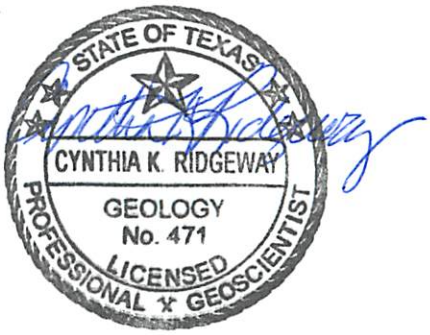
GAM Run 11-011 MAG: Modeled Available Groundwater for the Nacatoch Aquifer in Groundwater Management Area 8

by Wade Oliver
Texas Water Development Board
Groundwater Resources Division
Groundwater Availability Modeling Section
(512) 463-3132
December 14, 2011



Cynthia K. Ridgeway, the Manager of the Groundwater Availability Modeling Section and Interim Director of the Groundwater Resources Division, 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 December 14, 2011.

This page is intentionally blank.

GAM RUN 11-011 MAG: MODELED AVAILABLE GROUNDWATER FOR THE NACATOCH AQUIFER IN GROUNDWATER MANAGEMENT AREA 8

by Wade Oliver
Texas Water Development Board
Groundwater Resources Division
Groundwater Availability Modeling Section
(512) 463-3132
December 14, 2011

EXECUTIVE SUMMARY:

The modeled available groundwater for the Nacatoch Aquifer as a result of the desired future conditions adopted by the members of Groundwater Management Area 8 is approximately 13,800 acre-feet per year and is summarized by county, river basin, and regional water planning area in Table 2. The pumping estimates were extracted from Groundwater Availability Model Run 10-006, Scenario 4, which Groundwater Management Area 8 used as the basis for developing their desired future conditions.

REQUESTOR:

Mr. Eddy Daniel of North Texas Groundwater Conservation District on behalf of Groundwater Management Area 8

DESCRIPTION OF REQUEST:

In a letter dated August 31, 2011, Mr. Daniel provided the Texas Water Development Board (TWDB) with the desired future conditions of the Nacatoch Aquifer in Groundwater Management Area 8. The desired future conditions for the Nacatoch Aquifer, adopted June 23, 2011 by the groundwater conservation districts in Groundwater Management Area 8, are shown in Table 1.

METHODS:

Groundwater Management Area 8 contains a portion of the Nacatoch Aquifer, a minor aquifer in Texas according to the 2007 State Water Plan (TWDB, 2007). The locations of Groundwater Management Area 8, the Nacatoch Aquifer, and the groundwater availability model cells that represent the aquifer are shown in Figure 1.

The Texas Water Development Board previously completed a series of simulations using the groundwater availability model (GAM) for the Nacatoch Aquifer to assist the members of Groundwater Management Area 8 in developing desired future conditions. These are documented in draft GAM Run 10-006 (Hassan, 2011). As shown in the desired future condition resolution, the simulation on which the desired future conditions above are based is Scenario 4 of GAM Run 10-006. The estimates of modeled available groundwater for the Nacatoch Aquifer presented here, taken directly from the above scenario, have been divided by county, regional water planning area, river basin, and groundwater conservation district. These areas are shown in Figure 2.

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. 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 required to develop after soliciting input from applicable groundwater conservation districts, will be provided in a separate report.

PARAMETERS AND ASSUMPTIONS:

- The results presented in this report are based on Scenario 4 in Draft GAM Run 10-006 (Hassan, 2011). See Draft GAM Run 10-006 for a full description of the methods, assumptions, and results of the groundwater availability model run.

- We used version 1.01 of the groundwater availability model for the Nacatoch Aquifer (Beach and others, 2009). See Beach and others (2009) for assumptions and limitations of the model
- The groundwater availability model contains two layers, which generally correspond to:
    - the Kemp Clay and Midway Units (Layer 1)
    - the Nacatoch Aquifer (Layer 2)
- The mean absolute error (a measure of the difference between simulated and measured water levels during model calibration) for the Nacatoch Aquifer is 30 feet (Beach and others, 2009).
- The average recharge between 1980 and 1997, the historical-calibration period of the model, was applied each year during the 2011 to 2060 predictive simulation.

RESULTS:

The modeled available groundwater for the Nacatoch Aquifer in Groundwater Management Area 8 that achieves the above desired future conditions is approximately 13,800 acre-feet per year. Table 2 contains the modeled available groundwater by decade subdivided by county, regional water planning area, and river basin for use in the regional water planning process. Note that the minor differences in pumping shown in Table 2 compared with Hassan (2011) are due to rounding. Tables 3, 4, 5, and 6 show the modeled available groundwater for the Nacatoch Aquifer summarized by county, regional water planning area, river basin, and groundwater conservation district, respectively, within Groundwater Management Area 8.

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.

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:

Beach, J. A., Huang, Y., Symank, L., Ashworth, J. B., Davidson, T., Vreugdenhil, A., M., and Deeds, N. E., 2009, Nacatoch Aquifer Groundwater Availability Model. Prepared for the Texas Water Development Board, 304 p.

Hassan, M.M., 2011, Draft GAM Run 10-006, Texas Water Development Board Draft Groundwater Availability Model Run Report, 9 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.

Texas Water Development Board, 2007, Water for Texas – 2007—Volumes I-III; Texas Water Development Board Document No. GP-8-1, 392 p.

TABLE 1: DESIRED FUTURE CONDITIONS FOR THE NACATOCH AQUIFER ADOPTED BY THE GROUNDWATER CONSERVATION DISTRICTS IN GROUNDWATER MANAGEMENT AREA 8.

County	*Basin*	*Drawdown (feet)*
Bowie	Red	10
	Sulphur	17
Delta	Sulphur	5
Ellis	Trinity	4
Franklin	Sulphur	6
Hopkins	Sabine	10
	Sulphur	12
Hunt	Sabine	10
	Sulphur	6
Kaufman	Sabine	7
	Trinity	4
Lamar	Sulphur	5
Navarro	Trinity	4
Rains	Sabine	13
Red River	Red	10
	Sulphur	8
Rockwall	Trinity	5
Groundwater Management Area 8 Average		**9**

TABLE 2: MODELED AVAILABLE GROUNDWATER FOR THE NACATOCH AQUIFER IN GROUNDWATER MANAGEMENT AREA 8. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE DIVIDED BY COUNTY, REGIONAL WATER PLANNING AREA, AND RIVER BASIN.

County	Region	Basin	Year					
			2010	2020	2030	2040	2050	2060
Bowie	D	Red	3,071	3,071	3,071	3,071	3,071	3,071
		Sulphur	1,942	1,942	1,942	1,942	1,942	1,942
Delta	D	Sulphur	575	575	575	575	575	575
Ellis	C	Trinity	20	20	20	20	20	20
Franklin	D	Sulphur	30	30	30	30	30	30
Hopkins	D	Sabine	291	291	291	291	291	291
		Sulphur	916	916	916	916	916	916
Hunt	D	Sabine	3,303	3,303	3,303	3,303	3,303	3,303
		Sulphur	491	491	491	491	491	491
Kaufman	C	Sabine	49	49	49	49	49	49
		Trinity	877	877	877	877	877	877
Lamar	D	Sulphur	110	110	110	110	110	110
Navarro	C	Trinity	980	980	980	980	980	980
Rains	D	Sabine	1	1	1	1	1	1
Red River	D	Red	58	58	58	58	58	58
		Sulphur	1,047	1,047	1,047	1,047	1,047	1,047
Rockwall	C	Sabine	0	0	0	0	0	0
		Trinity	13	13	13	13	13	13
Total			**13,774**	**13,774**	**13,774**	**13,774**	**13,774**	**13,774**

TABLE 3: MODELED AVAILABLE GROUNDWATER FOR THE NACATOCH AQUIFER BY COUNTY FOR EACH DECADE BETWEEN 2010 AND 2060. RESULTS ARE IN ACRE-FEET PER YEAR.

County	Year					
	2010	2020	2030	2040	2050	2060
Bowie	5,013	5,013	5,013	5,013	5,013	5,013
Delta	575	575	575	575	575	575
Ellis	20	20	20	20	20	20
Franklin	30	30	30	30	30	30
Hopkins	1,207	1,207	1,207	1,207	1,207	1,207
Hunt	3,794	3,794	3,794	3,794	3,794	3,794
Kaufman	926	926	926	926	926	926
Lamar	110	110	110	110	110	110
Navarro	980	980	980	980	980	980
Rains	1	1	1	1	1	1
Red River	1,105	1,105	1,105	1,105	1,105	1,105
Rockwall	13	13	13	13	13	13
Total	**13,774**	**13,774**	**13,774**	**13,774**	**13,774**	**13,774**

TABLE 4: MODELED AVAILABLE GROUNDWATER FOR THE NACATOCH AQUIFER BY REGIONAL WATER PLANNING AREA FOR EACH DECADE BETWEEN 2010 AND 2060. RESULTS ARE IN ACRE-FEET PER YEAR.

Region	Year					
	2010	2020	2030	2040	2050	2060
C	1,939	1,939	1,939	1,939	1,939	1,939
D	11,835	11,835	11,835	11,835	11,835	11,835
Total	**13,774**	**13,774**	**13,774**	**13,774**	**13,774**	**13,774**

TABLE 5: MODELED AVAILABLE GROUNDWATER FOR THE NACATOCH AQUIFER BY RIVER BASIN FOR EACH DECADE BETWEEN 2010 AND 2060. RESULTS ARE IN ACRE-FEET PER YEAR.

Basin	Year					
	2010	2020	2030	2040	2050	2060
Red	3,129	3,129	3,129	3,129	3,129	3,129
Sabine	3,644	3,644	3,644	3,644	3,644	3,644
Sulphur	5,111	5,111	5,111	5,111	5,111	5,111
Trinity	1,890	1,890	1,890	1,890	1,890	1,890
Total	**13,774**	**13,774**	**13,774**	**13,774**	**13,774**	**13,774**

TABLE 6: MODELED AVAILABLE GROUNDWATER FOR THE NACATOCH AQUIFER BY GROUNDWATER CONSERVATION DISTRICT (GCD) FOR EACH DECADE BETWEEN 2010 AND 2060. RESULTS ARE IN ACRE-FEET PER YEAR.

District	Year					
	2010	2020	2030	2040	2050	2060
Prairielands GCD	20	20	20	20	20	20
No District	13,754	13,754	13,754	13,754	13,754	13,754
Total	**13,774**	**13,774**	**13,774**	**13,774**	**13,774**	**13,774**

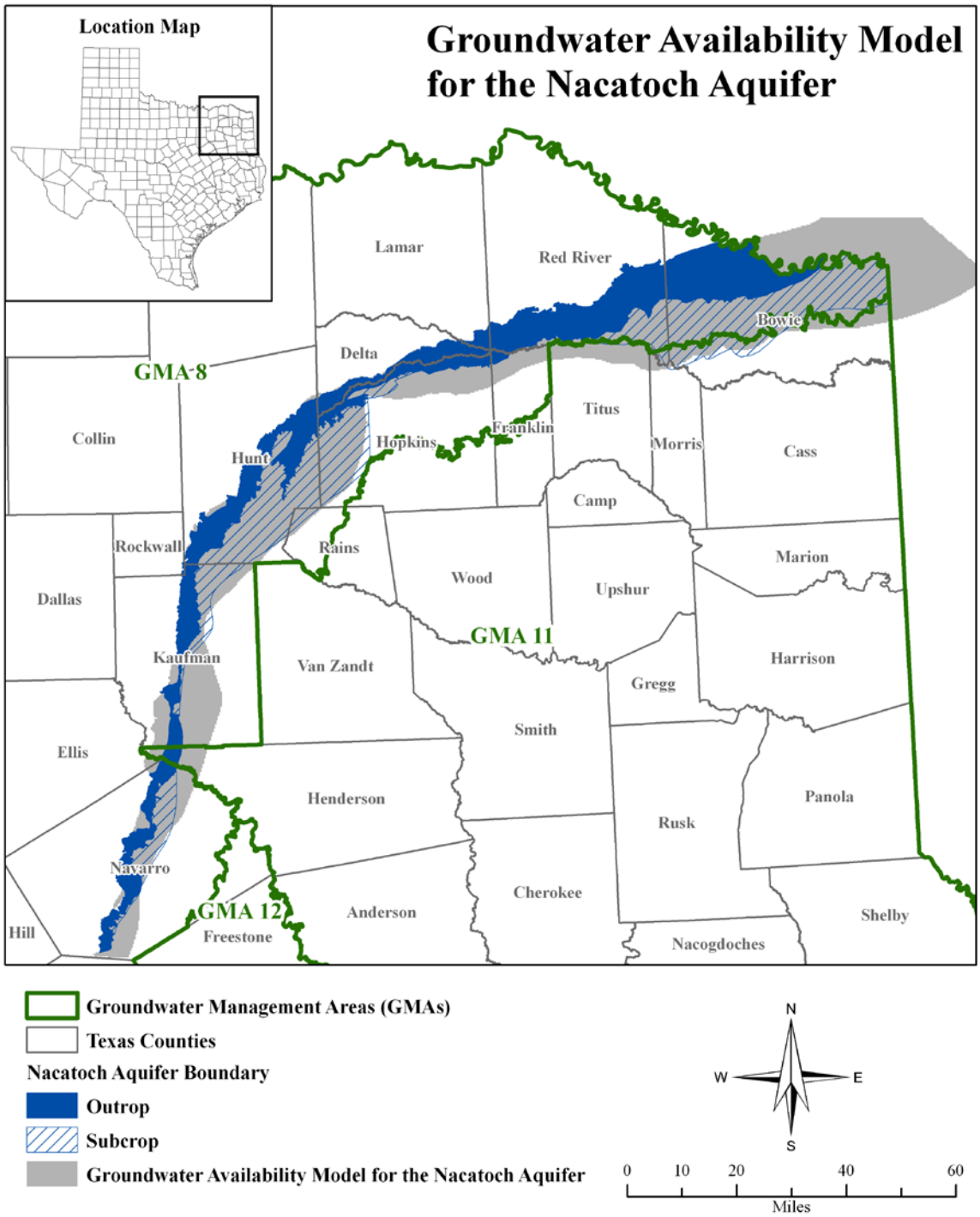


FIGURE 1: MAP SHOWING GROUNDWATER MANAGEMENT AREA 8 AND THE BOUNDARY OF THE NACATOCH AQUIFER ACCORDING TO THE 2007 STATE WATER PLAN (TWDB, 2007).

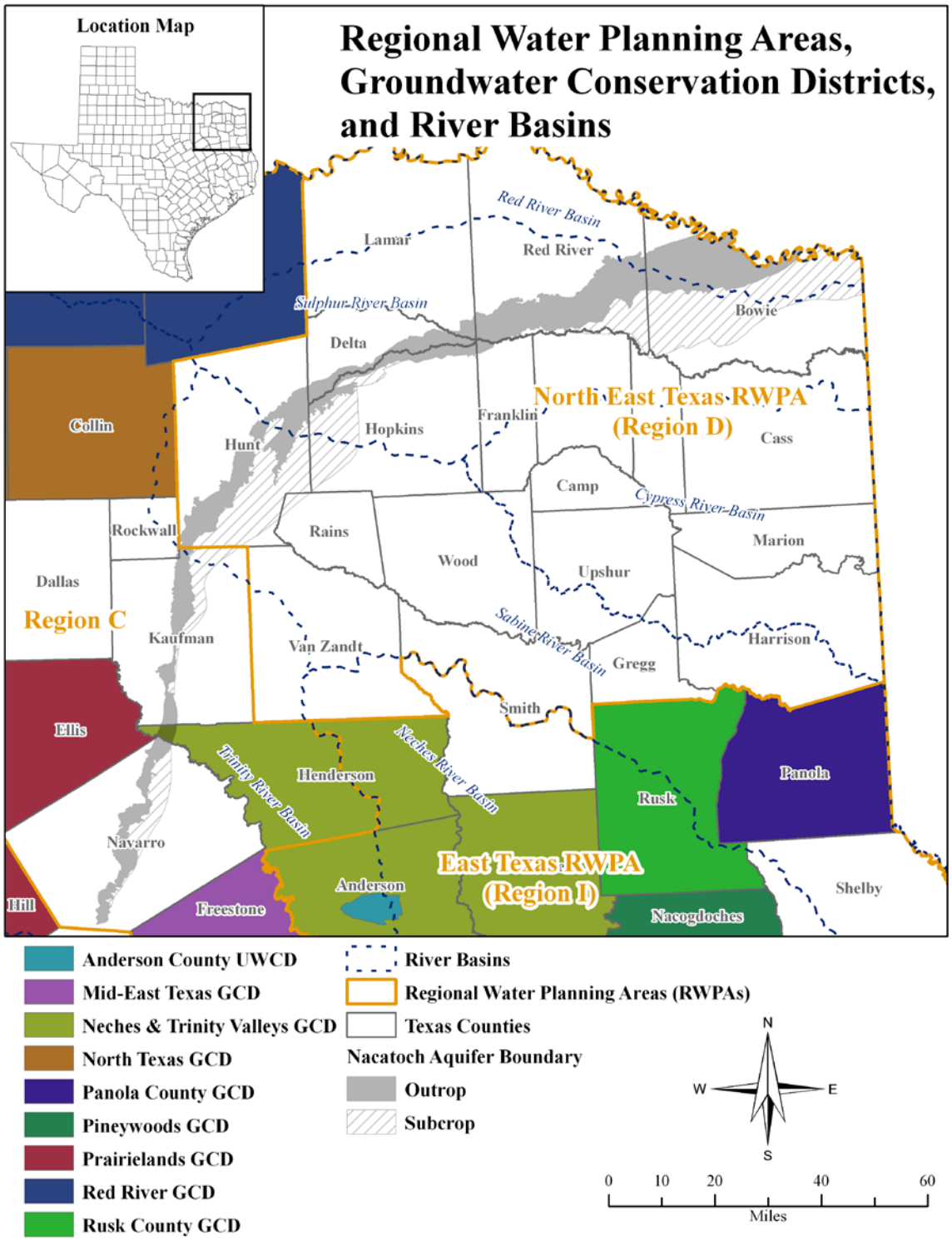


FIGURE 2: MAP SHOWING GROUNDWATER CONSERVATION DISTRICTS, REGIONAL WATER PLANNING AREAS, COUNTIES, AND RIVER BASINS IN AND NEIGHBORING GROUNDWATER MANAGEMENT AREA 8.