GAM Run 16-027 MAG: Modeled Available Groundwater for the Aquifers in Groundwater Management Area 3

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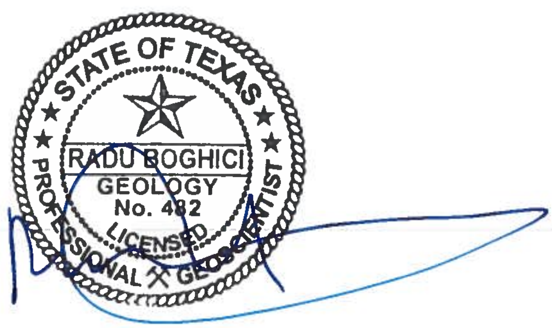
Texas Water Development Board
Groundwater Division
Groundwater Availability Modeling Department
(512) 463-5808

March 14, 2018



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GAM RUN 16-027 MAG: MODELED AVAILABLE GROUNDWATER FOR THE AQUIFERS IN GROUNDWATER MANAGEMENT AREA 3

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EXECUTIVE SUMMARY:

The modeled available groundwater for the relevant aquifers of Groundwater Management Area 3—the Capitan Reef Complex, Dockum, Edwards-Trinity (Plateau), Pecos Valley, and Rustler aquifers—are summarized by decade for use by the groundwater conservation districts (Tables 1, 3, 5, and 7) and by the regional water planning process (Tables 2, 4, 6, and 8). The modeled available groundwater estimates are: 381 acre-feet per year in the Capitan Reef Complex Aquifer; 17,378 acre-feet per year in the Dockum Aquifer; 420,541 acre-feet per year in the Edwards-Trinity (Plateau) and Pecos Valley aquifers; and 2,590 acre-feet per year in the Rustler Aquifer. The modeled available groundwater estimates were extracted from results of model runs using the following groundwater availability models: Eastern Arm of the Capitan Reef Complex, the alternative model for the Edwards-Trinity (Plateau) and Pecos Valley, High Plains Aquifer System, and Rustler aquifers. The explanatory report and other materials submitted to the Texas Water Development Board (TWDB) were determined to be administratively complete on December 8, 2017.

REQUESTOR:

Mr. Ty Edwards, coordinator of Groundwater Management Area 3.

DESCRIPTION OF REQUEST:

In a letter dated February 15, 2017, Dr. William R. Hutchison, on behalf of Groundwater Management Area 3, provided the TWDB with the desired future conditions of the Capitan Reef Complex, Dockum, Edwards-Trinity (Plateau), Pecos Valley, and Rustler aquifers adopted by the groundwater conservation districts in Groundwater Management Area 3. The groundwater conservation districts in Groundwater Management Area 3 proposed to adopt desired future conditions for these aquifers on April 26, 2016. The groundwater conservation districts in Groundwater Management Area 3 adopted the desired future conditions, described in Resolutions No. 16-01, 16-02, 16-03, 16-04, and 16-05, on October 20, 2016. On December 13, 2017, the groundwater conservation districts revised the desired future conditions for the Edwards-Trinity (Plateau) and Pecos Valley aquifers, described in Resolution No. 17-01. The final desired future conditions for the relevant aquifers in Groundwater Management Area 3 are listed below:

Capitan Reef Complex Aquifer

- Total net drawdown not to exceed 4 feet in Pecos County (Middle Pecos GCD) in 2070 as compared with aquifer levels in 2006 […];
- Total net drawdown in Ward and Winkler Counties no (sic) to exceed 2 feet in 2070 as compared with in 2006 aquifer levels […];
- The Capitan Reef Aquifer is not relevant for joint planning purposes in all other areas of Groundwater Management Area 3.

Dockum Aquifer

Total net drawdown in the following counties not to exceed drawdowns in 2070, as compared with aquifer levels in 2012 […]:

County (GCD)	No. Feet of Drawdown 2070
Crane	0
Loving	5
Pecos (Middle Pecos GCD)	52
Reeves (Reeves County GCD)	20
Ward	30
Winkler	22

Edwards-Trinity (Plateau) and Pecos Valley aquifers

Average drawdown in the following counties not to exceed drawdowns from 2010 to 2070 [...]:

County (GCD)	Average Drawdown 2010 to 2070
Crane	58
Loving	5
Pecos (Middle Pecos GCD)	14
Reeves (Reeves County GCD)	8
Ward	63
Winkler	161

Rustler Aquifer

Total net drawdowns in the following counties not to exceed drawdowns in 2070, as compared with 2009 aquifer levels [...]:

County (GCD)	No. of Feet of Drawdown 2070
Loving	28
Pecos (Middle Pecos GCD)	69
Reeves (Reeves County GCD)	40
Ward	30
Winkler	31
The Rustler Aquifer is not relevant for joint planning purposes in Crane County	

In Resolution 16-05, Groundwater Management Area 3 declared the Igneous and Ogallala aquifers non-relevant for joint planning purposes.

TWDB staff reviewed the model files associated with the desired future conditions and received clarification on procedures and assumptions from the Groundwater Management Area 3 Technical Coordinator on March 13 and 15, 2017. Clarification requests included drawdown calculation methodologies, whether drawdown averages and modeled available groundwater values should be based on official aquifer extent or model extent, and whether to include pass-through layers in drawdown averaging for Dockum Aquifer.

On December 13, 2017, groundwater conservation districts changed the desired future conditions for the Edwards-Trinity (Plateau) and Pecos Valley aquifers from the values adopted on February 15, 2017 to the values listed in the desired future conditions summary listed above. These changes were based on the analysis done by Dr. Hutchison in Technical Memorandum 17-01 (2017). In a response on November 6, 2017 to a request for clarifications from the TWDB, the consultant for Groundwater Management Area 3, Dr. Hutchison, explained how he had developed model files that computed average drawdowns and modeled available groundwater volumes for the Dockum Aquifer. To be consistent with this approach, the TWDB excluded the pass-through cells from drawdown averaging thereby reducing the modeled available groundwater volumes.

In another response on November 20, 2017 to a request for clarifications from the TWDB, Dr. Hutchison revised the model files to support the update of the desired future condition for the Edwards-Trinity (Plateau) and Pecos V alley aquifers by Groundwater Management Area 3. On December 14, 2017, Dr. Hutchison submitted an update to the Technical Memorandum 17-01 for the Edwards-Trinity (Plateau) and Pecos Valley aquifers reflecting the revised desired future conditions and associated pumping volumes.

METHODS:

The TWDB attempted to replicate the predictive modeling scenarios submitted by Groundwater Management Area 3 that achieved the adopted desired future conditions. As part of this investigation, the TWDB used the same models used by Dr. Hutchison to extract simulated water levels for the baseline year (2006, 2009, 2010, and 2012 depending on each aquifer's desired future condition statement) and for year 2070, and drawdown was calculated as the difference between water levels in the start year and water levels in 2070.

The individual drawdowns in all active model cells were averaged by aquifer for each county and groundwater conservation district. Any dry model cells (that is, cells where simulated water levels dropped below the base of the cells) were included in the averaging. The calculated drawdown averages were compared with the desired future conditions to verify that the pumping scenario achieved the desired future conditions within one foot. The calculated drawdown averages compared well with the desired future conditions and verified that the desired future conditions adopted by the districts can be achieved within the assumptions and limitations associated with each groundwater availability model. Modeled available groundwater volumes were determined by extracting pumping rates by decade from the model results using ZONEBUDGET Version 3.01 (Harbaugh, 2009). Annual pumping rates by aquifer are presented by county and groundwater conservation district, subtotaled by groundwater conservation district, and then summed for Groundwater Management Area 3 (Tables 1, 3, 5, and 7). Annual pumping rates by aquifer are also presented by county, river basin, and regional water planning area within Groundwater Management Area 3 (Tables 2, 4, 6, and 8).

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.

PARAMETERS AND ASSUMPTIONS:

Capitan Reef Complex Aquifer

- Version 1.01 of the groundwater availability model of the eastern arm of the Capitan Reef Complex Aquifer was used. See Jones (2016) for assumptions and limitations of the groundwater availability model. See Hutchison (2016a) for details on the assumptions used for predictive simulations.
- The model has five layers: Layer 1, the Edwards-Trinity (Plateau) and Pecos Valley aquifers; Layer 2, the Dockum Aquifer and the Dewey Lake Formation; Layer 3, the Rustler Aquifer; Layer 4, a confining unit made up of the Salado and Castile formations, and the overlying portion of the Artesia Group; and Layer 5, the Capitan Reef Complex Aquifer, part of the Artesia Group, and the Delaware Mountain Group. Layers 1 through 4 are intended to act solely as boundary conditions facilitating groundwater inflow and outflow relative to the Capitan Reef Complex Aquifer (Layer 5).
- The model was run with MODFLOW-2000 (Harbaugh and others, 2000).
- The model was run for the interval 2006 through 2070 for a 64-year predictive simulation. Drawdowns were calculated by subtracting 2006 simulated water levels from 2070 simulated water levels, which were then averaged over the portion of the aquifer in Groundwater Management Area 3.
- During predictive simulations, there were no cells where water levels were below the base elevation of the cell ("dry" cells). Therefore, all drawdowns were included in the averaging.

Dockum Aquifer

- Version 1.01 of the groundwater availability model for the High Plains Aquifer System by Deeds and Jigmond (2015) was used to construct the predictive model simulation for this analysis. See Hutchison (2016b) for details of the initial assumptions.
- The model has four layers which represent the Ogallala and Pecos Valley Alluvium aquifers (Layer 1), the Edwards-Trinity (High Plains) and Edwards-Trinity (Plateau) aquifers (Layer 2), the Upper Dockum Aquifer (Layer 3), and the Lower Dockum Aquifer (Layer 4). Pass-through cells exist in layers 2 and 3 where the Dockum Aquifer was absent but provided pathway for flow between the Lower Dockum and the Ogallala or Edwards-Trinity (High Plains) aquifers vertically. These pass-through cells were excluded from the calculations of drawdowns and modeled available groundwater.
- The model was run with MODFLOW-NWT (Niswonger and others, 2011). The model uses the Newton formulation and the upstream weighting package which automatically reduces pumping as heads drop in a particular cell as defined by the user. This feature may simulate the declining production of a well as saturated thickness decreases. Deeds and Jigmond (2015) modified the MODFLOW-NWT code to use a saturated thickness of 30 feet as the threshold (instead of percent of the saturated thickness) when pumping reductions occur during a simulation.
- The model was run for the interval 2012 through 2070 for a 58-year predictive simulation. Drawdowns were calculated by subtracting 2012 simulated water levels from 2070 simulated water levels, which were then averaged over the portion of the aquifer in Groundwater Management Area 3.
- During predictive simulations, there were no cells where water levels were below the base elevation of the cell ("dry" cells). Therefore, all drawdowns were included in the averaging.

Drawdown averages and modeled available groundwater volumes are based on the model boundaries within Groundwater Management Area 3.

Edwards-Trinity (Plateau) and Pecos Valley Alluvium Aquifers

- The single-layer numerical groundwater flow model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers used for this analysis. This model 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. See Hutchison (2016c) for details on the assumptions used for predictive simulations.

- 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 model was run with MODFLOW-2000 (Harbaugh and others, 2000).
- The model was run for the interval 2005 through 2070 for a 65-year predictive simulation. Drawdowns were calculated by subtracting 2010 simulated water levels from 2070 simulated water levels, which were then averaged over the portion of the aquifer in Groundwater Management Area 3. We are unable to verify that water levels in the model for 2010 were compared to measured water levels.
- Drawdowns for cells with water levels below the base elevation of the cell ("dry" cells) were included in the averaging.

Rustler Aquifer

- Version 1.01 of the groundwater availability model for the Rustler Aquifer by Ewing and others (2012) was used to construct the predictive model simulation for this analysis. See Hutchison (2016d) for details of the initial assumptions.
- The model has two layers, the top one representing the Rustler Aquifer, and the other representing the Dewey Lake Formation and the Dockum Aquifer.
- The model was run with MODFLOW-NWT (Niswonger and others, 2011).
- The model was run for the interval 2009 through 2070 for a 61-year predictive simulation. Drawdowns were calculated by subtracting 2009 simulated water levels from 2070 simulated water levels, which were then averaged over the portion of the aquifer in Groundwater Management Area 3. During predictive simulations, there were no cells where water levels were below the base elevation of the cell ("dry" cells). Therefore, all drawdowns were included in the averaging.

RESULTS:

Tables 1 through 8 show the combination of modeled available groundwater for relevant aquifers in Groundwater Management Area 3 summarized (1) by county, river basin, and regional water planning area for use in the regional water planning process; and (2) by groundwater conservation district and county.

The modeled available groundwater for the Capitan Reef Complex Aquifer that achieves the adopted desired future conditions is 381 acre-feet per year between 2020 and 2070 (Tables 1 and 2).

The modeled available groundwater for the Dockum Aquifer that achieves the adopted desired future conditions is 17,378 acre-feet per year between 2020 and 2070 (Tables 3 and 4).

The modeled available groundwater for the Edwards-Trinity (Plateau) and Pecos Valley Alluvium aquifers that achieves the adopted desired future conditions is 420,541 acre-feet per year between 2020 and 2070 (Tables 5 and 6).

The modeled available groundwater for the Rustler Aquifer that achieves the adopted desired future conditions is 2,590 acre-feet per year between 2020 and 2070 (Tables 7 and 8).

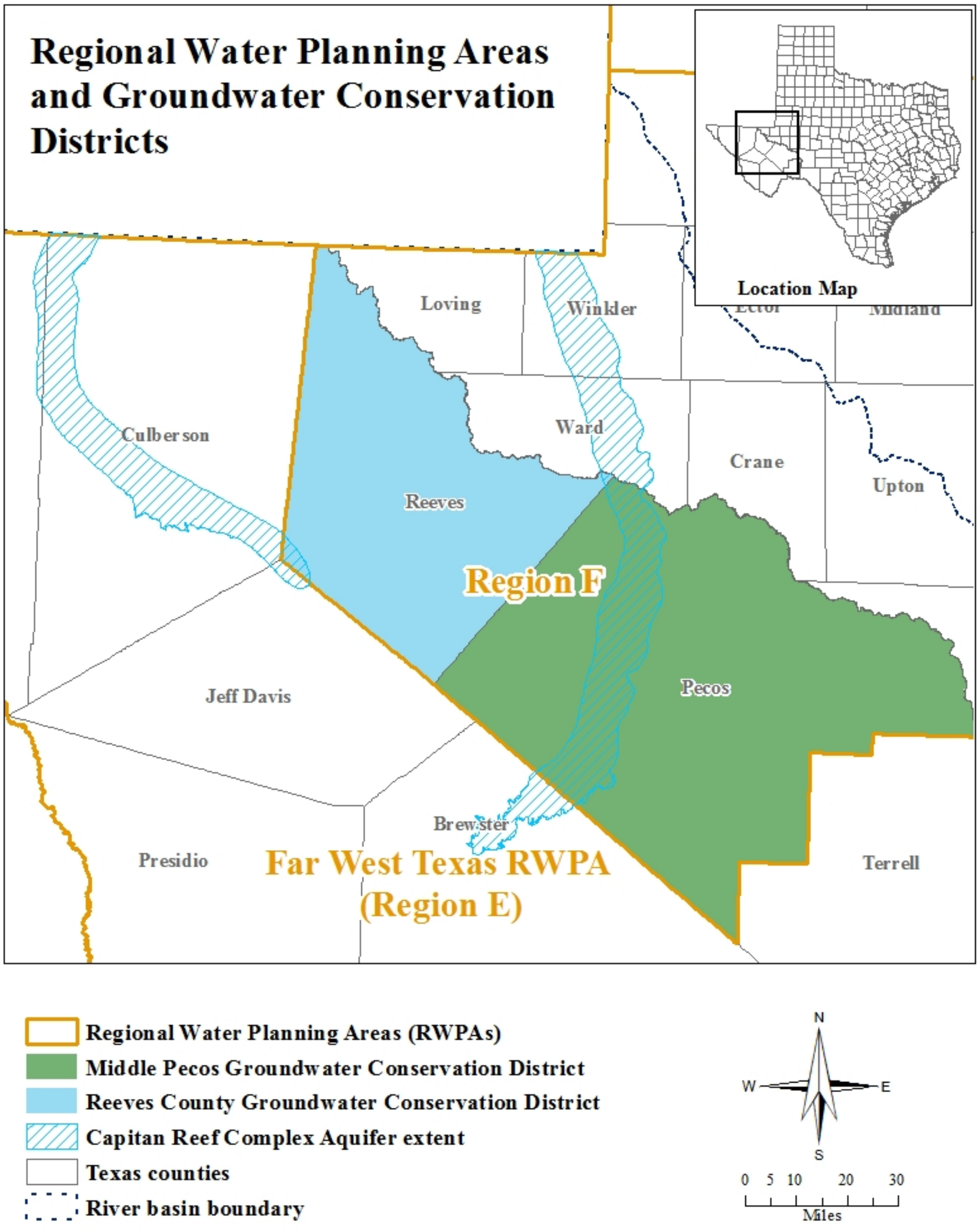

FIGURE 1. MAP SHOWING REGIONAL WATER PLANNING AREAS (RWPAS), GROUNDWATER CONSERVATION DISTRICTS (GCDS), AND COUNTIES IN THE VICINITY OF THE CAPITAN REEF COMPLEX AQUIFER IN GROUNDWATER MANAGEMENT AREA 3.

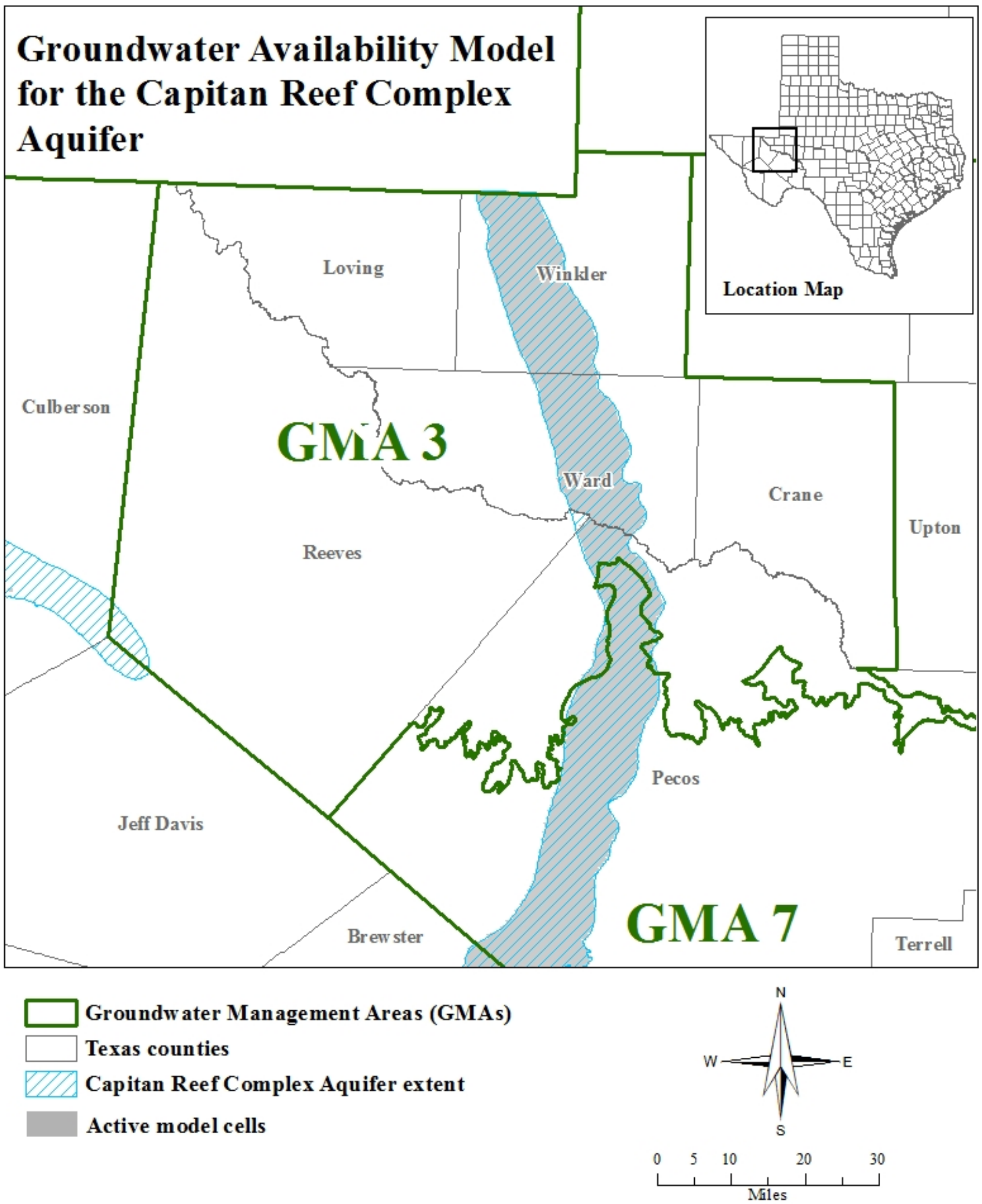

FIGURE 2. MAP SHOWING THE AREAS COVERED BY THE GROUNDWATER AVAILABILITY MODEL FOR CAPITAN REEF COMPLEX AQUIFER IN GROUNDWATER MANAGEMENT AREA 3.

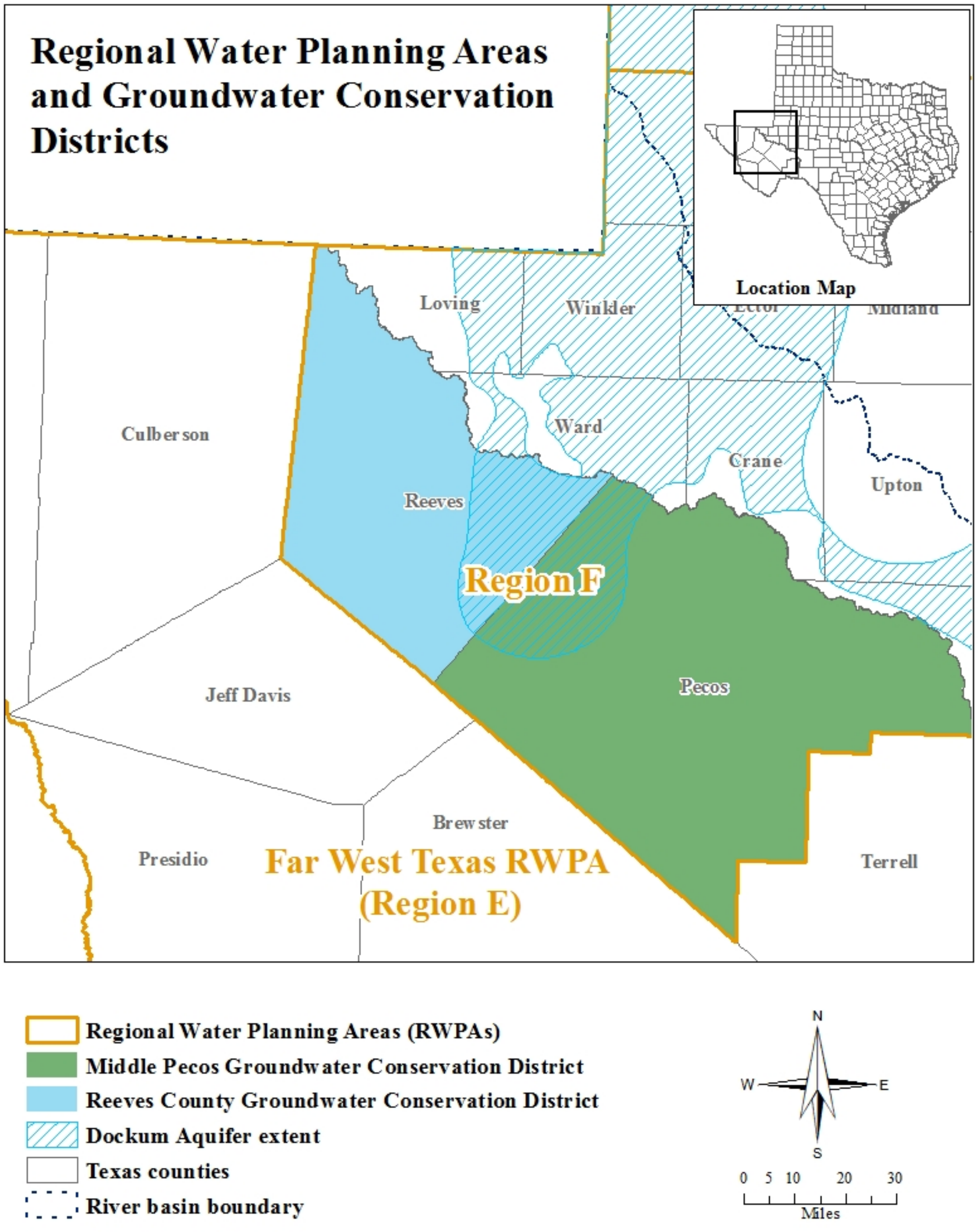

FIGURE 3. MAP SHOWING REGIONAL WATER PLANNING AREAS (RWPAS), GROUNDWATER CONSERVATION DISTRICTS (GCDS), AND COUNTIES IN THE VICINITY OF THE DOCKUM AQUIFER IN GROUNDWATER MANAGEMENT AREA 3.

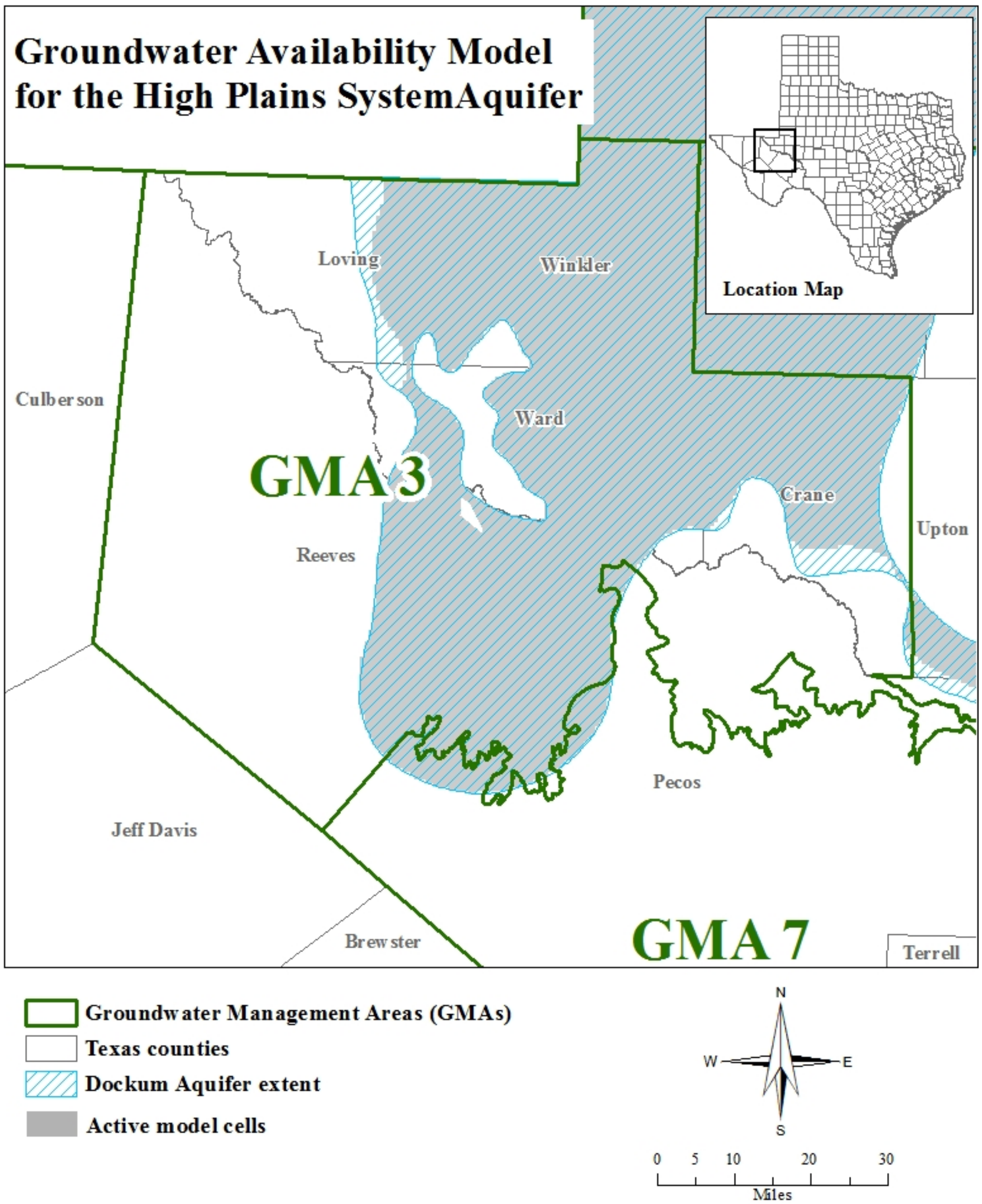

FIGURE 4. MAP SHOWING THE AREAS COVERED BY THE GROUNDWATER AVAILABILITY MODEL FOR THE HIGH PLAINS AQUIFER SYSTEM, INCLUDING THE DOCKUM AQUIFER, IN GROUNDWATER MANAGEMENT AREA 3.

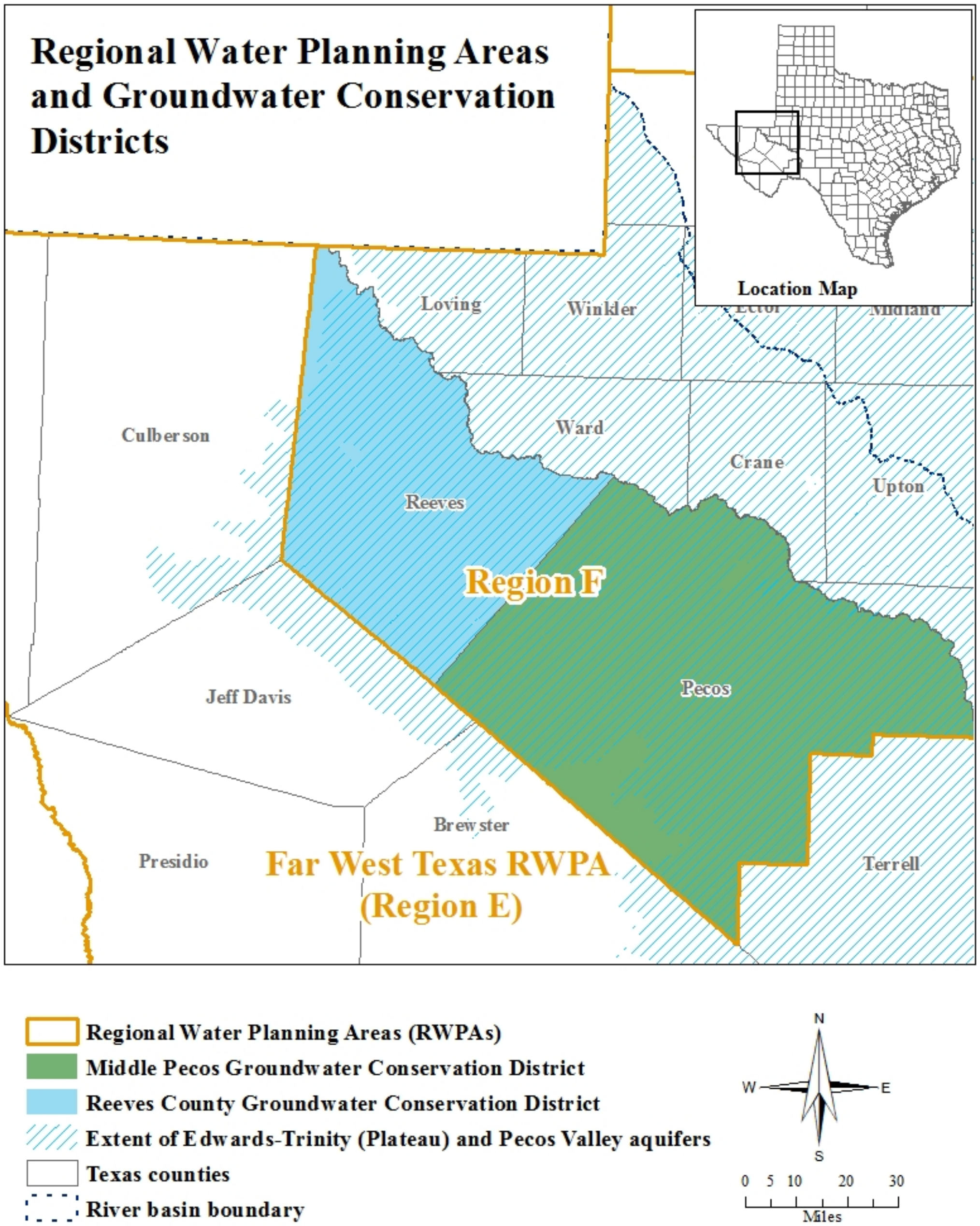

FIGURE 5. MAP SHOWING REGIONAL WATER PLANNING AREAS (RWPAS), GROUNDWATER CONSERVATION DISTRICTS (GCDS), AND COUNTIES IN THE VICINITY OF THE EDWARDS-TRINITY (PLATEAU) AND PECOS VALLEY AQUIFERS IN GROUNDWATER MANAGEMENT AREA 3.

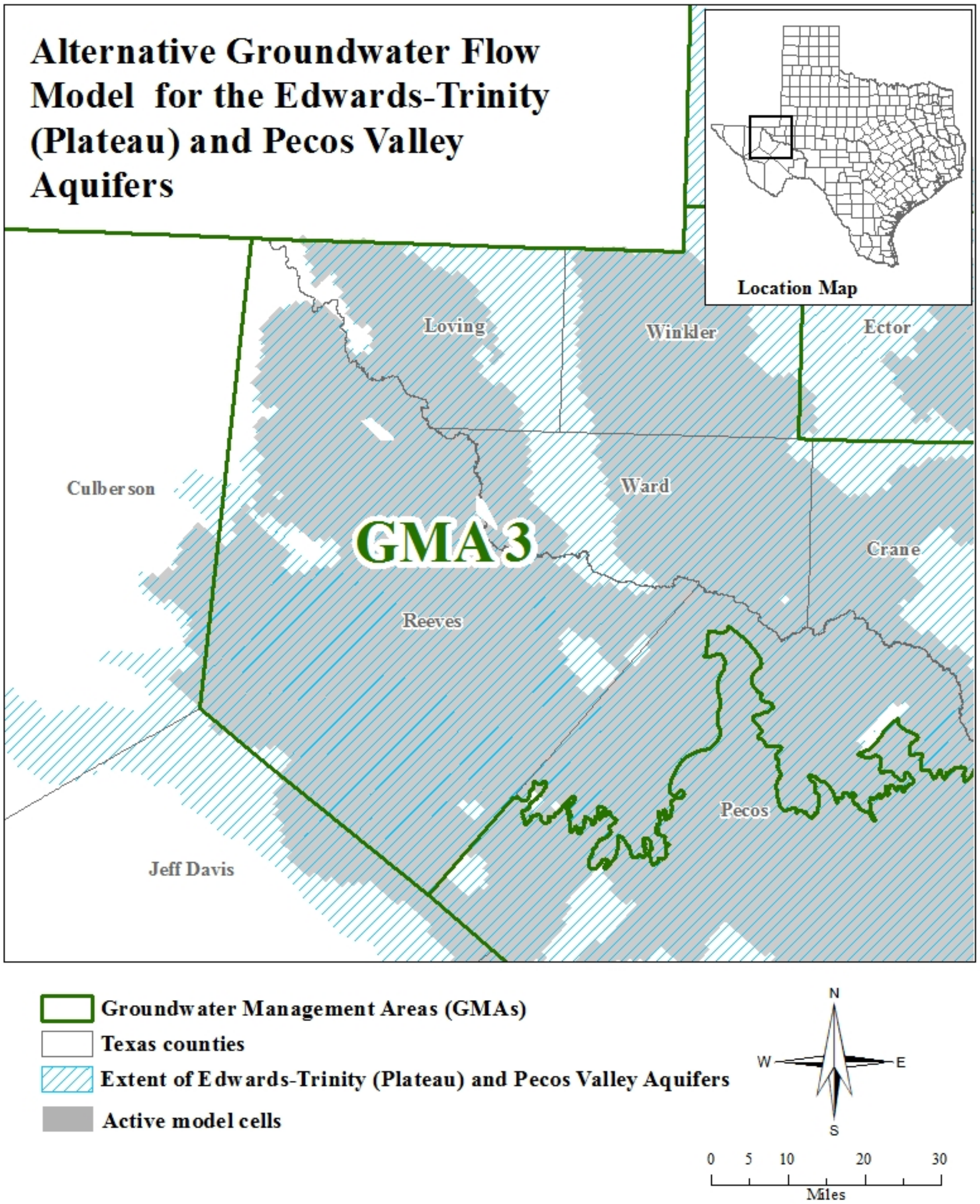

FIGURE 6. MAP SHOWING THE AREAS COVERED BY THE GROUNDWATER AVAILABILITY MODEL FOR THE EDWARDS-TRINITY (PLATEAU) AND PECOS VALLEY AQUIFERS IN GROUNDWATER MANAGEMENT AREA 3.

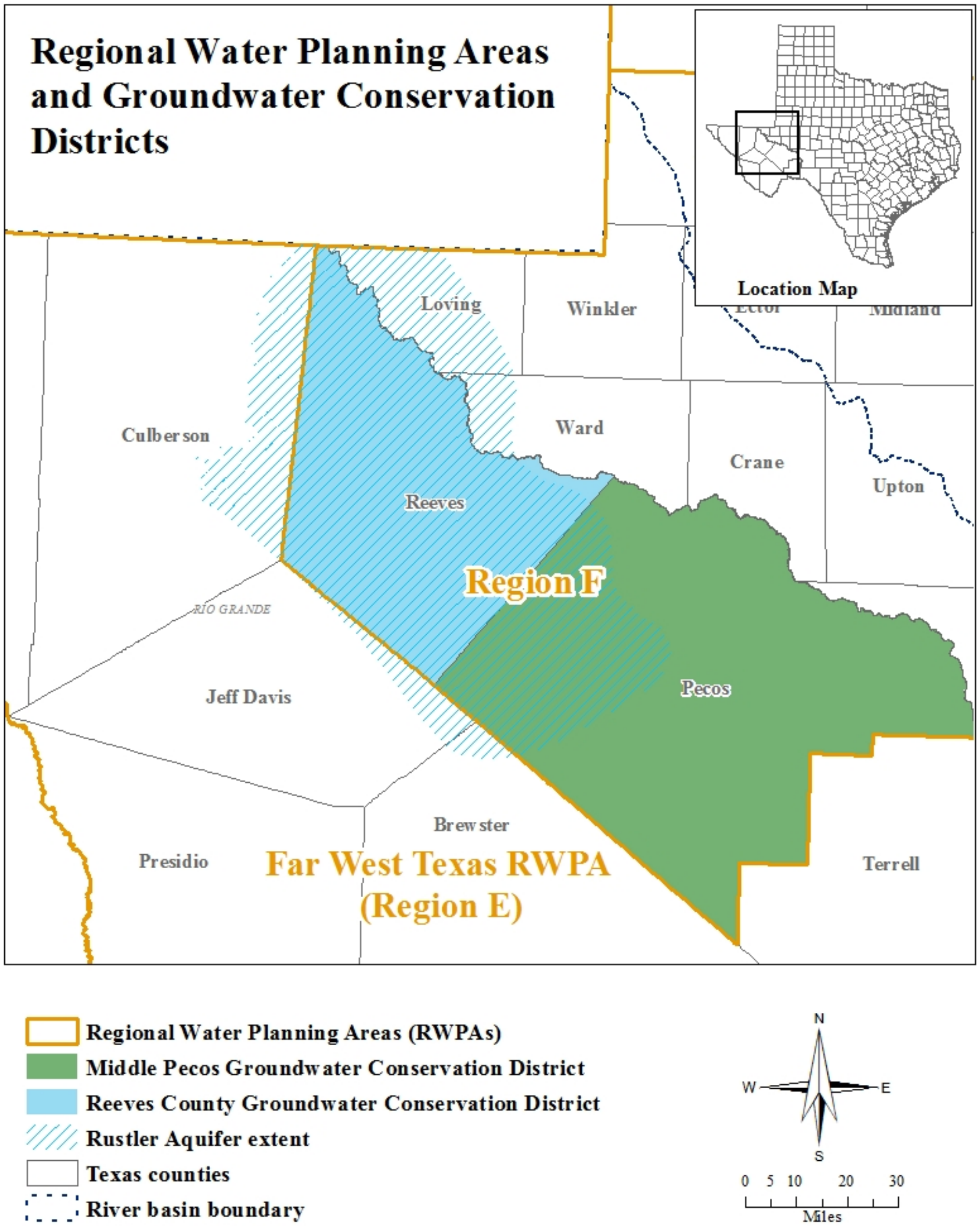

FIGURE 7. **MAP SHOWING REGIONAL WATER PLANNING AREAS (RWPAS), GROUNDWATER CONSERVATION DISTRICTS (GCDS), AND COUNTIES IN THE VICINITY OF THE RUSTLER AQUIFER IN GROUNDWATER MANAGEMENT AREA 3.**

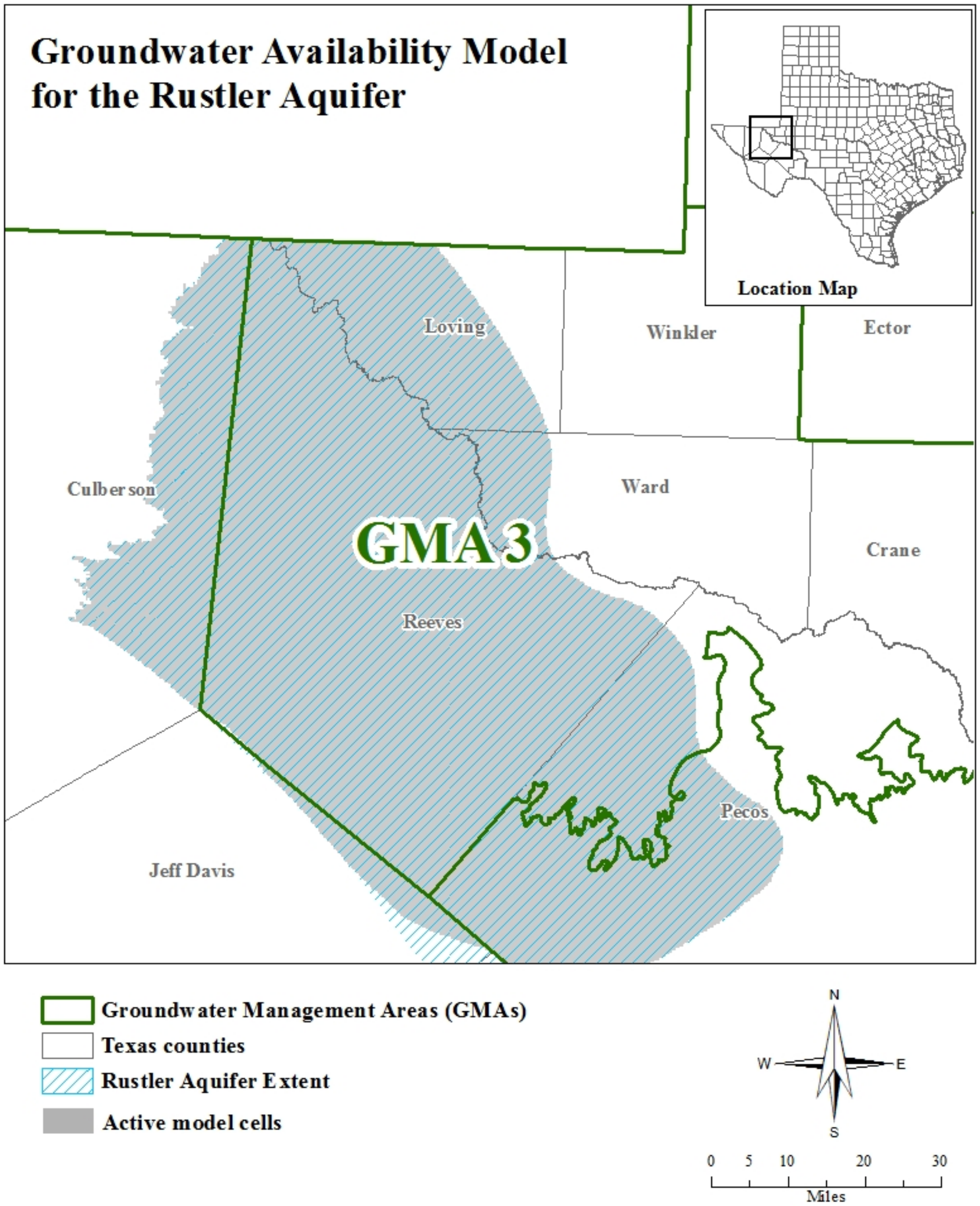

FIGURE 8. MAP SHOWING THE AREAS COVERED BY THE GROUNDWATER AVAILABILITY MODEL FOR THE RUSTLER AQUIFER IN GROUNDWATER MANAGEMENT AREA 3.

TABLE 1. MODELED AVAILABLE GROUNDWATER FOR THE CAPITAN REEF COMPLEX AQUIFER IN GROUNDWATER MANAGEMENT AREA 3 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2070. VALUES ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District[1]	County	2020	2030	2040	2050	2060	2070
Middle Pecos GCD	Pecos	4	4	4	4	4	4
-	Ward	103	103	103	103	103	103
-	Winkler	274	274	274	274	274	274
Total		**381**	**381**	**381**	**381**	**381**	**381**

Ward and Winkler counties are not in a groundwater conservation district.

TABLE 2. MODELED AVAILABLE GROUNDWATER FOR THE CAPITAN REEF COMPLEX AQUIFER IN GROUNDWATER MANAGEMENT AREA 3 SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN FOR EACH DECADE BETWEEN 2020 AND 2070. VALUES ARE IN ACRE-FEET PER YEAR.

County	RWPA	River Basin	2020	2030	2040	2050	2060	2070
Pecos	F	Rio Grande	4	4	4	4	4	4
Ward	F	Rio Grande	103	103	103	103	103	103
Winkler	F	Rio Grande	274	274	274	274	274	274
Total			**381**	**381**	**381**	**381**	**381**	**381**

TABLE 3. MODELED AVAILABLE GROUNDWATER FOR THE DOCKUM AQUIFER IN GROUNDWATER MANAGEMENT AREA 3 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2070. VALUES ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District[1]	County	2020	2030	2040	2050	2060	2070
-	Crane	94	94	94	94	94	94
-	Loving	453	453	453	453	453	453
Middle Pecos GCD	Pecos	6,142	6,142	6,142	6,142	6,142	6,142
Reeves County GCD	Reeves	2,539	2,539	2,539	2,539	2,539	2,539
-	Ward	2,150	2,150	2,150	2,150	2,150	2,150
-	Winkler	6,000	6,000	6,000	6,000	6,000	6,000
Total		**17,378**	**17,378**	**17,378**	**17,378**	**17,378**	**17,378**

[1]Crane, Loving, Ward, and Winkler counties are not in a groundwater conservation district.

TABLE 4. MODELED AVAILABLE GROUNDWATER FOR THE DOCKUM AQUIFER IN GROUNDWATER MANAGEMENT AREA 3 SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN FOR EACH DECADE BETWEEN 2020 AND 2070. VALUES ARE IN ACRE-FEET PER YEAR.

County	RWPA	River Basin	2020	2030	2040	2050	2060	2070
Crane	F	Rio Grande	94	94	94	94	94	94
Loving	F	Rio Grande	453	453	453	453	453	453
Pecos	F	Rio Grande	6,142	6,142	6,142	6,142	6,142	6,142
Reeves	F	Rio Grande	2,539	2,539	2,539	2,539	2,539	2,539
Ward	F	Rio Grande	2,150	2,150	2,150	2,150	2,150	2,150
Winkler	F	Rio Grande	5,987	5,987	5,987	5,987	5,987	5,987
Winkler	F	Colorado	13	13	13	13	13	13
Total			**17,378**	**17,378**	**17,378**	**17,378**	**17,378**	**17,378**

TABLE 5. MODELED AVAILABLE GROUNDWATER FOR THE EDWARDS-TRINITY (PLATEAU) AND PECOS VALLEY AQUIFERS IN GROUNDWATER MANAGEMENT AREA 3 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2070. VALUES ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District[1]	County	2020	2030	2040	2050	2060	2070
-	Crane	4,991	4,991	4,991	4,991	4,991	4,991
-	Loving	2,982	2,982	2,982	2,982	2,982	2,982
Middle Pecos GCD	Pecos	122,899	122,899	122,899	122,899	122,899	122,899
Reeves County GCD	Reeves	189,744	189,744	189,744	189,744	189,744	189,744
-	Ward	49,976	49,976	49,976	49,976	49,976	49,976
-	Winkler	49,949	49,949	49,949	49,949	49,949	49,949
Total		**420,541**	**420,541**	**420,541**	**420,541**	**420,541**	**420,541**

[1]Crane, Loving, Ward, and Winkler counties are not in a groundwater conservation district.

TABLE 6. MODELED AVAILABLE GROUNDWATER FOR THE EDWARDS-TRINITY (PLATEAU) AND PECOS VALLEY AQUIFES IN GROUNDWATER MANAGEMENT AREA 3 SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN FOR EACH DECADE BETWEEN 2020 AND 2070. VALUES ARE IN ACRE-FEET PER YEAR.

County	RWPA	River Basin	2020	2030	2040	2050	2060	2070
Crane	F	Rio Grande	4,991	4,991	4,991	4,991	4,991	4,991
Loving	F	Rio Grande	2,982	2,982	2,982	2,982	2,982	2,982
Pecos	F	Rio Grande	122,899	122,899	122,899	122,899	122,899	122,899
Reeves	F	Rio Grande	189,744	189,744	189,744	189,744	189,744	189,744
Ward	F	Rio Grande	49,976	49,976	49,976	49,976	49,976	49,976
Winkler	F	Rio Grande	49,949	49,949	49,949	49,949	49,949	49,949
Total			**420,541**	**420,541**	**420,541**	**420,541**	**420,541**	**420,541**

TABLE 7. MODELED AVAILABLE GROUNDWATER FOR THE RUSTLER AQUIFER IN GROUNDWATER MANAGEMENT AREA 3 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2070. VALUES ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District[1]	County	2020	2030	2040	2050	2060	2070
-	Loving	200	200	200	200	200	200
Middle Pecos GCD	Pecos	3	3	3	3	3	3
Reeves County GCD	Reeves	2,387	2,387	2,387	2,387	2,387	2,387
-	Ward	0	0	0	0	0	0
Total		**2,590**	**2,590**	**2,590**	**2,590**	**2,590**	**2,590**

[1]Loving and Ward counties are not in a groundwater conservation district.

TABLE 8. MODELED AVAILABLE GROUNDWATER FOR THE RUSTLER AQUIFER IN GROUNDWATER MANAGEMENT AREA 3 SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN FOR EACH DECADE BETWEEN 2020 AND 2070. VALUES ARE IN ACRE-FEET PER YEAR.

County	RWPA	River Basin	2020	2030	2040	2050	2060	2070
Loving	F	Rio Grande	200	200	200	200	200	200
Pecos	F	Rio Grande	3	3	3	3	3	3
Reeves	F	Rio Grande	2,387	2,387	2,387	2,387	2,387	2,387
Ward	F	Rio Grande	0	0	0	0	0	0
Total			**2,590**	**2,590**	**2,590**	**2,590**	**2,590**	**2,590**

LIMITATIONS:

The groundwater model used in completing this analysis is the best available scientific tool that can be used to meet the stated objectives. 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 groundwater levels in 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.

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Anaya, R., and Jones, I. C., 2009, Groundwater Availability Model for the Edwards-Trinity (Plateau) and Pecos Valley Aquifers of Texas: Texas Water Development Board Report 373, 103p.

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