GAM Run 08-09

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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 and acceptable 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, if any, to the groundwater resources within the district;
(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 Goliad County Groundwater Conservation District needed for its groundwater management plan. The groundwater management plan for the Goliad County Groundwater Conservation District is due for approval by the executive administrator of the Texas Water Development Board before May 12, 2008.

This report discusses the methods, assumptions, and results from model runs using the groundwater availability models for the central part of the Gulf Coast Aquifer. Table 2 summarizes the groundwater availability model data required by statute for the Goliad County Groundwater Conservation District's groundwater management plan.

METHODS:

We ran the groundwater availability model for the central part of the Gulf Coast Aquifer, and (1) extracted water budgets for each year of the 1981 through 1999 period and (2) averaged the annual water budget values for recharge, surface water inflow, 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 Gulf Coast aquifer located within the district.

PARAMETERS AND ASSUMPTIONS:

- We used Version 1.01 of the groundwater availability model for the central part of the Gulf Coast Aquifer. See Chowdhury and others (2004), and Waterstone and others (2003) for assumptions and limitations of the groundwater availability model for the central part of the Gulf Coast Aquifer.

- The model simulates groundwater flow through four hydrostratigraphic layers. From top to bottom, these layers are: the Chicot Aquifer, Evangeline Aquifer, Burkeville Confining System, and the Jasper Aquifer.

- The mean absolute error (a measure of the difference between simulated and actual water levels during model calibration) in the entire model for 1999 is 26 feet. This mean absolute error is 4.6 percent of the hydraulic head drop across the model area (Chowdhury and others, 2004).

- The transient portion of the model has a total of 85 stress periods. Of these, monthly stress periods were assigned for 1987 through 1989 and 1996 through 1998. Monthly stress periods were assigned to better simulate possible effects of drought on the groundwater flow system. The remainders of the stress periods represent annual stress periods.

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

RESULTS:

A groundwater budget summarizes the water entering and leaving the aquifer according to the groundwater availability model. The groundwater budget for the annual average values for the central part of the Gulf Coast Aquifer Model (1981 to 1999) in the district is shown in Table 1. The components of the modified budgets shown in Table 1 include:

- Surface water inflow and outflow—This is the total surface water entering the aquifer (inflow) through streams or reservoirs, and the total surface water exiting the aquifer (outflow) to streams, reservoirs, drains (springs), or through evapotranspiration (return of moisture to the air through both evaporation from the soil and transpiration or loss of water vapor by plants).

- Lateral flow into and out of district—This component describes lateral flow within the aquifer between the district and adjacent counties.

- Net inter–aquifer flow—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 occur. “Inflow” to an aquifer from an

overlying or underlying aquifer will always equal the "Outflow" from the other aquifer.

- Precipitation recharge is the areally distributed recharge due to precipitation falling on the outcrop areas of the aquifers (where the aquifer is exposed at land surface) within the district. The information needed for the district's management plan is summarized in Table 2.

It is important to note that sub-regional water budgets for individual counties, such as Goliad County are not exact. This is due to the one-mile spacing of the model grid and because we assumed each model cell is assigned to a single county. The water budgets for an individual cell containing a county boundary are assigned to either one county or the other and therefore very minor variations in the county-wide budgets may be observed.

As described by Kalaswad and Arroyo (2006), groundwater in the Gulf Coast Aquifer ranges from fresh to saline. The reported values in this report for flow terms include fresh (less than 1,000 milligrams per liter total dissolved solids), and slightly saline (1,000 to 3,000 milligrams per liter total dissolved solids) groundwater.

REFERENCES:

Chowdhury, A.H., Wade, S.W., Mace, R.E., and Ridgeway, C., 2004, Groundwater availability model of the central Gulf Coast Aquifer system—Numerical simulations through 1999: Unpublished Texas Water Development Board report, 114 p. http://www.twdb.state.tx.us/gam/glfc_c/glfc_c_TWDB_SummaryReport.pdf

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

Kalaswad, S., and Arroyo, J., 2006, Status report on brackish groundwater and desalination in the Gulf Coast Aquifer of Texas *in* Mace, R.E., Davison, S.C., Angle, E.S., and Mullican, III, W.F., eds., Aquifers of the Gulf Coast of Texas: Texas Water Development Board Report 365, p. 231–240.

Waterstone Environmental Hydrology and Engineering, Inc., and Parsons, 2003, Groundwater availability of the Central Gulf Coast Aquifer: Numerical Simulations to 2050, Central Gulf Coast, Texas, unpublished report, variously paginated.

Table 1: Selected flow terms for each aquifer layer, into and out of the Goliad County Groundwater Conservation District, averaged for the years 1981 to 1999 from the groundwater availability model of the central part of the Gulf Coast Aquifer. Flows include fresh to slightly saline waters. Flows are reported in acre-feet per year. All numbers are rounded to the nearest 1 acre-foot. Note: a negative sign refers to flow out of the aquifer in the district. A positive sign refers to flow into the aquifer in the district.

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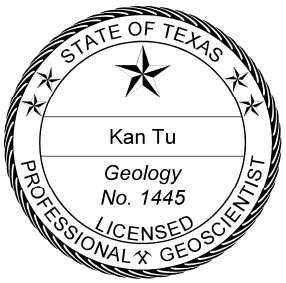
Aquifer	Surface water inflow	Surface water outflow	Lateral inflow into district	Lateral outflow from district	Net inter-aquifer flow (upper)	Net inter-aquifer flow (lower)
Chicot (Layer 1)	3,360	-8,583	712	-4,586	0	-771
Evangeline (Layer 2)	11,441	-13,996	3,641	-9,299	771	369
Burkeville (Layer 3)	0	0	46	-50	-369	265
Jasper (Layer 4)	0	0	647	-503	-265	0

Table 2: Summarized information needed for the Goliad County Ground Water Conservation District's management plan. All values reported in acre-feet per year. All numbers are rounded to the nearest 1 acre-foot.

Management Plan requirement	**Aquifer**	**Results**
Estimated annual amount of recharge from precipitation to the district	Chicot (Layer 1)	9,437
	Evangeline (Layer 2)	7,139
	Burkeville (Layer 3)	0
	Jasper (Layer 4)	0
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Chicot (Layer 1)	8,583
	Evangeline (Layer 2)	13,996
	Burkeville (Layer 3)	0
	Jasper (Layer 4)	0
Estimated annual volume of flow into the district within each aquifer in the district	Chicot (Layer 1)	712
	Evangeline (Layer 2)	3,641
	Burkeville (Layer 3)	46
	Jasper (Layer 4)	647
Estimated annual volume of flow out of the district within each aquifer in the district	Chicot (Layer 1)	4,586
	Evangeline (Layer 2)	9,299
	Burkeville (Layer 3)	50
	Jasper (Layer 4)	503
Estimated annual net volume of flow between each aquifer in the district	Chicot into Evangeline	771
	Burkeville into Evangeline	369
	Burkeville into Jasper	265



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