GAM Run 10-018

by Mohammad Masud Hassan, PE
Texas Water Development Board
Groundwater Availability Modeling Section
(512) 463-3337

Mohammad Masud Hassan is a Hydrologist in the Groundwater Availability Modeling Section and is responsible for the work performed. The seal appearing on this document was authorized by Mohammad Masud Hassan, P.E.95699 on July 27, 2010.

EXECUTIVE SUMMARY:

Texas State Water Code, Section 36.1071, Subsection (h), states that, in developing its groundwater management plan, groundwater conservation districts 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 report is to provide information to Menard County Underground Water Conservation District for its groundwater management plan. The groundwater management plan for Menard County Underground Water Conservation District is due for approval by the Executive Administrator of the Texas Water Development Board before October 25, 2010.

This report discusses the methods, assumptions, and results from model runs using the groundwater availability model for the Edwards-Trinity (Plateau) Aquifer. Table 1 summarizes the groundwater availability model data required by the statute, and Figure 1 shows the model from which the values in the respective table were extracted.

The Llano Uplift aquifers, which include the Marble Falls, Hickory, and Ellenburger-San Saba aquifers, also underlie the Menard Ground Water Conservation District. Groundwater availability models have not yet been completed for these minor aquifers. If the district would like information for the Llano Uplift aquifers, 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 Edwards-Trinity (Plateau) Aquifer (1980 through 2000); and (1) extracted water budgets for each year of the transient model 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 aquifers located within the district.

PARAMETERS AND ASSUMPTIONS:

Edwards-Trinity (Plateau) Aquifer

- We used version 1.01 of the groundwater availability model for the Edwards-Trinity (Plateau) Aquifer. See Anaya and Jones (2009) for assumptions and limitations of this model.

- The Edwards-Trinity (Plateau) Aquifer model includes two layers representing the Edwards Group and associated limestone hydrostratigraphic units (Layer 1) and the undifferentiated Trinity Group hydrostratigraphic units (Layer 2). An individual water budget for the district was determined for the Edwards-Trinity (Plateau) Aquifer (Layer 1 and Layer 2 collectively).

- The root mean square error (a measure of the difference between simulated and measured water levels) of the Edwards-Trinity (Plateau) groundwater availability model for the period of 1980 to 2000 is 143 feet, or six percent of the range of measured water levels (Anaya and Jones, 2009).

- We used Processing MODFLOW for Windows (PMWIN) version 5.3 (Chiang and Kinzelbach, 2001) 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 runs 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 Tables 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).

Table 1: Summarized information for the Edwards-Trinity (Plateau) Aquifer that is needed for Menard County Underground Water 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	Results
Estimated annual amount of recharge from precipitation to the district	Edwards-Trinity (Plateau) Aquifer	19,613
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Edwards-Trinity (Plateau) Aquifer	20,402
Estimated annual volume of flow into the district within each aquifer in the district	Edwards-Trinity (Plateau) Aquifer	10,277
Estimated annual volume of flow out of the district within each aquifer in the district	Edwards-Trinity (Plateau) Aquifer	10,299
Estimated net annual volume of flow between each aquifer in the district	Not applicable	Not applicable

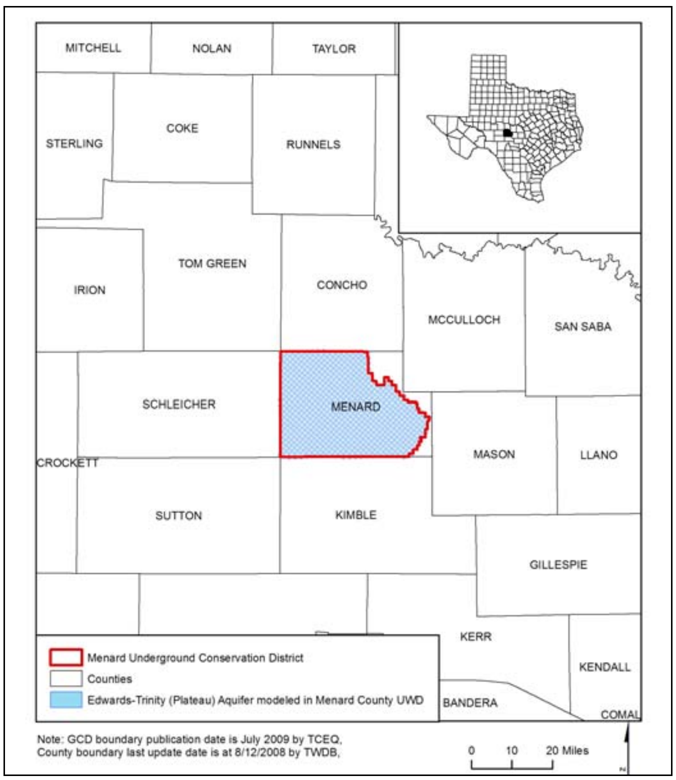

Figure 1: Area of the groundwater availability model for the Edwards-Trinity (Plateau) Aquifer from which the information in Table 1 was extracted (the aquifer extent within the district boundary).

REFERENCES:

Anaya, R., and Jones, I., 2009, Groundwater Availability Model for the Edwards-Trinity (Plateau) and Pecos Valley Aquifers of Texas: Texas Water Development Board Report 373, 103 p., http://www.twdb.state.tx.us/gam/eddt_p/eddt_p.htm.

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