# GAM Run 10-037 MAG

**by Mr. Wade Oliver**

Texas Water Development Board
Groundwater Availability Modeling Section
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## EXECUTIVE SUMMARY:

The estimated total pumping from the Wild Horse Flat, Michigan Flat, Ryan Flat, and Lobo Flat portions of the West Texas Bolsons Aquifer that achieves the desired future conditions adopted by the members of Groundwater Management Area 4 declines from approximately 51,000 acre-feet per year to 50,000 acre-feet per year between 2010 and 2060. This is summarized by county, regional water planning area, and river basin as shown in Table 1. The estimated managed available groundwater for these portions of the West Texas Bolsons Aquifer, the amount available for permitting, is shown in Table 4. The total pumping estimates were taken from a previously completed model simulation for the aquifer documented in Groundwater Availability Modeling (GAM) Task 10-028. The managed available groundwater was determined by subtracting estimated exempt pumping due to domestic and livestock uses from the total pumping in each district.

## REQUESTOR:

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

## DESCRIPTION OF REQUEST:

In a letter dated August 13, 2010 and received August 18, 2010, Ms. Adams provided the Texas Water Development Board (TWDB) with the desired future conditions of the West Texas Bolsons Aquifer adopted by the members of Groundwater Management Area 4. The desired future conditions for the West Texas Bolsons Aquifer, as described in Resolution No. R 2010-01 and adopted August 13, 2010, are shown below:

| Groundwater Conservation District* | Desired Future Condition (feet of drawdown) |
|---|---|
| Culberson County GCD | 78 |
| Jeff Davis County UWCD | 72 |
| Presidio County UWCD | 72 |

*Note that "GCD" refers to Groundwater Conservation District and "UWCD" refers to Underground Water Conservation District.

In response to receiving the adopted desired future conditions, the Texas Water Development Board has estimated the managed available groundwater for the West Texas Bolsons Aquifer within Groundwater Management Area 4.

## METHODS:

Groundwater Management Area 4 contains the West Texas Bolsons Aquifer, a minor aquifer in Texas according to the 2007 State Water Plan (TWDB, 2007). The location of Groundwater Management Area 4, the West Texas Bolsons Aquifer, and the groundwater availability model cells that represent the aquifer are shown in Figure 1.

It should be noted that this report only addresses the Wild Horse Flat, Michigan Flat, Ryan Flat, and Lobo Flat portions of the West Texas Bolsons Aquifer. The managed available groundwater for the Presidio-Redford Bolson and Upper Salt Basin, for which Groundwater Management Area 4 designated separate desired future conditions, will be included in separate reports. The remaining portions of the aquifer were either designated as not relevant for the purpose of joint planning by the members of Groundwater Management Area 4 or are small enough as to have a negligible effect on the results presented in this report.

The Texas Water Development Board previously completed several predictive groundwater availability model simulations of the Igneous Aquifer to assist the members of Groundwater Management Area 4 in developing desired future conditions. As stated in Resolution No. R 2010-01, the members of Groundwater Management Area 4 considered Groundwater Availability Modeling (GAM) Task 10-026 (Oliver, 2010a) and GAM Task 10-028 (Oliver, 2010b). The desired future conditions above for the West Texas Bolsons Aquifer match each of the simulations in the above reports, as the changes among the simulations were only applied to the underlying Igneous Aquifer. Therefore, the results shown below are taken from "Scenario 3" in GAM Task 10-028 since this scenario most closely matches the desired future conditions for the underlying Igneous Aquifer adopted by the members of Groundwater Management Area 4.

One change from the previous simulations, however, is what is reported as the boundary between Jeff Davis County Underground Water Conservation District and Presidio County Underground Water Conservation District. The boundaries of these districts now coincide with the boundaries of Jeff Davis and Presidio counties, respectively, as shown in Figure 2. Previously, a portion of Jeff Davis County Underground Water Conservation District was shown as located in Presidio County. This change was made due to a finding in Attorney General Opinion No. GA-0792, released subsequent to the above reports, relating to the jurisdiction of each groundwater conservation district.

## PARAMETERS AND ASSUMPTIONS:

The parameters and assumptions for the model run using the groundwater availability model for the Igneous and parts of the West Texas Bolsons aquifers are described below:

- We used Version 1.01 of the groundwater availability model for the Igneous and parts of the West Texas Bolsons aquifers. See Beach and others (2004) for assumptions and limitations of the model.

- The model includes three layers representing the Wild Horse Flat, Michigan Flat, Ryan Flat and Lobo Flat portions of the West Texas Bolsons Aquifer (Layer 1), the Igneous Aquifer (Layer 2), and the underlying Cretaceous and Permian units (Layer 3).

- Cells were assigned to individual counties, river basins, regional water planning areas, and groundwater conservation districts as shown in the August 3, 2010 version of the file that associates the model grid to political and natural boundaries for the

Igneous and West Texas Bolsons aquifers. Note that some minor adjustments were made to the file to better reflect the relationship of model cells to political boundaries.

- See GAM Task 10-026 (Oliver, 2010a) and GAM Task 10-028 (Oliver, 2010b) for a full description of the methods and assumptions used in the groundwater availability model simulation. Note that the simulations in the above reports were over a period of 50 years whereas the period from 2010 through 2060 (inclusive) is 51 years. Since the changes in annual pumping through the predictive simulation are relatively small, the first year of the predictive model run is referred to in the results below as 2010, though it comes from the stress period in the simulation for the year 2011.

**Determining Managed Available Groundwater**

As defined in Chapter 36 of the Texas Water Code, "managed available groundwater" is the amount of water that may be permitted. The pumping output from groundwater availability models, however, represents the total amount of pumping from the aquifer. The total pumping includes uses of water both subject to permitting and exempt from permitting. Examples of exempt uses include domestic, livestock, and oil and gas exploration. Each district may also exempt additional uses as defined by its rules or enabling legislation.

Since exempt uses are not available for permitting, it is necessary to account for them when determining managed available groundwater. To do this, the Texas Water Development Board developed a standardized method for estimating exempt use for domestic and livestock purposes based on projected changes in population and the distribution of domestic and livestock wells in the area. Because other exempt uses can vary significantly from district to district, and there is much higher uncertainty associated with estimating use due to oil and gas exploration, estimates of exempt pumping outside domestic and livestock uses have not been included. The districts were encouraged to evaluate the estimates of exempt pumping and, if desired, provide updated estimates. Once established, the estimates of exempt pumping were subtracted from the total pumping output from the groundwater availability model to yield the estimated managed available groundwater for permitting purposes.

**RESULTS:**

The estimated total pumping from the Wild Horse Flat, Michigan Flat, Ryan Flat, and Lobo Flat portions of the West Texas Bolsons Aquifer in Groundwater Management Area 4 that achieves the above desired future conditions declines from approximately 51,000 acre-feet per year in 2010 to 50,000 acre-feet per year in 2060. This pumping 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). Note that the aquifer is located entirely within the Far West Texas Regional Water Planning Area (Region E) and the Rio Grande Basin.

The total pumping estimates for the Igneous Aquifer are also summarized by groundwater conservation district as shown in Table 2. Table 3 contains the estimates of exempt pumping for the Wild Horse Flat, Michigan Flat, Ryan Flat, and Lobo Flat portions of the West Texas Bolsons Aquifer in each groundwater conservation district due to domestic and livestock uses.

The managed available groundwater for each of the districts, the difference between the total pumping in the district (Table 2) and the estimated exempt use (Table 3) is shown in Table 4.

**LIMITATIONS:**

Managed available groundwater numbers included in this report are the result of subtracting the estimated future exempt use from the estimated total pumping that would achieve the desired future condition adopted by the groundwater conservation districts in the groundwater management area. These numbers, therefore, are the result of (1) running the groundwater model to estimate the total pumping required to achieve the desired future condition and (2) estimating the future exempt use in the area.

The groundwater model used in developing estimates of total pumping is the best available scientific tool that can be used to estimate the pumping that will achieve the desired future condition. 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 total 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 condition of the groundwater resources in the area that relate to the adopted desired future condition.

In addition, certain assumptions have been made regarding future precipitation, recharge, and streamflow in developing these total pumping estimates. Those assumptions also need to be considered and compared to actual future data when evaluating compliance with the desired future condition.

In the case of TWDB's estimates of future exempt use, key assumptions were made as to the pattern of population growth relative to the need for domestic wells or supplied water, per capita use from domestic wells, and livestock uses of water. In the case of district estimates of future exempt use, including exempt use associated with the exploration of oil and gas, the assumptions are specific to that district. In either case, these assumptions need to be considered when reviewing future data related to exempt use.

Given these limitations, users of this information are cautioned that the total pumping 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 groundwater model and the assumptions in this analysis, it is important that the groundwater conservation districts work with the TWDB to refine these managed 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 AND ASSOCIATED MODEL RUNS:**

Beach, J.A., Ashworth, J.B., Finch, Jr., S.T., Chastain-Howley, A., Calhoun, K., Urbanczyk, K.M., Sharp, J.M., and Olson, J., 2004, Groundwater availability model for the Igneous and parts of the West Texas Bolsons (Wild Horse Flat, Michigan Flat, Ryan Flat and Lobo Flat) aquifers: contract report to the Texas Water Development Board, 208 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 10-026: Texas Water Development Board, GAM Task 10-026 Report, 7 p.

Oliver, W., 2010b, GAM Task 10-028: Texas Water Development Board, GAM Task 10-028 Report, 8 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. Estimated total annual pumping for the West Texas Bolsons 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 | Regional Water Planning Area | Basin | Year | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 2010 | 2020 | 2030 | 2040 | 2050 | 2060 |
| Culberson | E | Rio Grande | 35,826 | 35,749 | 35,678 | 35,601 | 35,550 | 35,509 |
| Jeff Davis | E | Rio Grande | 6,074 | 6,055 | 6,055 | 5,989 | 5,960 | 5,942 |
| Presidio | E | Rio Grande | 9,126 | 9,112 | 8,982 | 8,834 | 8,710 | 8,640 |
| **Total** | | | **51,026** | **50,916** | **50,715** | **50,424** | **50,220** | **50,091** |

Table 2. Estimated total annual pumping for the West Texas Bolsons 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 | Year | | | | | |
|---|---|---|---|---|---|---|
| | 2010 | 2020 | 2030 | 2040 | 2050 | 2060 |
| Culberson County GCD | 35,826 | 35,749 | 35,678 | 35,601 | 35,550 | 35,509 |
| Jeff Davis County UWCD | 6,074 | 6,055 | 6,055 | 5,989 | 5,960 | 5,942 |
| Presidio County UWCD | 9,126 | 9,112 | 8,982 | 8,834 | 8,710 | 8,640 |
| **Total** | **51,026** | **50,916** | **50,715** | **50,424** | **50,220** | **50,091** |

Table 3. Estimates of annual exempt use for the West Texas Bolsons Aquifer in Groundwater Management Area 4 by groundwater conservation district (GCD) for each decade between 2010 and 2060. Results are in acre-feet per year. UWCD refers to Underground Water Conservation District.

| Groundwater Conservation District | Source | Year | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2010 | 2020 | 2030 | 2040 | 2050 | 2060 |
| Culberson County GCD | TA | 107 | 115 | 118 | 119 | 119 | 119 |
| Jeff Davis County UWCD | TA | 64 | 65 | 65 | 65 | 65 | 65 |
| Presidio County UWCD | TA | 26 | 21 | 18 | 14 | 12 | 12 |
| **Total** | | **197** | **201** | **201** | **198** | **196** | **196** |

TA = Estimated exempt use calculated by TWDB and accepted by district

Table 4. Estimates of annual managed available groundwater for the West Texas Bolsons Aquifer in Groundwater Management Area 4 by groundwater conservation district (GCD) for each decade between 2010 and 2060. Results are in acre-feet per year. UWCD refers to Underground Water Conservation District.

| Groundwater Conservation District | Year | | | | | |
|---|---|---|---|---|---|---|
| | 2010 | 2020 | 2030 | 2040 | 2050 | 2060 |
| Culberson County GCD | 35,719 | 35,634 | 35,560 | 35,482 | 35,431 | 35,390 |
| Jeff Davis County UWCD | 6,010 | 5,990 | 5,990 | 5,924 | 5,895 | 5,877 |
| Presidio County UWCD | 9,100 | 9,091 | 8,964 | 8,820 | 8,698 | 8,628 |
| **Total** | **50,829** | **50,715** | **50,514** | **50,226** | **50,024** | **49,895** |

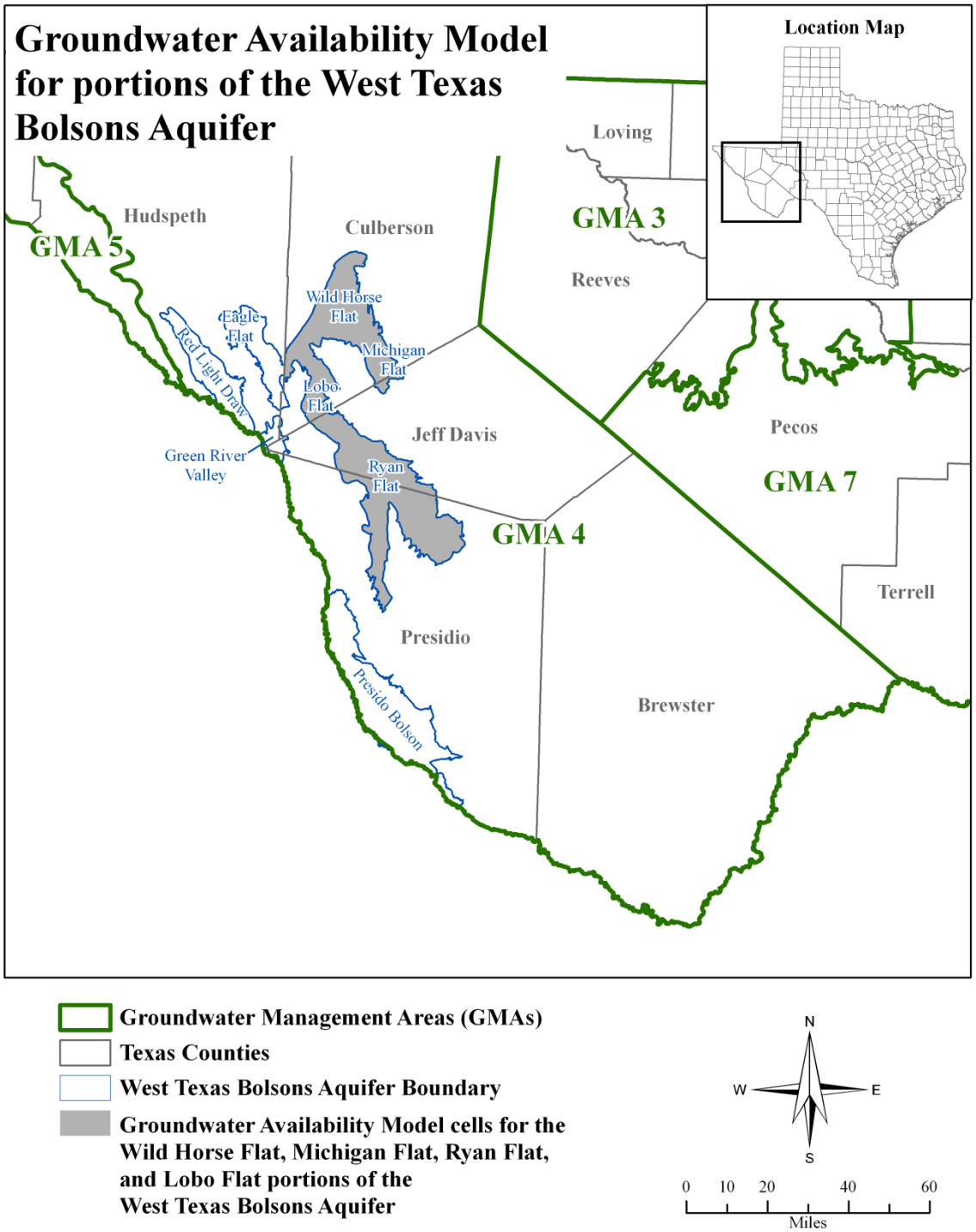


Figure 1. Map showing the areas covered by the groundwater availability model for the Wild Horse Flat, Michigan Flat, Ryan Flat, and Lobo Flat portions of the West Texas Bolsons Aquifer.

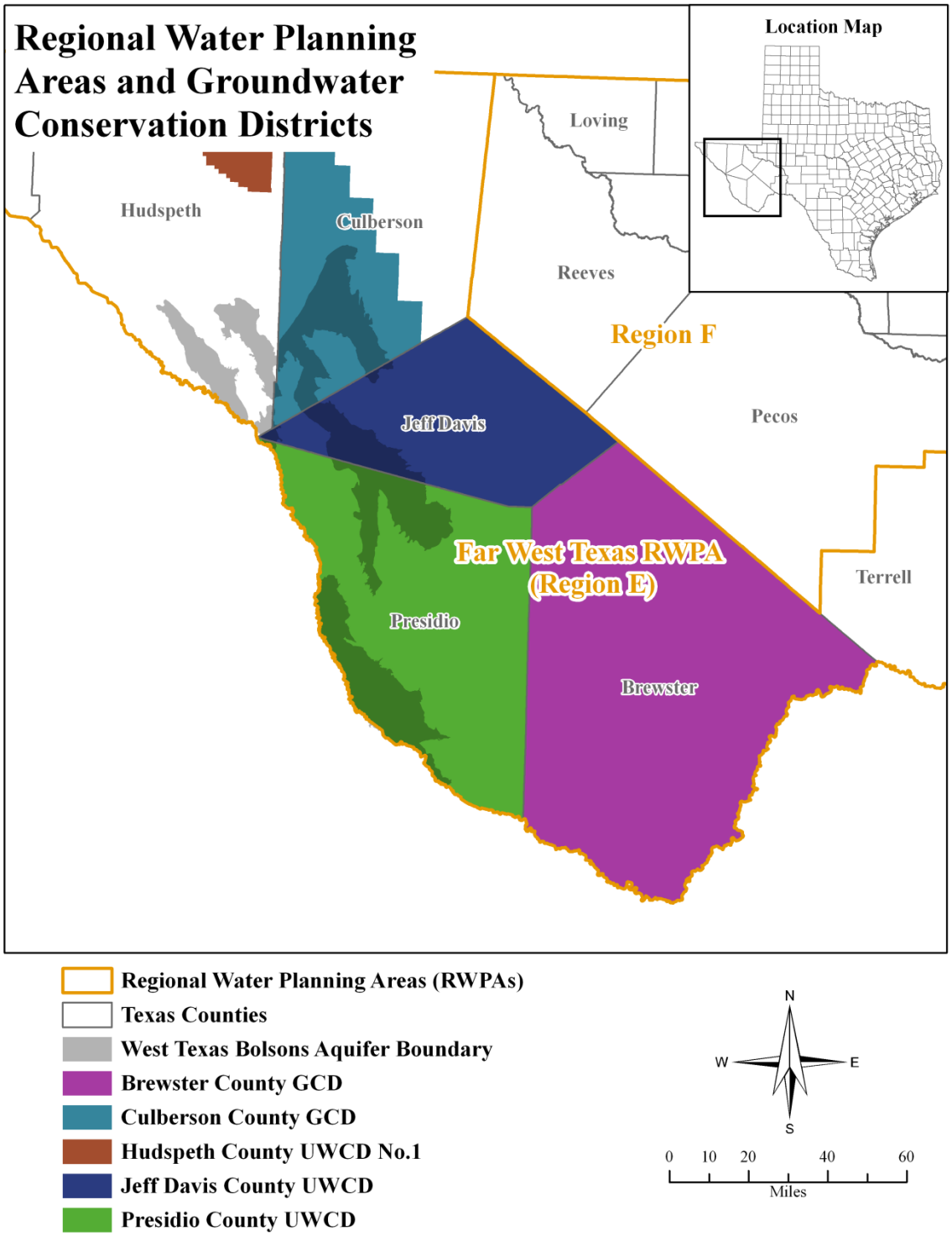


Figure 2. Map showing regional water planning areas (RWPAs), counties, and groundwater conservation districts (GCDs) in Groundwater Management Area 4. UWCD refers to Underground Water Conservation District.