

GAM Run 09-03

by **Mr. Wade Oliver**

Texas Water Development Board
Groundwater Availability Modeling Section
(512) 463-3132
January 23, 2009

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 additional information to High Plains Underground Water Conservation District No. 1 for its groundwater management plan. This modeling information, based on the newly approved groundwater availability model for the Dockum Aquifer, is to be used in addition to the results presented in Groundwater Availability Model Run 08-63 in development of the district's groundwater management plan. The groundwater management plan for High Plains Underground Water Conservation District No. 1 is due for approval by the Executive Administrator of the Texas Water Development Board before June 16, 2009.

This report discusses the methods, assumptions, and results from model runs using the groundwater availability model for the Dockum Aquifer. Table 1 summarizes the groundwater availability model data required by statute for the groundwater management plan for High Plains Underground Water Conservation District No. 1. 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 Dockum 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, net inter-aquifer flow (upper), and net inter-aquifer flow (lower) for the portions of the Dockum Aquifer located within the district.

PARAMETERS AND ASSUMPTIONS:

- We used version 1.01 of the groundwater availability model for the Dockum Aquifer. See Ewing and others (2008) for assumptions and limitations of the groundwater availability model.
- The model includes three layers representing: geologic units overlying the Dockum Aquifer including the Ogallala, Edwards-Trinity (High Plains), Edwards-Trinity (Plateau), Pecos Valley, and Rita Blanca aquifers (Layer 1), the upper portion of the Dockum Aquifer (Layer 2), and the lower portion of the Dockum Aquifer (Layer 3).
- The aquifers represented in Layer 1 of the groundwater availability model are only included in the model for the purpose of more accurately representing flow between these units and the Dockum Aquifer. This model is not intended to explicitly simulate flow in these overlying units (Ewing and others, 2008).
- The mean absolute error (a measure of the difference between simulated and measured water levels during model calibration) in the entire model between 1980 and 1997 is 65.0 feet and 69.6 feet for the upper and lower portions of the Dockum Aquifer, respectively (Ewing and others, 2008). This represents 2.7 and 3.0 percent of the hydraulic head drop across the model area for these same aquifers, respectively.
- The MODFLOW Drain package was used to simulate both evapotranspiration and springs. However, only the results from model grid cells representing springs were incorporated into the surface water outflow values shown in Table 1.
- 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. Selected components were extracted from the groundwater budget for the aquifers located within the district and averaged over the duration of the calibrated portion of the model run (1980 to 1997) in the district, as shown in Table 1. 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 a district or county boundary, 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.

Table 1: Summarized information needed for the groundwater management plan for High Plains Underground Water Conservation District No. 1. 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	Upper portion of the Dockum Aquifer	0
	Lower portion of the Dockum Aquifer	1,029
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Upper portion of the Dockum Aquifer	0
	Lower portion of the Dockum Aquifer	2,485
Estimated annual volume of flow into the district within each aquifer in the district	Upper portion of the Dockum Aquifer	519
	Lower portion of the Dockum Aquifer	8,265
Estimated annual volume of flow out of the district within each aquifer in the district	Upper portion of the Dockum Aquifer	283
	Lower portion of the Dockum Aquifer	12,166
Estimated net annual volume of flow between each aquifer in the district	From the upper portion of the Dockum Aquifer to the overlying units	3,194
	From the lower to the upper portion of the Dockum Aquifer	1,992
	From the overlying units (other than the upper portion of the Dockum Aquifer) to the lower portion of the Dockum Aquifer	7,537

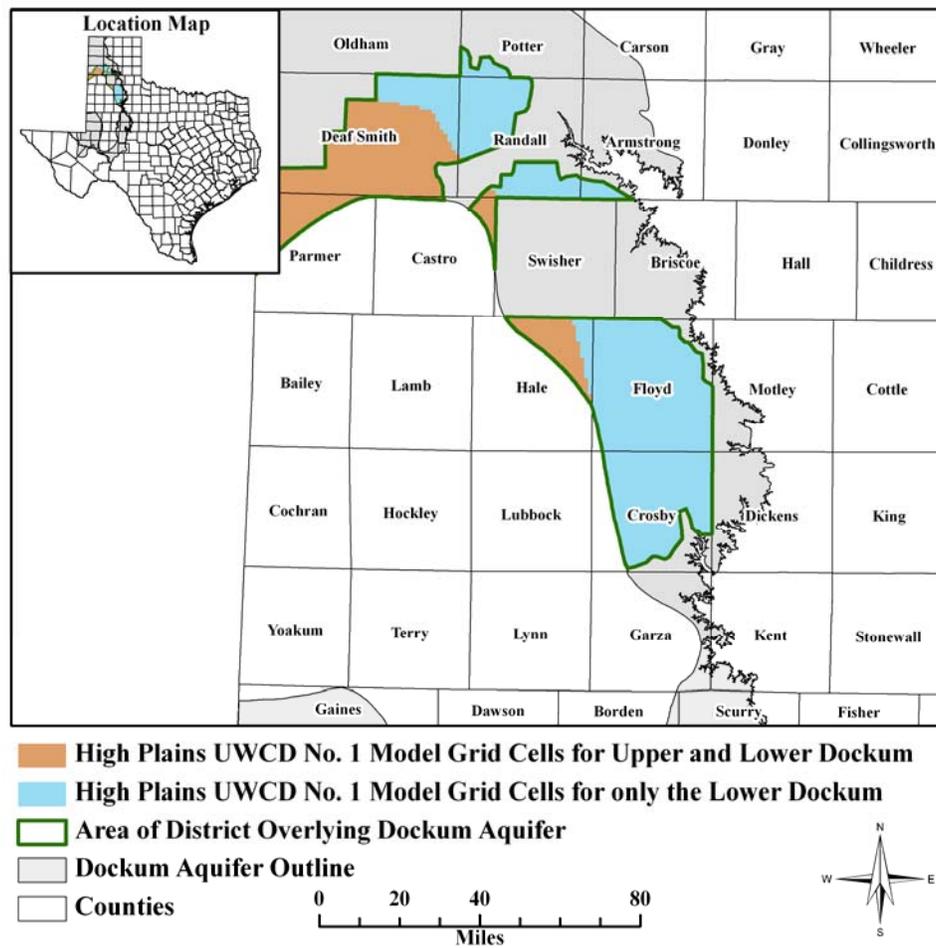


Figure 1: Area of the groundwater availability model for the Dockum Aquifer from which the information in Table 1 was extracted. Note that model grid cells that straddle a political boundary were assigned to one side of the boundary based on the centroid of the model cell as described above.

REFERENCES:

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

Ewing, J.E., Jones, T.L., Yan, T., Vreugdenhil, A.M., Fryar, D.G., Pickens, J.F., Gordon, K., Nicot, J.P., Scanlon, B.R., Ashworth, J.B., and Beach, J., 2008, Groundwater Availability Model for the Dockum Aquifer – Final Report: contract report to the Texas Water Development Board, 510 p.



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 January 23, 2009.