GAM Run 11-002: Red Sands Groundwater Conservation District Management Plan

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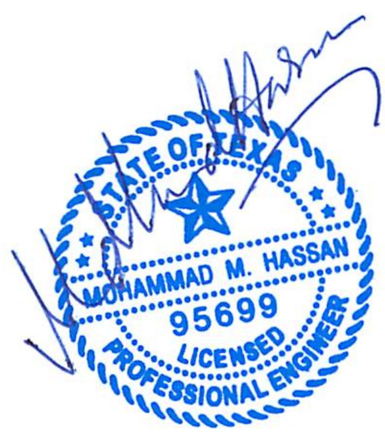

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EXECUTIVE SUMMARY:

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 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 model run is to provide information to the Red Sands Groundwater Conservation District for its groundwater management plan based on the district boundaries. Red Sands Groundwater Conservation District overlies the Gulf Coast Aquifer.

This report discusses the method, assumptions, model/analysis limitations, and results from a model run using the groundwater availability model for the southern section of the Gulf Coast Aquifer. Table 1 summarizes the groundwater availability model data required by statute, and figure 1 shows the areas of the model from which the values in table 1 were extracted. If after review of figure 1, Red Sands Groundwater Conservation District determines that the district boundaries used in the assessment do not reflect current district boundaries, please notify the Texas Water Development Board.

METHODS:

We ran the groundwater availability model for the southern section of the Gulf Coast Aquifer and (1) extracted the water budget for each year of the 1981 through 2000 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).

PARAMETERS AND ASSUMPTIONS:

Groundwater availability model for the southern section of the Gulf Coast Aquifer

- We used version 2.01 of the groundwater availability model for the southern section of the Gulf Coast Aquifer. See Chowdhury and others (2003) for assumptions and limitations of the model.
- 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 including parts of the Catahoula Formation, as appropriate (Layer 4).
- The model was calibrated to the transient water levels for 1981 to 2000. The mean absolute error (a measure of the difference between simulated and actual water levels during model calibration) for the aquifers is 14 feet for 1980-1990, and 15 feet for 1990-2000.
- We used Processing MODFLOW for Windows (PMWIN) (Version 5.3.0, W. H. Chiang & W. Kinzelbach 1991-2001) as the interface to process model output.

RESULTS:

A groundwater budget summarizes the amount of water entering and leaving the aquifers according to the groundwater availability models. 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 section of each model run (1981 through 1999 for the southern section of the Gulf Coast Aquifer) in the district as shown in Table 1. The components of the modified budget shown in Table 1 include:

- Precipitation recharge—This is the 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.

TABLE 1: SUMMARIZED INFORMATION FOR THE GULF COAST AQUIFER THAT IS NEEDED FOR RED SANDS 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	182
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	0
Estimated annual volume of flow into the district within each aquifer in the district	Gulf Coast Aquifer	2,277
Estimated annual volume of flow out of the district within each aquifer in the district	Gulf Coast Aquifer	2,036
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 THE GROUNDWATER AVAILABILITY MODELS FOR THE GULF COAST AQUIFER FROM WHICH THE INFORMATION IN TABLE 1 WAS EXTRACTED (THE AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).

LIMITATIONS:

The groundwater model(s) used in completing this analysis is the best available scientific tool that can be used to meet the stated objective(s). 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.

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).

REFERENCES:

Chowdhury, Ali H. and Mace Robert, 2003, A Groundwater Availability Model of the Gulf Coast Aquifer in the Lower Rio Grande Valley, Texas: Numerical Simulations through 2050: a report by the Texas Water Development Board,176 p., http://www.twdb.state.tx.us/gam/glfc_s/Glfc_s_Oct2003Report.pdf

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

National Research Council, 2007. Models in Environmental Regulatory Decision Making. Committee on Models in the Regulatory Decision Process, National Academies Press, Washington D.C., 287 p.