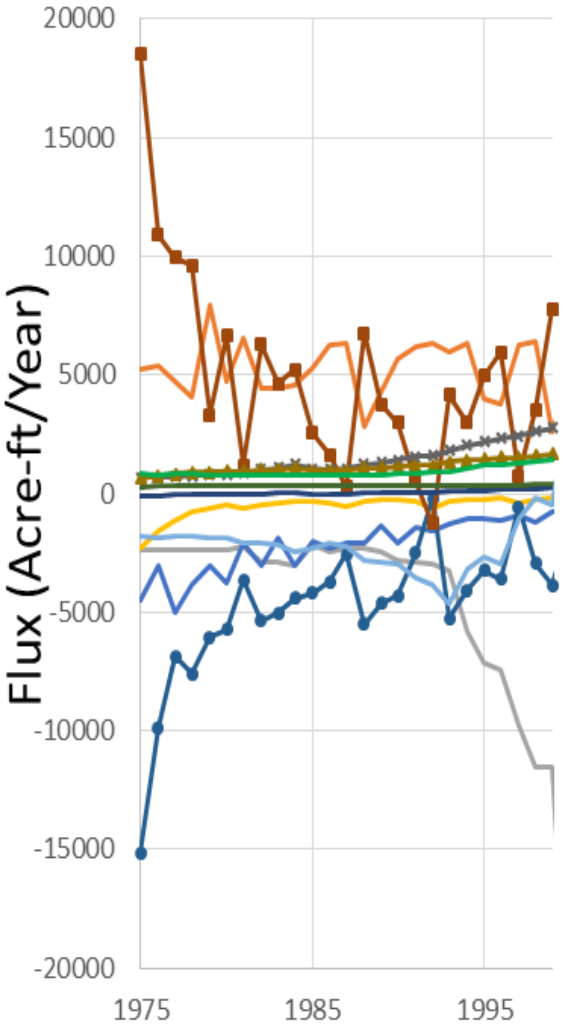
Lost Pines GCD: Carrizo

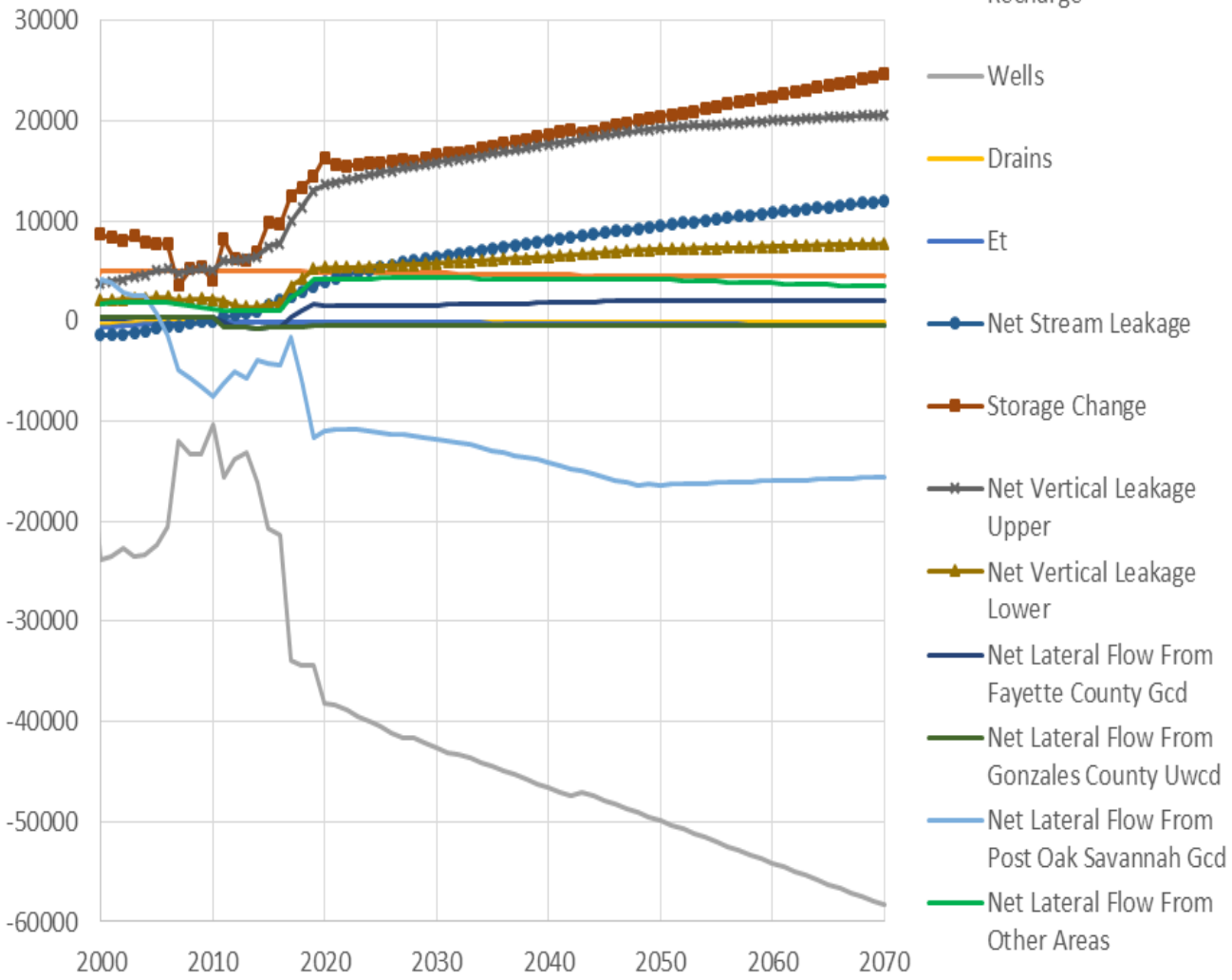
\+ Aquifer Gains - Aquifer Losses



Lost Pines GCD: Simsboro

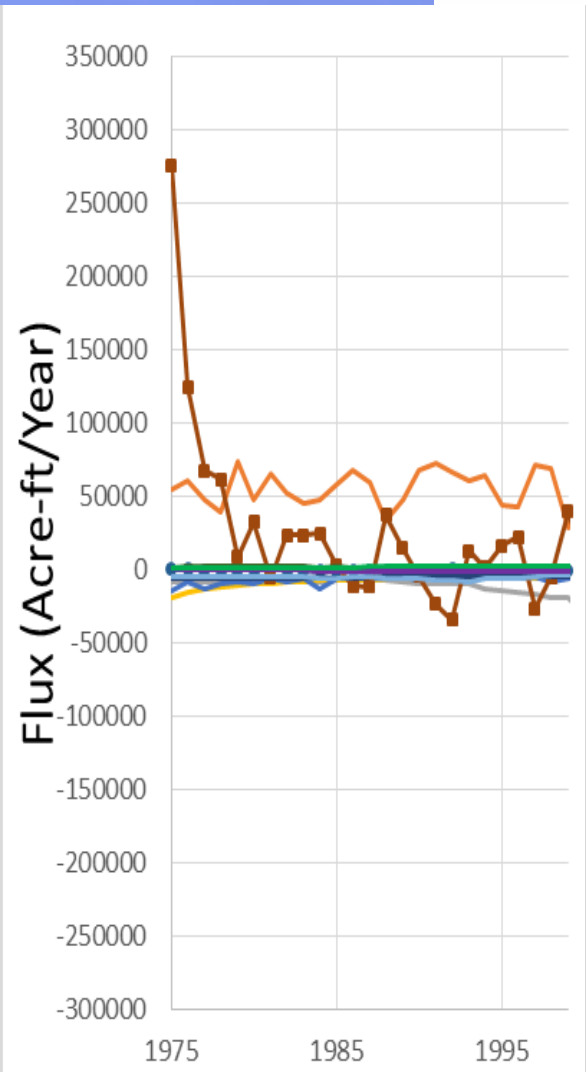
\+ Aquifer Gains - Aquifer Losses

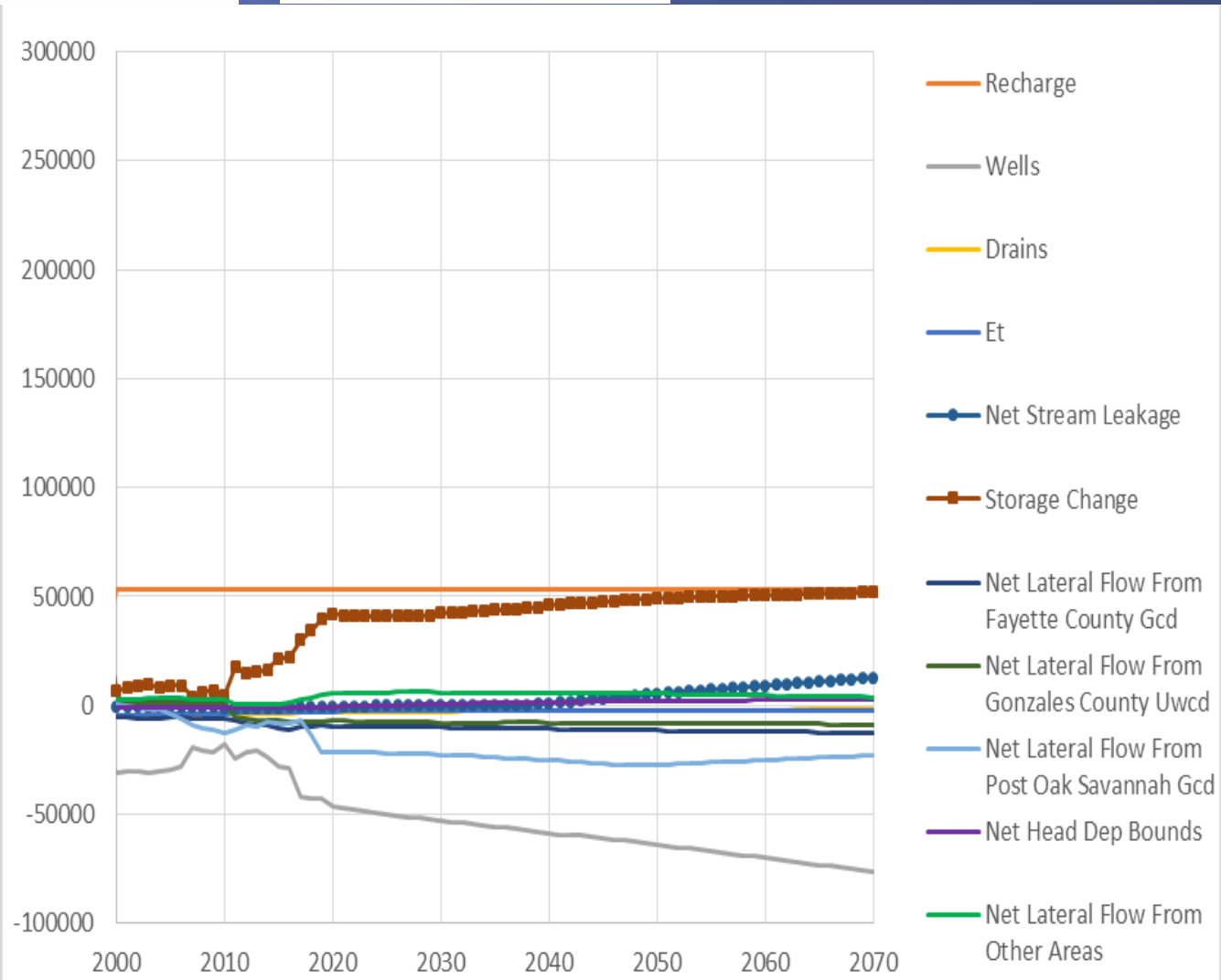




Lost Pines GCD: Overall

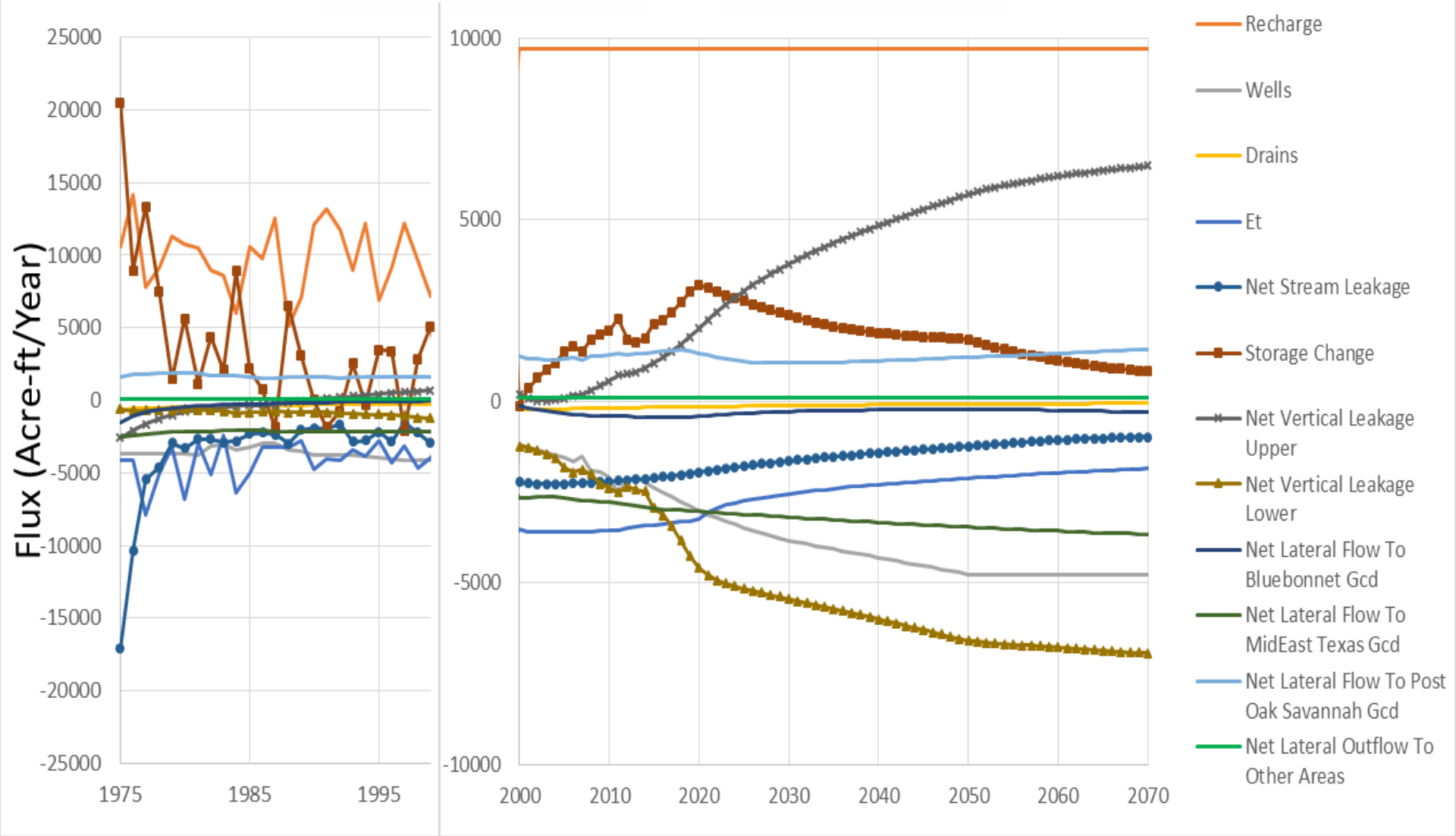
\+ Aquifer Gains - Aquifer Losses





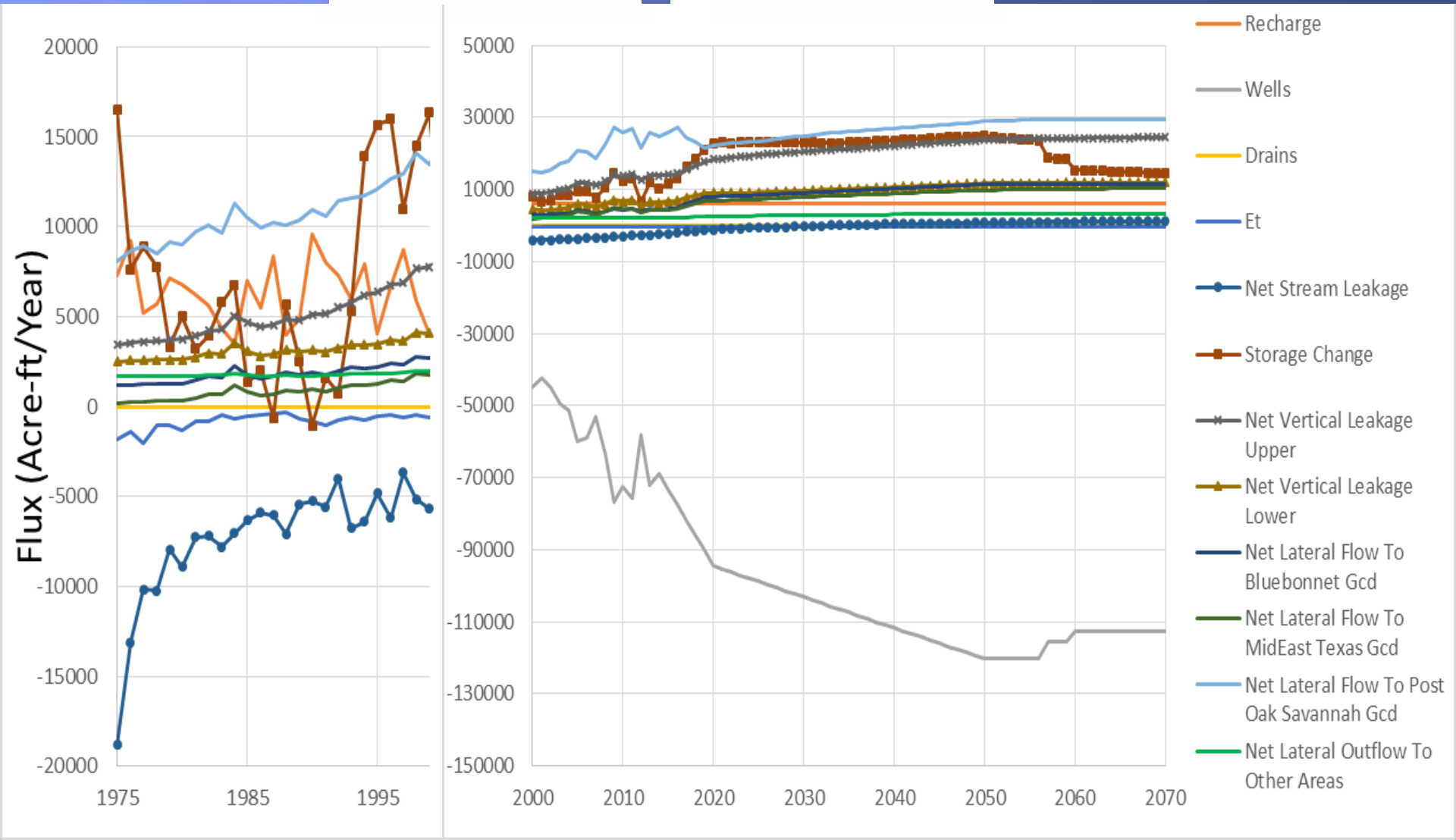
Brazos Valley GCD: Carrizo

\+ Aquifer Gains - Aquifer Losses



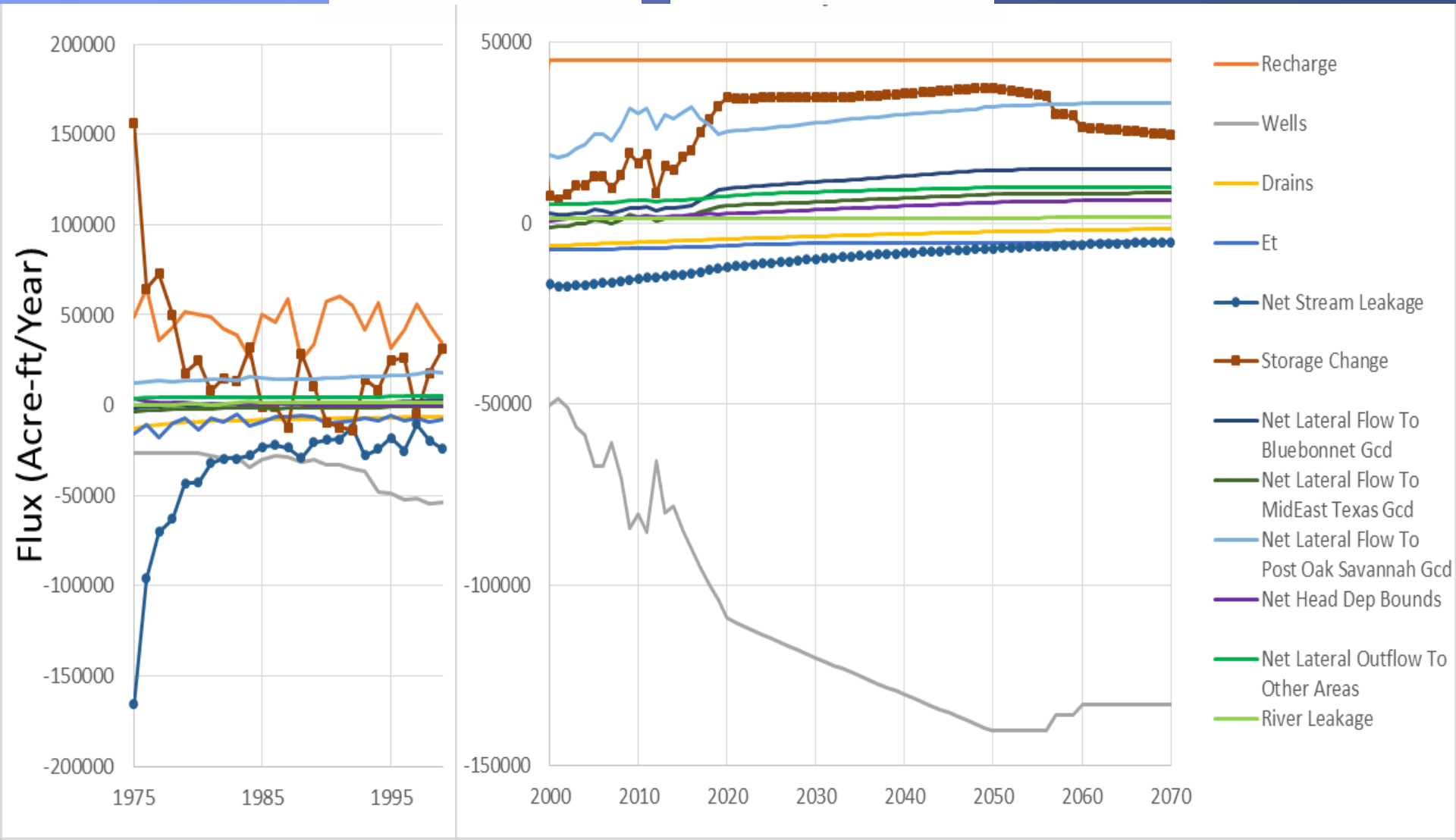
Brazos Valley GCD: Simsboro

\+ Aquifer Gains - Aquifer Losses



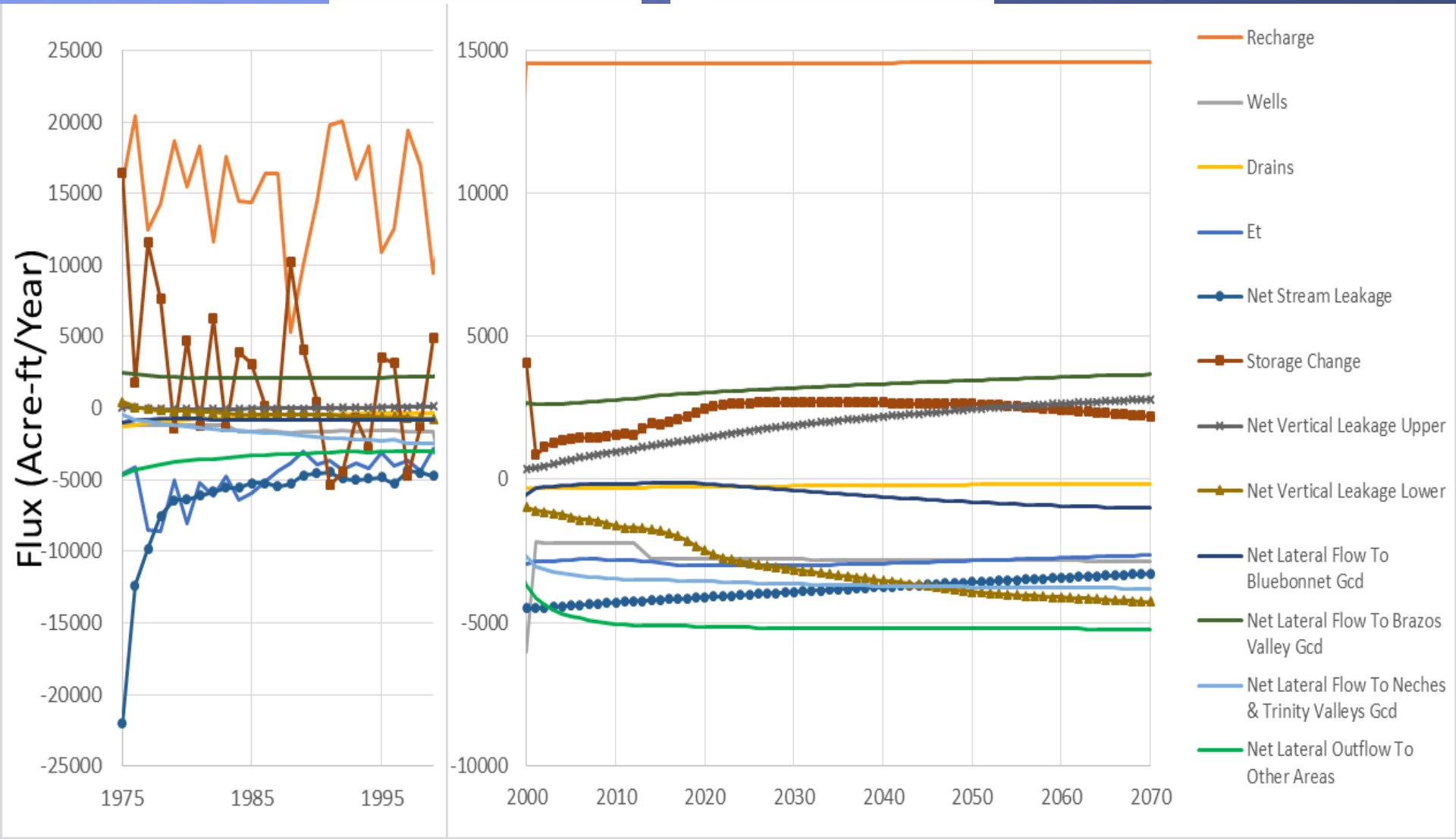
Brazos Valley GCD: Overall

\+ Aquifer Gains - Aquifer Losses



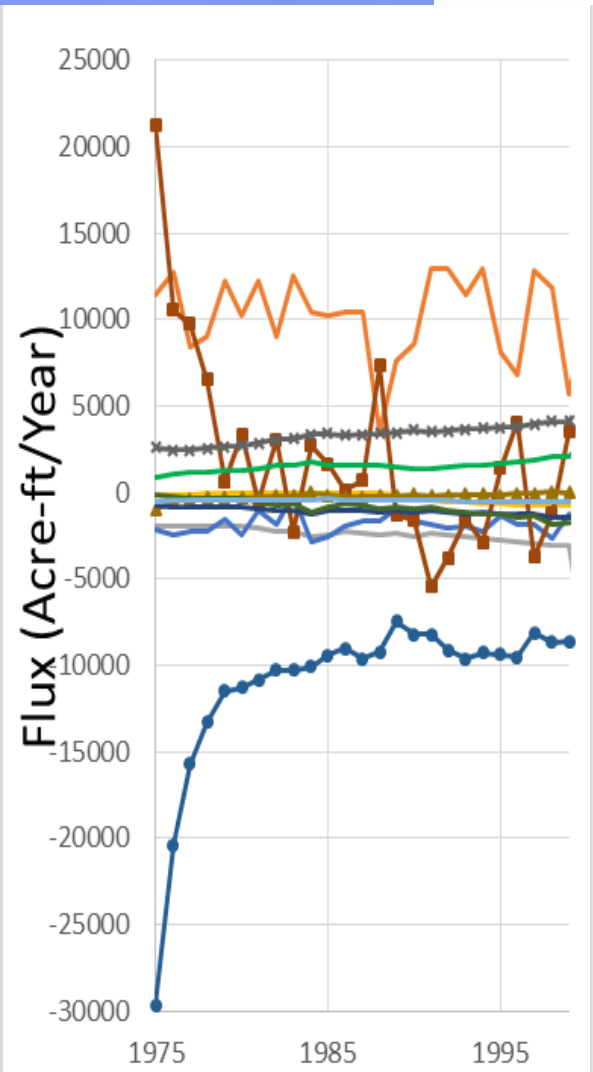
Mid-east Texas GCD: Carrizo

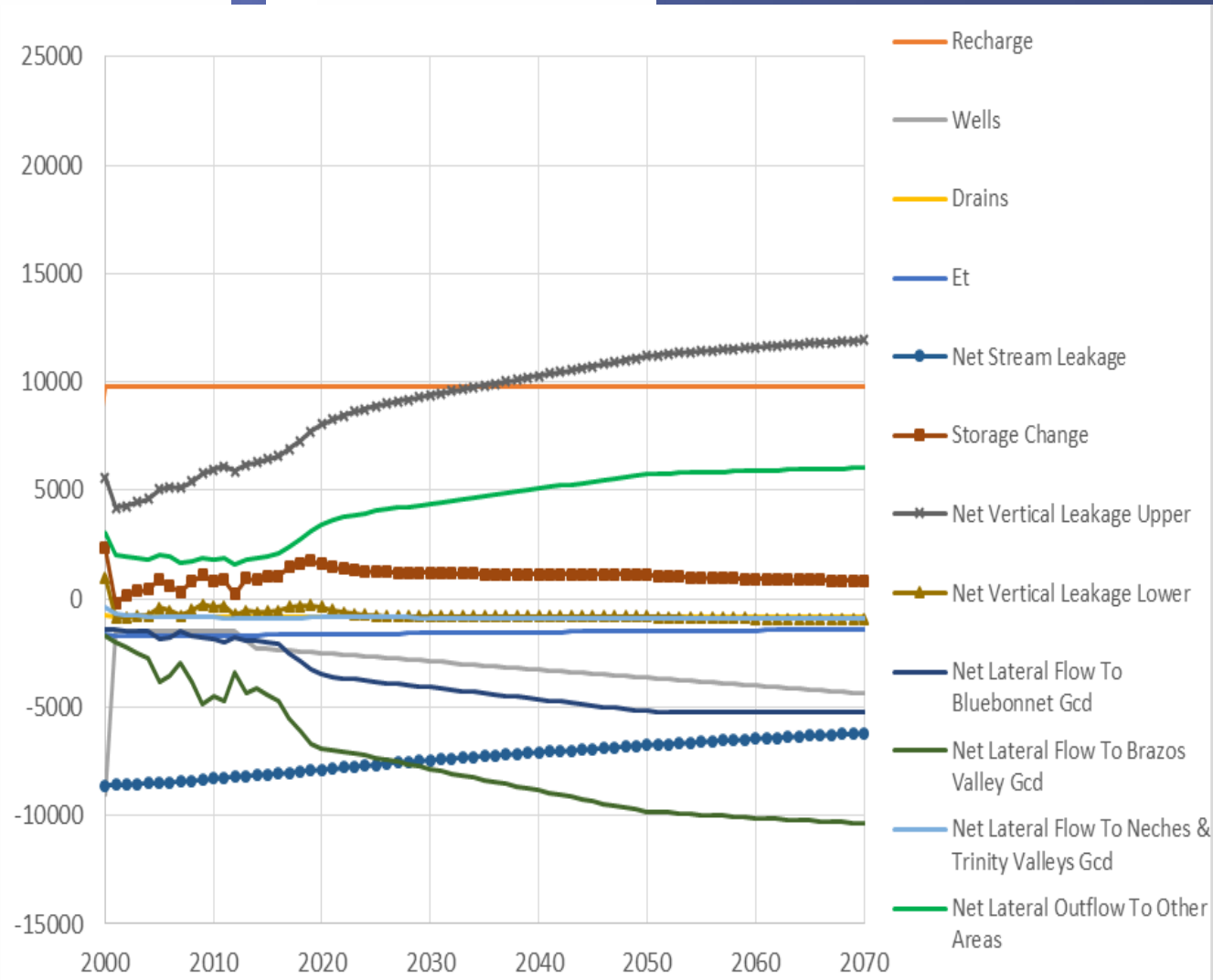
\+ Aquifer Gains | - Aquifer Losses



Mid-east Texas GCD: Simsboro

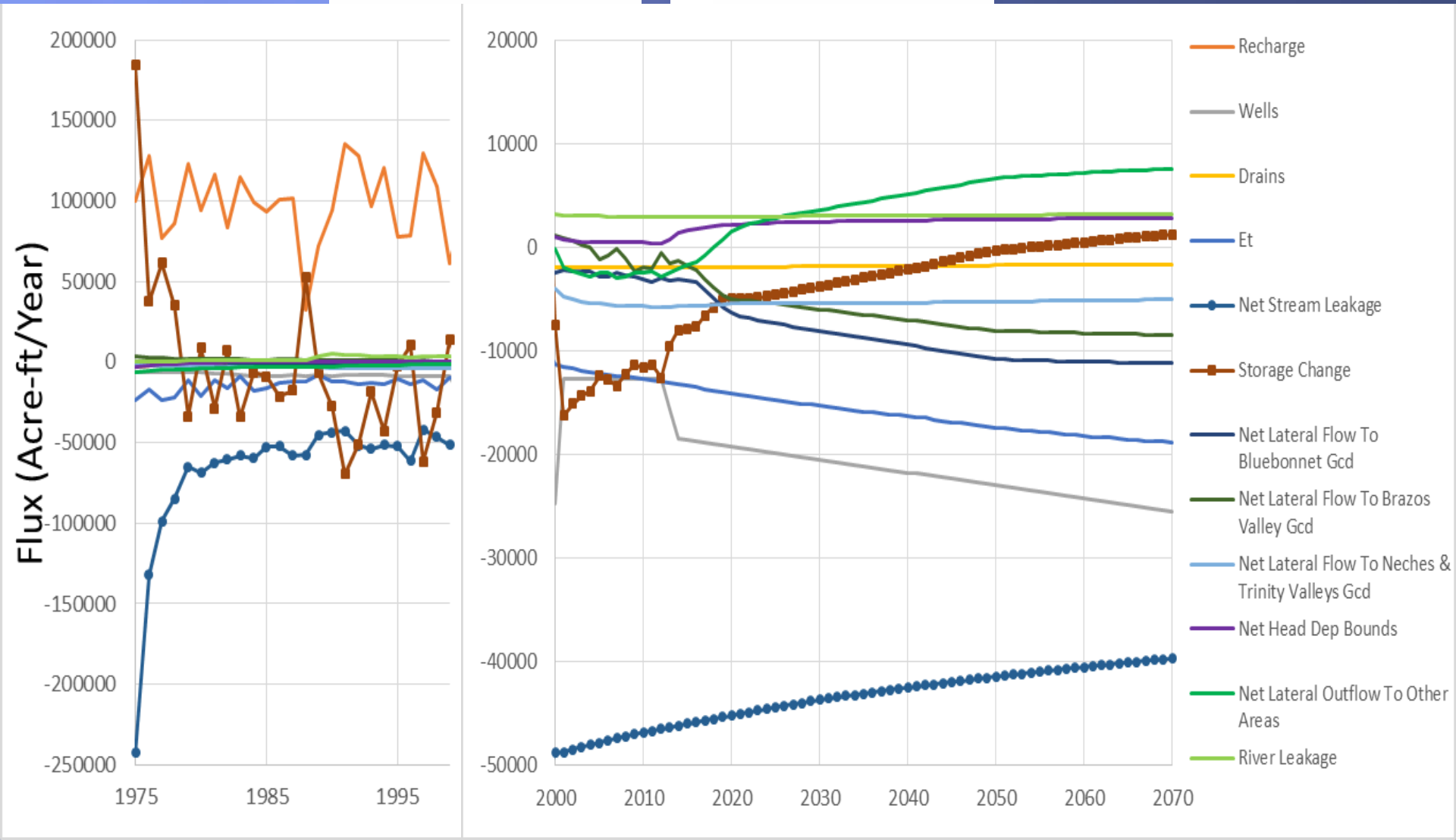
\+ Aquifer Gains - Aquifer Losses





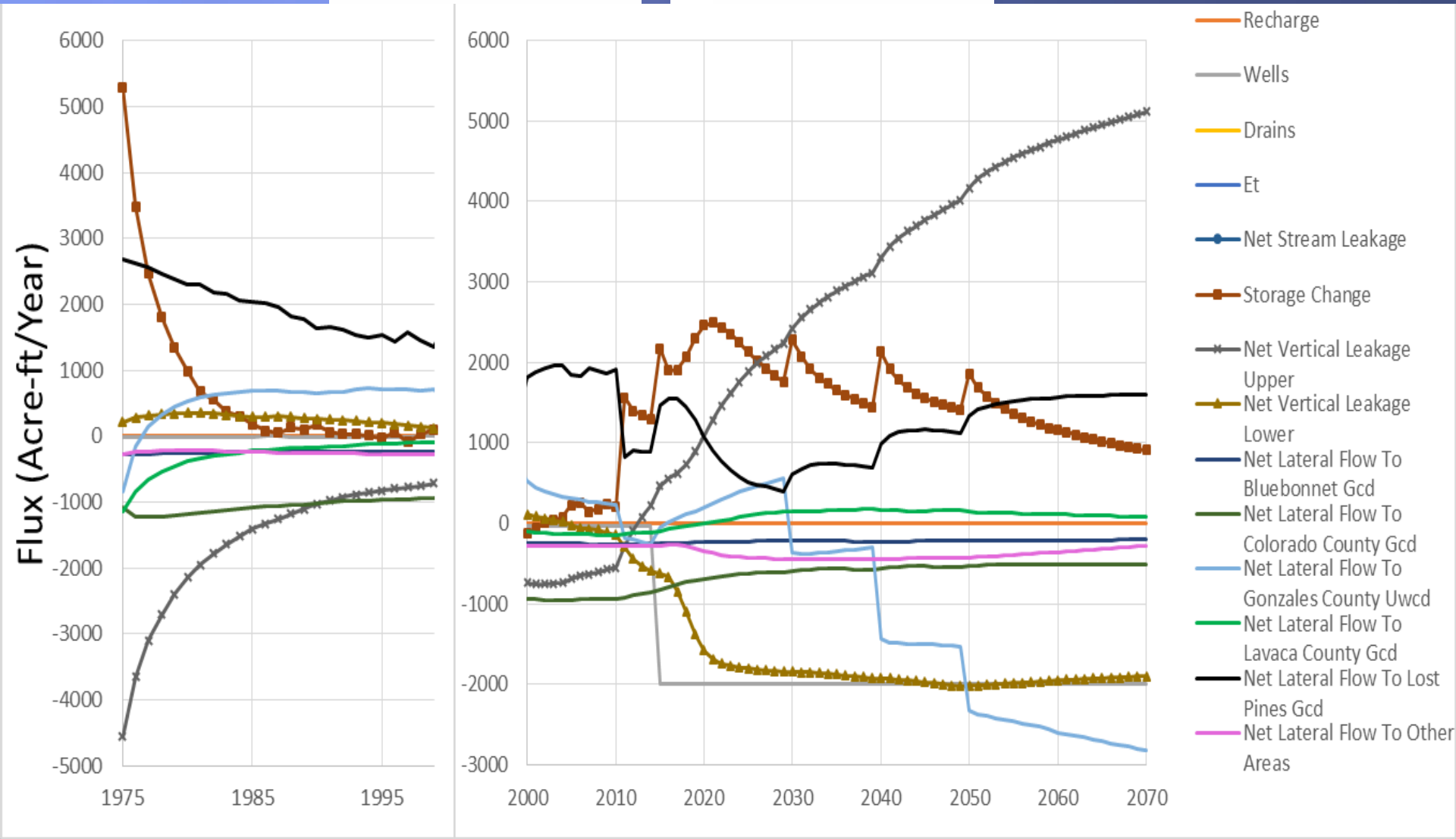
Mid-east Texas GCD: Overall

\+ Aquifer Gains - Aquifer Losses



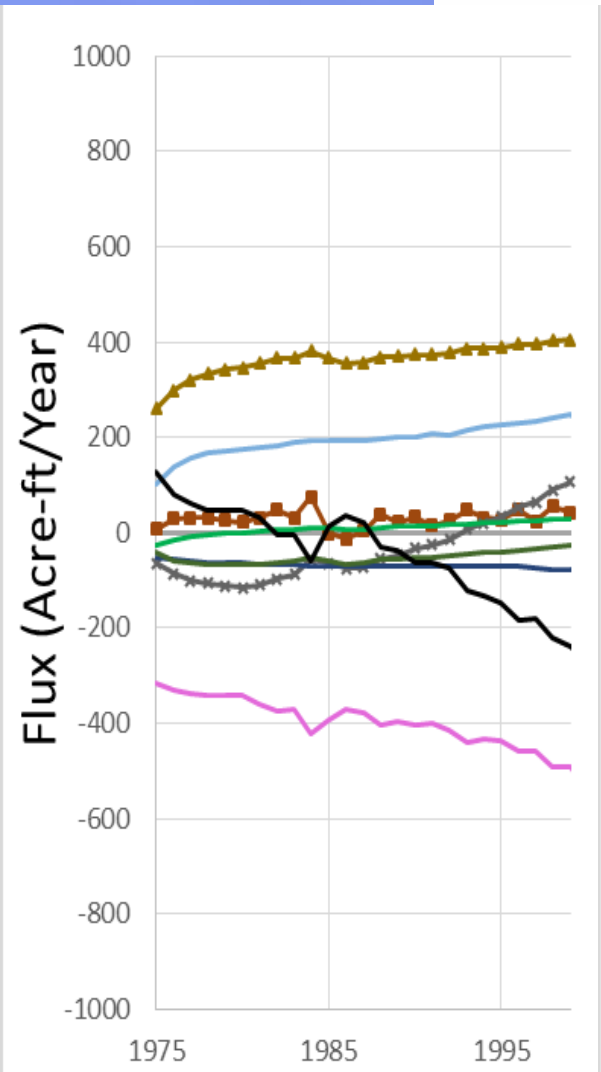
Fayette County GCD: Carrizo

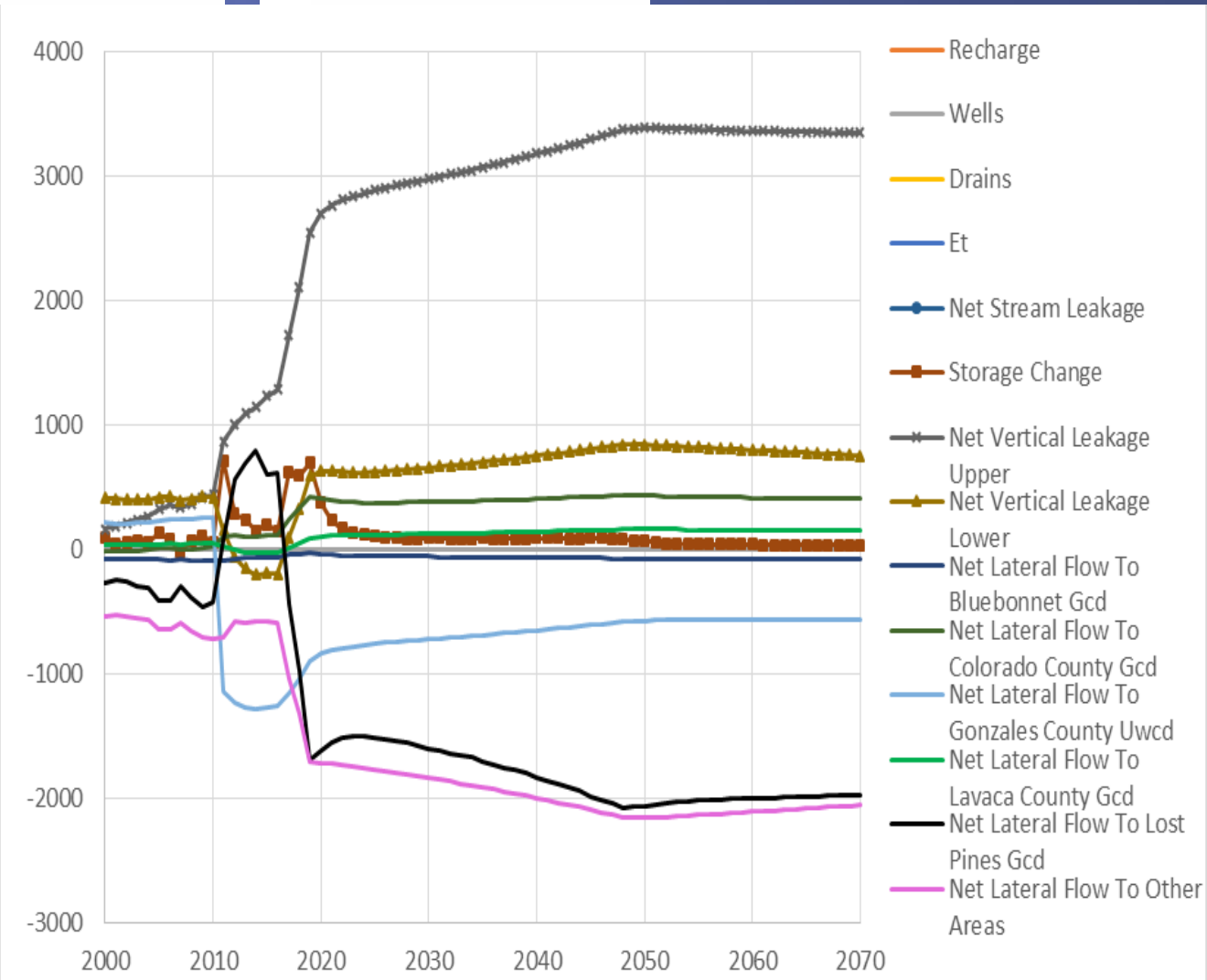
\+ Aquifer Gains - Aquifer Losses



Fayette County GCD: Simsboro

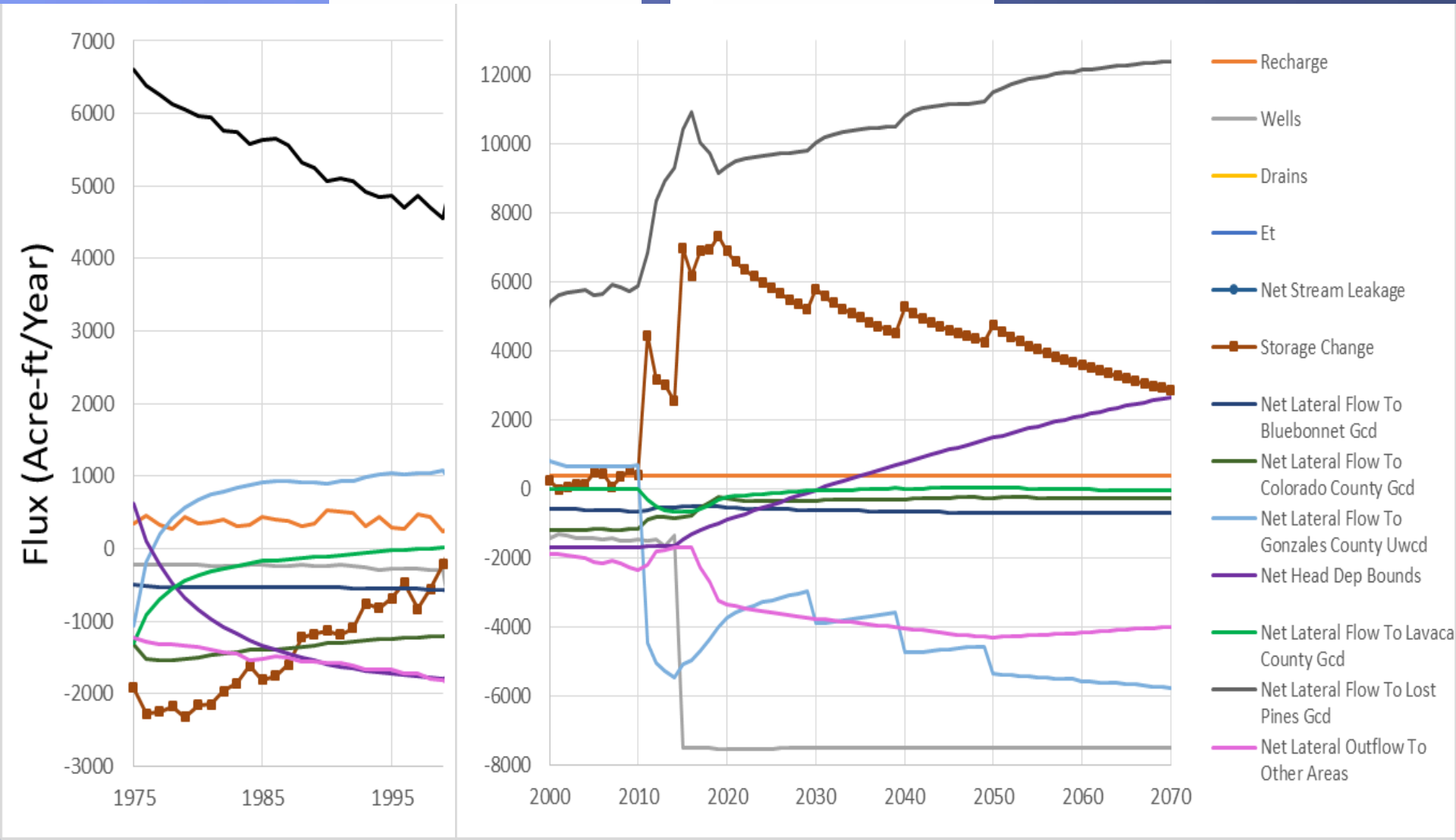
\+ Aquifer Gains | - Aquifer Losses





Fayette County GCD: Overall

\+ Aquifer Gains - Aquifer Losses



QUESTIONS?