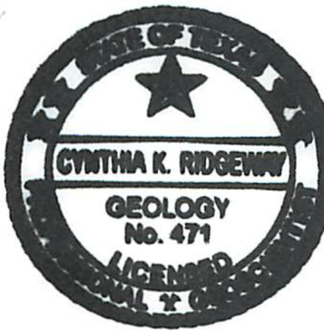
GAM Run 10-004

by Mr. Eric Aschenbach
Texas Water Development Board
Groundwater Availability Modeling Section
(512) 463-1708

Cynthia K. Ridgeway is the 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. 471 on April 15, 2010.



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.

This report supersedes GAM Run 08-72 dated October 3, 2008. The Middle Trinity Groundwater Conservation District boundaries have expanded to include Bosque and Coryell counties since the previous report was completed. The purpose of this model run is to provide information to the Middle Trinity Groundwater Conservation District for its groundwater management plan based on the new district boundaries. This report discusses the method, 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 Middle Trinity Groundwater Conservation District's groundwater management plan. Figure 1 shows the area of the model from which the values in Table 1 were extracted.

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 northern section 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 that generally represent:

  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).

  It should be noted that Layer 1 is not present in the district.

- 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 through 1999) 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 Groundwater Vistas Version 5 (Environmental Simulations, Inc. 2007) as the interface to process model output.

RESULTS:

A groundwater budget summarizes the amount of 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 calibration and verification portion of the model run (1980 through 1999) in the district, as shown in Table 1. The components of the modified budget 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 (see Figure 1).

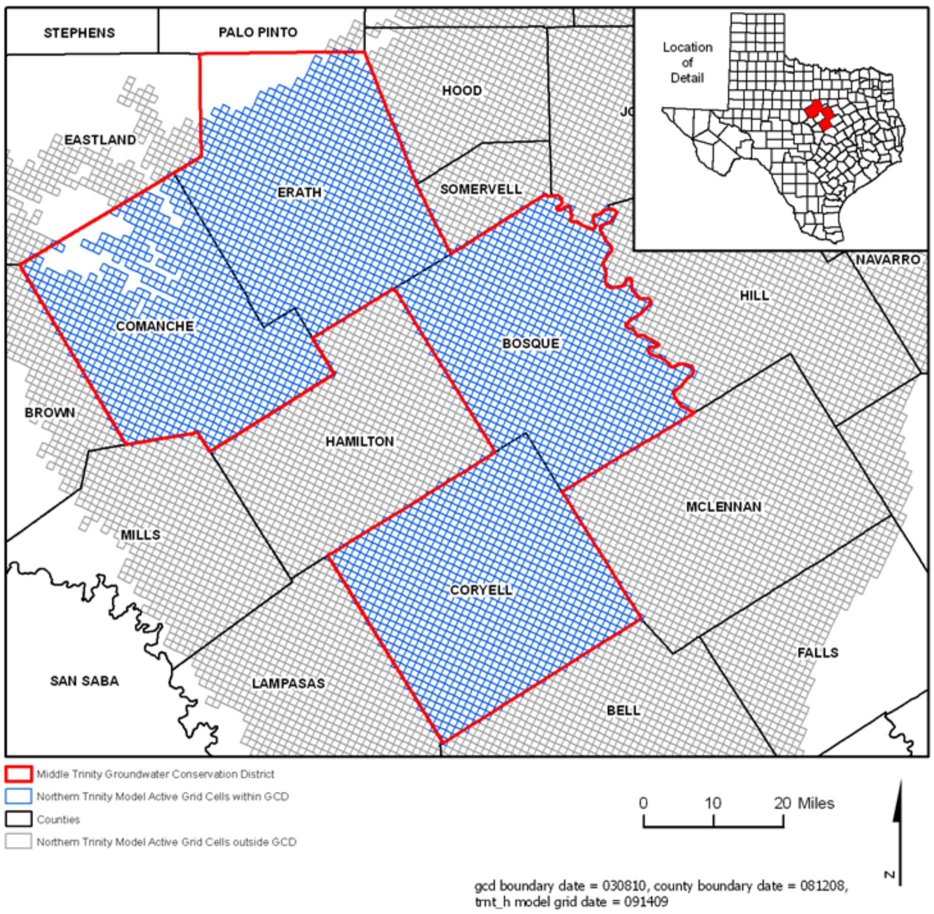
As depicted by Bené and others (2004) and LBG-Guyton Associates (2003), groundwater in the Trinity Aquifer within the Upper Trinity Groundwater Conservation District ranges predominantly from fresh (less than 1,000 milligrams per liter total dissolved solids) to brackish (1,000 to 10,000 milligrams per liter total dissolved solids). The values reported for the flow terms in Table 1 of this report include fresh and brackish groundwater.

Table 1: Summarized information needed for Middle Trinity Groundwater Conservation District's groundwater management plan. All values are reported in acre-feet per year and 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	Washita and Fredericksburg series	118,454
	Paluxy Aquifer	59,135
	Glen Rose Formation	60,145
	Hensell Aquifer	33,591
	Pearsall/Cow Creek/Hammett/Sligo formations	0
	Hosston Aquifer	19,738
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers*	Washita and Fredericksburg series	21,956
	Paluxy Aquifer	6,052
	Glen Rose Formation	15,679
	Hensell Aquifer	8,748
	Pearsall/Cow Creek/Hammett/Sligo formations	0
	Hosston Aquifer	3,323
Estimated annual volume of flow into the district within each aquifer in the district	Washita and Fredericksburg series	1,221
	Paluxy Aquifer	646
	Glen Rose Formation	2,135
	Hensell Aquifer	7,767
	Pearsall/Cow Creek/Hammett/Sligo formations	9
	Hosston Aquifer	5,975
Estimated annual volume of flow out of the district within each aquifer in the district	Washita and Fredericksburg series	1,686
	Paluxy Aquifer	587
	Glen Rose Formation	1,813
	Hensell Aquifer	9,514
	Pearsall/Cow Creek/Hammett/Sligo formations	11
	Hosston Aquifer	6,925
Estimated net annual volume of flow between each aquifer in the district	Washita and Fredericksburg series and overlying units into the Paluxy Aquifer	526
	Paluxy Aquifer into the Glen Rose Formation	1,328
	Glen Rose Formation into the Hensell Aquifer	4,782
	Hensell Aquifer into the Pearsall/Cow Creek/Hammett/Sligo formations	13,611
	Pearsall/Cow Creek/Hammett/Sligo formations into the Hosston Aquifer	14,124

* 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 portion of the Trinity Aquifer from which the information in Table 1 was extracted (the aquifer extent within the district is indicated by the blue grid cells).



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., http://www.twdb.state.tx.us/gam/trnt_n/trnt_n.htm.

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

LBG-Guyton Associates, 2003, Brackish Groundwater Manual for Texas Regional Water Planning Groups: contract report to the Texas Water Development Board, 188 p., http://www.twdb.state.tx.us/RWPG/rpgm_rpts/2001483395.pdf.