GAM Run 08-69

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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 the groundwater management plan 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 the currently unconfirmed McLennan County Groundwater Conservation District for its groundwater management plan. The groundwater management plan for McLennan County Groundwater Conservation District is due for approval by the executive administrator of the Texas Water Development Board three years after the date of the district confirmation election, currently scheduled for November 2008.

This report discusses the methods, assumptions, and results from model runs using the groundwater availability model for the northern section of the Trinity Aquifer. Table 1 summarizes the groundwater availability model data required by statute for McLennan County Groundwater Conservation District's groundwater management plan. Figure 1 shows the area of the model from which the values in Table 1 were extracted.

The Brazos River Alluvium Aquifer also underlies the McLennan County Groundwater Conservation District; however, a groundwater availability model for this minor aquifer has not been completed at this time. If the district would like information for the Brazos River Alluvium Aquifer, they may request it from the Groundwater Technical Assistance Section of the Texas Water Development Board.

METHODS:

We ran the groundwater availability model for the northern section of the Trinity Aquifer and (1) extracted water budgets for each year of the 1980 through 1999 period and (2) averaged the annual water budget values for recharge, surface water outflow, inflow to the district, outflow from the district, net inter-aquifer flow (upper), and net inter-aquifer flow (lower) for the portions of the Trinity Aquifer located within the district.

PARAMETERS AND ASSUMPTIONS:

- We used version 1.01 of the groundwater availability model for the northern section of the Trinity Aquifer. See Bené and others (2004) for assumptions and limitations of the model.

- The northern section of the Trinity Aquifer model includes seven layers representing:

    1. the Woodbine Aquifer (Layer 1),
    2. the Washita and Fredericksburg Confining Unit (Layer 2),
    3. the Paluxy Aquifer (Layer 3),
    4. the Glen Rose Confining Unit (Layer 4),
    5. the Hensell Aquifer (Layer 5),
    6. the Pearsall/Cow Creek/Hammett/Sligo Confining Unit (Layer 6), and
    7. the Hosston Aquifer (Layer 7).

- The mean absolute error (a measure of the difference between simulated and actual water levels during model calibration) for the four main aquifers in the model (Woodbine, Paluxy, Hensell, and Hosston) for the calibration and verification time periods (1980 to 2000) ranged from approximately 37 to 75 feet. The root mean squared error was less than ten percent of the maximum change in water levels across the model (Bené and others, 2004).

- The evapotranspiration package of the groundwater availability model was used to represent evaporation, transpiration, springs, seeps, and discharge to streams not modeled by the streamflow-routing package as described in Bené and others (2004).

- We used Processing Modflow for Windows (PMWIN) version 5.3 (Chiang and Kinzelbach, 2001) as the interface to process model output results.

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 for the aquifers located within the district and averaged over the duration of the calibrated portion of the model run (1980 to 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 aquifers (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.

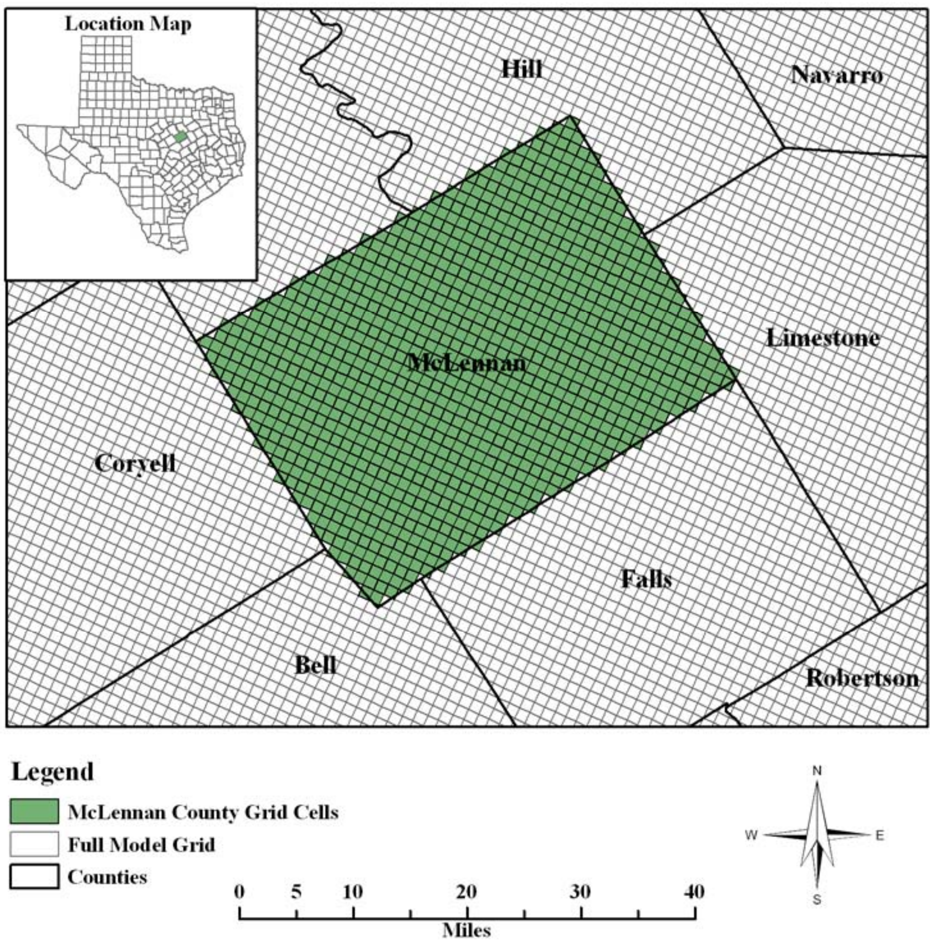
The information needed for the district's management plan is summarized in Table 1. It is important to note that sub-regional water budgets are not exact. This is due to the size of the model cells and the approach used to extract data from the model. To avoid double accounting, a model cell that straddles a political boundary, such as district or county boundaries, 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 McLennan County Groundwater Conservation District's groundwater management plan. 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	Woodbine Aquifer	1,312
	Washita and Fredericksburg series	28,373
	Paluxy Aquifer	0
	Glen Rose Formation	0
	Hensell Aquifer	0
	Pearsall/Cow Creek/Hammett/Sligo formations	0
	Hosston Aquifer	0
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers*	Woodbine Aquifer	36
	Washita and Fredericksburg series	9,534
	Paluxy Aquifer	0
	Glen Rose Formation	0
	Hensell Aquifer	0
	Pearsall/Cow Creek/Hammett/Sligo formations	0
	Hosston Aquifer	0
Estimated annual volume of flow into the district within each aquifer in the district	Woodbine Aquifer	40
	Washita and Fredericksburg series	426
	Paluxy Aquifer	134
	Glen Rose Formation	362
	Hensell Aquifer	3,011
	Pearsall/Cow Creek/Hammett/Sligo formations	12
	Hosston Aquifer	6,301
Estimated annual volume of flow out of the district within each aquifer in the district	Woodbine Aquifer	69
	Washita and Fredericksburg series	291
	Paluxy Aquifer	54
	Glen Rose Formation	45
	Hensell Aquifer	181
	Pearsall/Cow Creek/Hammett/Sligo formations	0
	Hosston Aquifer	283
Estimated net annual volume of flow between each aquifer in the district	Washita and Fredericksburg series to Woodbine Aquifer	2
	Washita and Fredericksburg series to Paluxy Aquifer	91
	Paluxy Aquifer to Glen Rose Formation	309
	Glen Rose Formation to Hensell Aquifer	748
	Hensell Aquifer to Pearsall/Cow Creek/Hammett/Sligo formations	1,483
	Pearsall/Cow Creek/Hammett/Sligo formations to Hosston Aquifer	1,814

* The evapotranspiration package of the groundwater availability model includes evaporation, transpiration, springs, seeps, and discharge to streams not modeled by the streamflow-routing package as described in Bené and others (2004). The surface water outflow estimate in Table 1 includes the results from the evapotranspiration package for model grid cells containing springs and streams not modeled by the streamflow-routing package.

Figure 1: Area of the groundwater availability model for the northern section of the Trinity Aquifer 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:

Bené, J., Harden, B., O'Rourke, D., Donnelly, A., and Yelderman, J., 2004, Northern Trinity/Woodbine Groundwater Availability Model: contract report to the Texas Water Development Board by R.W. Harden and Associates, 391 p.

Chiang, W., and Kinzelbach, W., 2001, Groundwater Modeling with PMWIN, 346 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 10, 2008.