GAM run 05-11

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Groundwater Availability Modeling Section
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REQUESTOR:

Mr. Stefan Schuster with Freese and Nichols, Inc. on behalf of the Panhandle Regional Water Planning Group

DESCRIPTION OF REQUEST:

Mr. Schuster requested that we run the Groundwater Availability Model (GAM) for the southern part of the Ogallala aquifer for the period 2000 to 2050 for Randall and Oldham counties and (1) compute groundwater volumes for the same counties and (2) estimate groundwater volumes for 2060. He wanted this information for 2000, 2010, 2020, 2030, 2040, 2050, and 2060.

METHODS:

We used the GAM for the southern part of the Ogallala aquifer (Blandford and others, 2003) with average recharge and the 2000 to 2050 predictive scenario. We calculated saturated thickness by subtracting the bottom of the Ogallala aquifer, as included in the GAM, from the GAM calculated water levels. We then used ArcView to generate total volumes for each county based on the saturated thickness for each decade. On a cell-by-cell basis in the GAM, we multiplied the saturated thickness by the area of the cell and by a specific yield of 0.15. We used trend line projections, as calculated in Excel, to estimate aquifer volumes for 2060.

In addition, we adjusted the partial values listed in Table 1 of GAM run 05-10 (Smith and Mace, 2005) for Oldham and Randall counties to reflect the full aquifer volumes for these counties and included the results in this report.

PARAMETERS AND ASSUMPTIONS:

- See Blandford and others (2003) for assumptions and limitations of the GAM. Root mean squared error for this model is 44 ft. This error will have more of an effect on model results where the aquifer is thin.
- Recharge represents average conditions for the predictive period.
- Assumed a uniform specific yield of 0.15 across aquifer.
- Assumed the trend line analysis represents a reasonable projection based on 2000 to 2050 volumes.

RESULTS:

Table 1 shows the estimated aquifer volumes for the parts of Oldham and Randall counties that were modeled in the GAM of the southern part of the Ogallala aquifer. Note that the GAM run may include less pumpage than initially assigned because, according to the GAM, the aquifer cannot support the pumpage and begins to go dry in Randall County. In the GAM, once a part of the model goes dry, it stays dry, and the pumping is "shut off." This can result in water levels rising in nearby areas once the pumping in the area is stopped (Figure 1). This also results in less pumping in the model because the pumping has been stopped in these areas. In reality, the aquifer will probably not go dry because pumping will become uneconomical before the aquifer goes dry in any particular area. However, the GAM is suggesting that these areas may experience water supply problems sometime in the next 50 years.

The polynomial trend line and linear analysis to project the aquifer volume for 2060 for Randall and Oldham counties had a 98 percent R-squared value and a 90 percent R-squared value, respectively (see Figures 1 and 2).

Table 2 shows the adjusted groundwater volumes to reflect all of Oldham and Randall counties. The projected volumes are consistently higher than the 1.25% analysis from GAM run 04-13 (Smith, 2004). See GAM Run 05-10 (Smith and Mace, 2005) for an analysis of what these numbers mean.

REFERENCES:

Blandford, T. N., Blazer, D. J., Calhoun, K. C., Dutton, A. R., Naing, T., Reedy, R. C., and Scanlon, B. R., 2003, Groundwater Availability of the Southern Ogallala Aquifer in Texas and New Mexico; Numerical Simulations Through 2050: final report prepared for the Texas Water Development Board.

Smith, R., 2004, GAM Run 04-13: Texas Water Development Board, 7 p.

Smith, R., 2005, GAM Run 05-09: Texas Water Development Board, 14 p.

Smith, R. and Mace, R., 2005, GAM Run 05-10: Texas Water Development Board, 4 p.

Table 1. Estimates of groundwater volumes for the portions of Oldham and Randall counties located in the GAM of the southern part of the Ogallala aquifer.

County	GAM 2000 (acre-feet)	GAM 2010 (acre-feet)	GAM 2020 (acre-feet)	GAM 2030 (acre-feet)	GAM 2040 (acre-feet)	GAM 2050 (acre-feet)	*GAM 2060 (acre-feet)
Oldham	2,220,000	2,120,000	2,100,000	2,070,000	2,050,000	2,050,000	1,990,000
Randall	4,840,000	4,370,000	4,100,000	4,040,000	4,140,000	4,220,000	4,620,000

- Values are rounded to three significant figures.
* 2060 is not based on the GAM.

Table 2. Update to Table 1 in GAM run 05-10 for Oldham and Randall counties reflecting the combination of aquifer volumes from the northern and southern parts of the GAMs of the Ogallala aquifer.

County	1.25% 2000 (acre-feet)	GAM 2000 (acre-feet)	1.25% 2010 (acre-feet)	GAM 2010 (acre-feet)	1.25% 2020 (acre-feet)	GAM 2020 (acre-feet)	1.25% 2030 (acre-feet)	GAM 2030 (acre-feet)	1.25% 2040 (acre-feet)	GAM 2040 (acre-feet)
Oldham*	2,580,000	2,660,000	2,310,000	2,560,000	2,080,000	2,530,000	1,870,000	2,490,000	1,690,000	2,470,000
Randall*	6,230,000	6,400,000	5,730,000	5,820,000	5,290,000	5,460,000	4,900,000	5,320,000	4,560,000	5,360,000

County	1.25% 2050 (acre-feet)	GAM 2050 (acre-feet)	1.25% 2060 (acre-feet)	GAM 2060 (acre-feet)
Oldham*	1,530,000	2,460,000	1,390,000	2,400,000**
Randall*	4,250,000	5,390,000	3,990,000	5,750,000**

- Values are rounded to three significant figures.
* Additional information on the method and assumptions used to calculate the 1.25% reduction can be found in GAM run 04-13 (Smith, 2004) and the method and assumptions used to estimate the portion of the counties in the northern portion of the Ogallala aquifer GAM can be found in GAM run 05-09 (Smith, 2005).
** 2060 is not based on the GAM.

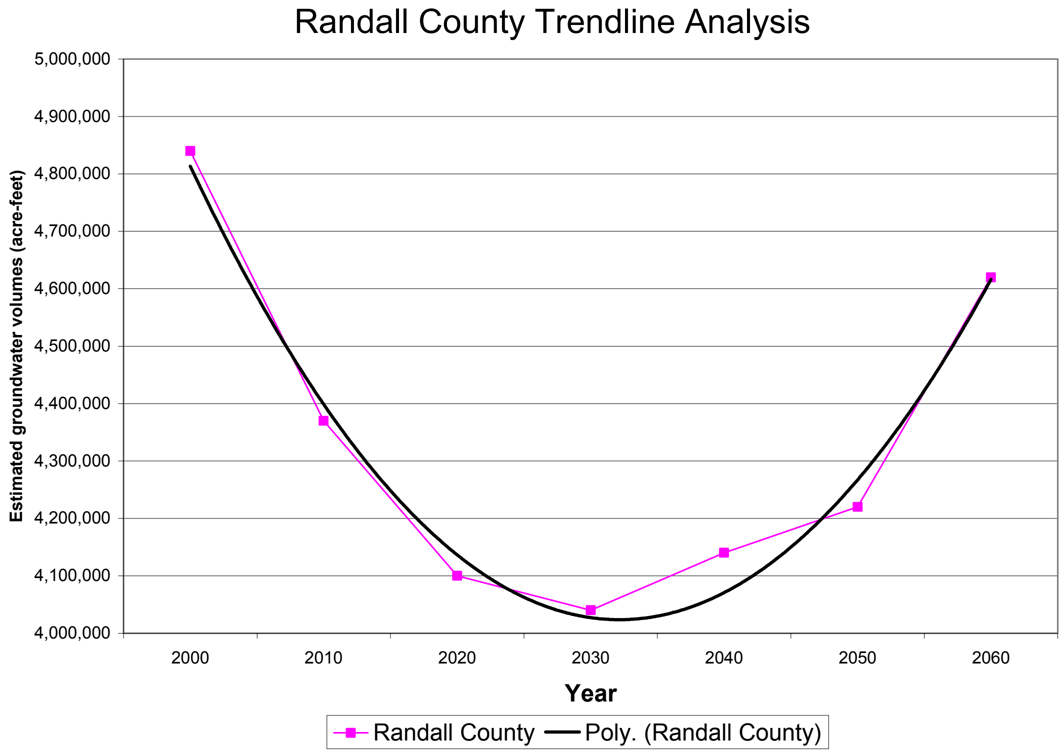

Figure 1. Polynomial best fit trend analysis for groundwater volume in Randall County (Equation is $y = 76{,}429x^2 - 644{,}286x + 5{,}380{,}000$; $R^2 = 0.9811$).

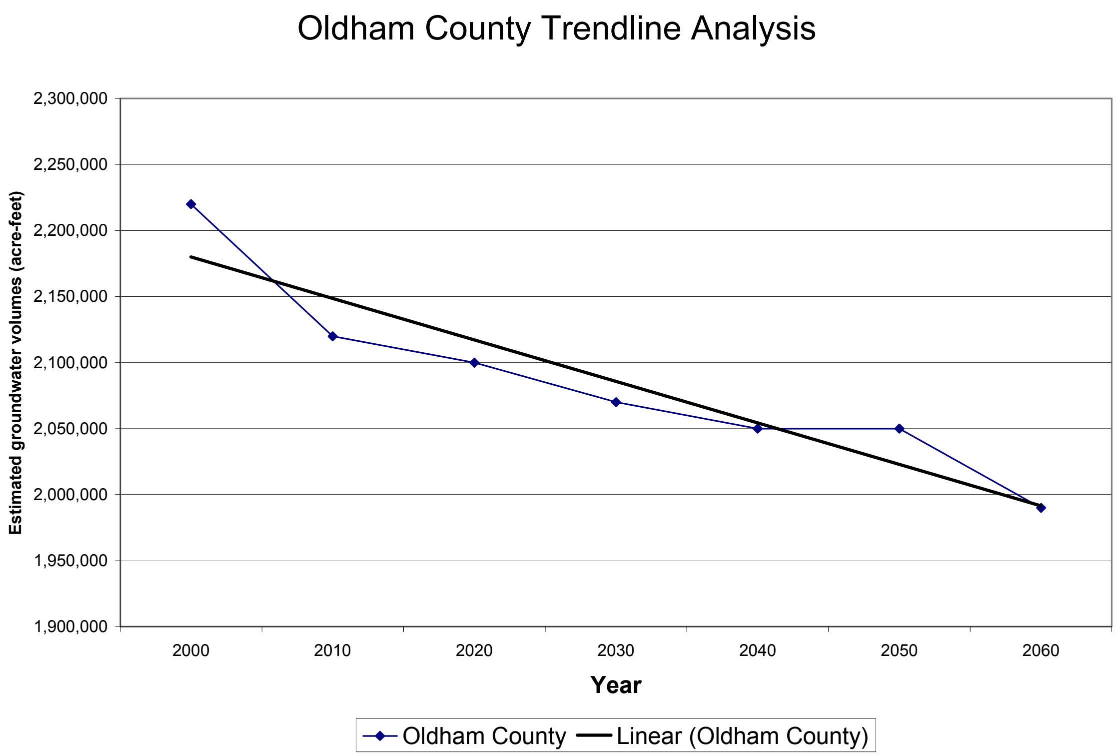

Figure 2 Linear trend analysis for groundwater volume in Oldham County (Equation is $y = -31{,}429x + 2{,}000{,}000$; $R^2 = 0.8816$).