

# GAM Run 09-015

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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 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 San Patricio County Groundwater Conservation District for its groundwater management plan. The groundwater management plan for San Patricio County Groundwater Conservation District is due for approval by the Executive Administrator of the Texas Water Development Board before May 12, 2010.

This report discusses the methods, assumptions, and results from model runs using the groundwater availability model for the central portion of the Gulf Coast Aquifer. Table 1 summarizes the groundwater availability model data required by statute, and 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 central portion 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 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 aquifer located within the district.

## **PARAMETERS AND ASSUMPTIONS:**

- We used version 1.01 of the groundwater availability model for the central portion 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 portion 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 portion 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 (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.

## **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 (1981 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). It should be noted that the values listed in GAM Run 7-26 (Chowdhury 2007) are different than the values listed in Table 1 due to the approach used to extract data from the model.

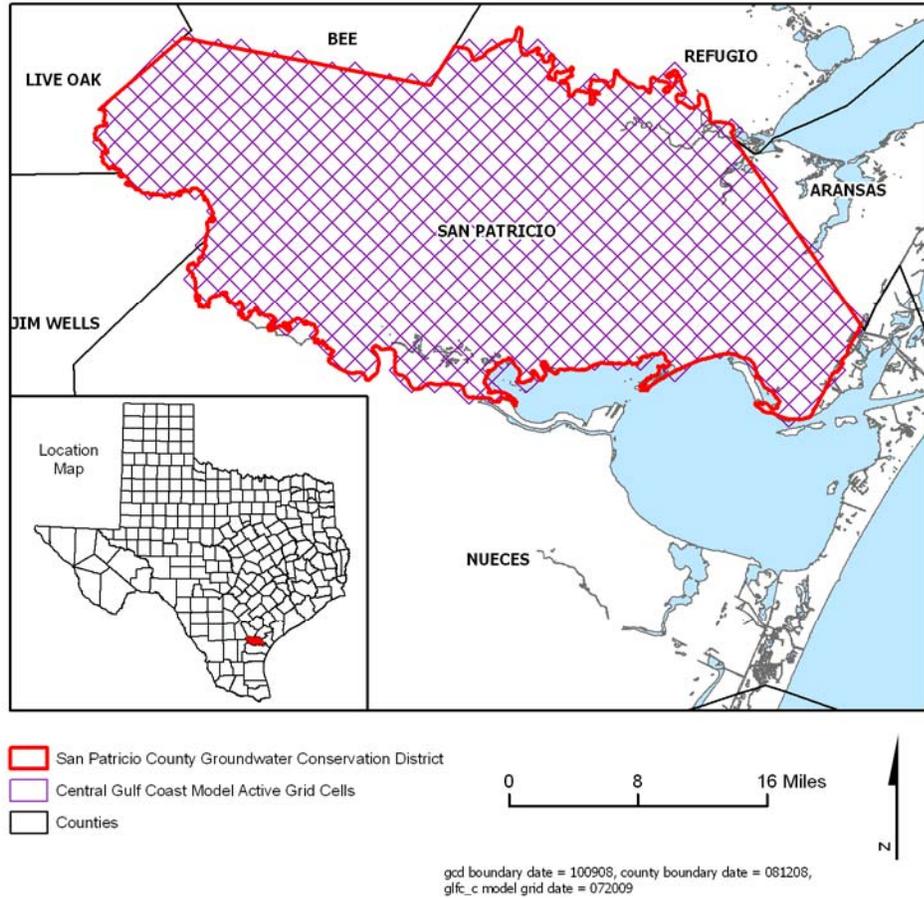
As depicted by Kalaswad and Arroyo (2006), groundwater in the Gulf Coast Aquifer ranges from fresh to saline. The reported values in this report for flow terms include fresh (less than 1,000 milligrams per liter total dissolved solids) and brackish (1,000 to 10,000 milligrams per liter total dissolved solids) groundwater.

Table 1: Summarized information needed for San Patricio County Groundwater 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.

<b>Management Plan requirement</b>	<b>Aquifer or confining unit</b>	<b>Results</b>
Estimated annual amount of recharge from precipitation to the district	Chicot Aquifer	11,461
	Evangeline Aquifer	133
	Burkeville Confining Unit	0
	Jasper Aquifer	0
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Chicot Aquifer*	14,344
	Evangeline Aquifer	648
	Burkeville Confining Unit	0
	Jasper Aquifer	0
Estimated annual volume of flow into the district within each aquifer in the district	Chicot Aquifer	7,381
	Evangeline Aquifer	2,583
	Burkeville Confining Unit	16
	Jasper Aquifer	362
Estimated annual volume of flow out of the district within each aquifer in the district	Chicot Aquifer	3,709
	Evangeline Aquifer	1,245
	Burkeville Confining Unit	3
	Jasper Aquifer	33
Estimated net annual volume of flow between each aquifer in the district	Evangeline Aquifer to the Chicot Aquifer	521
	Burkeville Confining Unit to the Evangeline Aquifer	397
	Jasper Aquifer to the Burkeville Confining Unit	344

\* A portion of the flow from the Chicot Aquifer is discharging to the Gulf of Mexico based on the use of a General Head Boundary (GHB) in Layer 1 of the model.

Figure 1: Area of the groundwater availability model for the central portion of the Gulf Coast Aquifer from which the information in Table 1 was extracted (the aquifer extent within the San Patricio County Groundwater Conservation District boundary).



## REFERENCES:

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

Chowdhury, A.H., 2007, GAM Run 7-26, 4 p.,  
<http://www.twdb.state.tx.us/gam/GAMruns/GR07-26.pdf>.

Chowdhury, A.H., Wade, S., Mace, R.E., and Ridgeway, C., 2004, Groundwater Availability Model of the Central Gulf Coast Aquifer System: Numerical Simulations through 1999- Model Report, 114 p., [http://www.twdb.state.tx.us/gam/glfc\\_c/glfc\\_c.htm](http://www.twdb.state.tx.us/gam/glfc_c/glfc_c.htm).

Kalaszad, 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.,  
<http://www.twdb.state.tx.us/publications/reports/GroundWaterReports/GWReports/R365/ch13-GulfCoastBrackPaper.pdf>.

Waterstone Engineering, Inc., and Parsons, Inc., 2003, Groundwater Availability of the Central Gulf Coast Aquifer: Numerical Simulations to 2050 Central Gulf Coast, Texas- Final Report: contract report to the Texas Water Development Board, 158 p.,  
[http://www.twdb.state.tx.us/GAM/glfc\\_c/glfc\\_c.htm](http://www.twdb.state.tx.us/GAM/glfc_c/glfc_c.htm).



Cynthia K. Ridgeway is 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., on September 28, 2009.