GAM Run 08-78

Shirley Wade, Ph.D., P.G.
Texas Water Development Board
Groundwater Availability Modeling Section
(512) 463-8499
October 13, 2008

EXECUTIVE SUMMARY:

We ran a 10-year predictive simulation with the groundwater availability model for the northern part of the Queen City, Sparta, and Carrizo-Wilcox aquifers using baseline (1999) pumpage with 8,000 acre-feet per year additional pumpage located in western Anderson County in the Carrizo and Middle Wilcox aquifers. The pumping occurs for four years and is then discontinued.

- Maximum water level declines of 85 feet occur at the center of a small cone of depression in the Carrizo Aquifer;
- Maximum water level declines of 230 feet occur at the center of a somewhat larger cone of depression in the Middle Wilcox Aquifer;
- The cones of depression are limited to the area surrounding western Anderson County.
- Water levels recover about two years after pumping is discontinued.

REQUESTOR:

State Senator Kevin P. Eltife

DESCRIPTION OF REQUEST:

Senator Kevin P. Eltife asked us to perform a model run using the groundwater availability model for the northern part of the Queen City, Sparta, and Carrizo-Wilcox aquifers. The request specified that we extract an additional 8,000 acre-feet per year from western Anderson County for 4 years. The additional pumping should be located south of Bethel Hub from the Carrizo and Middle Wilcox aquifers.

METHODS:

To address the request, we used baseline 1999 pumpage (GAM Run 07-20; Smith and Wade, 2007) and added 4,000 acre-feet per year of pumpage to a model cell in the Carrizo Aquifer and added 4,000 acre-feet per year of pumpage to a model cell in the Middle Wilcox Aquifer in western Anderson County. After pumping four years, the additional pumping in western Anderson County was discontinued. Resulting water declines after four years of pumping were evaluated and are described in the results section below. The amount of time for the aquifer to recover after the pumping was discontinued was also estimated using the model.

PARAMETERS AND ASSUMPTIONS:

- We used version 2.01 of the groundwater availability model for the northern portion of the Queen City, Sparta, and Carrizo-Wilcox aquifers.

- We used Groundwater Vistas Version 5 (Environmental Simulations, Inc. 2007) as the interface to process model output results.

- See Fryar and others (2003) and Kelley and others (2004) for assumptions and limitations of the groundwater availability model for the northern part of the Queen City, Sparta, and Carrizo-Wilcox aquifers.

- The model includes eight layers, representing:

    1. Sparta Aquifer (Layer 1)
    2. Weches confining unit (Layer 2)
    3. Queen City Aquifer (Layer 3)
    4. Reklaw confining unit (Layer 4)
    5. Carrizo Aquifer (Layer 5)
    6. Upper Wilcox Aquifer (Layer 6)
    7. Middle Wilcox Aquifer (Layer 7)
    8. Lower Wilcox Aquifer (Layer 8)

- In the Sabine Uplift area, the Simsboro Formation (Middle Wilcox Aquifer) is not distinguishable and the Wilcox Group is informally divided into the Upper Wilcox and the Lower Wilcox aquifers (Kelley and others, 2004). In the current version of the groundwater availability model, layers 6 and 7 represent the Upper Wilcox and Lower Wilcox aquifers in this area. Layer 8 is included in the model in this area, but it is of nominal thickness and is not intended to represent the Lower Wilcox aquifer.

- The mean absolute error (a measure of the difference between simulated and actual water levels during model calibration) in the groundwater availability model is 16 feet for the Sparta Aquifer, 21 feet for the Queen City Aquifer, 25 feet for the Carrizo Aquifer, and 21 feet for the Upper Wilcox Aquifer for the calibration period (1980 to 1989) and 15, 24, 28, and 24 feet for the same aquifers respectively in the verification period (1990 to 1999), or between five and eight percent of the range of measured water levels (Kelley and others, 2004).

- Recharge rates are based on average (1961 to 1990) precipitation (Kelley and others, 2004).

- Evaporation rates and initial streamflow rates are based on long-term steady-state conditions (Kelley and others, 2004).

RESULTS:

Figures 1 and 2 show water level declines in the Carrizo and Middle Wilcox aquifers after four years of the additional pumpage totaling 8,000 acre-feet per year. A small cone of depression occurs in the Carrizo Aquifer in western Anderson County resulting from the additional pumping (Figure 1). The maximum decline at the center is 85 feet. A somewhat larger cone of depression occurs in the Middle Wilcox Aquifer after four years (Figure 2). The maximum decline at the center is 230 feet. Within 2 years after the pumping is discontinued the model results show that water levels recover from the effects of the additional pumping. We used the regional scale groundwater availability model as a screening tool to estimate water level declines and time of recovery. It should be noted that, because the grid cells are one mile square and hence the pumping is spread over one square mile, the model may underestimate drawdown. However, the model may overestimate the area of influence for a single well or group of wells.

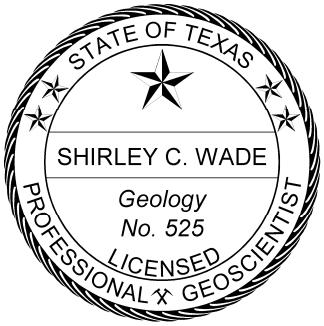
REFERENCES:

Environmental Simulations, Inc. 2007, Guide to Using Groundwater Vistas Version 5, 381 p.

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: contract report to the Texas Water Development Board, 529 p.

Kelley, V. A., Deeds, N. E., Fryar, D. G., and Nicot, J. P., 2004, Groundwater availability models for the Queen City and Sparta aquifers: contract report to the Texas Water Development Board, 867 p.

Smith, Richard M. and Wade, Shirley, 2007, GAM Run 07-20: Texas Water Development Board, GAM Run 07-20 Report, 55 p.



The seal appearing on this document was authorized by Shirley C. Wade, P.G. 525, on October 13, 2008.

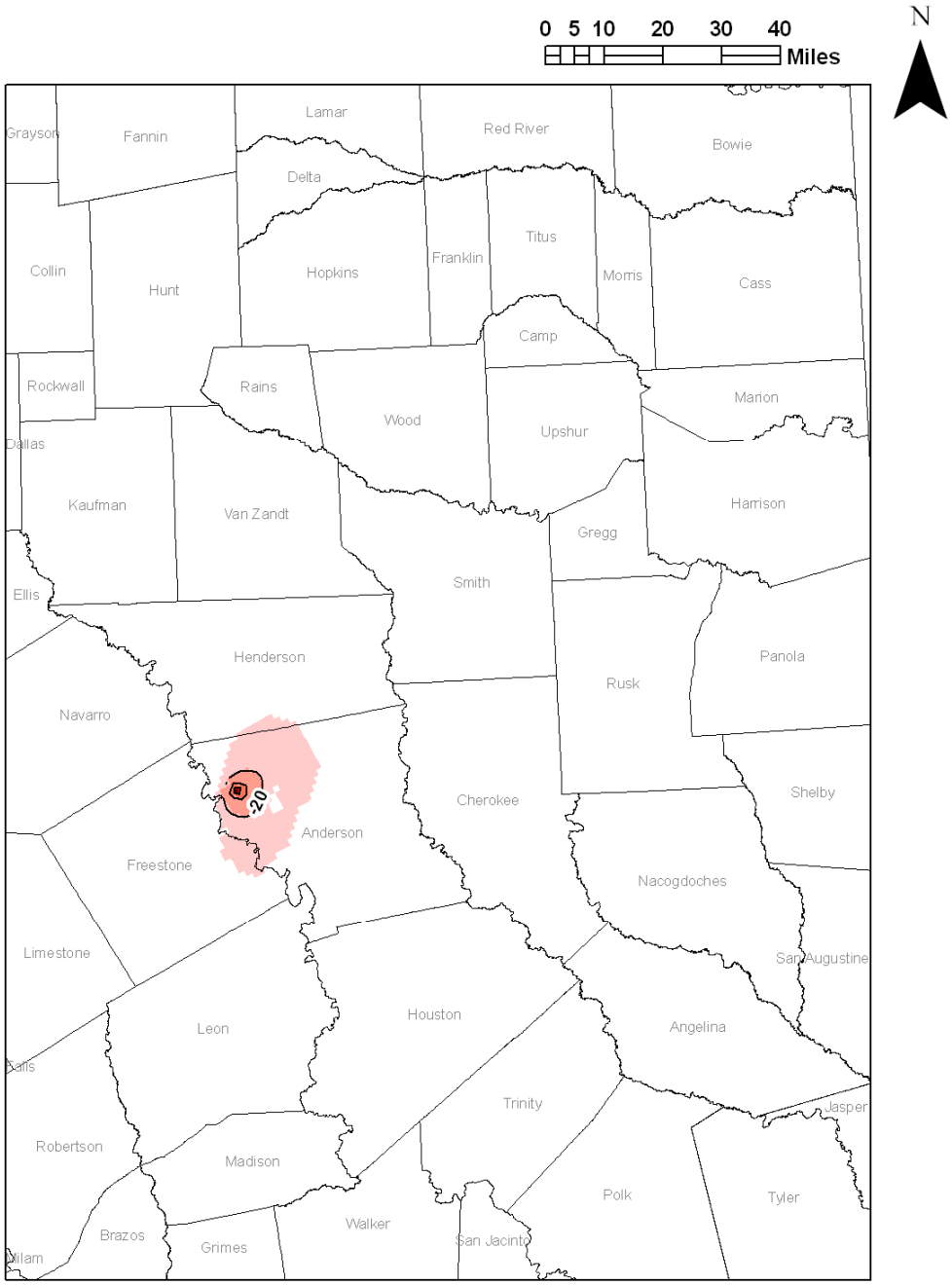


Figure 1. Water level declines in the Carrizo Aquifer after four years of pumping compared with pumping only baseline 1999 amounts. Shaded area represents declines greater than one foot and contour interval is 20 feet.

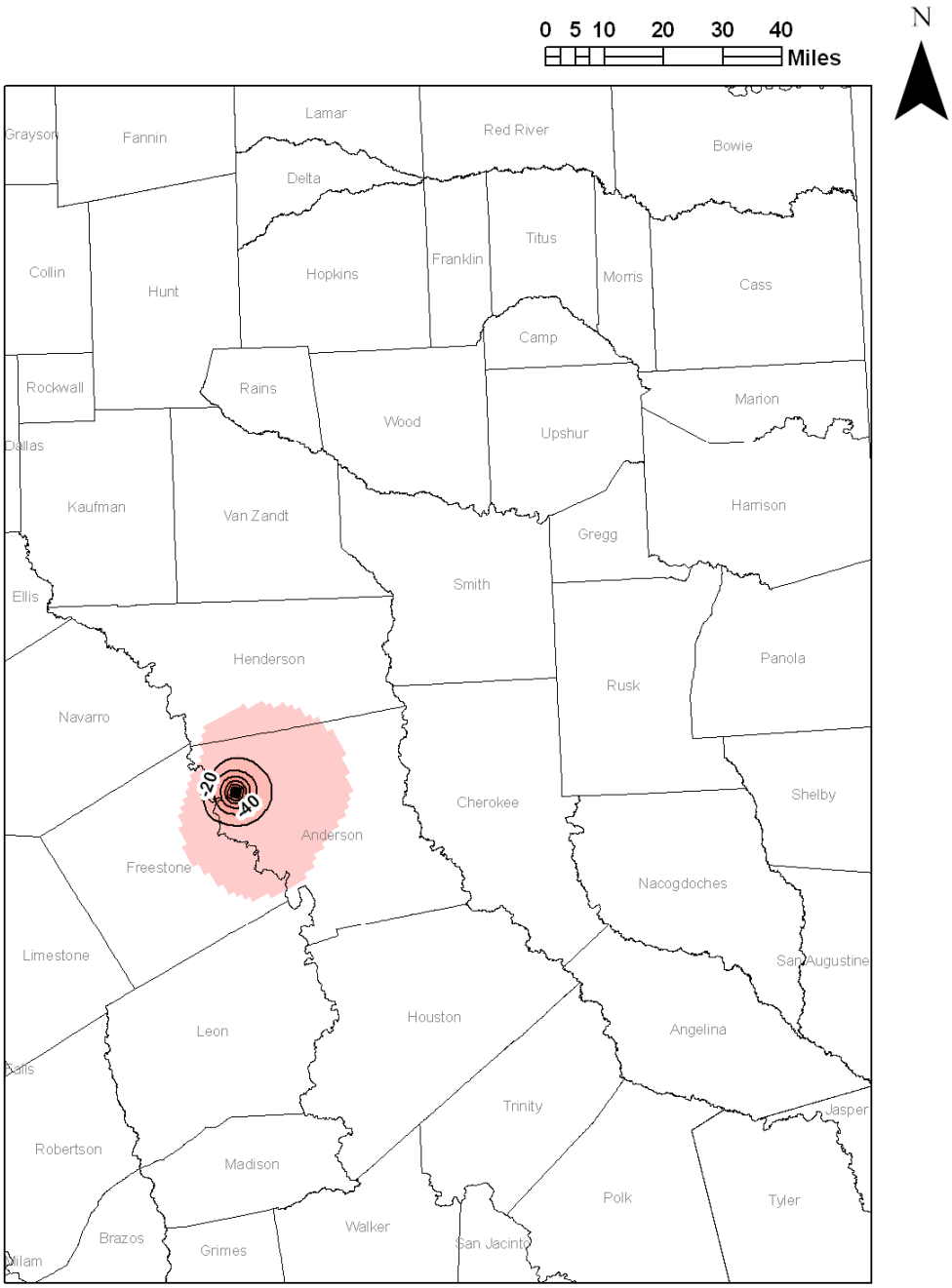


Figure 2. Water level declines in the Middle Wilcox Aquifer after four years of pumping compared with pumping only baseline 1999 amounts. Shaded area represents declines greater than one foot and contour interval is 20 feet.