GAM RUN 11-016: KENEDY COUNTY GROUNDWATER CONSERVATION DISTRICT MANAGEMENT PLAN

by Jerry Shi, Ph.D., P.G.
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Groundwater Resources Division
Groundwater Availability Modeling Section
March 20, 2012

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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:

- the annual amount of recharge from precipitation to the groundwater resources within the district, if any;
- 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
- the annual volume of flow into and out of the district within each aquifer and between aquifers in the district.

The purpose of this report is to provide Part 2 of a two-part package of information from the Texas Water Development Board to Kenedy County Groundwater Conservation District to fulfill the requirements noted above. The groundwater management plan for Kenedy County Groundwater Conservation District is due for approval by the Executive Administrator of the Texas Water Development Board before September 11, 2012.

This report is an update to the Groundwater Availability Model (GAM) Run 06-10 (Petrossian, 2006). GAM Run 06-10 used the model for the Central Gulf Coast Aquifer System (Chowdhury and others, 2004) and the model for the Gulf Coast Aquifer in the Lower Rio Grande Valley (Chowdhury and Mace, 2007). This report is based on the

alternative model developed specifically for the Groundwater Management Area 16 (Hutchison and others, 2011).

This report discusses the method, assumptions, and results from model runs using the model developed for Groundwater Management Area 16 (Hutchison and others, 2011). Table 1 summarizes the groundwater model data required by the statute and figure 1 shows the area of the model from which the values in the table were extracted. If, after review of figure 1, Kenedy County Groundwater Conservation District determines that the district boundary used in the assessment does not reflect the current boundary, please notify the Texas Water Development Board immediately. This model run replaces the results of GAM Run 06-10. GAM Run 11-016 meets current standards set after the release of GAM Run 06-10.

METHODS:

The groundwater model for the Groundwater Management Area 16 for the Gulf Coast Aquifer (Hutchison and others, 2011) was used for this analysis. Water budgets for selected years of the transient model calibration period were extracted and the average annual water budget values for recharge, surface water outflow, lateral inflow to the district, lateral outflow from the district, and vertical flow for the portions of the aquifers located within the district are summarized in this report.

PARAMETERS AND ASSUMPTIONS:

Gulf Coast Aquifer

- The alternative model developed by Hutchison and others (2011) contains the whole Groundwater Management Area 16 with Kenedy County Groundwater Conservation District approximately located at the center of the model domain, while the model for the Central Gulf Coast Aquifer System (Chowdhury and others, 2004) and the model for the Gulf Coast Aquifer in the Lower Rio Grande Valley (Chowdhury and Mace, 2007) only cover the northern and southern halves of the Kenedy County Groundwater Conservation District, respectively. As a result, the alternative model developed by Hutchison and others (2011) was used for this management plan data analysis. The model was calibrated based on groundwater elevation data from 1963 to 1999; however, data was extracted only for the period from 1980 to 1999 to be consistent with the analysis completed for previous management plan.

- The model has six layers representing the following hydrogeologic units (from top to bottom): Chicot Aquifer (layer 1), Evangeline Aquifer (layer 2), Burkeville Confining Unit (layer 3), Jasper Aquifer (layer 4), Yegua-Jackson Aquifer (layer 5), and Queen-City/Sparta/Carrizo-Wilcox aquifers (layer 6). However, the bottom two layers were not simulated in the Kenedy County Groundwater Conservation District.

- The standard deviation of groundwater elevation residuals (a measure of the difference between simulated and actual water levels during model calibration) for the entire model domain is 41 feet and the absolute residual mean is 15 feet.

- The model was run with MODFLOW-2000 (Harbaugh and others, 2000).

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 MODFLOW-2000 budget file and averaged over the duration of 1980 through 1999 for the aquifers located within the district, as shown in table 1:

- Precipitation recharge—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—The total water discharging from the aquifer (outflow) to surface water features, such as springs, rivers, reservoirs, and the Gulf, inside or adjacent to the district.

- Flow into and out of district—The lateral flow within the aquifer between the district and adjacent counties.

- Flow between aquifers—The net vertical flow 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. Because Yegua-Jackson Aquifer and Queen-City/Sparta/Carrizo-Wilcox aquifers are not present in the district, flow between aquifers in this analysis is not applicable.

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. Figure 1 shows the active model cells used for this analysis.

LIMITATIONS:

The groundwater model used in completing this analysis is the best available scientific tool that can be used to meet the stated objective. To the extent that this analysis will be used for planning purposes and/or regulatory purposes related to pumping in the past and into the future, it is important to recognize the assumptions and limitations associated with the use of the results. In reviewing the use of models in environmental regulatory decision making, the National Research Council (2007) noted:

> "Models will always be constrained by computational limitations, assumptions, and knowledge gaps. They can best be viewed as tools to help inform decisions rather than as machines to generate truth or make decisions. Scientific advances will never make it possible to build a perfect model that accounts for every aspect of reality or to prove that a given model is correct in all respects for a particular regulatory application. These characteristics make evaluation of a regulatory model more complex than solely a comparison of measurement data with model results."

A key aspect of using the groundwater model to evaluate historic groundwater flow conditions includes the assumptions about the location in the aquifer where historic pumping was placed. Understanding the amount and location of historic pumping is as important as evaluating the volume of groundwater flow into and out of the district, between aquifers within the district (as applicable), interactions with surface water (as applicable), recharge to the aquifer system (as applicable), and other metrics that describe the impacts of that pumping. In addition, assumptions regarding precipitation, recharge, and streamflow are specific to a particular historic time period.

Because the application of the groundwater model was designed to address regional scale questions, the results are most effective on a regional scale. The TWDB makes no warranties or representations relating to the actual conditions of any aquifer at a particular location or at a particular time.

It is important for groundwater conservation districts to monitor groundwater pumping and overall conditions of the aquifer. Because of the limitations of the groundwater model and the assumptions in this analysis, it is important that the groundwater conservation districts work with the TWDB to refine this analysis in the future given the reality of how the aquifer responds to the actual amount and location of pumping now and in the future. Historic precipitation patterns also need to be placed in context as future climatic conditions, such as dry and wet year precipitation patterns, may differ and affect groundwater flow conditions.

TABLE 1: SUMMARIZED INFORMATION FOR THE GMA 16 OF GULF COAST AQUIFER THAT IS NEEDED FOR KENEDY COUNTY GROUNDWATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND 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	Gulf Coast Aquifer	6,419
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Gulf Coast Aquifer	17,140
Estimated annual volume of flow into the district within each aquifer in the district	Gulf Coast Aquifer	40,338
Estimated annual volume of flow out of the district within each aquifer in the district	Gulf Coast Aquifer	31,884
Estimated net annual volume of flow between each aquifer in the district	Not applicable	*Not applicable

*Groundwater availability models assume no interaction between the Gulf Coast Aquifer System and underlying units.

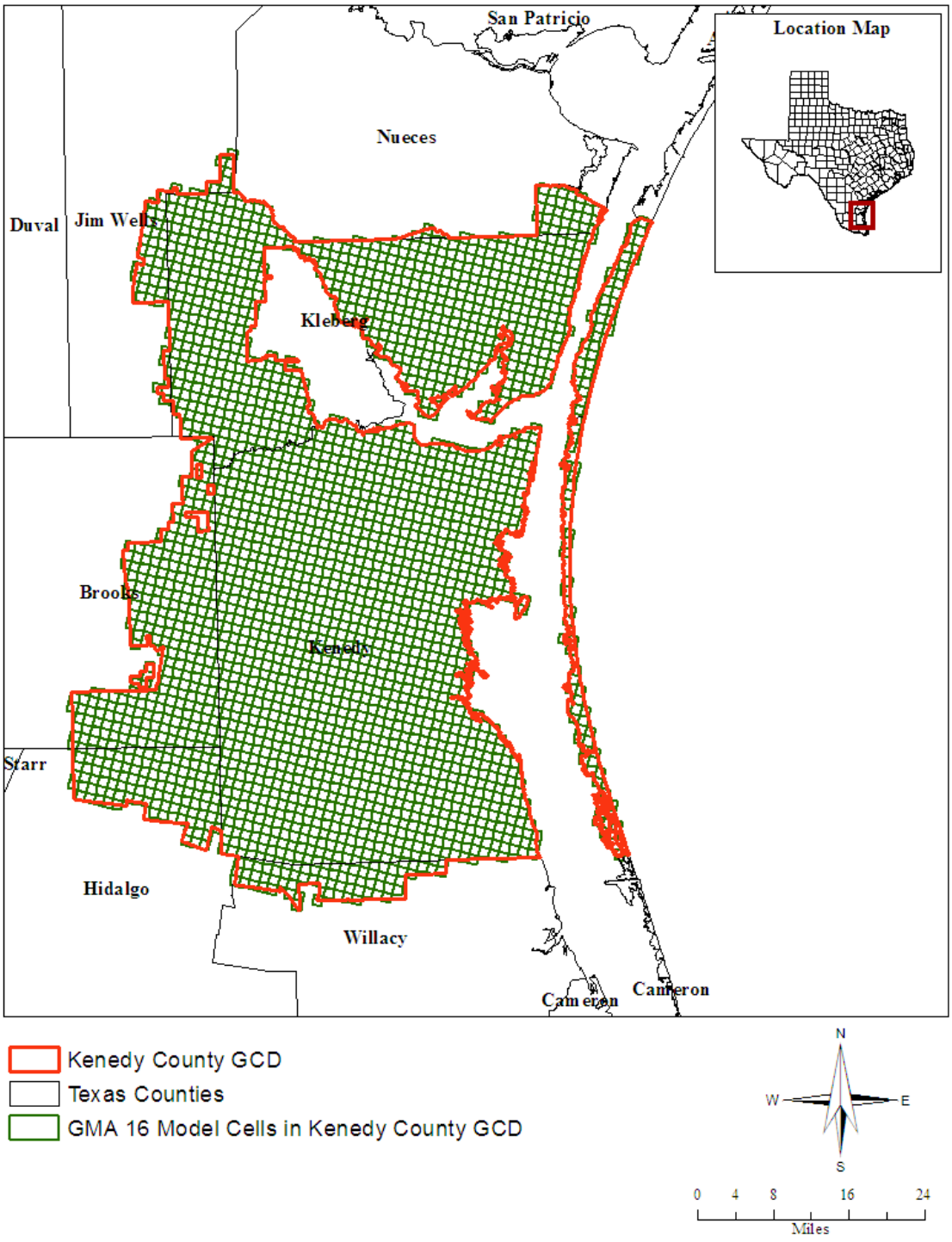

FIGURE 1: AREA OF ACTIVE MODEL CELLS FOR THE GULF COAST AQUIFER IN KENEDY COUNTY GROUNDWATER CONSERVATION DISTRICT FROM WHICH THE INFORMATION IN TABLE 1 WAS EXTRACTED (THE AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).

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