GAM Run 10-005

by Mohammad Masud Hassan P.E.
Texas Water Development Board
Groundwater Availability Modeling Section
(512) 463-3337

Mohammad Masud Hassan is the Hydrologist of 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 August 23, 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.

The purpose of this model run is to provide information to the Brush Country Groundwater Conservation District for its groundwater management plan based on the district boundaries. Brush Country Groundwater Conservation District overlies the Gulf Coast Aquifer and Yegua Jackson Aquifer.

This report discusses the method, assumptions, and results from model runs using the groundwater availability models for the southern and central section of the Gulf Coast Aquifer and the Yegua Jackson Aquifer. Tables 1 through 2 summarize the groundwater availability model data required by statute, and figures 1 through 2 show the areas of the model from which the values in tables were extracted.

METHODS:

We ran the groundwater availability model for the southern section of the Gulf Coast Aquifer and (1) extracted the water budget for each year of the 1981through 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).

We ran the groundwater availability model for the central section of the Gulf Coast Aquifer and (1) extracted the water budget for each year of the 1981 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).

The groundwater availability model for the central section of the Gulf Coast Aquifer and southern section of the Gulf Coast Aquifer overlap in the middle part of the district. We have averaged out the water budget values for this common area from the model runs. Therefore, the water budget values of the Gulf Coast Aquifer consist of three different components as follows:

- Water budget values from the section of the district which is covered by the southern portion of the Gulf Coast Aquifer groundwater availability model only.
- Water budget values from the section of the district which is covered by the central portion of the Gulf Coast Aquifer groundwater availability model only.
- Average of the water budget values from the common section of the district which is covered by the southern portion of the Gulf Coast Aquifer groundwater availability model and the central portion of the Gulf Coast Aquifer groundwater availability model.

We ran the groundwater availability model for Yegua Jackson Aquifer and (1) extracted water budgets for each year of the 1980 through 1997 period and (2) averaged the annual water budget values for recharge, surface water outflow, inflow to the district, outflow from the district for the sections of the Yegua Jackson Aquifer located within the district.

PARAMETERS AND ASSUMPTIONS:

Gulf Coast Aquifer

Groundwater Availability model for the southern section of the Gulf Coast Aquifer

- We used version 2.01 of the groundwater availability model for the southern section of the Gulf Coast Aquifer. See Chowdhury and others (2003) for assumptions and limitations of the model.
- The model includes four layers representing: the Chicot Aquifer (Layer 1), the Evangeline Aquifer (Layer 2), the Burkeville Confining Unit (Layer 3), and the Jasper Aquifer including parts of the Catahoula Formation, as appropriate (Layer 4).
- The model was calibrated to the transient water levels for 1981 to 1990. The mean absolute error (a measure of the difference between simulated and actual water levels during model calibration) for the aquifers is 17.39 feet for 1980, 16.23 feet for 1990, and 15.34 feet for 2000.
- We used Processing MODFLOW for Windows (PMWIN) (Version 5.3.0, W. H. Chiang & W. Kinzelbach 1991-2001) as the interface to process model output.

Groundwater Availability model for the central section of the Gulf Coast Aquifer

- We used version 1.01 of the groundwater availability model for the central section of the Gulf Coast Aquifer. See Chowdhury and others (2004) and Waterstone and others (2003) for assumptions and limitations of the groundwater availability model.
- The model for the central section of the Gulf Coast Aquifer assumes partially penetrating wells in the Evangeline Aquifer due to a lack of data for aquifer properties in the lower section of the aquifer.
- The model includes four layers representing: the Chicot Aquifer (Layer 1), the Evangeline Aquifer (Layer 2), the Burkeville Confining Unit (Layer 3), and the Jasper Aquifer including parts of the Catahoula Formation, as appropriate (Layer 4).
- The mean absolute error (a measure of the difference between simulated and measured water levels) in the entire model for 1999 is 26 feet, which is 4.6 percent of the hydraulic head drop across the model area (Chowdhury and others, 2004).
- We used Processing Modflow for Windows (PMWIN) version 5.3 (Chiang and Kinzelbach, 2001) as the interface to process model output.

Yegua Jackson Aquifer

- We used version 1.01 of the groundwater availability model for the western section of the Yegua Jackson Aquifer. See Kelley and others (2010) for assumptions and limitations of the model.

- The Yegua Jackson Aquifer model includes five layers representing:
  1. outcrop section for the Yegua Jackson Aquifer and younger overlying units,
  2. the upper section of the Jackson Group,
  3. the lower section of the Jackson Group,
  4. the upper section of the Yegua Group, and
  5. the lower section of the Yegua Group.
- Information was extracted and summarized for sections of layer 1 that represent the Yegua Jackson as well as layers 2 to 5.

- 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 (Jackson Group, Upper Yegua and Lower Yegua) for the transient calibration period (1980 through 1997) ranged from approximately 31 to23 feet. The root mean squared error was about ten percent (or less) of the maximum change in water levels across the model (Deeds and others, 2010).

- The recharge used for the model run represents average recharge as described in Deeds and others (2010).

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

- The model results presented in this report were extracted from all areas of the model representing the units comprising the Yegua Jackson Aquifer. For this reason, the reported values may reflect water of quality ranging from fresh to brackish and saline. This is especially true for the subcrop sections of the aquifer in the southwestern part of the District.

RESULTS:

A groundwater budget summarizes the amount of water entering and leaving the aquifers according to the groundwater availability models. 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 section of each model run (1981 through 1999 for the southern and central section of the Gulf Coast Aquifer and 1980 through 1997 for the Yegua Jackson Aquifer) in the district as shown in tables 1 through 2. The components of the modified budget shown in tables 1 through 2 include:

- Precipitation recharge—This is the 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 through 2. 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 figures 1 through 2).

Table 1: Summarized information for the Gulf Coast Aquifer that is needed for Brush Country 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	Gulf Coast Aquifer	54,547
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Gulf Coast Aquifer	48,065
Estimated annual volume of flow into the district within each aquifer in the district	Gulf Coast Aquifer	30,860
Estimated annual volume of flow out of the district within each aquifer in the district	Gulf Coast Aquifer	38,439
Estimated net annual volume of flow between each aquifer in the district	Not applicable	*Not applicable

*Groundwater availability models assume no interaction between the Gulf Coast Aquifer System and underlying units.

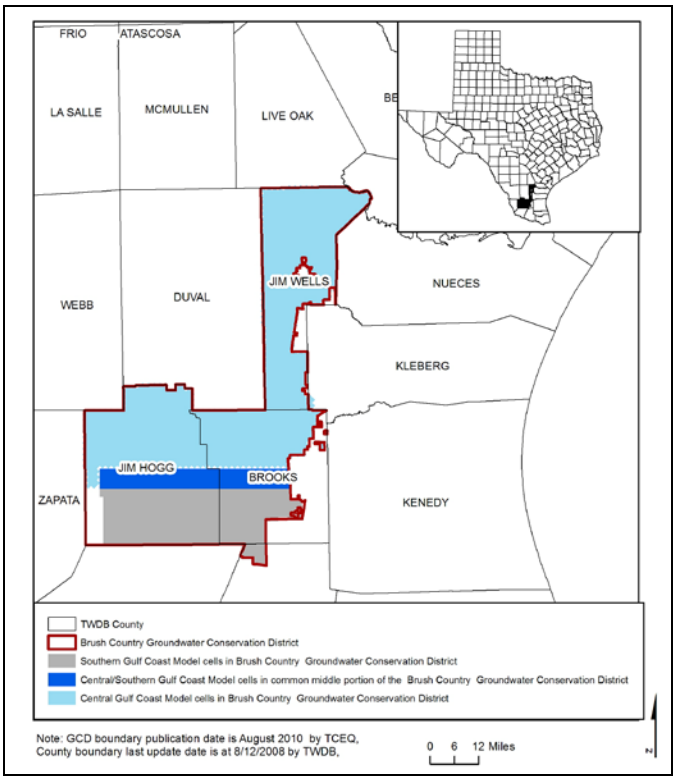

Figure 1: Area of the groundwater availability models for the Gulf Coast Aquifer from which the information in Table 1 was extracted (the aquifer extent within the district boundary).

Table 2: Summarized information for the Yegua Jackson Aquifer that is needed for Brush Country Groundwater Conservation District' 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	Yegua Jackson Aquifer	0
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Yegua Jackson Aquifer	0
Estimated annual volume of flow into the district within each aquifer in the district	Yegua Jackson Aquifer	151
Estimated annual volume of flow out of the district within each aquifer in the district	Yegua Jackson Aquifer	156
Estimated net annual volume of flow between each aquifer in the district	Not applicable	*Not applicable

*Groundwater availability models assume no interaction between the Yegua Jackson and underlying units.

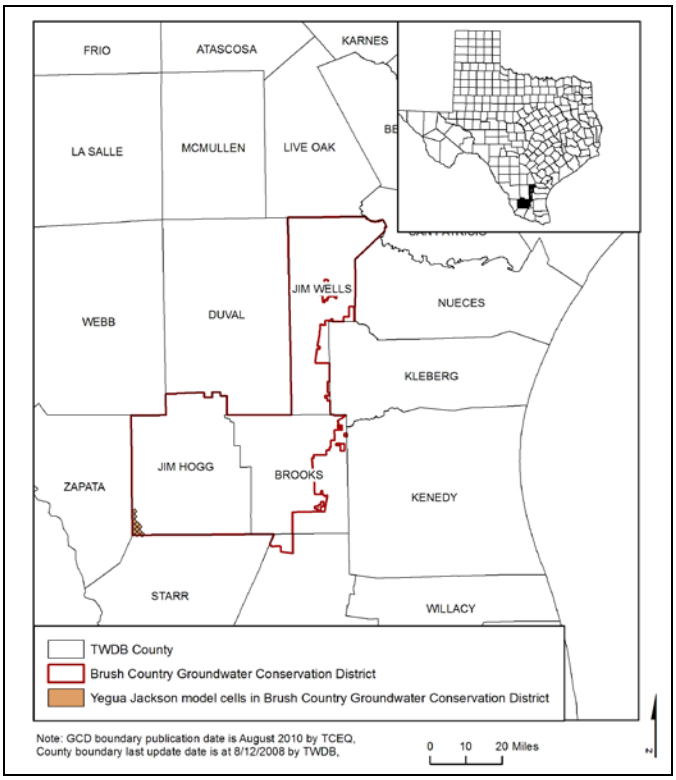

Figure 2: Area of the groundwater availability model for the Yegua Jackson Aquifer and outcrop section from which the information in Table 2 was extracted (the aquifer extent within the district boundary).

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