GAM Run 11-013: Menard County Underground Water District Management Plan

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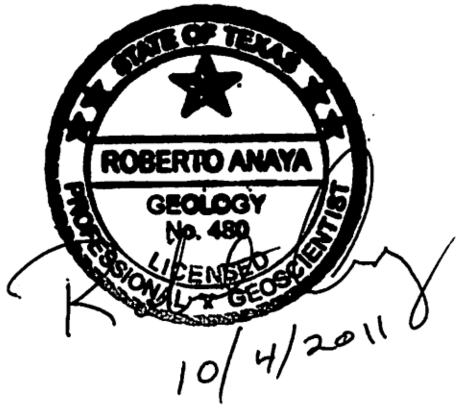

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EXECUTIVE SUMMARY:

Texas 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 before being used in the plan. Information for your groundwater management plan that was derived from groundwater availability model(s) in this report 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.

This report contains an alternative option to the data contained in Groundwater Availability Model (GAM) Run 10-018. GAM Run 10-018 used the original two-layer model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers while this report is based on data from the alternative one-layer model (Hutchison and others, 2011) for the same aquifers. The alternative one-layer model was used in determining the modeled available groundwater estimates for Groundwater Management Area 7. The purpose of this report is to provide Part 2 of a two-part package of information from the Texas Water Development Board to Menard County Underground Water District management plan to fulfill the requirements noted above. The groundwater required

for its groundwater management plan. The Menard County Underground Water District can use either GAM Run 10-018 or GAM Run 11-013 in their groundwater management plan for Menard County Underground Water District was due for approval by the Executive Administrator of the Texas Water Development Board before October 25, 2010.

This report discusses the method, assumptions, and results from the model run using the groundwater model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers developed for Groundwater Management Area 7. 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, Menard County Underground Water District determines that the district boundary used in the assessment does not reflect the current boundary, please notify the Texas Water Development Board immediately.

METHODS:

The groundwater model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers (Hutchison and others, 2011) was run 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, inflow to the district, and outflow from the district for the portions of the aquifers located within the district are summarized in this report.

PARAMETERS AND ASSUMPTIONS:

Edwards-Trinity (Plateau) Aquifer

- The recently modified and calibrated one-layer groundwater flow model of the Edwards-Trinity (Plateau) and Pecos Valley aquifers (Hutchison and others, 2011) was developed to more effectively simulate groundwater conditions. The modified one-layer model version was used for this management plan data extraction analysis because of model calibration enhancements and to be consistent with the Managed Available Groundwater (MAG) process. The model was calibrated based on groundwater elevation data from 1931 to 2005; however, data was extracted only for the period from 1980 to 2005 to avoid a 3.7 percent bias of the 1950’s drought of record and to be more consistent with the analysis completed for previous management plans.

- The model has one layer which represents the Pecos Valley Aquifer in the northwest portion of the model area, the Edwards-Trinity (Plateau) Aquifer in the southeast portion of the model area, and a lumped representation of both aquifers in the relatively narrow area where the Pecos Valley Aquifer overlies the Edwards-Trinity (Plateau) Aquifer.
- 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 70 feet and the absolute residual mean is 48 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 groundwater budget for the aquifers located within the district and averaged over the duration of the calibration and verification portion of the model runs in the district, as shown in table 1. The components of the modified budget shown in table 1:

- Precipitation recharge—The spatially 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 streams, reservoirs, and drains (springs).
- Flow into and out of district—The lateral flow within the aquifer between the district and adjacent counties.
- Flow between aquifers—The 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. Only the Edwards-Trinity (Plateau) Aquifer is contained with the Menard County Underground Water District boundary and therefore no flows between aquifers exist.

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(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.

TABLE 1: SUMMARIZED INFORMATION FOR THE EDWARDS-TRINITY (PLATEAU) AQUIFER THAT IS NEEDED FOR MENARD COUNTY UNDERGROUND WATER 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	Edwards-Trinity (Plateau) Aquifer	18,659
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Edwards-Trinity (Plateau) Aquifer	22,928
Estimated annual volume of flow into the district within each aquifer in the district	Edwards-Trinity (Plateau) Aquifer	16,380
Estimated annual volume of flow out of the district within each aquifer in the district	Edwards-Trinity (Plateau) Aquifer	11,903
Estimated net annual volume of flow between each aquifer in the district	Not applicable	Not applicable

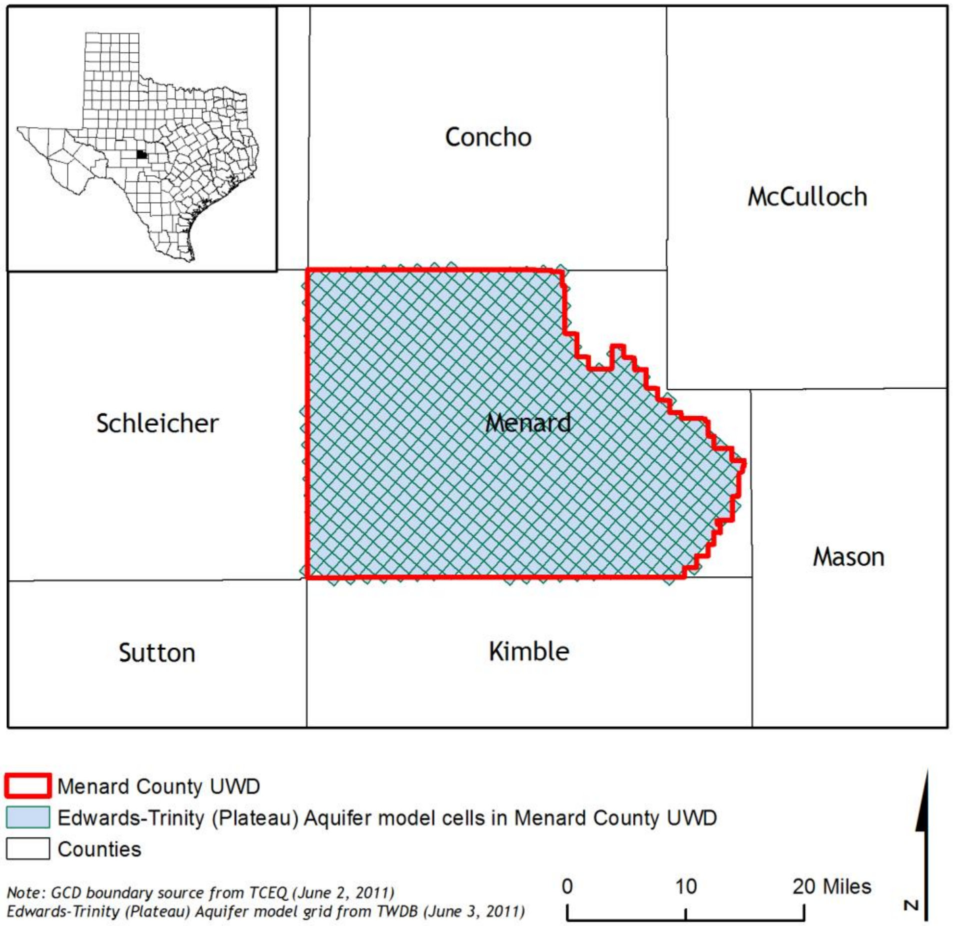

FIGURE 1: AREA OF ACTIVE MODEL CELLS FOR THE EDWARDS-TRINITY (PLATEAU) AQUIFER FROM WHICH THE INFORMATION IN TABLE 1 WAS EXTRACTED (THE AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).

REFERENCES:

Anaya, R., and Jones, I., 2009, Groundwater Availability Model for the Edwards-Trinity (Plateau) and Pecos Valley Aquifers of Texas: Texas Water Development Board Report 373, 103 p., http://www.twdb.state.tx.us/gam/eddt_p/eddt_p.htm.

Harbaugh, A. W., Banta, E. R., Hill, M. C., and McDonald, M. G., 2000, MODFLOW-2000, the U.S. Geological Survey modular ground-water model -- User guide to modularization concepts and the Ground-Water Flow Process: U.S. Geological Survey Open-File Report 00-92, 121 p.

Hassan, M. M., 2010, GAM run 10-018: Texas Water Development Board, GAM Run 10-018 Report, 5 p., http://www.twdb.state.tx.us/gam/GAMruns/GR10-018.pdf.

Hutchison, W., Jones, I., and Anaya, R., 2011. Update of the Groundwater Availiability Model for the Edwards-Trinity (Plateau) and Pecos Valley Aquifers of Texas. Texas Water Development Board Unpublished Report, 60 p., http://www.twdb.state.tx.us/gam/eddt_p/eddt_p.htm.

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., http://www.nap.edu/catalog.php?record_id=11972.