

GAM run 05-20

by Shirley Wade

Texas Water Development Board (TWDB)
Groundwater Availability Modeling Section
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REQUESTOR:

Len Luscomb, General Manager for Rusk County Groundwater Conservation District

DESCRIPTION OF REQUEST:

Mr. Luscomb requested the following information from the northern part of the Groundwater Availability Model (GAM) for the Queen City and Sparta aquifers:

- recharge, and
- water-level difference maps to demonstrate that projected groundwater demands are sustainable.

METHODS:

To address the request, we:

- ran the steady-state model for the northern part of the Queen City and Sparta aquifers GAM and extracted groundwater budget information, including long-term average recharge for Rusk County;
- ran the predictive (2000 through 2050) GAM and extracted simulated water levels for 2050 and 1999; and
- created water-level difference maps for the vicinity of Rusk County by subtracting water levels in 1999 from water levels in 2050.

PARAMETERS AND ASSUMPTIONS:

We used the following assumptions in this analysis:

- see Fryar and others (2003) and Kelley and others (2004) for assumptions and limitations of the GAM;
- the pumpage for the predictive simulation (2000 through 2050) is based on the 2001 Regional Water Plan demands;
- the pumpage in 1999 in the calibrated transient GAM was based on data collected through the TWDB Water Use Survey; and
- recharge represents long-term average climatic conditions.

RESULTS:

Recharge and Water Budget

A groundwater budget summarizes how the model estimates water entering and leaving the aquifer. The groundwater budget for the steady-state model is shown in Table 1. The total recharge for Rusk County from the GAM is 77,678 acre-feet per year. Total recharge in Table 1 represents contributions to the aquifer from precipitation entering the system where the geologic unit containing the aquifer is exposed at the surface. Some groundwater conservation districts consider recharge for their management plans to equal total recharge. Other groundwater conservation districts consider a net value, such as total recharge minus evapotranspiration which is 40,570 acre-feet per year.

Table 1. Groundwater flow budget for Rusk County in the steady-state GAM of the northern part of the Queen City and Sparta aquifers.

<i>Flow Term</i>	<i>Flow (acre-ft/year)</i>
Lateral flow in	5,348
Lateral flow out	-9,459
Drains	-1,027
Recharge	77,678
Evapotranspiration	-37,108
Net Stream Leakage	-35,433

In Table 1, a negative sign refers to flow out of the aquifer in Rusk County. A positive sign refers to flow into the aquifer in Rusk County. All numbers are rounded to the nearest 1 acre-foot. Values are probably only accurate to two significant figures.

Water-Level Difference Maps

We calculated water-level differences for the Queen City (Figure 1), Carrizo (Figure 2), and Middle Wilcox (Figure 3) layers of the GAM by subtracting water levels in 2050 from water levels in 1999. Therefore, if water levels rise, the values are positive, and if water levels decline, the values are negative. The Queen City aquifer experiences mostly water level rises or rebound through 2050 according to the GAM (Figure 1). The Carrizo aquifer experiences declines of less than 10 feet through 2050 over most of the area with a few areas of water level rise (Figure 2). The Middle Wilcox aquifer experiences mostly water levels rises through 2050 except in the northwest corner where there is a decline of less than 10 feet (Figure 3).

The total Rusk County pumping included in the GAM is listed by layer in Table 2. In the Carrizo layer there is a slight increase in the amount of pumping between 1999 and 2050. In the Wilcox layers there is a slight decrease in the amount of pumping between 1999 and 2050. These differences explain, at least in part, the water level changes predicted by the GAM in Rusk County over the period between 1999 and 2050 in those layers. However, the pumping is predicted to increase in the Queen City aquifer in the period 1999 through 2050, and water levels are still predicted to increase. The predicted increase in water levels in the Queen City aquifer from 1999 to 2050 are probably

because 1999 was a dry year in the area covered by the GAM for the northern portion of the Queen City and Sparta aquifers, and the GAM includes only about 28,000 acre-feet per year recharge in 1999 in Rusk County compared with about 77,000 acre-feet per year in 2050 (Table 1).

Table 2. Comparison of Rusk County pumping included in the GAM for the northern part of the Queen City and Sparta aquifer for 1999 and 2050.

<i>Layer</i>	<i>1999 Pumping (acre-feet)</i>	<i>2050 Pumping (acre-feet)</i>
Queen City	56	248
Carrizo	2,545	2,598
Upper Wilcox	1,880	1,813
Middle Wilcox	3,196	2,620
Lower Wilcox	0	4
Total	7,677	7,283

REFERENCES:

Fryar, D., Senger, R., Deeds, N., Pickens, J., Jones, T., Whallon, A. J., and Dean, K.E., 2003, Groundwater availability model for the northern Carrizo-Wilcox aquifer: final report prepared for the Texas Water Development Board by INTERA Inc.

Kelley, V. A., Deeds, N. E., Fryar, D. G., Nicot, J. P., Jones, T. L., Dutton, A. R., Bruehl, G., Unger-Holtz, T., and Machin J. L., 2004, Groundwater availability model for the Queen City and Sparta aquifers: final report prepared for the Texas Water Development Board by INTERA Inc.

Queen City

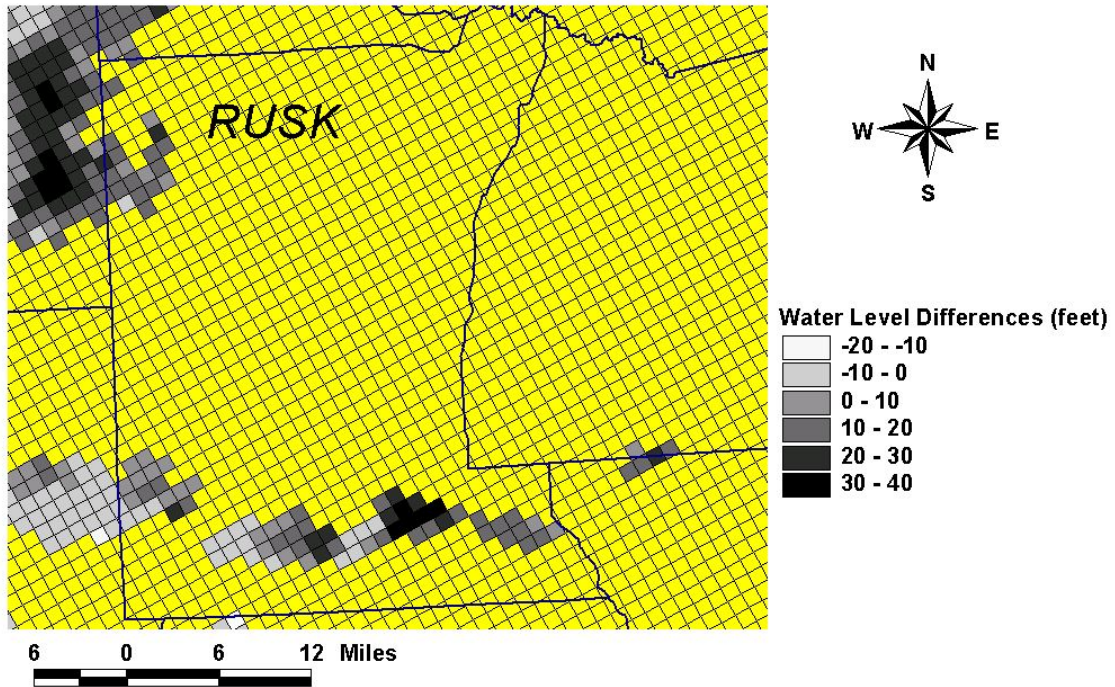


Figure 1. Simulated water-level differences in the Queen City aquifer in Rusk County in 2050 based on the GAM for the northern parts of the Queen City and Sparta aquifers. The yellow areas are inactive model cells for the layer (no aquifer is present at that location). Water-level differences are equal to simulated head in 2050 minus simulated head in 1999.

Carrizo

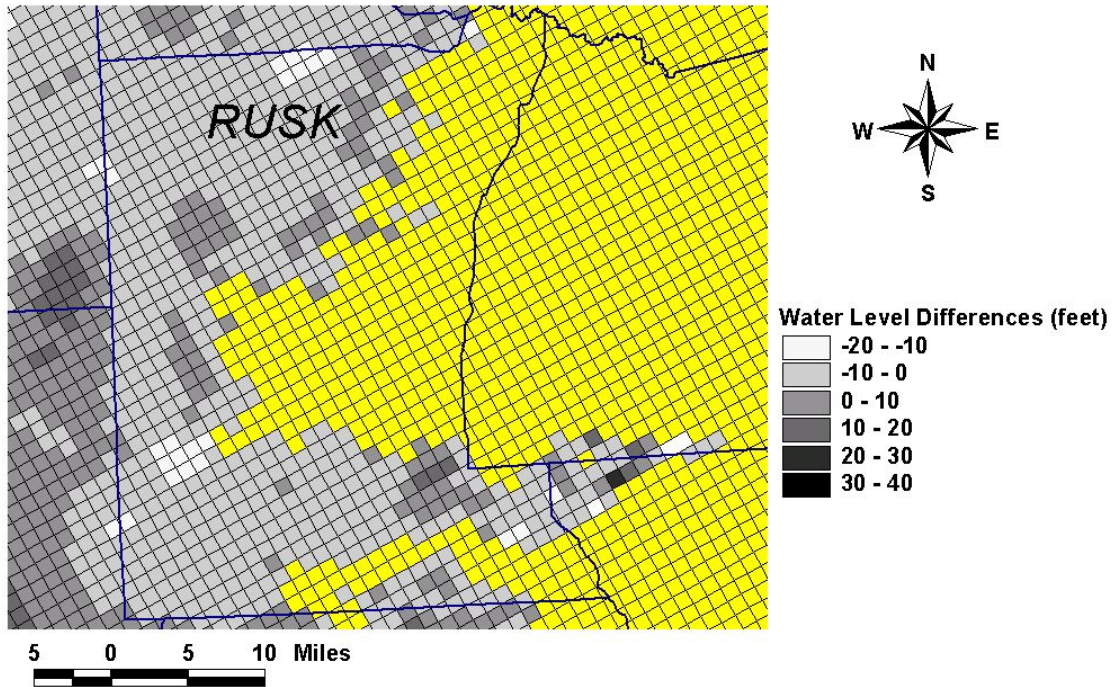


Figure 2. Simulated water-level differences in the Carrizo aquifer in Rusk County in 2050 based on the GAM for the northern parts of the Queen City and Sparta aquifers. The yellow areas are inactive model cells for the layer (no aquifer is present at that location). Water-level differences are equal to simulated head in 2050 minus simulated head in 1999.

Middle Wilcox

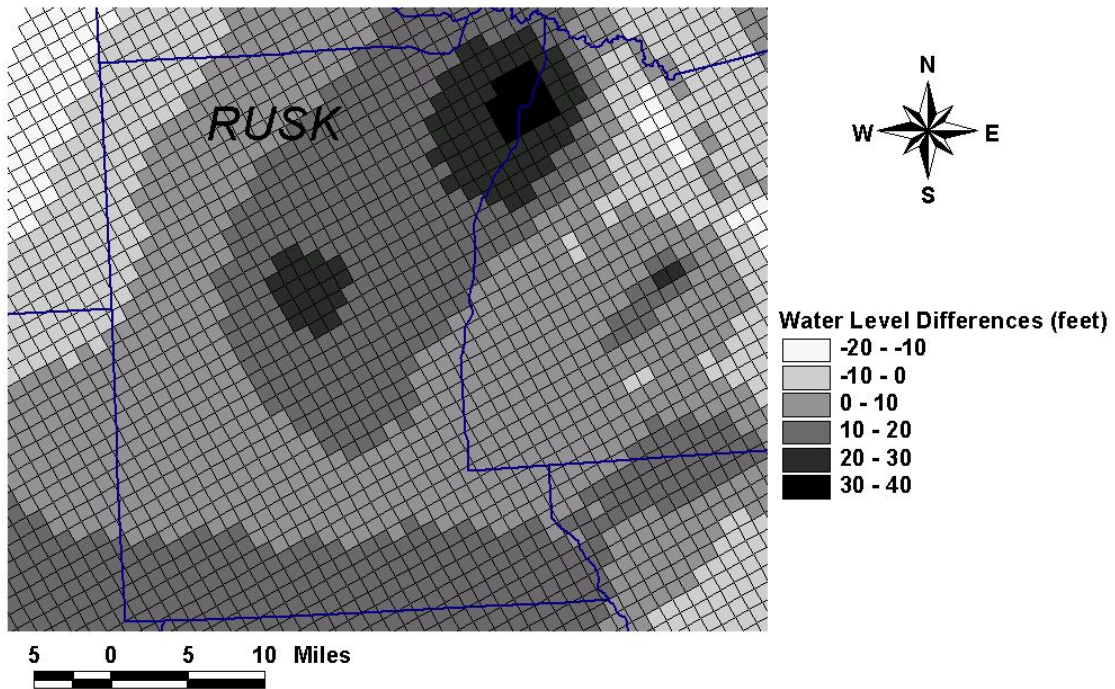


Figure 3. Simulated water-level differences in the Middle Wilcox aquifer in Rusk County in 2050 based on the GAM for the northern parts of the Queen City and Sparta aquifers. Water-level differences are equal to simulated head in 2050 minus simulated head in 1999.