# GAM run 07-01

**by Richard Smith, P.G.**
Texas Water Development Board
Groundwater Availability Modeling Section
(512) 936-0877
January 22, 2007

## EXECUTIVE SUMMARY:

Mr. C. E. Williams requested that we determine the groundwater remaining in storage for Dallam, Hartley, Moore, and Sherman counties using 2.0 percent annual depletion from the base year of 2000 for the time period 2000 through 2060 with average annual recharge. The results indicate that the groundwater availability model for the northern part of the Ogallala Aquifer is more conservative than the 2 percent annual depletion in three out of four cases. Only Moore County showed less water in storage in 2060 using the groundwater availability model.

## REQUESTOR:

Mr. C.E. Williams with the Panhandle Groundwater Conservation District on behalf of Groundwater Management Area 1.

## DESCRIPTION OF REQUEST:

Mr. Williams requested that we determine the groundwater remaining in storage for Dallam, Hartley, Moore, and Sherman counties in Groundwater Management Area 1 using 2.0 percent annual depletion from the base year of 2000 for the time period of 2000 through 2060 using average annual recharge. We compared the 2.0 percent annual depletion to the storage values generated by the groundwater availability model.

## METHODS:

To address the request, we:

- Extracted the annual model-wide recharge rates from the water budgets from the groundwater availability model runs for the northern part of the Ogallala Aquifer. Average recharge is based on a percentage of precipitation for the 1950 through 1990 period of record.
- Calculated the groundwater in storage for the baseline year 2000 and each decade to 2060 using unique cell values. To do this, we first calculated saturated thickness by subtracting the bottom of the Ogallala Aquifer, as included in the groundwater availability model, from the simulated and calibrated groundwater availability model water levels in 2000 and each decade to 2060. On a cell-by-cell basis in the groundwater availability model, we multiplied the saturated thickness by the area of the cell and by the model cell's specific yield to get a volume.

Previous estimates had used an average value of 0.15 for the specific yield across the models (groundwater availability model run 04-13 dated September 22, 2004), and we felt that using unique values for each cell in the groundwater availability model was more appropriate.

- Computed the 2.0 percent annual depletion from 2000 through 2060 using a spreadsheet analysis. Annual depletion was calculated based on a depletion of the previous year's total storage with the addition of average recharge.
- Compared the 2.0 percent annual depletion from 2000 through 2060 with the storage values generated by the groundwater availability model by using a graphical analysis.

## PARAMETERS AND ASSUMPTIONS:

- Used version 2.01 of the groundwater availability model for the northern part of the Ogallala Aquifer (Dutton, 2004).
- See Dutton and others (2001) and Dutton (2004) for assumptions and limitations of the groundwater availability model for the northern part of the Ogallala Aquifer. Root mean squared error for this model is 53 feet. This error has more of an effect on model results where the aquifer is thin.
- Recharge was reappraised in the updated groundwater availability model of the northern part of the Ogallala Aquifer (Dutton, 2004).
- Average recharge used in the groundwater availability model was based on a percentage of precipitation for the 1950 through 1990 period of record. Since this includes the 1950s drought of record, the average recharge used for this analysis is considered a conservative estimate.
- The predictive simulations were based on pumpage provided by the planning group for Region A as discussed in groundwater availability model run 05-09.

## RESULTS:

Table 1 shows the results of our analysis. Graphical results follow, Figures 1 through 4. Plots show volumes from both the spreadsheet depletion analysis and the decade-by-decade storage extracted from the groundwater availability model. The spreadsheet analysis indicates that more water is projected to be in storage in Dallam, Hartley, and Sherman counties by using the groundwater availability model versus the 2.0 percent annual decline over the period 2000 to 2060. Only the Moore County calculation showed a more conservative answer than that projected by the groundwater availability model. The volume of water in 2060 in storage as calculated using the groundwater availability model is 13 percent higher in Dallam County, 88 percent higher in Hartley County, and 5 percent higher in Sherman County. In contrast, the volume of water in Moore County was 15 percent less in 2060 using the groundwater availability model versus the 2 percent annual depletion.

## REFERENCES:


Dutton, A., 2004, Adjustments of parameters to improve the calibration of the Og-N model of the Ogallala aquifer, Panhandle Water Planning Area: Bureau of Economic Geology, The University of Texas at Austin, 9 p

Dutton, A., Reedy, R., and Mace, R., 2001, Saturated thickness of the Ogallala aquifer in the Panhandle Water Planning Area – Simulation of 2000 through 2050 Withdrawal Projections: prepared for the Panhandle Water Planning Group by the Bureau of Economic Geology, The University of Texas at Austin, 54 p.


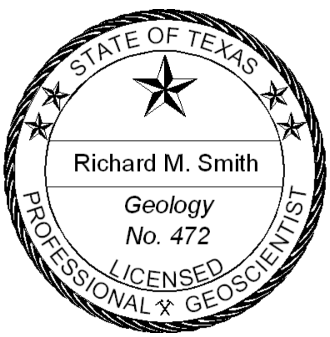


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**Table 1.Groundwater remaining in storage for the Ogallala Aquifer for Dallam, Hartley, Moore and Sherman counties in groundwater management area 1. Calculations start in 2000 with a 2.0 percent decrease in volume for each year with the addition of average recharge. All values are reported in acre-feet per year**

| County | Recharge | 2000 groundwater availability model storage | 2 percent reduction 2010 | 2010 groundwater availability model storage | 2 percent reduction 2020 | 2020 groundwater availability model storage | 2 percent reduction 2030 | 2030 groundwater availability model storage |
|---|---|---|---|---|---|---|---|---|
| Dallam | 21,547 | 17,604,513 | 14,581,245 | 14,622,921 | 12,111,016 | 12,134,853 | 10,092,658 | 10,126,050 |
| Hartley | 17,045 | 24,925,026 | 20,521,461 | 22,140,753 | 16,923,427 | 19,612,912 | 13,983,572 | 17,620,595 |
| Moore | 7,631 | 10,662,411 | 8,781,762 | 8,866,273 | 7,245,135 | 7,116,002 | 5,989,598 | 5,572,033 |
| Sherman | 7,654 | 19,498,315 | 16,001,549 | 16,814,464 | 13,144,437 | 14,188,402 | 10,809,968 | 11,708,499 |

| County | Recharge | 2000 groundwater availability model storage | 2 percent reduction 2040 | 2040 groundwater availability model storage | 2 percent reduction 2050 | 2050 groundwater availability model storage | 2 percent reduction 2060 | 2060 groundwater availability model storage |
|---|---|---|---|---|---|---|---|---|
| Dallam | 21,547 | 17,604,513 | 8,443,513 | 8,591,459 | 7,096,042 | 7,549,367 | 5,995,059 | 6,779,683 |
| Hartley | 17,045 | 24,925,026 | 11,581,496 | 16,366,457 | 9,618,825 | 15,570,650 | 8,015,180 | 15,033,727 |
| Moore | 7,631 | 10,662,411 | 4,963,734 | 4,394,052 | 4,125,528 | 3,551,754 | 3,440,653 | 2,928,227 |
| Sherman | 7,654 | 19,498,315 | 8,902,537 | 9,545,592 | 7,344,027 | 7,794,612 | 6,070,611 | 6,390,606 |

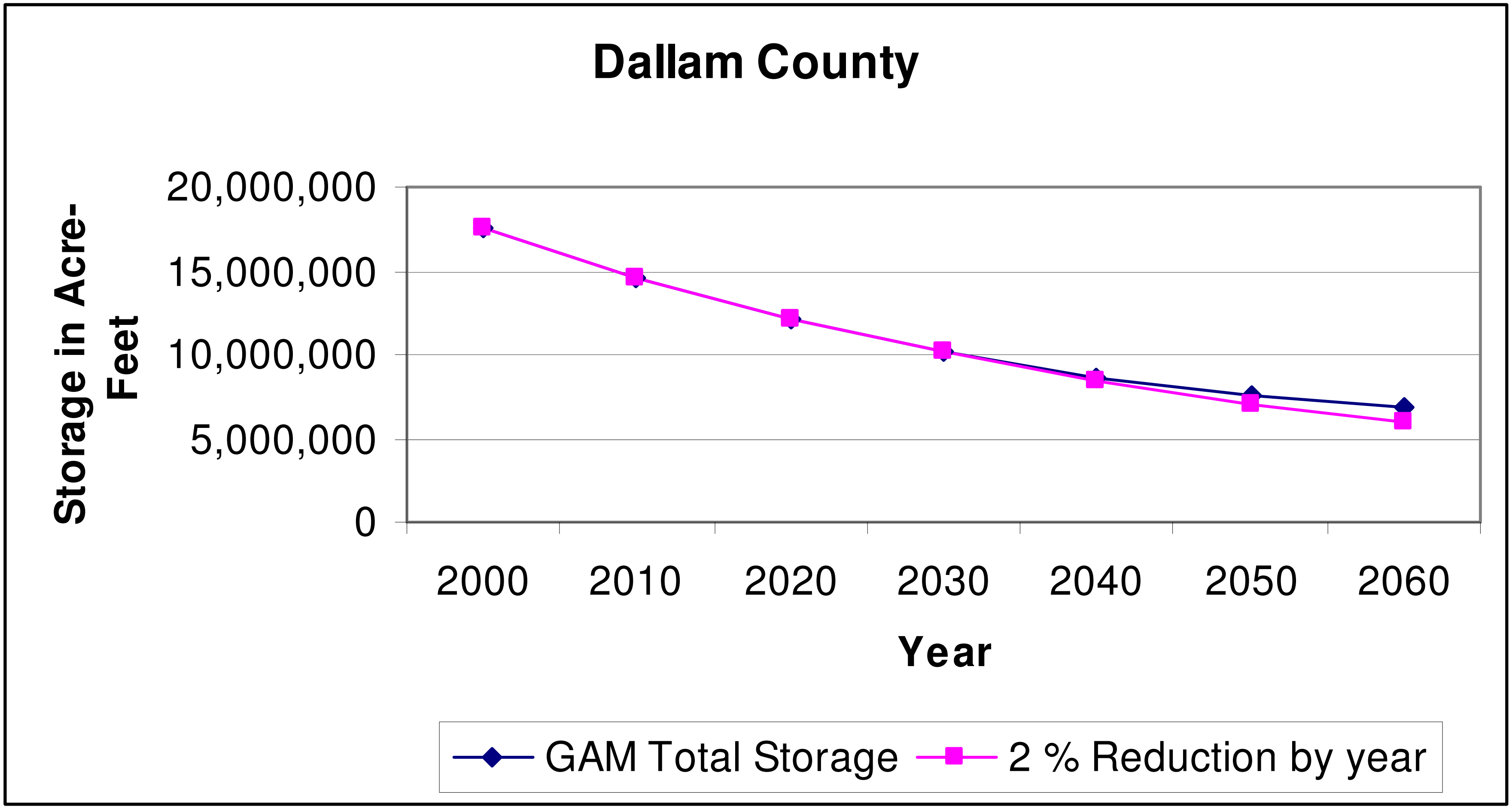


**Figure 1. Results of storage reduction analysis of the Ogallala Aquifer in Dallam County using the groundwater availability model (GAM) and a spreadsheet analysis.**

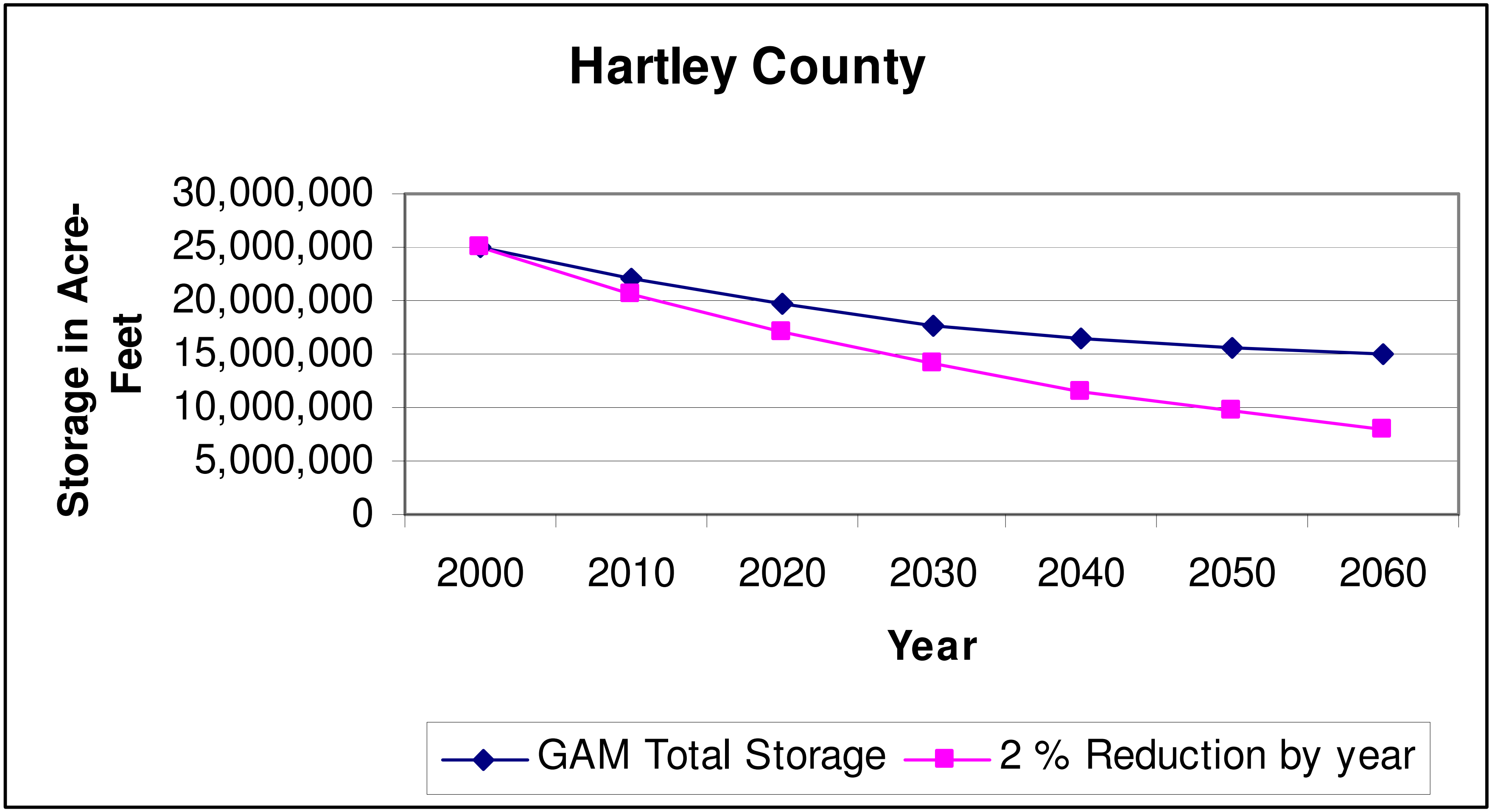


**Figure 2. Results of storage reduction analysis of the Ogallala Aquifer in Hartley County using the groundwater availability model (GAM) and a spreadsheet analysis.**

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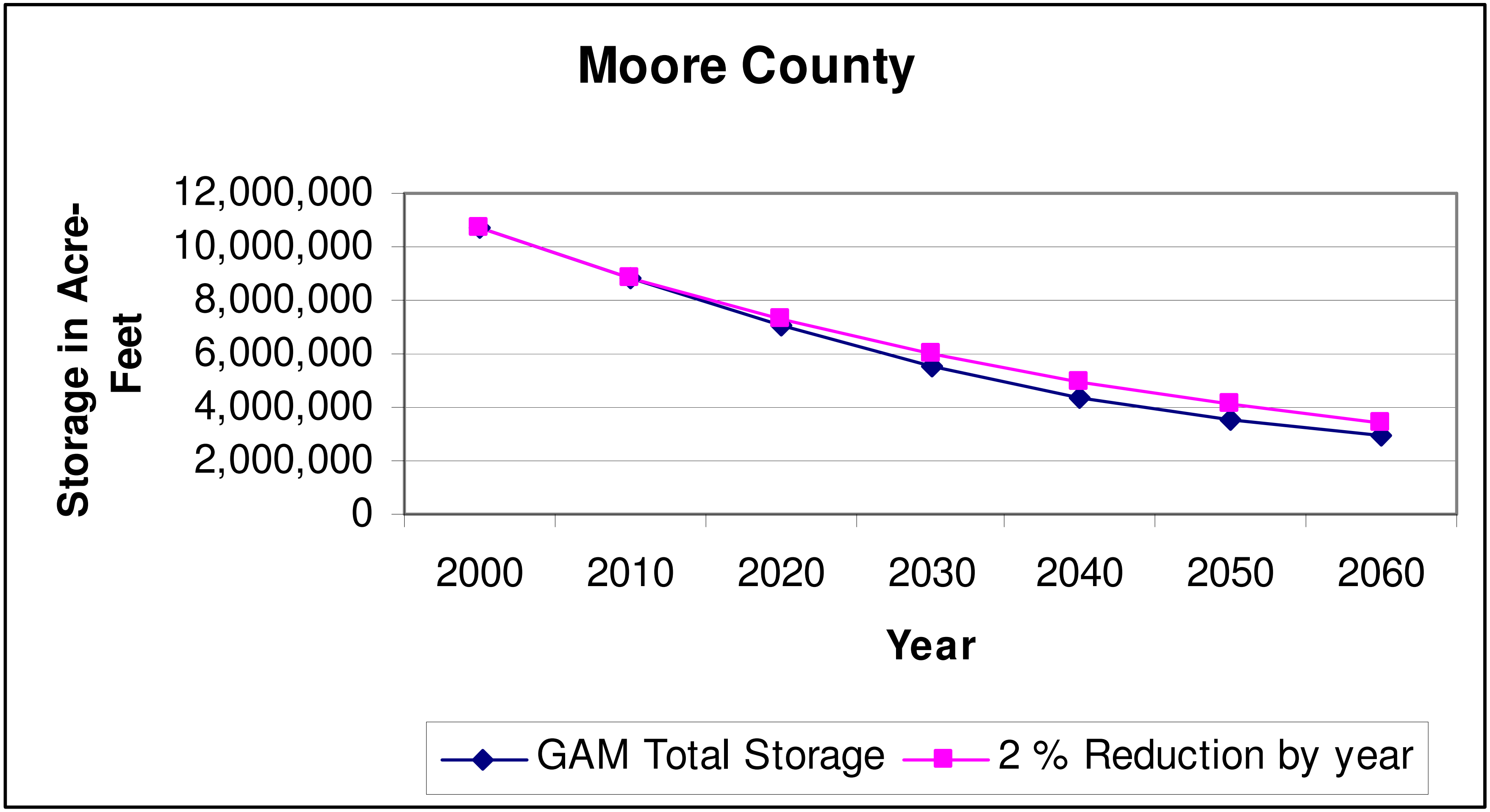


**Figure 3. Results of storage reduction analysis of the Ogallala Aquifer in Moore County using the groundwater availability model (GAM) and a spreadsheet analysis.**

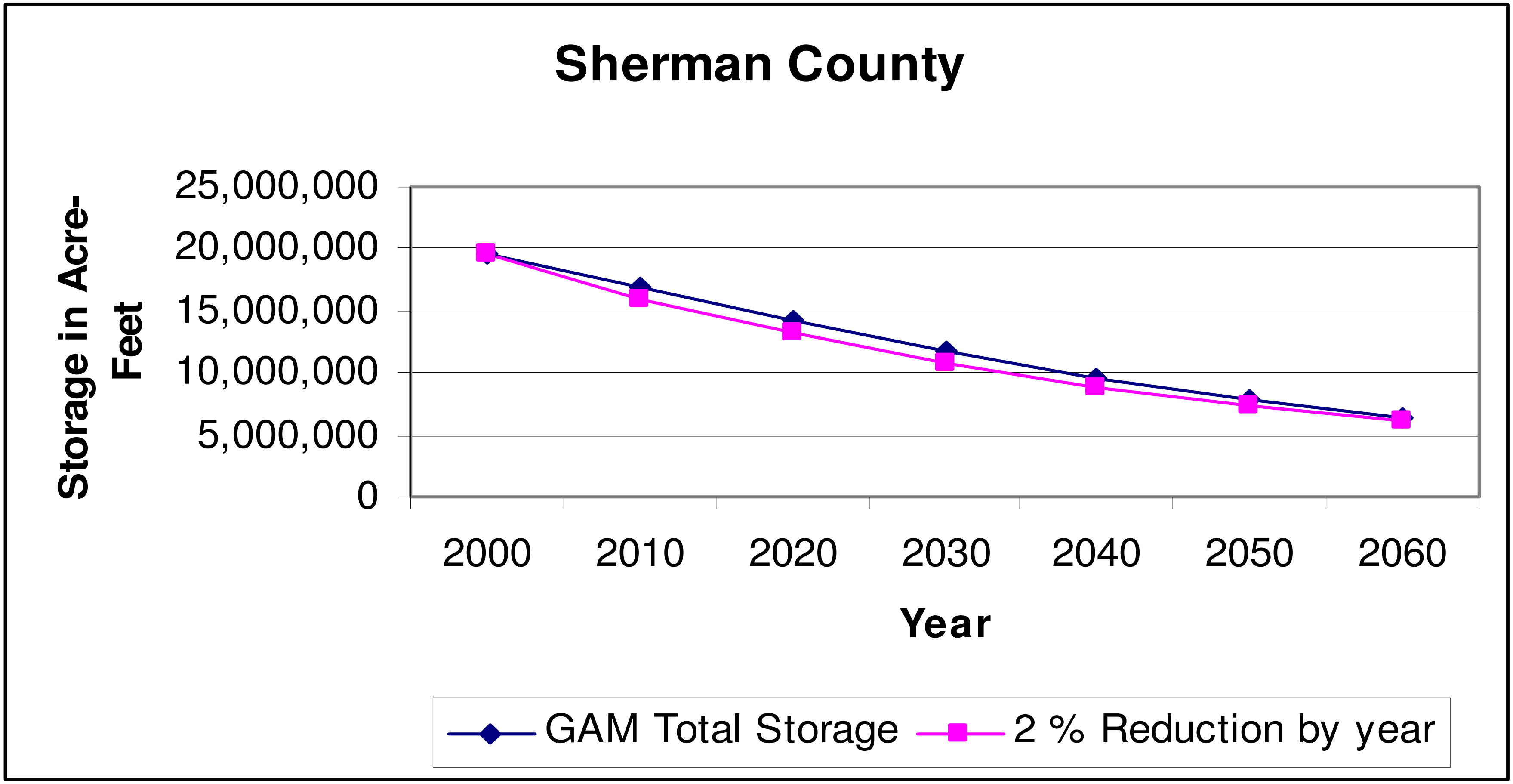


**Figure 4. Results of storage reduction analysis of the Ogallala Aquifer in Sherman County using the groundwater availability model (GAM) and a spreadsheet analysis.**