GAM Run 10-057 MAG

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Texas Water Development Board
Groundwater Availability Modeling Section
(512) 463-5076
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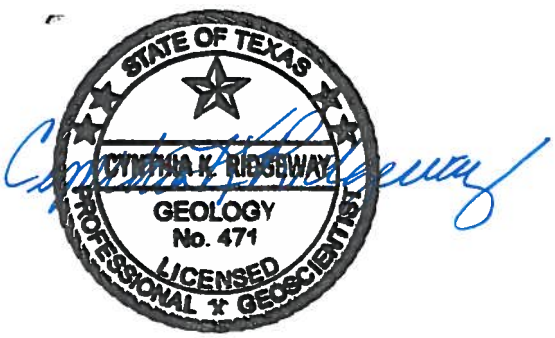

Cynthia K. Ridgeway, the Manager of the Groundwater Availability Modeling Section and Interim Director of the Groundwater Resources Division, is responsible for oversight of work performed by employees under her direct supervision. The seal appearing on this document was authorized by Cynthia K. Ridgeway, P.G. 471 on December 7, 2011.

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EXECUTIVE SUMMARY:

The modeled available groundwater for the Dockum Aquifer as a result of the desired future conditions adopted by the members of Groundwater Management Area 6 is approximately 15,700 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 pumping that achieves the desired future conditions was determined iteratively by adjusting the pumping in each county until the water level declines after 50 years matched the water level declines specified for each county.

REQUESTOR:

Mr. Mike McGuire of the Rolling Plains Groundwater Conservation District on behalf of Groundwater Management Area 6.

DESCRIPTION OF REQUEST:

In a letter dated August 13, 2010, Mr. Mike McGuire of Rolling Plains Groundwater Conservation District provided the Texas Water Development Board (TWDB) with the desired future conditions of the Dockum Aquifer adopted by the members of Groundwater Management Area 6. The desired future conditions of the Dockum Aquifer in Groundwater Management Area 6, as described in Resolution No. 2010-003, are:

> *"The Desired Future Condition for Fisher County, located in the Clear Fork Groundwater Conservation District is that condition whereby the total decline in water levels will be no more than 25 feet over the next 50 years*
>
> *The Desired Future Condition for Motley County, located in the Gateway Groundwater Conservation District is that condition whereby the total decline in water levels will be no more than 40 feet over the next 50 years*
>
> *The Desired Future Condition for Dickens & Kent Counties, not located within a Groundwater Conservation District, is that condition whereby the total decline in water levels will be no more than 40 feet over the next 50 years"*

In response to receiving the adopted desired future conditions, the Texas Water Development Board has estimated the modeled available groundwater for the Dockum Aquifer in Groundwater Management Area 6.

METHODS:

The location of Groundwater Management Area 6, the Dockum Aquifer, and the groundwater model cells that represent the aquifer are shown in Figure 1. The Texas Water Development Board previously completed Groundwater Availability Modeling (GAM) Task 10-025 (Oliver, 2010a), which the members of Groundwater Management Area 6 used when developing their desired future conditions. Though no model simulation in GAM Task 10-025 meets the desired future

conditions specified, the methods and assumptions used here are the same as described in that report. Specifically, the pumping in the Dockum Aquifer for the "base" scenario in GAM Task 10-025 was adjusted iteratively in each county within Groundwater Management Area 6 until the water level declines in the model matched the water level declines specified as desired future conditions. The pumping in the simulation that achieved the desired future conditions was then divided by county, regional water planning area, river basin, and groundwater conservation district. These areas are shown in Figure 2.

The historical-calibration period of the model ends in 1997 while the predictive simulation documented here begins in 2010. To determine the appropriate level of pumping between 1998 and 2009, the interim period leading up to the predictive simulation, a preliminary analysis of water levels in several selected wells in Groundwater Management Area 6 was performed. Based on this analysis, the pumping levels and distribution for the last year of the historical-calibration portion of the model were determined to be appropriate for the interim period. Pumping was therefore, held constant at 1997 levels between 1998 and 2009

PARAMETERS AND ASSUMPTIONS:

The parameters and assumptions for the model run using the modified groundwater model for the Dockum Aquifer are described below:

- The methods and assumptions for the model simulation documented here are the same as described in GAM Task 10-025 (Oliver, 2010a).

- The modified version the groundwater model for the Dockum Aquifer described in Oliver and Hutchison (2010) was used for this analysis. This model is an update to the previously developed groundwater availability model for the Dockum Aquifer described in Ewing and others (2008), which was completed in order to more effectively simulate predictive conditions. See Oliver and Hutchison (2010) and Ewing and others (2008) for assumptions and limitations of the model.

- The model includes two active layers which represent the upper and lower portions of the Dockum Aquifer (Layers 2 and 3, respectively). Layer 1, which is active in version 1.01 of the model documented in Ewing and others (2008), was inactivated in the modified model as described in Oliver and Hutchison (2010). Note that Groundwater Management Area 6 does not contain the upper portion of the Dockum Aquifer.

- The mean absolute error (a measure of the difference between simulated and measured water levels during model calibration) for the lower portion of the Dockum Aquifer between 1980 and 1997 is 53 feet (Oliver and Hutchison, 2010). This represents 2.5 percent of the hydraulic head drop across the model area.

- The MODFLOW General-Head Boundary package was used to simulate flow between the Dockum Aquifer and overlying aquifers. The water levels in the overlying aquifers were applied as described in Oliver (2010a) using GAM Run 09-023 (Oliver, 2010b) for the southern portion of the Ogallala Aquifer.

- Cells were assigned to individual counties and groundwater conservation districts as shown in the September 14, 2009 version of the file that associates the model grid to political and natural boundaries for the Dockum Aquifer.

- The recharge used for the model run represents average recharge as described in Ewing and others (2008).

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 November 30, 2010, 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 Dockum Aquifer in Groundwater Management Area 6 consistent with the desired future conditions is approximately 15,700 acre-feet per year between 2010 and 2060. This has been divided by county, regional water planning area, and river basin for each decade between 2010 and 2060 for use in the regional water planning process (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. In Table 5, note that the modeled available groundwater is totaled both including and excluding areas outside of a groundwater conservation district.

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:

Ewing, J.E., Jones, T.L., Yan, T., Vreugdenhil, A.M., Fryar, D.G., Pickens, J.F., Gordon, K., Nicot, J.P., Scanlon, B.R., Ashworth, J.B., Beach, J., 2008, Groundwater Availability Model for the Dockum Aquifer – Final Report: contract report to the Texas Water Development Board, 510 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.

Oliver, W., 2010a, GAM Task 10-025: Texas Water Development Board, GAM Task 10-025 Report, 61 p.

Oliver, W., 2010b, GAM Run 09-023: Texas Water Development Board, GAM Run 09-023 Report, 30 p.

Oliver, W., Hutchison, W.R., 2010, Modification and recalibration of the Groundwater Availability Model of the Dockum Aquifer: Texas Water Development Board, 114 p.

Table 1. Modeled available groundwater for the Dockum Aquifer in Groundwater Management Area 6. 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
Dickens	O	Brazos	2,126	2,126	2,126	2,126	2,126	2,126
		Red	1,584	1,584	1,584	1,584	1,584	1,584
Fisher	G	Brazos	2,880	2,880	2,880	2,880	2,880	2,880
Kent	G	Brazos	6,250	6,250	6,250	6,250	6,250	6,250
Motley	O	Red	2,860	2,860	2,860	2,860	2,860	2,860
Total			**15,700**	**15,700**	**15,700**	**15,700**	**15,700**	**15,700**

Table 2. Modeled available groundwater for the Dockum Aquifer summarized by county in Groundwater Management Area 6 for each decade between 2010 and 2060. Results are in acre-feet per year.

County	Year					
	2010	2020	2030	2040	2050	2060
Dickens	3,710	3,710	3,710	3,710	3,710	3,710
Fisher	2,880	2,880	2,880	2,880	2,880	2,880
Kent	6,250	6,250	6,250	6,250	6,250	6,250
Motley	2,860	2,860	2,860	2,860	2,860	2,860
Total	**15,700**	**15,700**	**15,700**	**15,700**	**15,700**	**15,700**

Table 3. Modeled available groundwater for the Dockum Aquifer summarized by regional water planning area in Groundwater Management Area 6 for each decade between 2010 and 2060. Results are in acre-feet per year.

Regional Water Planning Area	Year					
	2010	2020	2030	2040	2050	2060
G	9,130	9,130	9,130	9,130	9,130	9,130
O	6,570	6,570	6,570	6,570	6,570	6,570
Total	**15,700**	**15,700**	**15,700**	**15,700**	**15,700**	**15,700**

Table 4. Modeled available groundwater for the Dockum Aquifer summarized by river basin in Groundwater Management Area 6 for each decade between 2010 and 2060. Results are in acre-feet per year.

River Basin	Year					
	2010	2020	2030	2040	2050	2060
Brazos	11,256	11,256	11,256	11,256	11,256	11,256
Red	4,444	4,444	4,444	4,444	4,444	4,444
Total	**15,700**	**15,700**	**15,700**	**15,700**	**15,700**	**15,700**

Table 5. Modeled available groundwater for the Dockum Aquifer summarized by groundwater conservation district (GCD) in Groundwater Management Area 6 for each decade between 2010 and 2060. Results are in acre-feet per year.

Groundwater Conservation District	**Year**					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Clear Fork GCD	2,880	2,880	2,880	2,880	2,880	2,880
Gateway GCD	2,860	2,860	2,860	2,860	2,860	2,860
Total (excluding non-district areas)	**5,740**	**5,740**	**5,740**	**5,740**	**5,740**	**5,740**
No District	9,960	9,960	9,960	9,960	9,960	9,960
Total (including non-district areas)	**15,700**	**15,700**	**15,700**	**15,700**	**15,700**	**15,700**

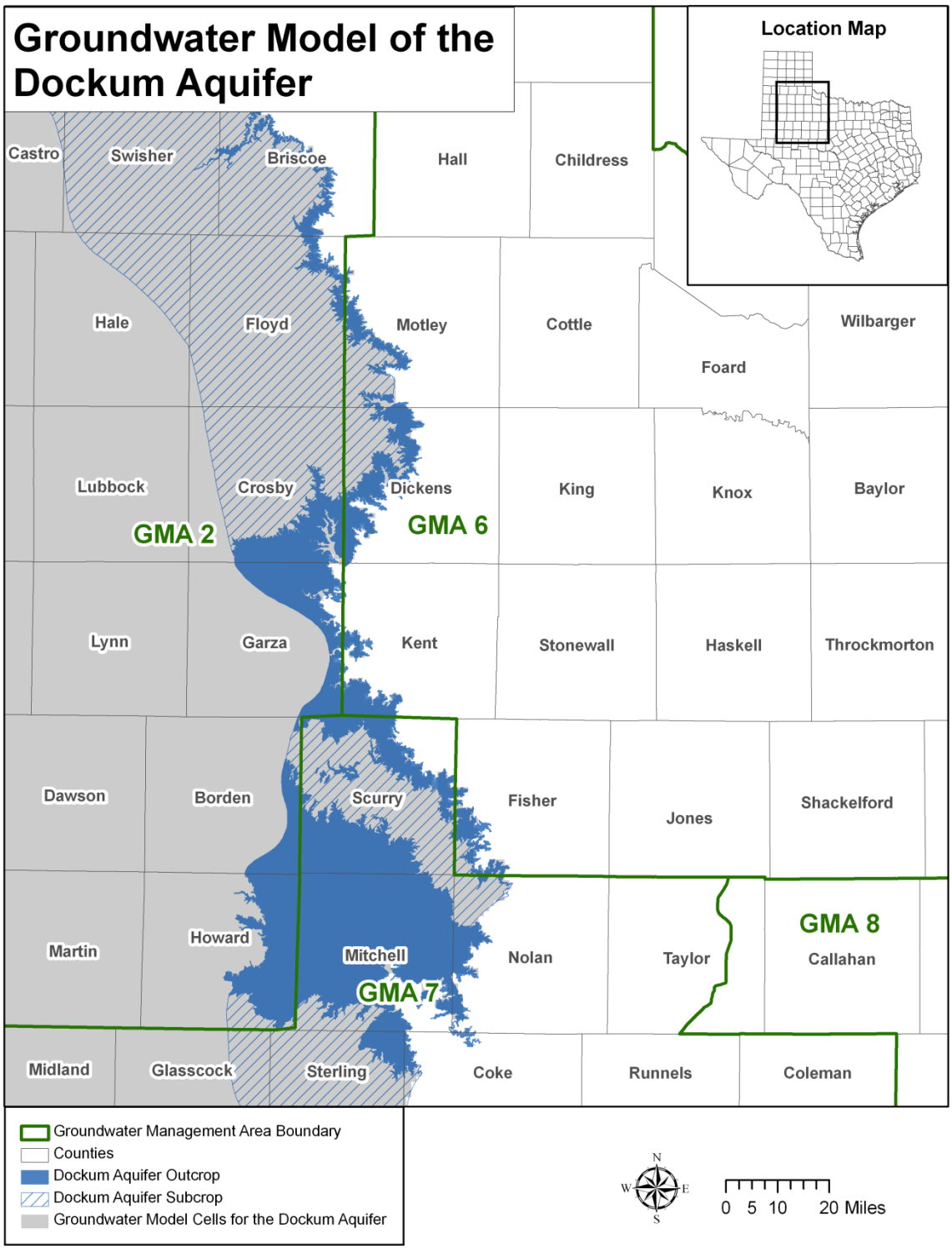

Figure 1: Map showing the areas covered by the groundwater model for the Dockum Aquifer.

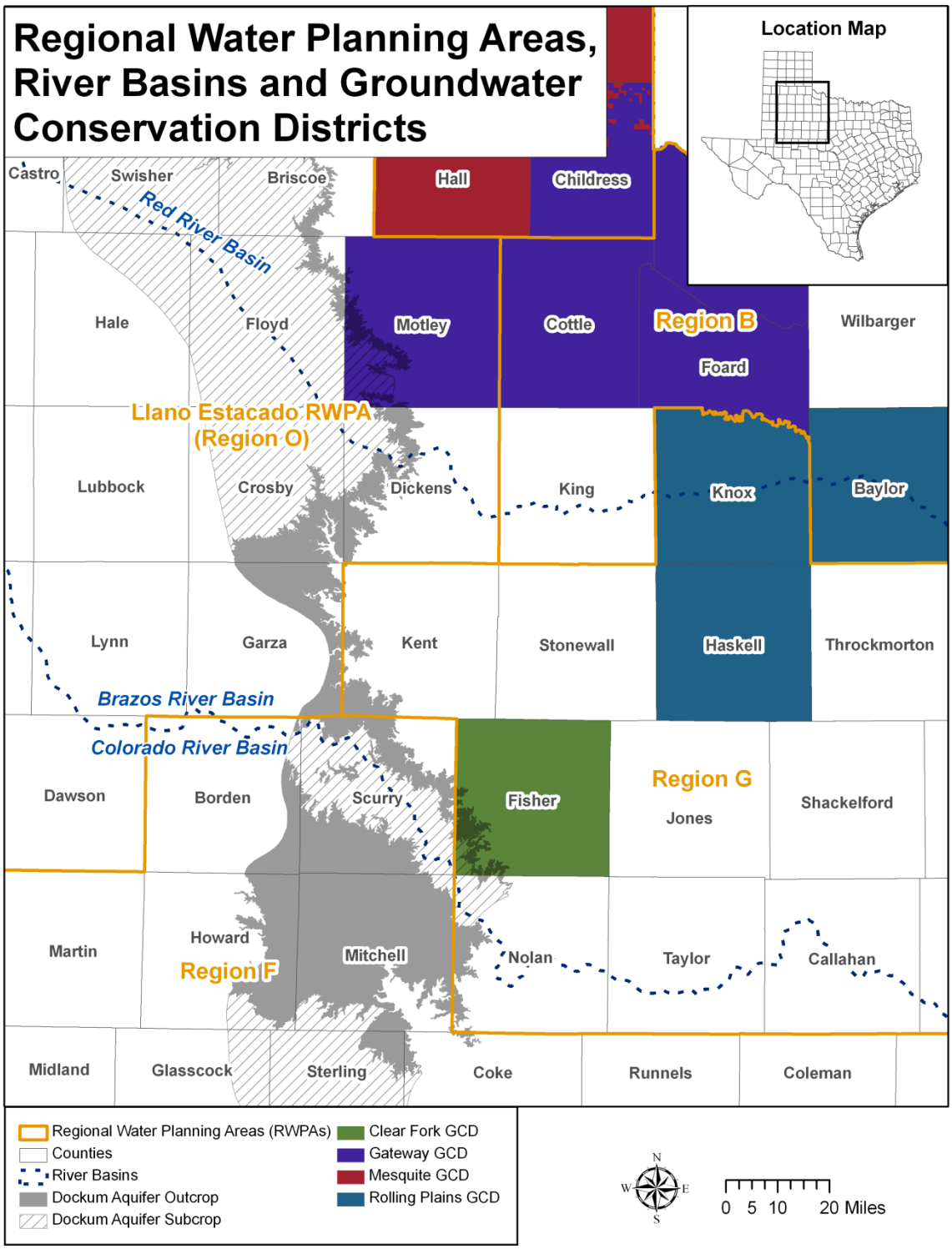

Figure 2: Map showing regional water planning areas (RWPAs), groundwater conservation districts (GCDs), counties, and river basins in Groundwater Management Area 6.