GAM Run 08-63

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EXECUTIVE SUMMARY:

Texas State Water Code, Section 36.1071, Subsection (h), states that, in developing its groundwater management plan, a groundwater conservation district shall use groundwater availability modeling information provided by the Executive Administrator of the Texas Water Development Board in conjunction with any available site-specific information provided by the district for review and comment to the Executive Administrator. Information derived from groundwater availability models that shall be included in groundwater management plans includes:

(1) the annual amount of recharge from precipitation to the groundwater resources within the district, if any;
(2) for each aquifer within the district, the annual volume of water that discharges from the aquifer to springs and any surface water bodies, including lakes, streams, and rivers; and
(3) the annual volume of flow into and out of the district within each aquifer and between aquifers in the district.

The purpose of this model run is to provide information to High Plains Underground Water Conservation District No. 1 for its groundwater management plan. The groundwater management plan for High Plains Underground Water Conservation District No. 1 is due for approval by the executive administrator of the Texas Water Development Board before June 16, 2009.

This report discusses the methods, assumptions, and results from model runs using the groundwater availability models for the northern and southern parts of the Ogallala Aquifer. Table 1 summarizes the groundwater availability model information required by statute for the groundwater management plan for High Plains Underground Water Conservation District No. 1. Figure 1 shows the area of each model from which the values in Table 1 were extracted.

The Dockum Aquifer also underlies High Plains Underground Water Conservation District No. 1; however, a groundwater availability model for this minor aquifer has not been completed at this time. If the district would like information for the Dockum Aquifer, they may request it from the Groundwater Technical Assistance Section of the Texas Water Development Board.

METHODS:

We ran the groundwater availability models for the northern and southern parts of the Ogallala Aquifer, and (1) extracted water budgets for each year of the 1980 through 1999 period and (2) averaged the water budget values for recharge, surface water outflow, inflow to the district, and outflow from the district for the portion of the Ogallala Aquifer located within the district.

PARAMETERS AND ASSUMPTIONS:

- We used version 1.01 of the groundwater availability model for the southern portion of the Ogallala Aquifer. See Blandford and others (2003) for assumptions and limitations of this model.

- We used version 2.01 of the groundwater availability model for the northern portion of the Ogallala Aquifer. See Dutton and others (2001) and Dutton (2004) for assumptions and limitations of this model.

- In the analysis, the pumpage distribution for the transient calibrated models is the same as described in Blandford and others (2003) and Dutton and others (2001) for the southern and northern portions of the Ogallala Aquifer, respectively.

- The root mean squared error (a measure of the difference between simulated and actual water levels during model calibration) for the model for the southern portion of the Ogallala Aquifer is 47 feet. The root mean squared error for the model for the northern portion of the Ogallala Aquifer is 53 feet. These errors will have more of an effect on model results where the aquifer is thin.

- The groundwater availability models for the northern and southern portions of the Ogallala Aquifer have only one layer representing the Ogallala hydrostratigraphic unit in the district. The models do not, therefore, consider flow into or out of the Ogallala Aquifer from other formations.

- The model for the southern portion of the Ogallala Aquifer has monthly stress periods from 1982 to 1984 and 1992 to 1994. All other stress periods for both models are annual.

- In the small overlap area represented by the models for both the northern and southern portions of the Ogallala Aquifer, the model for the southern portion was used since it is the primary model representing the Ogallala Aquifer within the district.

- We used Processing Modflow for Windows (PMWIN) version 5.3 (Chiang and Kinzelbach, 2001) as the interface to process model output for the groundwater availability models for the northern and southern portions of the Ogallala Aquifer.

RESULTS:

A groundwater budget summarizes the water entering and leaving the aquifer according to the groundwater availability model. Selected components were extracted from the groundwater budget and averaged over the duration of the calibrated portion of the model run (1980 through 1999) in the district, as shown in Table 1. The components of the modified budgets shown in Table 1 include:

- Precipitation recharge—This is the areally distributed recharge sourced from precipitation falling on the outcrop areas of the aquifer (where the aquifer is exposed at land surface) within the district.

- Surface water outflow—This is the total water exiting the aquifer (outflow) to surface water features such as streams, reservoirs, and drains (springs).

- Flow into and out of district—This component describes lateral flow within the aquifer between the district and adjacent counties.

- Flow between aquifers—This describes the vertical flow, or leakage, between aquifers or confining units. This flow is controlled by the relative water levels in each aquifer or confining unit and aquifer properties of each aquifer or confining unit that define the amount of leakage that occurs. “Inflow” to an aquifer from an overlying or underlying aquifer will always equal the “Outflow” from the other aquifer. Since these models represent only a single aquifer, flow between aquifers was not included.

The information needed for the district’s management plan is summarized in Table 1. The area of the models from which the water budgets were extracted is shown in Figure 1. It is important to note that sub-regional water budgets are not exact. This is due to the size of the model cells and the approach used to extract data from the model. To avoid double accounting, a model cell that straddles a political boundary, such as a district or county boundary, is assigned to one side of the boundary based on the location of the centroid of the model cell. For example, if a cell contains two counties, the cell is assigned to the county where the centroid of the cell is located.

Table 1: Summarized information needed for the management plan for High Plains Underground Water Conservation District No. 1. All values are reported in acre-feet per year. All numbers are rounded to the nearest 1 acre-foot.

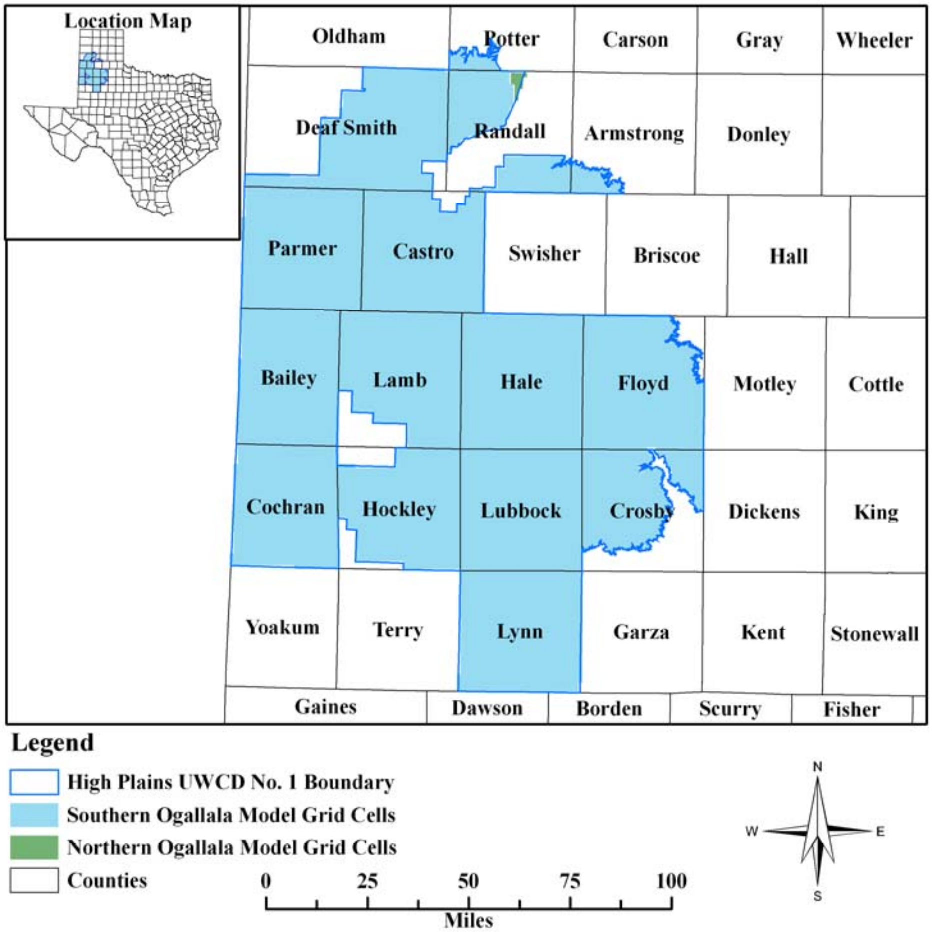
Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Northern portion of the Ogallala Aquifer	51
	Southern portion of the Ogallala Aquifer	639,469[a]
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Northern portion of the Ogallala Aquifer	0[b]
	Southern portion of the Ogallala Aquifer	9,571
Estimated annual volume of flow into the district within each aquifer in the district	Northern portion of the Ogallala Aquifer	392
	Southern portion of the Ogallala Aquifer	19,101
Estimated annual volume of flow out of the district within each aquifer in the district	Northern portion of the Ogallala Aquifer	845
	Southern portion of the Ogallala Aquifer	26,181
Estimated net annual volume of flow between each aquifer in the district	Flow in or out of the Ogallala Aquifer	N.A.[c]

[a] Irrigation return flow was accounted for in the model for the southern portion of the Ogallala Aquifer by a reduction in agricultural pumping as described in Blandford and others (2003). Return flow was not considered to be a significant factor in the model for the northern portion of the Ogallala Aquifer (Dutton and others, 2004).

[b] The model for the northern portion of the Ogallala Aquifer does not include any major springs, lakes, streams, or rivers within the district.

[c] N.A.: Not applicable, the models do not consider flow into or out of the Ogallala Aquifer from other formations.

Figure 1: Area of the groundwater availability models from which the information in Table 1 was extracted. Note that model grid cells that straddle a political boundary were assigned to one side of the boundary based on the centroid of the model cell as described above.



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 by Daniel B. Stephens & Associates, Inc., 158 p.

Chiang, W., and Kinzelbach, W., 2001, Groundwater Modeling with PMWIN, 346 p.

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.

Cynthia K. Ridgeway is Manager of the Groundwater Availability Modeling Section and is responsible for oversight of work performed by employees under her direct supervision. The seal appearing on this document was authorized by Cynthia K. Ridgeway, P.G., on September 24, 2008.