GAM Run 10-048 MAG: Modeled Available Groundwater for the Edwards-Trinity (Plateau) Aquifer in Groundwater Management Area 4

By Wade Oliver

Edited and finalized by Ian Jones, Ph.D., P.G. and Shirley Wade, Ph.D., P.G. to reflect statutory changes effective September 1, 2011

Texas Water Development Board
Groundwater Resources Division
Groundwater Availability Modeling Section
(512) 936-0883
June 22, 2012

Cynthia K. Ridgeway, the Manager of the Groundwater Availability Modeling Section, 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. 471 on June 22, 2012.

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EXECUTIVE SUMMARY:

The modeled available groundwater for the Edwards-Trinity (Plateau) Aquifer as a result of the desired future conditions adopted by the members of Groundwater Management Area 4 is approximately 3,500 acre-feet per year between 2010 and 2060. This is shown divided by county, regional water planning area, and river basin in Table 1 for use in the regional water planning process. Modeled available groundwater is summarized by groundwater conservation district in Table 2.

REQUESTOR:

Ms. Janet Adams of Jeff Davis County Underground Water Conservation District on behalf of Groundwater Management Area 4

DESCRIPTION OF REQUEST:

In a letter dated August 13, 2010, Ms. Adams provided the Texas Water Development Board (TWDB) with the desired future conditions of the Edwards-Trinity (Plateau) Aquifer adopted by the members of Groundwater Management Area 4. After an analysis using the recently updated groundwater model for the aquifer, the Texas Water Development Board found the desired future condition of 0 feet of drawdown in Brewster County Groundwater Conservation District between 2010 and 2060 to not be achievable due to the impacts of pumping in neighboring areas. After notifying the member districts of the results of this analysis, including the drawdowns achieved for several different

levels of pumping, the districts in Groundwater Management Area 4 adopted an updated desired future condition for the aquifer in the district on May 19, 2011. The desired future conditions of the Edwards-Trinity (Plateau) Aquifer in Groundwater Management Area 4, as shown in Resolution R 2010-01 and amended in Resolution R 2011-01, are 3 feet of drawdown in Brewster County Groundwater Conservation District and 50 feet of drawdown for Culberson County Groundwater Conservation District. All other portions of the aquifer in Groundwater Management Area 4 not listed were considered non-relevant for the purpose of joint planning in Resolution R 2010-01.

In response to receiving the adopted desired future conditions, the Texas Water Development Board has estimated the modeled available groundwater for the Edwards-Trinity (Plateau) Aquifer in Groundwater Management Area 4 for Culberson and Brewster counties. The modeled available groundwater was not estimated for certain portions of the aquifer that have been designated as non-relevant. These areas include all of Jeff Davis County and the portion of the aquifer in Culberson County that is not within the Culberson County groundwater conservation district.

METHODS:

The locations of Groundwater Management Area 4 and the groundwater model cells that represent the Edwards-Trinity (Plateau) Aquifer are shown in Figure 1. The groundwater conservation districts and regional water planning areas in the area are shown in Figure 2.

When estimating the pumping that could occur and meet the desired future conditions, the Texas Water Development Board uses the best available scientific tool. In Brewster County, this tool is the recently updated single-layer, numerical groundwater flow model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers documented in Hutchison and others (2011). In Culberson County, a water budget approach, as documented in Aquifer Assessment 09-12, was considered the best available method and was used for this analysis (Thorkildsen and Backhouse, 2010). The methods and assumptions for each of these approaches are described below.

Brewster County – Numerical Groundwater Flow Model

On November 15, 2010, the Texas Water Development Board presented the results of several model simulation scenarios to the districts within Groundwater Management Area 4 after finding that the original desired future condition of 0 feet of drawdown in Brewster County Groundwater Conservation District was not achievable. One of these scenarios provided for 1,394 acre-feet of pumping per year in the aquifer in the district and resulted in 2.9 feet of drawdown using 2005 conditions as a baseline. This is also the scenario referenced by the districts in Resolution No. R 2011-01. Since this simulation matches the desired future condition for the area, the results of this run were

used to estimate the modeled available groundwater. Additional details on the numerical groundwater flow model used for Brewster County include:

- The single-layer, numerical groundwater flow model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers used for this analysis (Hutchison and others, 2011) is an update to the previously developed groundwater availability model documented in Anaya and Jones (2009). See Hutchison and others (2011) and Anaya and Jones (2009) for assumptions and limitations of the model.
- The groundwater model has one layer representing the Pecos Valley Aquifer and the Edwards-Trinity (Plateau) Aquifer. In the relatively narrow area where both aquifers are present, the model is a lumped representation of both aquifers.
- The standard deviation of residuals in the model, a measure of the difference between measured and simulated water levels, is 70 feet between 1930 and 2005 (Hutchison and others, 2011). This represents approximately 2 percent of the range of measured water levels.
- The recharge used for the model simulation represents average recharge as described in Hutchison and others (2011).

Culberson County—Water Budget Analysis

In Culberson County, a water budget approach was used as documented in Aquifer Assessment 09-12 (Thorkildsen and Backhouse, 2010). In Aquifer Assessment 09-12, the desired future condition of 50 feet of drawdown in Culberson County Groundwater Conservation District over 50 years was met with 2,154 acre-feet of pumping per year.

As with the approach for Brewster County above, average recharge conditions were assumed. See Aquifer Assessment 09-12 for additional details on the methods, assumptions, and limitations of the analysis (Thorkildsen and Backhouse, 2010).

Modeled Available Groundwater and Permitting

As defined in Chapter 36 of the Texas Water Code, “modeled available groundwater” is the amount of water that may be produced annually to achieve a desired future condition. This is distinct from “managed available groundwater,” shown in the draft version of this report dated July 15, 2011, which was a permitting value and accounted for the estimated use of the

aquifer exempt from permitting. This change was made to reflect changes in statute by the 82nd Texas Legislature, effective September 1, 2011.

Groundwater conservation districts are required to consider modeled available groundwater, along with several other factors, when issuing permits in order to manage groundwater production to achieve the desired future condition(s). The other factors districts must consider include annual precipitation and production patterns, the estimated amount of pumping exempt from permitting, existing permits, and a reasonable estimate of actual groundwater production under existing permits. The estimated amount of pumping exempt from permitting, which the Texas Water Development Board is now required to develop after soliciting input from applicable groundwater conservation districts, will be provided in a separate report.

RESULTS:

The modeled available groundwater for the Edwards-Trinity (Plateau) Aquifer in Groundwater Management Area 4 as a result of the desired future conditions is 3,548 acre-feet per year. This is shown divided by county, regional water planning area, and river basin in Table 1 for regional water planning purposes. Table 2 shows the pumping summarized by groundwater conservation district. In Table 2, note that the pumping is subtotaled for only district areas relevant to the desired future conditions.

LIMITATIONS:

The groundwater model 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 the impacts of future pumping is the need to make assumptions about the location in the aquifer where future pumping will occur. As actual pumping changes in the future, it

will be necessary to evaluate the amount of that pumping as well as its location in the context of the assumptions associated with this analysis. Evaluating the amount and location of future pumping is as important as evaluating the changes in groundwater levels, spring flows, and other metrics that describe the impacts of that pumping. This analysis does not assess the possible impacts of pumping such as reduced water quality or land surface subsidence.

In addition, certain assumptions have been made regarding future precipitation, recharge, and streamflow in evaluating the impacts of future pumping. Those assumptions also need to be considered and compared to actual future data.

Given these limitations, users of this information are cautioned that the results should not be considered a definitive, permanent prediction of the changes in groundwater storage, streamflow, and spring flow. Because the application of the groundwater availability 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 future groundwater pumping and overall conditions of the aquifer. Because of the limitations of the groundwater availability 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.

REFERENCES:

Anaya, R.A., and Jones, I.C., 2009, Report 373 - Groundwater Availability Model for the Edwards-Trinity (Plateau) and Pecos Valley Aquifers of Texas, Texas Water Development Board, 115 p.

Hutchison, W.R., Jones, I.C., and Anaya, R.A., 2011, Update of the Groundwater Availability Model for the Edwards-Trinity (Plateau) and Pecos Valley Aquifers of Texas, Texas Water Development Board, 61 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.

Thorkildsen, D., Backhouse, S., GTA Aquifer Assessment 09-12, Texas Water Development Board Groundwater Technical Assistance Aquifer Assessment Report, 8 p.

TABLE 1: MODELED AVAILABLE GROUNDWATER FOR THE EDWARDS-TRINITY (PLATEAU) AQUIFER IN GROUNDWATER MANAGEMENT AREA 4. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE DIVIDED BY COUNTY, REGIONAL WATER PLANNING AREA, AND RIVER BASIN.

County	*Region*	*Basin*	*2010*	*2020*	*2030*	*2040*	*2050*	*2060*
Brewster	E	Rio Grande	1,394	1,394	1,394	1,394	1,394	1,394
Culberson	E	Rio Grande	2,154	2,154	2,154	2,154	2,154	2,154
Total			**3,548**	**3,548**	**3,548**	**3,548**	**3,548**	**3,548**

TABLE 2: MODELED AVAILABLE GROUNDWATER FOR THE EDWARDS-TRINITY (PLATEAU) AQUIFER SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) IN GROUNDWATER MANAGEMENT AREA 4 FOR EACH DECADE BETWEEN 2010 AND 2060. RESULTS ARE IN ACRE-FEET PER YEAR. UWCD REFERS TO UNDERGROUND WATER CONSERVATION DISTRICT.

Groundwater Conservation District	*2010*	*2020*	*2030*	*2040*	*2050*	*2060*
Brewster County GCD	1,394	1,394	1,394	1,394	1,394	1,394
Culberson County GCD	2,154	2,154	2,154	2,154	2,154	2,154
Total for District Areas Considered Relevant in Desired Future Conditions	**3,548**	**3,548**	**3,548**	**3,548**	**3,548**	**3,548**

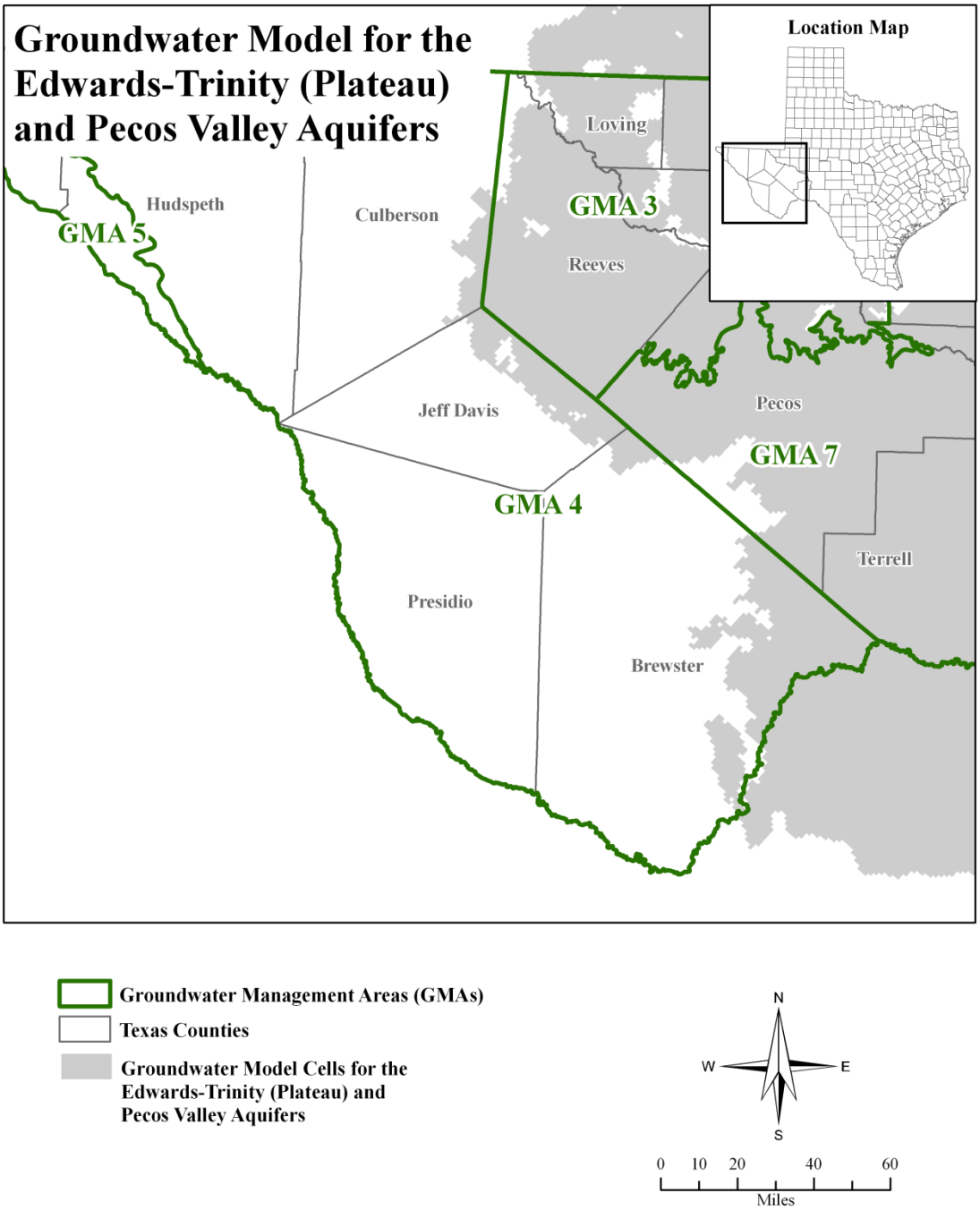

FIGURE 1. MAP SHOWING THE AREAS COVERED BY THE GROUNDWATER MODEL REPRESENTING THE EDWARDS-TRINITY (PLATEAU) AQUIFER.

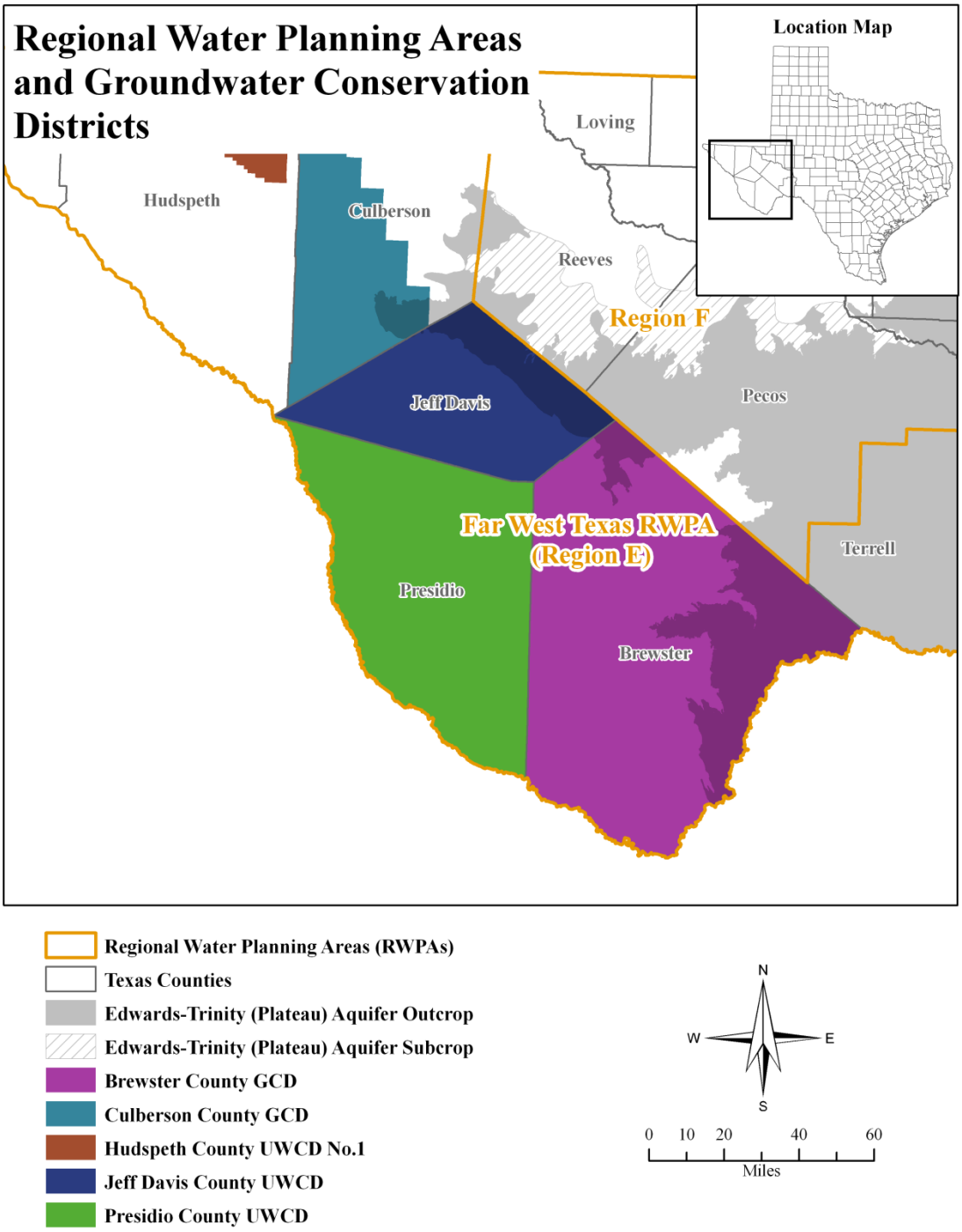

FIGURE 2. MAP SHOWING REGIONAL WATER PLANNING AREAS AND GROUNDWATER CONSERVATION DISTRICTS IN GROUNDWATER MANAGEMENT AREA 4.