GAM Run 08-29

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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 groundwater management plans include:

(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 Jeff Davis County Underground Water Conservation District for its groundwater management plan. The groundwater management plan for the Jeff Davis County Underground Water Conservation District is due for approval by the executive administrator of the Texas Water Development Board before October 31, 2008.

This report discusses the methods, assumptions, and results from model runs using the groundwater availability model for the Edwards-Trinity (Plateau) Aquifer and the groundwater availability model for the Igneous and parts of the West Texas Bolsons aquifers. Table 1 summarizes the groundwater availability model data required by statute for the Jeff Davis County Underground Water Conservation District's groundwater management plan.

Although the Capitan Reef Complex, Rustler, and the Green River Valley Bolson of the West Texas Bolsons aquifers also occurs in Jeff Davis County, groundwater availability models have not yet been completed for these minor aquifers. If the Jeff Davis County Underground Water Conservation District would like information for these aquifers, the district can request it from the Groundwater Technical Assistance Section of the TWDB.

METHODS:

We ran the groundwater availability model for the Igneous and parts of the West Texas Bolsons aquifers and the groundwater availability model for the Edwards-Trinity (Plateau) Aquifer and (1) extracted annual water budgets from 1980 through 1999 and (2) averaged the annual water budget values for recharge, surface water outflow, groundwater inflow to the district, groundwater outflow from the district, net inter-aquifer flow (upper) and net inter-aquifer flow (lower) for the portions of the Edwards-Trinity (Plateau), Igneous, and West Texas Bolsons aquifers located within the district.

PARAMETERS AND ASSUMPTIONS:

The parameters and assumptions used for the run using the groundwater availability model for the Igneous and parts of the West Texas Bolsons aquifers are described below:

- We used Version 1.01 of the groundwater availability model for the Igneous and parts of the West Texas Bolsons aquifers.

- See Beach and others (2004) for assumptions and limitations of the model for the Igneous and West Texas Bolsons aquifers.

- The mean absolute error (a measure of the difference between simulated and actual water levels during model calibration) in the entire model for the period of 1990 to 2000 is 64 feet, or four percent of the range of measured water levels (Beach and others, 2004).

- The model includes three layers, representing the Salt Basin Bolson Aquifer (Layer 1), the Igneous Aquifer (Layer 2), and the underlying Cretaceous and Permian units (Layer 3).

- The model uses the MODFLOW recharge package to model both recharge from alluvial fans/stream beds and precipitation. It is assumed that precipitation recharge directly to the Salt Basin Bolson Aquifer is zero; therefore, all recharge included in the recharge package to Layer 1 is from alluvial fan/stream bed infiltration. Recharge applied with the recharge package to the Igneous Aquifer (Layer 2) is both direct precipitation recharge and alluvial fan/stream bed recharge.

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

The parameters and assumptions used for the run using the groundwater availability model for the Edwards-Trinity (Plateau) Aquifer are described below:

- We used version 1.01 of the groundwater availability models for the Edwards-Trinity (Plateau) Aquifer.

- See Anaya and Jones (2004) for assumptions and limitation of the model for the Edwards-Trinity (Plateau) Aquifer.

- The root mean square error (a measure of the difference between simulated and actual water levels during model calibration) of the Edwards-Trinity (Plateau) groundwater availability model for the period of 1990 to 2000 is 143 feet, or six percent of the range of measured water levels.

- The Edwards-Trinity (Plateau) Aquifer model includes two layers representing the Edwards Group and equivalent limestone hydrostratigraphic units (Layer 1) and the undifferentiated Trinity Group hydrostratigraphic units (Layer 2); however, in the district both the Edwards and Trinity Groups are modeled together in layer 1.

- We used Groundwater Vistas Version 5 (Environmental Simulations, Inc. 2007) 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 and averaged over the duration of the calibrated portion of the model run (1980 through 1999). 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.

REFERENCES:

Anaya, R., and Jones, I., 2004, Groundwater availability model for the Edwards-Trinity (Plateau) and Cenozoic Pecos Alluvium aquifer systems, Texas: Texas Water Development Board, GAM Report, 208 p., http://www.twdb.state.tx.us/gam/eddt_p/eddt_p.htm

Beach, J.A., Ashworth, J.B., Finch, Jr., S.T., Chastain-Howley, A., Calhoun, K., Urbanczyk, K.M., Sharp, J.M., and Olson, J., 2004, Groundwater availability model for the Igneous and parts of the West Texas Bolsons (Wild Horse Flat, Michigan Flat, Ryan Flat and Lobo Flat) aquifers: contract report to the Texas Water Development Board, 208 p.

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

Table 1: Summarized information needed for the Jeff Davis County Underground Water 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. Negative values indicate water is leaving the aquifer system using the parameters or boundaries listed in the table.

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Edwards-Trinity (Plateau) Aquifer	5,359
	Salt Basin Bolson Aquifer	0*
	Igneous Aquifer	26,525**
	Cretaceous and Permian units	1,371
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	0
	Salt Basin Bolson Aquifer	0
	Igneous Aquifer	-2,574
	Cretaceous and Permian units	0
Estimated annual volume of flow into the district within each aquifer in the district	Edwards-Trinity (Plateau) Aquifer	2,054
	Salt Basin Bolson Aquifer	3,806
	Igneous Aquifer	611
	Cretaceous and Permian units	1,016
Estimated annual volume of flow out of the district within each aquifer in the district	Edwards-Trinity (Plateau) Aquifer	-9,094
	Salt Basin Bolson Aquifer	-7,417
	Igneous Aquifer	-4,076
	Cretaceous and Permian units	-8,302
Estimated annual net volume of flow between each aquifer in the district	Igneous Aquifer to Salt Basin Bolson Aquifer	1,843
	Igneous Aquifer to Cretaceous and Permian units	14,552

* It is assumed that precipitation recharge directly to the Salt Basin Bolson Aquifer is zero. The recharge package suggests, on average, 155 acre-feet per year from alluvial fan/stream bed infiltration enters the Salt Basin Bolson Aquifer in the district.
** Recharge applied with the recharge package to the Igneous Aquifer (Layer 2) is both direct precipitation recharge and alluvial fan/stream bed recharge.

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