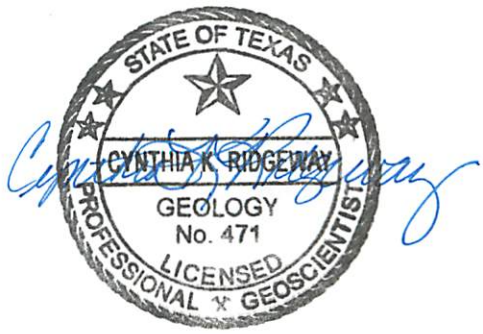
GAM Run 10-049 MAG Version 2

By Mohammad Masud Hassan, P.E.

Edited by Marius Jigmond to reflect statutory changes effective September 1, 2011

Updated to version 2 by Wade Oliver and Radu Boghici to reflect refined modeled available groundwater estimates

Texas Water Development Board
Groundwater Availability Modeling Section
(512) 463-8499
March 28, 2012



Cynthia K. Ridgeway is the 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. 471 on March 28, 2012

This page is intentionally blank.

EXECUTIVE SUMMARY:

The modeled available groundwater for the Edwards Group of the Edwards-Trinity (Plateau) Aquifer as a result of the desired future condition adopted by the members of Groundwater Management Area 9 is approximately 1,001 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 county, regional water planning area, river basin, and groundwater conservation district in tables 2 through 5. The estimates were extracted from the previous Groundwater Availability Model Run 08-90mag (Chowdhury, 2009), which meets the desired future condition adopted by the members of Groundwater Management Area 9.

The first version of this report showed modeled available groundwater for Bandera, Kendall, and Kerr counties based on the pumping assumed in the groundwater availability model simulation. However, Groundwater Management Area 9 declared Kerr County "not relevant" for joint planning purposes. Since modeled available groundwater only applies to areas with a specified desired future condition, we updated this report to only depict modeled available groundwater in Kendall and Bandera counties.

REQUESTOR:

Mr. Ronald G. Fieseler of the Blanco Pedernales Groundwater Conservation District on behalf of Groundwater Management Area 9

DESCRIPTION OF REQUEST:

In a letter dated August 26, 2010 and received August 30, 2010, Mr. Ronald G. Fieseler provided the Texas Water Development Board (TWDB) with the desired future condition of the Edwards Group of Edwards-Trinity (Plateau) Aquifer adopted by the members of Groundwater Management Area 9. As described in Resolution #072610-01, the desired future condition for the Edwards Group of the Edwards-Trinity (Plateau) Aquifer in Groundwater Management Area 9 is:

"[…] Allow for no net increase in average drawdown in the Edwards Group of the Edward-Trinity (Plateau) Aquifer in Kendall and Bandera [c]ounties.

In addition, GMA 9 declared the Edward Group of the Edward-Trinity (Plateau) to be "Not Relevant" in Kerr and Blanco [c]ounties"

In response to receiving the adopted desired future condition, the Texas Water Development Board has estimated the modeled available groundwater for the Edwards Group of the Edwards-Trinity (Plateau) Aquifer for Kendall and Bandera counties.

METHODS:

The Texas Water Development Board previously completed Groundwater Availability Model (GAM) Run 08-90mag (Chowdhury, 2009) containing "managed available groundwater" information based on the desired future conditions adopted on August 28, 2008 by the groundwater

conservation districts in Groundwater Management Area 9. Subsequent to the release of GAM Run 08-90mag, the desired future conditions for the Edwards Group of the Edwards-Trinity (Plateau) Aquifer were petitioned, and presented to the Texas Water Development Board at a special meeting on January 21, 2010. At that meeting, the Board found that the adopted desired future condition of zero drawdown was not reasonable. The Board further recommended that the desired future condition in Kerr County be 9 feet of drawdown and that the Edwards Group of the Edwards-Trinity (Plateau) Aquifer be found not relevant in Bandera and Kendall counties. The Board's recommended desired future condition was discussed at a meeting for Groundwater Management Area 9 on February 22, 2010, and a public hearing was held during that same meeting. At their July 26, 2010, meeting, the districts adopted new desired future conditions for the Edwards Group of the Edwards-Trinity (Plateau) Aquifer. In Bandera and Kendall counties, the new desired future condition is the same as the original desired future condition: zero drawdown. Because no changes were made to the desired future condition in Bandera and Kendall counties, the results in the GAM Run 08-90mag report were still applicable to the "new" desired future condition.

The location of Groundwater Management Area 9, the Edwards Group of the Edwards-Trinity (Plateau) Aquifer, and the groundwater availability model cells that represent the aquifer are shown in Figure 1. The pumping was divided by county, regional water planning area, river basin, and groundwater conservation district (Figure 2).

PARAMETERS AND ASSUMPTIONS:

The parameters and assumptions for the model run using the groundwater availability model for the Hill Country portion of the Trinity Aquifer, which contains a portion representing the Edwards Group of the Edwards-Trinity (Plateau) Aquifer, are described below:

- Version 1.03 of the groundwater availability model for the Hill Country portion of the Trinity Aquifer developed by Mace and others (2000) was used for this analysis. See Mace and others (2000) for details on model construction, recharge, discharge, assumptions and limitations of the model.
- The model has three layers: layer 1 represents the Edwards Group, layer 2 represents the Upper Trinity Aquifer, and layer 3 represents the Middle Trinity Aquifer.
- The model has a total of 79 stress periods with 2 stress periods representing pre-development conditions, 24 monthly stress periods for representing transient conditions (1996 to 1997), and 53 predictive annual stress periods (2008 to 2060).
- The root-mean squared error of the model (a measure of the difference between simulated and measured water levels) is approximately 56 feet. This represents 5 percent of the range of measured water levels across the model area.
- We assigned the baseline pumping to the first predictive stress period in the model to represent 2008 pumping conditions based on the assumption that the aquifers in the area recharge rapidly and groundwater movement is fast enough to quickly bring about a dynamic equilibrium. Comparisons of water level changes in selected hydrographs in the

predictive period suggest that the aquifer attains a dynamic equilibrium within a year (Chowdhury, 2009).

- Average recharge was used throughout the predictive period for this model run. Average recharge in the model was estimated for normal climatic conditions by using the average precipitation for the period 1960 to 1990 and the recharge coefficients estimated from baseflow analyses for each model cell (Mace and others, 2000).
- The model was run in Processing MODFLOW for Windows (version 5.3; Chiang and Kinzelbach, 1998).

Modeled Available Groundwater and Permitting

As defined in Chapter 36 of the Texas Water Code, "modeled available groundwater" is the estimated average 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 January 31, 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 Group of the Edward-Trinity (Plateau) Aquifer consistent as a result of the desired future condition adopted by the members of Groundwater Management Area 9 is approximately 1,001 acre-feet per year between 2010 and 2060. This is subdivided by county, regional water planning area, and river basin as shown in Table 1. The modeled available groundwater is also summarized by county, regional water planning area, river basin, and groundwater conservation district as shown in tables 2, 3, 4, and 5, respectively.

LIMITATIONS:

The groundwater model used in developing estimates of modeled available groundwater is the best available scientific tool that can be used to estimate the pumping that will achieve the desired future conditions. Although the groundwater model used in this analysis is the best available scientific tool for this purpose, it, like all models, has limitations. 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 develop estimates of modeled available groundwater 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 condition of the groundwater resources in the area that relate to the adopted desired future condition(s).

Given these limitations, users of this information are cautioned that the modeled available groundwater numbers should not be considered a definitive, permanent description of the amount of groundwater that can be pumped to meet the adopted desired future condition. 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 future groundwater pumping as well as whether or not they are achieving their desired future conditions. Because of the limitations of the model and the assumptions in this analysis, it is important that the groundwater conservation districts work with the TWDB to refine the modeled available groundwater numbers given the reality of how the aquifer responds to the actual amount and location of pumping now and in the future.

REFERENCES:

Chiang, W.H. and Kinzelbach, W., 1998, Processing Modflow: A simulation system for modeling groundwater flow and pollution: Hamburgh, Zurich, variously paginated.

Chowdhury, A.H., 2009, GAM Run 08-090mag, Texas Water Development Board, GAM Run 09-80mag Report, 8 p.

Mace, R.E., Chowdhury, A.H., Anaya, R., and Way, S-C., 2000, Groundwater availability of the Trinity Aquifer, Hill Country Area, Texas—Numerical simulations through 2050: Texas Water Development Board Report 353, 119 p.

Table 1. Modeled available groundwater for the Edwards Group of Edwards-Trinity (Plateau) Aquifer in Groundwater Management Area 9. Results are in acre-feet per year and are divided by county, regional water planning area, and river basin.

County	Regional Water Planning Area	River Basin	Year					
			2010	2020	2030	2040	2050	2060
Bandera	J	Guadalupe	21	21	21	21	21	21
		Nueces	101	101	101	101	101	101
		San Antonio	561	561	561	561	561	561
Kendall	L	Colorado	46	46	46	46	46	46
		Guadalupe	103	103	103	103	103	103
		San Antonio	169	169	169	169	169	169
Total			**1,001**	**1,001**	**1,001**	**1,001**	**1,001**	**1,001**

Table 2. Modeled available groundwater for the Edwards Group of Edwards-Trinity (Plateau) Aquifer in Groundwater Management Area 9. Results are in acre-feet per year and are summarized by county.

County	Year					
	2010	2020	2030	2040	2050	2060
Bandera	683	683	683	683	683	683
Kendall	318	318	318	318	318	318
Total	**1,001**	**1,001**	**1,001**	**1,001**	**1,001**	**1,001**

Table 3. Modeled available groundwater for the Edwards Group of Edwards-Trinity (Plateau) Aquifer in Groundwater Management Area 9. Results are in acre-feet per year and are summarized by regional water planning area.

Regional Water Planning Area	Year					
	2010	2020	2030	2040	2050	2060
J	683	683	683	683	683	683
L	318	318	318	318	318	318
Total	**1,001**	**1,001**	**1,001**	**1,001**	**1,001**	**1,001**

Table 4: Modeled available groundwater for the Edwards Group of Edwards-Trinity (Plateau) Aquifer in Groundwater Management Area 9. Results are in acre-feet per year and summarized by river basin.

River Basin	Year					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Colorado	46	46	46	46	46	46
Guadalupe	124	124	124	124	124	124
Nueces	101	101	101	101	101	101
San Antonio	730	730	730	730	730	730
Total	**1,001**	**1,001**	**1,001**	**1,001**	**1,001**	**1,001**

Table 5: Modeled available groundwater for the Edwards Group of Edwards-Trinity (Plateau) Aquifer in Groundwater Management Area 9. Results are in acre-feet per year and summarized by groundwater conservation district (GCD). RA refers to River Authority. GWD refers to Groundwater District.

Groundwater Conservation District	Year					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Bandera County RA & GWD	683	683	683	683	683	683
Cow Creek GCD	318	318	318	318	318	318
Total	**1,001**	**1,001**	**1,001**	**1,001**	**1,001**	**1,001**

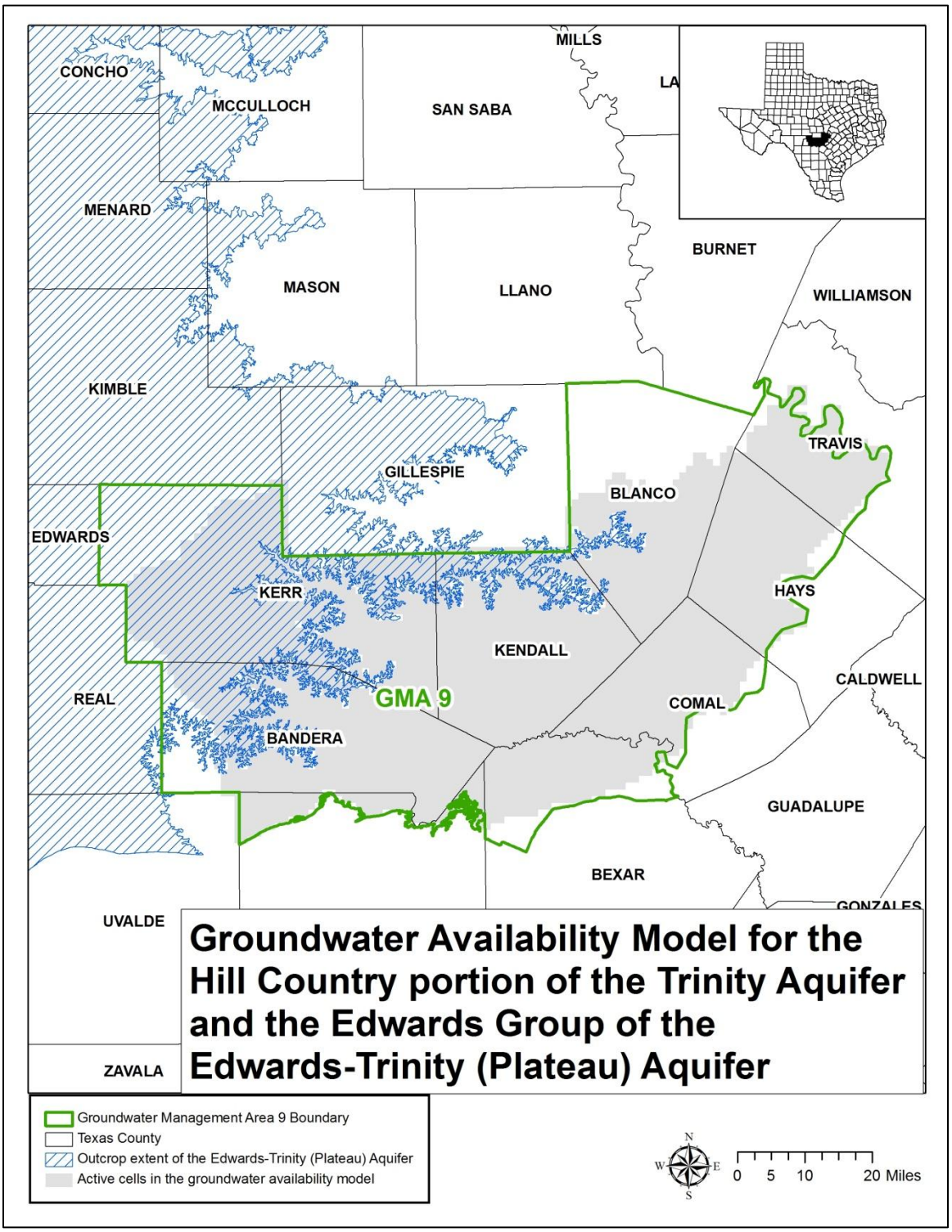


Figure 1: Map showing the areas covered by the groundwater availability model for the Hill Country portion of the Trinity Aquifer, which also contains the Edwards group of the Edwards-Trinity (Plateau) Aquifer.

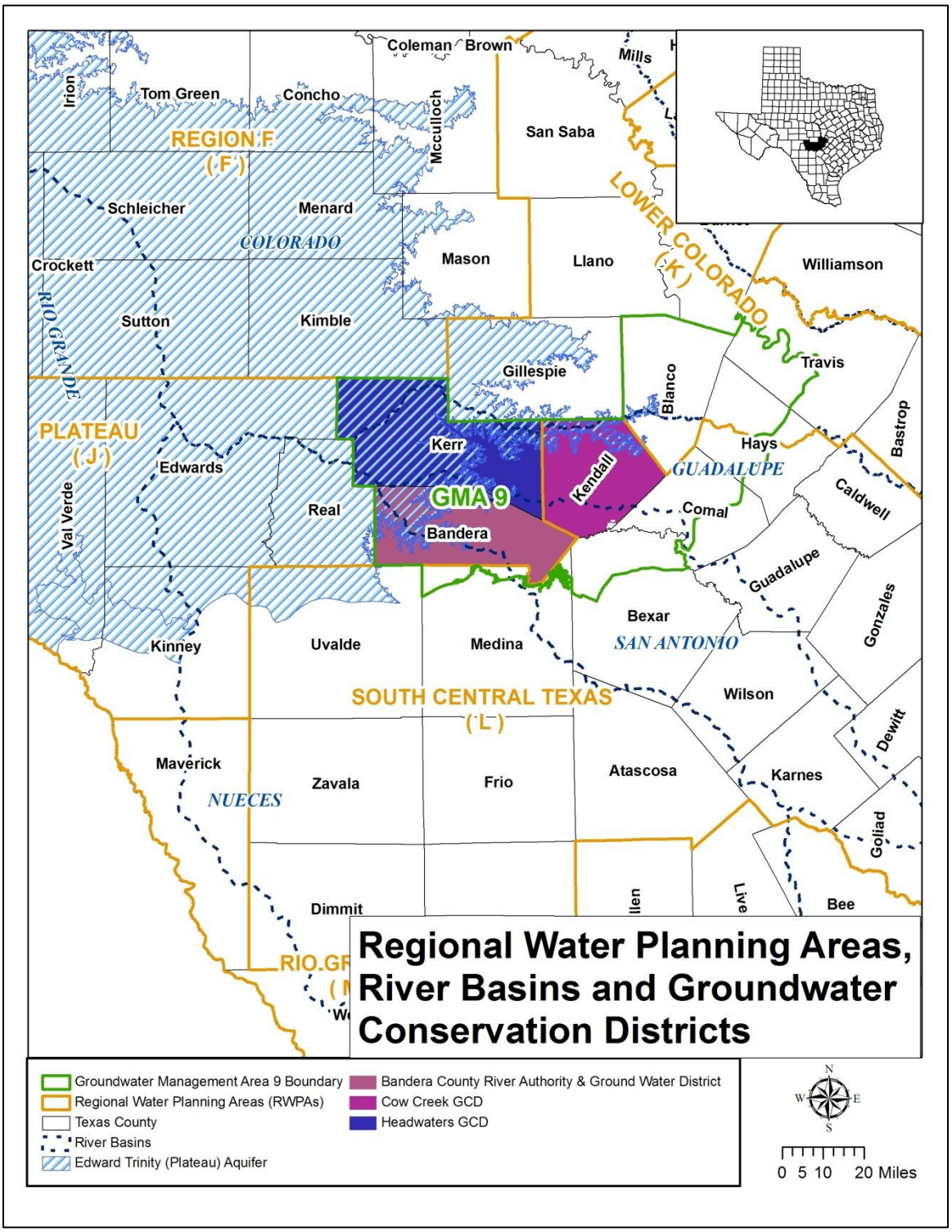


Figure 2: Map showing regional water planning areas (RWPAs), groundwater conservation districts (GCDs), counties, and river basins in Groundwater Management Area 9.