GAM Run 07-07

by Richard M. Smith, P.G.
Texas Water Development Board
Groundwater Availability Modeling Section
(512) 936-0877
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REQUESTOR:

Mr. Tom Wardell of the Anderson County Underground Water Conservation District.

DESCRIPTION OF REQUEST:

Mr. Wardell requested the following information for his district from the groundwater availability model for the northern part of the Queen City, Sparta, and Carrizo-Wilcox aquifers:

1) estimated annual amount of recharge from precipitation to the district;
2) estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers;
3) estimated annual volume of flow into and out of the district within each aquifer and between each aquifer in the district; and

METHODS:

To address the request, we:

- ran the transient groundwater availability model for the northern part of the Queen City, Sparta, and Carrizo-Wilcox aquifers and extracted water budgets for each year of the 1980 through 1999 period and

- averaged the twenty year period 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).

PARAMETERS AND ASSUMPTIONS:

- See Fryar and others (2003) and Kelley and others (2004) for assumptions and limitations of the groundwater availability model for the northern part of the Queen City, Sparta, and Carrizo-Wilcox aquifers.

- The groundwater availability model includes eight layers, representing:

    1. Sparta Aquifer (Layer 1),
    2. Weches Confining Unit (Layer 2),

3. Queen City Aquifer (Layer 3),
4. Reklaw Confining Unit (Layer 4),
5. Carrizo Aquifer (Layer 5),
6. Upper Wilcox Aquifer (Calvert Bluff Formation—Layer 6),
7. Middle Wilcox Aquifer (Simsboro Formation—Layer 7), and
8. Lower Wilcox Aquifer (Hooper Formation—Layer 8).

- The mean absolute error (a measure of the difference between simulated and actual water levels during model calibration) in the groundwater availability model is 16 feet for the Sparta Aquifer, 21 feet for the Queen City Aquifer, 25 feet for the Carrizo Aquifer, and 26 feet for the Middle Wilcox Aquifer (Layer 7) for the calibration period (1980-89) and 15, 24, 28, and 29 feet for the same aquifers respectively in the verification period (1990-99), or between three and six percent of the range of measured water levels (Kelley and others, 2004).

- The results of this analysis only include the aquifers that are in the groundwater availability model. They do not include younger sediments such as the Yegua-Jackson Aquifer that overlie the Sparta Aquifer.

RESULTS:

Recharge and water budget

A groundwater budget summarizes how the model estimates water entering and leaving the aquifer. The groundwater budget for the average values from the transient model (1980 to 1999) is shown in Table 1. The components of the 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, or 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 and aquifer properties of each aquifer that define the amount of leakage that can occur. “Inflow” to an aquifer from an overlying or underlying aquifer will always equal the “Outflow” from the other aquifer, except for the top layer where flow from and to overlying younger aquifers are simulated with a general head boundary condition.

Recharge from precipitation 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.

REFERENCES:

Fryar, D., Senger, R., Deeds, N., Pickens, J., Jones, T., Whallon, A.J., and Dean, K.E., 2003, Groundwater availability model for the Northern Carrizo-Wilcox Aquifer: contract report to the Texas Water Development Board, 529 p.

Kelley, V.A., Deeds, N.E., Fryar, D.G., and Nicot, J.P., 2004, Groundwater availability models for the Queen City and Sparta aquifers: contract report to the Texas Water Development Board, 867 p.

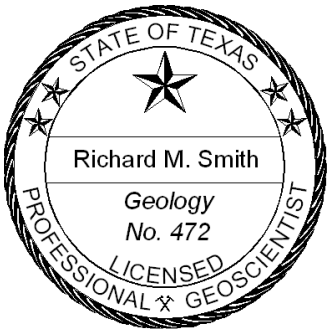

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Table 1: Selected flow terms for each aquifer layer, into and out of the Anderson County Underground Water Conservation District, averaged for the years 1980 to 1999 from the groundwater availability model of the northern part of the Queen City, Sparta, and Carrizo-Wilcox aquifers. Flows are in acre-feet per year. 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. All numbers are rounded to the nearest 1 acre-foot and are probably only accurate to two significant figures. Flow into and out of the confining layers are negligible compared to the aquifers and are not included.

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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)
Sparta Aquifer (Layer 1)	0	0	0	0	0	0
Queen City Aquifer (Layer 3)	0	-1,387	448	572	0	-116
Carrizo Aquifer (Layer 5)	0	0	386	418	125	-13
Upper Wilcox (Calvert Bluff Aquifer—Layer 6)	0	0	272	235	13	-27
Middle Wilcox (Simsboro Aquifer—Layer 7)	0	0	372	276	27	-81
Lower Wilcox (Hooper Aquifer—Layer 8)	0	0	722	666	81	0

Table 2: Summarized information needed for the district's management plan. All values reported in acre-feet per year. All numbers are rounded to the nearest 1 acre-foot and are probably only accurate to two significant figures.

Management plan requirement	**Aquifer**	**Results from model simulation**
Estimated annual amount of recharge from precipitation to the district	All aquifers and confining units	2,832
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Sparta, Queen City, Carrizo, and Upper Wilcox aquifers (no discharge from Middle and Lower Wilcox aquifers)	-1,387
Estimated annual volume of flow into the district within each aquifer in the district	Sparta Aquifer	0
	Queen City Aquifer	448
	Carrizo Aquifer	386
	Upper Wilcox (Calvert Bluff Formation)	272
	Middle Wilcox (Simsboro Formation)	372
	Lower Wilcox (Hooper Formation)	722
Estimated annual volume of flow out of the district within each aquifer in the district	Sparta Aquifer	0
	Queen City Aquifer	-572
	Carrizo Aquifer	-418
	Upper Wilcox (Calvert Bluff Formation)	-235
	Middle Wilcox (Simsboro Formation)	-276
	Lower Wilcox (Hooper Formation)	-666
Estimated annual volume of flow between each aquifer in the district	Younger units and Sparta Aquifer	0
	Sparta Aquifer and Weches Confining Unit	0
	Weches Confining Unit and Queen City Aquifer	0
	Queen City Aquifer and Reklaw Confining Unit	-116
	Reklaw Confining Unit and Carrizo Aquifer	-125
	Carrizo Aquifer and Upper Wilcox Aquifer	-13
	Upper Wilcox Aquifer and Middle Wilcox Aquifer	-27
	Middle Wilcox Aquifer and Lower Wilcox Aquifer	-81