# GAM run 03-31

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**REQUESTOR:**

Mid-East Texas Groundwater Conservation District

**DESCRIPTION OF REQUEST:**

The Mid-East Texas Groundwater Conservation District requested the following information for the aquifers in their counties:

- Total recharge amounts from the (Central) Carrizo-Wilcox Groundwater Availability Model,
- Maximum annual production consistent with maintenance of current aquifer levels.

**METHODS:**

To address the request, we:

- Ran the predictive (2000-2050) model for the Central Carrizo-Wilcox aquifer Groundwater Availability Model (Dutton and others, 2003) and queried the budget files for each aquifer layer in Leon, Freestone and Madison Counties for the year 2050 with long-term average recharge.
- Examined hydrographs from Leon, Freestone and Madison county to determine whether water levels are stable under current aquifer production.

**PARAMETERS AND ASSUMPTIONS:**

Pumpage for the predictive simulation period, 2000 to 2050, is based on the regional water planning group demand predictions.

**RESULTS:**

<u>Recharge</u>

The flow budget for Leon, Freestone, and Madison Counties in the Central Carrizo-Wilcox GAM is shown in Table 1. Layers 3, 4, 5, and 6 are shown. Layer 1 represents stream channel alluvium and is very limited in areal extent. Layer 2 is an aquitard.

The Carrizo-Wilcox model does not have any direct infiltration recharge in Madison County. However, TWDB rules concerning groundwater management plan certification define recharge as "The addition of water from precipitation or runoff by seepage or infiltration to an aquifer from the land surface, streams, or lakes directly into a formation or indirectly by way of leakage from another formation." Leakage into the aquifers is listed in the columns "upper Z flow in and lower Z flow in" (Table 1).

The recharge values are in bold text in Table 1.

## Maintenance of Current Aquifer Levels

Hydrographs were examined to determine whether water levels are stable under recent and current aquifer production. If water levels do not change through time or if they fluctuate slightly without progressively increasing or decreasing, then water is not being added to aquifer storage or being withdrawn from aquifer storage. Therefore, current and recent aquifer production would be consistent with maintenance of current aquifer levels.

Water level data from 17 wells were examined to determine whether current aquifer production is consistent with maintenance of current water levels. The wells were located as follows: 8 from the Wilcox formation in Freestone county, 1 from the Carrizo formation in Madison County, 5 from the Carrizo in Leon County, 1 from the Wilcox in Leon County and 2 from the Calvert Bluff in Leon County. Representative hydrographs from each county are shown in Figures 1 – 6. With three exceptions from the Wilcox Formation in Freestone County, the hydrographs are stable in the period 1995 – 2000. Therefore, current production levels should allow current aquifer levels to be maintained as long as neighboring counties do not make significant changes in their production amounts. One of the hydrographs showing some fluctuation from Freestone County is shown in Figure 2. Although the water levels vary somewhat from 1995 – 2000 in Figure 2, the variation is within 10 feet and the trend is not in one direction, i.e. the average water level is somewhat constant through the period. The total production for Freestone, Leon, and Madison counties for 1995 – 2000 used as input to the groundwater availability model is shown in Table 2. It should be noted that additional water could be pumped if additional declines in water levels could be tolerated.

**REFERENCES:**

Dutton, A. R., Harden, R., Nicot, J. P., and O' Rourke, D., 2003, Groundwater Availability Model for the Central part of the Carrizo-Wilcox Aquifer in Texas: Final Report prepared for the Texas Water Development Board.
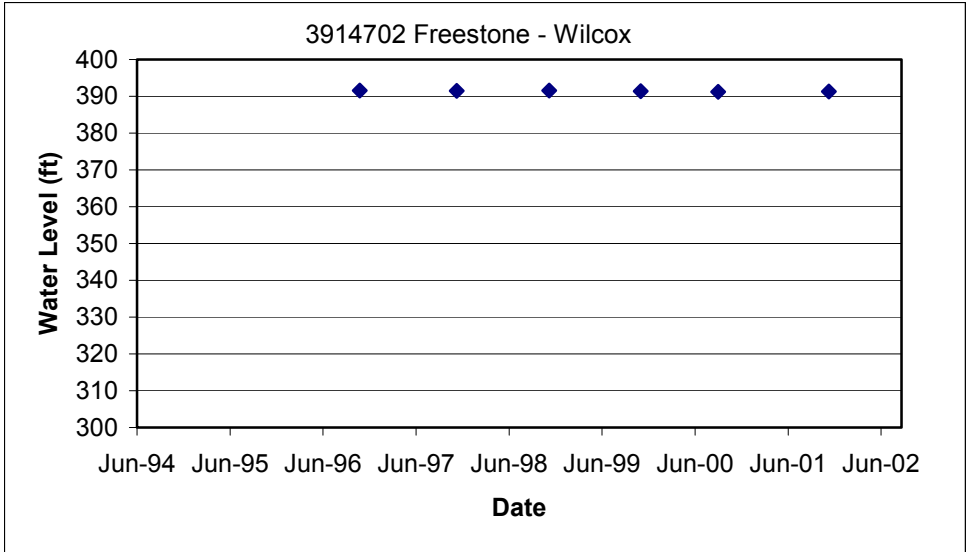
Figure 1. Hydrograph of state well number 3914702 in Freestone County. The well is in the Wilcox Formation.
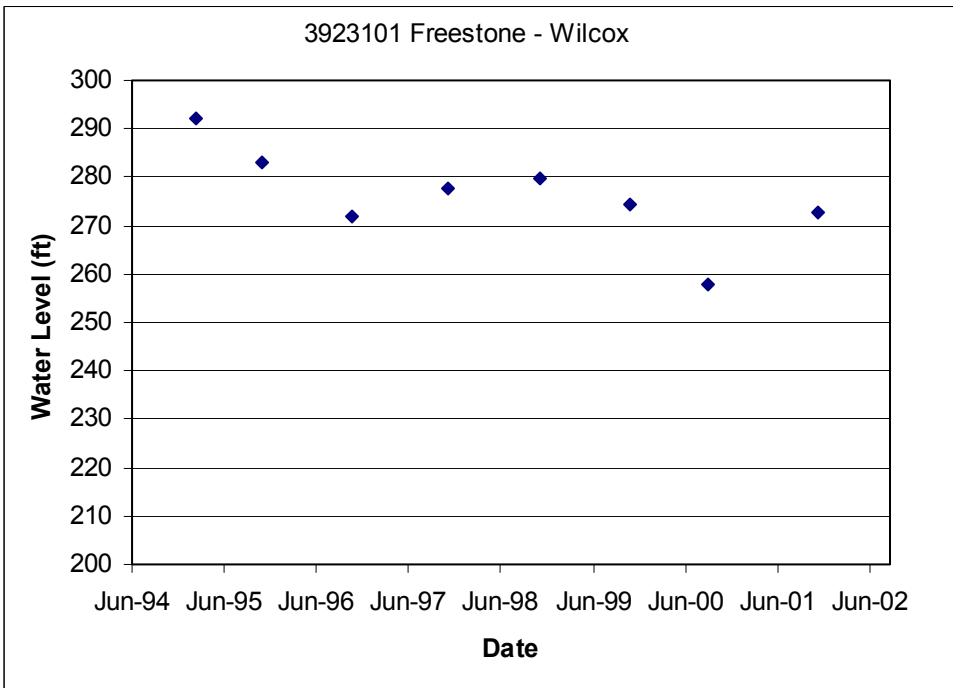


Figure 2. Hydrograph of state well number 3923101 in Freestone County. The well is in the Wilcox Formation.
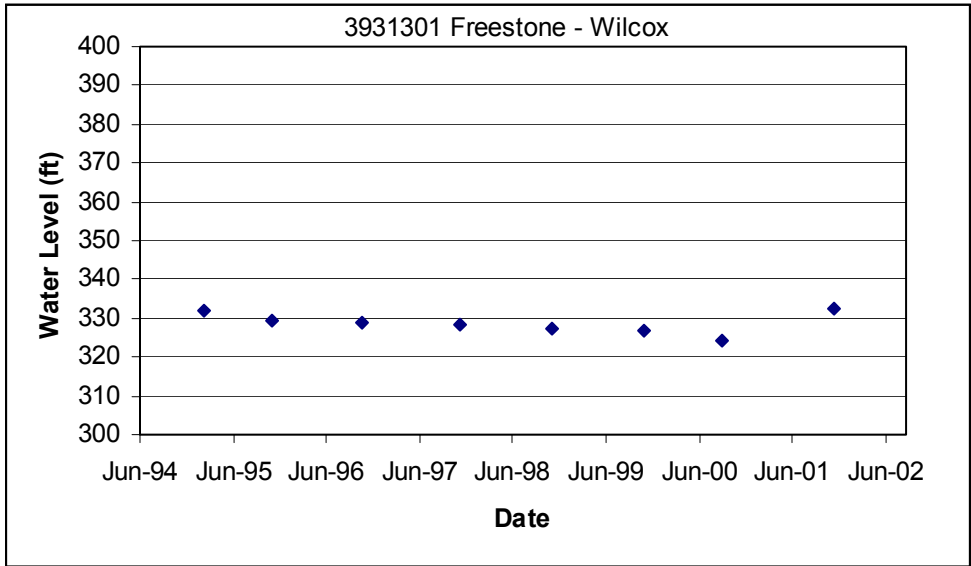
Figure 3. Hydrograph of state well number 3931301 in Freestone County. The well is in the Wilcox Formation.
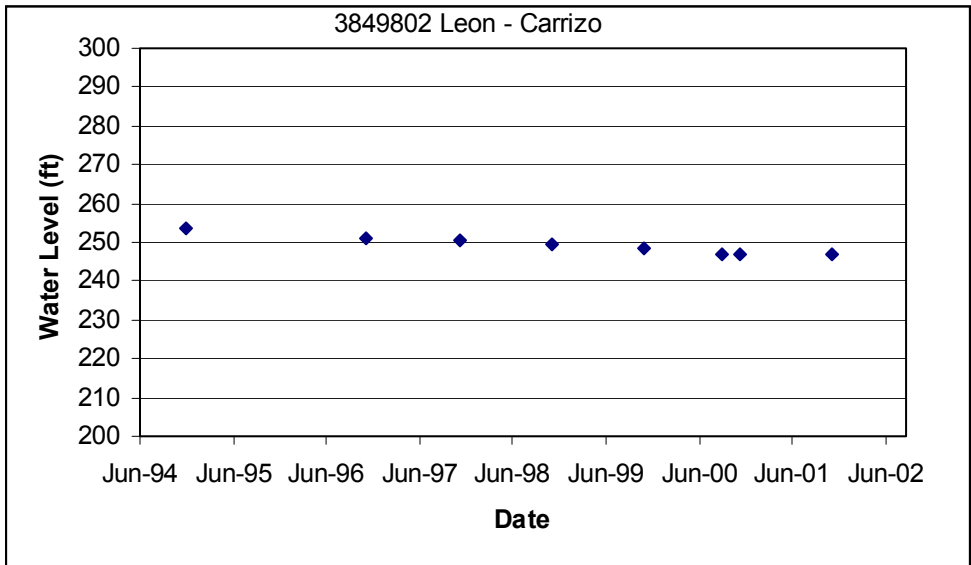


Figure 4. Hydrograph of state well number 3849802 in Leon County. The well is in the Carrizo Formation.
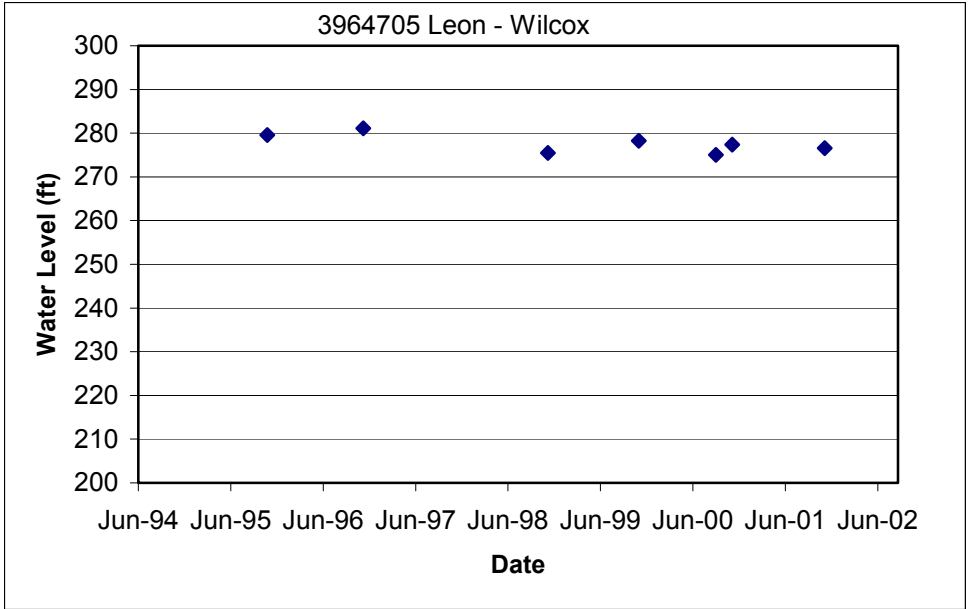
Figure 5.  Hydrograph of state well number 3964705 in Leon County.  The well is in the Wilcox Formation.
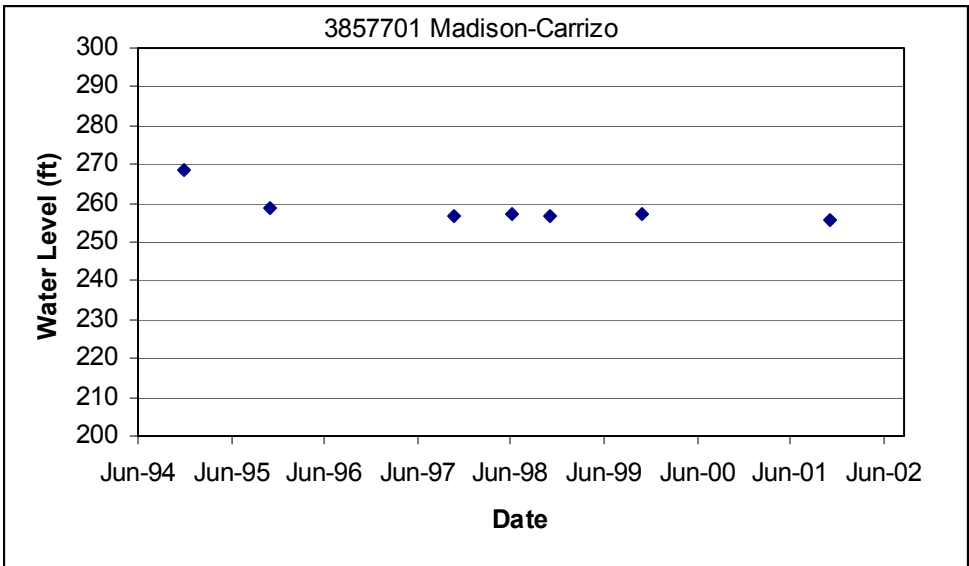


Figure 6.  Hydrograph of state well number 3857701 in Madison County.  The well is in the Carrizo Formation.

Table 1.  Mid-East Texas GCD flow budget for the Central Carrizo-Wilcox aquifer model in acre-feet per year for average conditions.

| County | Lyr | Storage | X-flow in | X-flow out | upper Z flow in | upper Z flow out | lower Z flow in | lower Z flow out | Wells | Recharge | ET | GHB | Streams | Reservoir Leakage | Total In | Total Out | % diff |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average Recharge Conditions | | | | | | | | | | | | | | | | | |
| Madison | 3 | 3 | 6,165 | -4,095 | 1,072 | -1,085 | 0 | -541 | -1,518 | **0** | 0 | 0 | 0 | 0 | 7,240 | -7,240 | 0 |
| | 4 | 26 | 1,840 | -1,499 | 541 | 0 | 0 | -908 | 0 | **0** | 0 | 0 | 0 | 0 | 2,406 | -2,406 | 0 |
| | 5 | 40 | 8,414 | -10,266 | 908 | 0 | 904 | 0 | 0 | **0** | 0 | 0 | 0 | 0 | 10,266 | -10,266 | 0 |
| | 6 | 30 | 4,501 | -3,627 | 0 | -904 | 0 | 0 | 0 | **0** | 0 | 0 | 0 | 0 | 4,531 | -4,531 | 0 |
| | All | 99 | 20,920 | -19,487 | 2,521 | -1,989 | 904 | -1,449 | -1,518 | **0** | 0 | 0 | 0 | 0 | 24,443 | -24,443 | 0 |
| Freestone | 3 | 102 | 857 | -3,740 | 793 | -2,617 | 1,533 | -253 | -120 | **13,734** | -8,303 | 0 | -1,985 | 0 | 17,019 | -17,019 | 0 |
| | 4 | 2,527 | 237 | -2,269 | 253 | -1,533 | 1,400 | -4,954 | -425 | **10,196** | -3,895 | 0 | -1,668 | 130 | 14,743 | -14,744 | 0 |
| | 5 | 463 | 2,530 | -5,913 | 4,954 | -1,400 | 149 | -1,092 | -2,194 | **9,111** | -5,093 | 0 | -1,645 | 130 | 17,337 | -17,337 | 0 |
| | 6 | 716 | 1,754 | -3,894 | 1,092 | -149 | 0 | 0 | -495 | **3,550** | -1,111 | 0 | -1,462 | 0 | 7,110 | -7,110 | 0 |
| | All | 3,808 | 5,378 | -15,816 | 7,092 | -5,699 | 3,082 | -6,299 | -3,234 | **36,591** | -18,402 | 0 | -6,760 | 260 | 56,210 | -56,210 | 0 |
| Leon | 3 | 132 | 6,439 | -8,622 | 7,774 | -2,061 | 14 | -1,589 | -3,630 | **7,182** | -4,998 | 0 | -641 | 0 | 21,541 | -21,541 | 0 |
| | 4 | 701 | 3,490 | -3,524 | 1,589 | -14 | 0 | -1,490 | -948 | **1,033** | -683 | 0 | -471 | 317 | 7,131 | -7,131 | 0 |
| | 5 | 82 | 9,039 | -11,342 | 1,490 | 0 | 1,743 | -64 | -948 | **0** | 0 | 0 | 0 | 0 | 12,354 | -12,354 | 0 |
| | 6 | 64 | 8,183 | -6,567 | 64 | -1,743 | 0 | 0 | 0 | **0** | 0 | 0 | 0 | 0 | 8,310 | -8,310 | 0 |
| | All | 979 | 27,151 | -30,055 | 10,917 | -3,818 | 1,757 | -3,143 | -5,526 | **8,215** | -5,681 | 0 | -1,112 | 317 | 49,336 | -49,336 | 0 |

Notes:
1. Layer 3: Carrizo aquifer
2. Layer 4: Calvert Bluff
3. Layer 5: Simsboro
4. Layer 6: Hooper
5. All: sum of layers 3, 4, 5, and 6
6. **GHB** refers to flow into or out of the top of the Reklaw.
7. **ET** refers to groundwater extraction due to evapotranspiration.
8. **X-flow in** refers to lateral flow into the county.
9. **X-flow out** refers to lateral flow out of the county.
10. **upper - Z-flow in** refers to flow into the layer from the layer above.
11. **upper - Z-flow out** refers to flow out of the layer into the layer above.
12. **lower - Z-flow in** refers to flow into the layer from the layer below.
13. **lower - Z-flow out** refers to flow out of the layer into the layer below.
14. **Wells** is for pumping.

15. A negative sign refers to flow out of the layer in the county.
16. A positive sign refers to flow into the layer in the county.
17. The numbers are rounded to the nearest 1 acre-ft.

Table 2.  Production rates in acre-ft/year used in the Central Carrizo-Wilcox GAM based on water use survey and other data.

| County | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
|---|---|---|---|---|---|---|
| **Freestone** | 2,848 | 3,118 | 2,824 | 2,908 | 2,887 | 2,887 |
| **Leon** | 2,608 | 2,636 | 2,635 | 2,680 | 2,641 | 2,641 |
| **Madison** | 36 | 42 | 46 | 48 | 48 | 48 |