GAM Run 12-026: Presidio County Underground Water Conservation District Management Plan

by Shirley C. Wade, Ph.D., P.G.
Texas Water Development Board
Groundwater Resources Division
Groundwater Availability Modeling Section
(512) 936-0883
March 21, 2013

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EXECUTIVE SUMMARY:

Texas State Water Code, Section 36.1071, Subsection (h), states that, in developing its groundwater management plan, a groundwater conservation district shall use groundwater availability modeling information provided by the executive administrator of the Texas Water Development Board (TWDB) in conjunction with any available site-specific information provided by the district for review and comment to the executive administrator. Information derived from groundwater availability models that shall be included in the groundwater management plan includes:

- the annual amount of recharge from precipitation to the groundwater resources within the district, if any;
- for each aquifer within the district, the annual volume of water that discharges from the aquifer to springs and any surface water bodies, including lakes, streams, and rivers; and
- the annual volume of flow into and out of the district within each aquifer and between aquifers in the district.

This report (Part 2 of a two-part package of information from the TWDB to Presidio County Underground Water Conservation District) fulfills the requirements noted above. Part 1 of the 2-part package is the Historical Water Use/State Water Plan data report. The District should have received, or will receive, this data report from the Groundwater Technical Assistance Section. Questions about the data report can be directed to Mr. Stephen Allen, Stephen.Allen@twdb.texas.gov, (512) 463-7317.

The groundwater management plan for the Presidio County Underground Water Conservation District should be adopted by the district on or before October 14, 2014 and submitted to the executive administrator of the TWDB on or before November 13,

2014. The current management plan for the Presidio County Underground Water Conservation District expires on January 12, 2015.

This report discusses the methods, assumptions, and results from model runs using the groundwater availability models of the Igneous and parts of the West Texas Bolsons (Wild Horse Flat, Michigan Flat, Ryan Flat, and Lobo Flat) aquifers, the West Texas Bolsons (Red Light Draw, Green River Valley, and Eagle Flat) Aquifer, and the West Texas Bolsons (Presidio and Redford) Aquifer. Tables 1 and 2 summarize the groundwater availability model data required by the statute, and Figures 1 and 2 show the area of the models from which the values in the tables were extracted. This model run replaces the results of GAM Run 08-088. GAM Run 12-026 meets current standards set after the release of GAM Run 08-088 and includes results for the recently completed Groundwater Availability Model for the West Texas Bolsons (Presidio and Redford) Aquifer. If after review of the figures, Presidio County Underground Water Conservation District determines that the district boundaries used in the assessment do not reflect current conditions, please notify the TWDB immediately.

METHODS:

In accordance with the provisions of the Texas State Water Code, Section 36.1071, Subsection (h), the groundwater availability models for the Igneous and parts of the West Texas Bolsons (Wild Horse Flat, Michigan Flat, Ryan Flat, and Lobo Flat) aquifers, the West Texas Bolsons (Red Light Draw, Green River Valley, and Eagle Flat) Aquifer, and the West Texas Bolsons (Presidio and Redford) Aquifer were run for this analysis (Beach and others, 2004; Beach and others, 2008; Wade and Jigmond, 2013). Water budgets within Presidio County Underground Water Conservation District for 1980 through 1999 were extracted using ZONEBUDGET Version 3.01 (Harbaugh, 2009). The average annual water budget values for recharge, surface water outflow, inflow to the district, outflow from the district, net inter-aquifer flow (upper), and net inter-aquifer flow (lower) for the portions of the aquifers located within the district are summarized in this report.

PARAMETERS AND ASSUMPTIONS:

Igneous and parts of the West Texas Bolsons (Wild Horse Flat, Michigan Flat, Ryan Flat, and Lobo Flat) Aquifers

- Version 1.01 of the groundwater availability model of the Igneous and parts of the West Texas Bolsons (Wild Horse Flat, Michigan Flat, Ryan Flat, and

Lobo Flat) aquifers was used. See Beach and others (2004) for assumptions and limitations of the groundwater availability model.

- The model includes three layers representing the West Texas Bolsons Aquifer (layer 1), Igneous Aquifer (layer 2), and Cretaceous and Permian units (layer 3) (Beach and others, 2004, Oliver, 2009).
- Of the three layers, individual water budgets for the district were determined for the West Texas Bolsons Aquifer and Igneous Aquifer (layers 1 and 2).

West Texas Bolsons (Red Light Draw, Green River Valley, and Eagle Flat) Aquifer

- Version 1.01 of the groundwater availability model of the West Texas Bolsons (Red Light Draw, Green River Valley, and Eagle Flat) aquifer was used. See Beach and others (2008) for assumptions and limitations of the groundwater availability model.
- The model includes three layers representing the West Texas Bolsons Aquifer (layer 1), Cretaceous and Permian units (layer 2), and Cretaceous and Paleozoic units (layer 3).
- Of the three layers, individual water budgets for the district were determined for the West Texas Bolsons Aquifer (layer 1).

West Texas Bolsons (Presidio and Redford) Aquifer

- Version 1.01 of the groundwater availability model of the West Texas Bolsons (Presidio and Redford) Aquifer was used. See Wade and Jigmond (2013) for assumptions and limitations of the groundwater availability model.
- The model includes three layers representing the Rio Grande Alluvium (layer 1), West Texas Bolsons (Presidio and Redford) Aquifer (layer 2), and Tertiary and Cretaceous units (layer 3) (Wade and Jigmond, 2013).
- The model uses the MODFLOW river package to simulate net river/groundwater exchange and evapotranspiration discharge.
- Of the three layers, individual water budgets for the district were determined for the West Texas Bolsons Aquifer (layer 2).

RESULTS:

A groundwater budget summarizes the amount of water entering and leaving the aquifer according to the groundwater availability model. Selected groundwater budget components listed below were extracted from the model results for the aquifers located within the district and averaged over the duration of the calibration and verification portion of the model runs in the district, as shown in Tables 1 and 2. The results from all three of the groundwater availability models for the West Texas Bolsons are combined in Table 2.

- Precipitation recharge—The areally distributed recharge sourced from precipitation falling on the outcrop areas of the aquifers (where the aquifer is exposed at land surface) within the district.
- Surface water outflow—The total water discharging from the aquifer (outflow) to surface water features such as streams, reservoirs, and drains (springs).
- Flow into and out of district—The lateral flow within the aquifer between the district and adjacent counties.
- Flow between aquifers—The net vertical flow between aquifers or confining units. This flow is controlled by the relative water levels in each aquifer or confining unit and aquifer properties of each aquifer or confining unit that define the amount of leakage that occurs. “Inflow” to an aquifer from an overlying or underlying aquifer will always equal the “Outflow” from the other aquifer.

The information needed for the District’s management plan is summarized in Tables 1 and 2. It is important to note that sub-regional water budgets are not exact. This is due to the size of the model cells and the approach used to extract data from the model. To avoid double accounting, a model cell that straddles a political boundary, such as a district or county boundary, is assigned to one side of the boundary based on the location of the centroid of the model cell. For example, if a cell contains two counties, the cell is assigned to the county where the centroid of the cell is located (Figures 1 and 2).

TABLE 1. SUMMARIZED INFORMATION FOR THE IGNEOUS AQUIFER (FIGURE 1) THAT IS NEEDED FOR PRESIDIO COUNTY UNDERGROUND WATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT.

Management Plan requirement	*Aquifer*	*Results*
Estimated annual amount of recharge from precipitation to the district	Igneous Aquifer	9,409[1]
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Igneous Aquifer	3,252
Estimated annual volume of flow into the district within each aquifer in the district	Igneous Aquifer	4,429
Estimated annual volume of flow out of the district within each aquifer in the district	Igneous Aquifer	1,783
Estimated net annual volume of flow between each aquifer in the district[2]	From Igneous Aquifer into overlying West Texas Bolsons Aquifer	1,611
	From Igneous Aquifer into underlying Cretaceous and Permian units	5,909

[1] Recharge applied with the recharge package to the Igneous Aquifer is both direct precipitation recharge and alluvial fan/stream bed recharge.
[2] The total estimated net annual volume of flow from the Igneous Aquifer to West Texas Bolsons Aquifer and other formations is 7,520 acre-feet per year.

TABLE 2. SUMMARIZED INFORMATION FOR THE WEST TEXAS BOLSONS AQUIFER (FIGURE 2) THAT IS NEEDED FOR PRESIDIO COUNTY UNDERGROUND WATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT.

Management Plan requirement	*Aquifer*	*Results*[3]
Estimated annual amount of recharge from precipitation to the district	West Texas Bolsons Aquifer	14,660
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	West Texas Bolsons Aquifer	9,117[4]
Estimated annual volume of flow into the district within each aquifer in the district	West Texas Bolsons Aquifer	22,987
Estimated annual volume of flow out of the district within each aquifer in the district	West Texas Bolsons Aquifer	39,097
Estimated net annual volume of flow between each aquifer in the district[5]	From West Texas Bolsons Aquifer into overlying river alluvium	911
	From Igneous Aquifer and other underlying units into West Texas Bolsons Aquifer	13,372

[3]Total for Presidio County from all three groundwater availability models for the West Texas Bolsons.

[4]Total also includes annual estimated riparian evapotranspiration discharge for the Groundwater Availability Model for the West Texas Bolsons (Presidio and Redford Bolsons).

[5] The total estimated net annual volume of flow between the West Texas Bolsons Aquifer and river alluvium, the Igneous Aquifer, Cretaceous units and Permian units is 12,461 acre-feet per year.

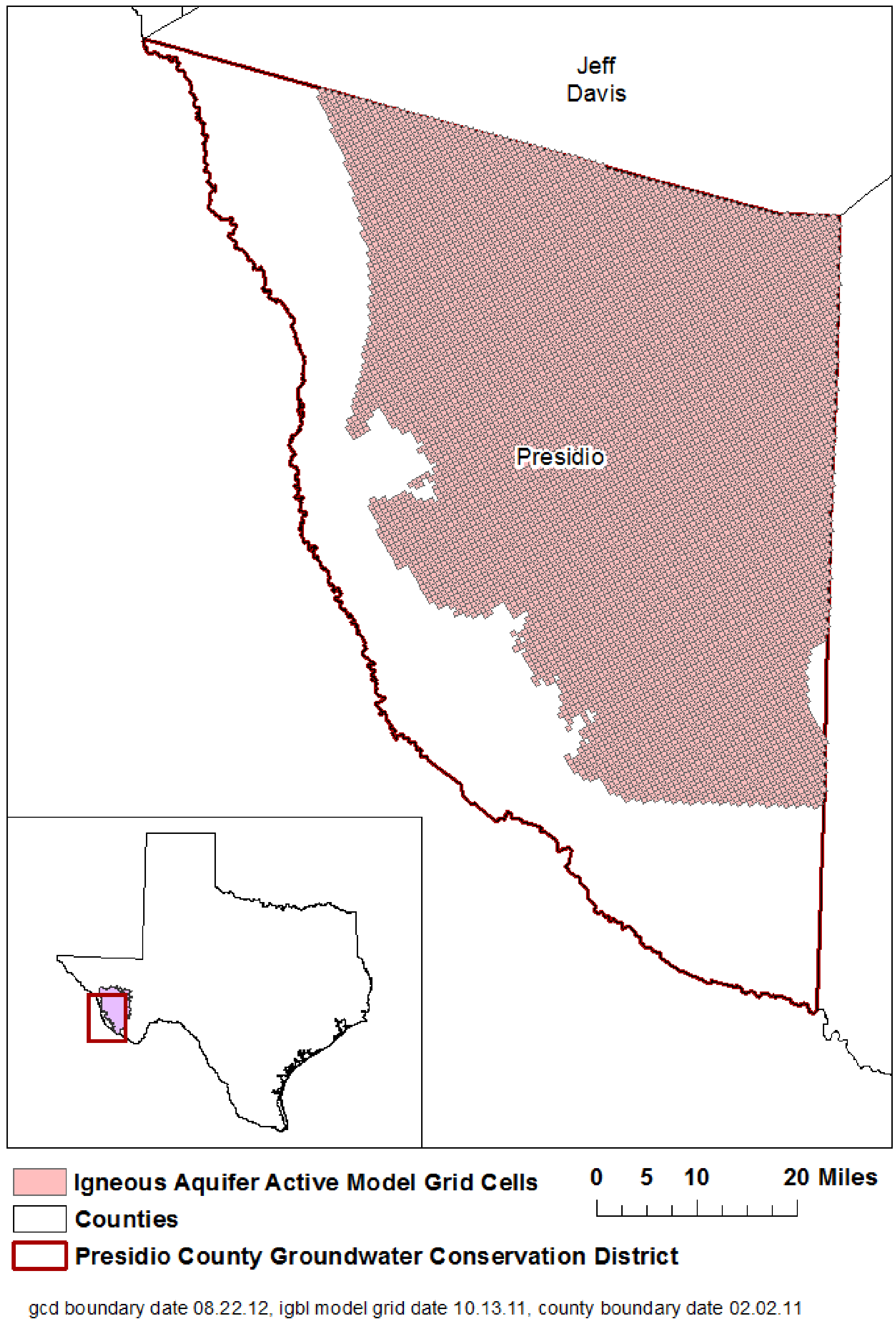

FIGURE 1: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE IGNEOUS AND PARTS OF THE WEST TEXAS BOLSONS (WILD HORSE FLAT, MICHIGAN FLAT, RYAN FLAT, AND LOBO FLAT) AQUIFERS FROM WHICH THE INFORMATION IN TABLE 1 WAS EXTRACTED FOR THE IGNEOUS AQUIFER.

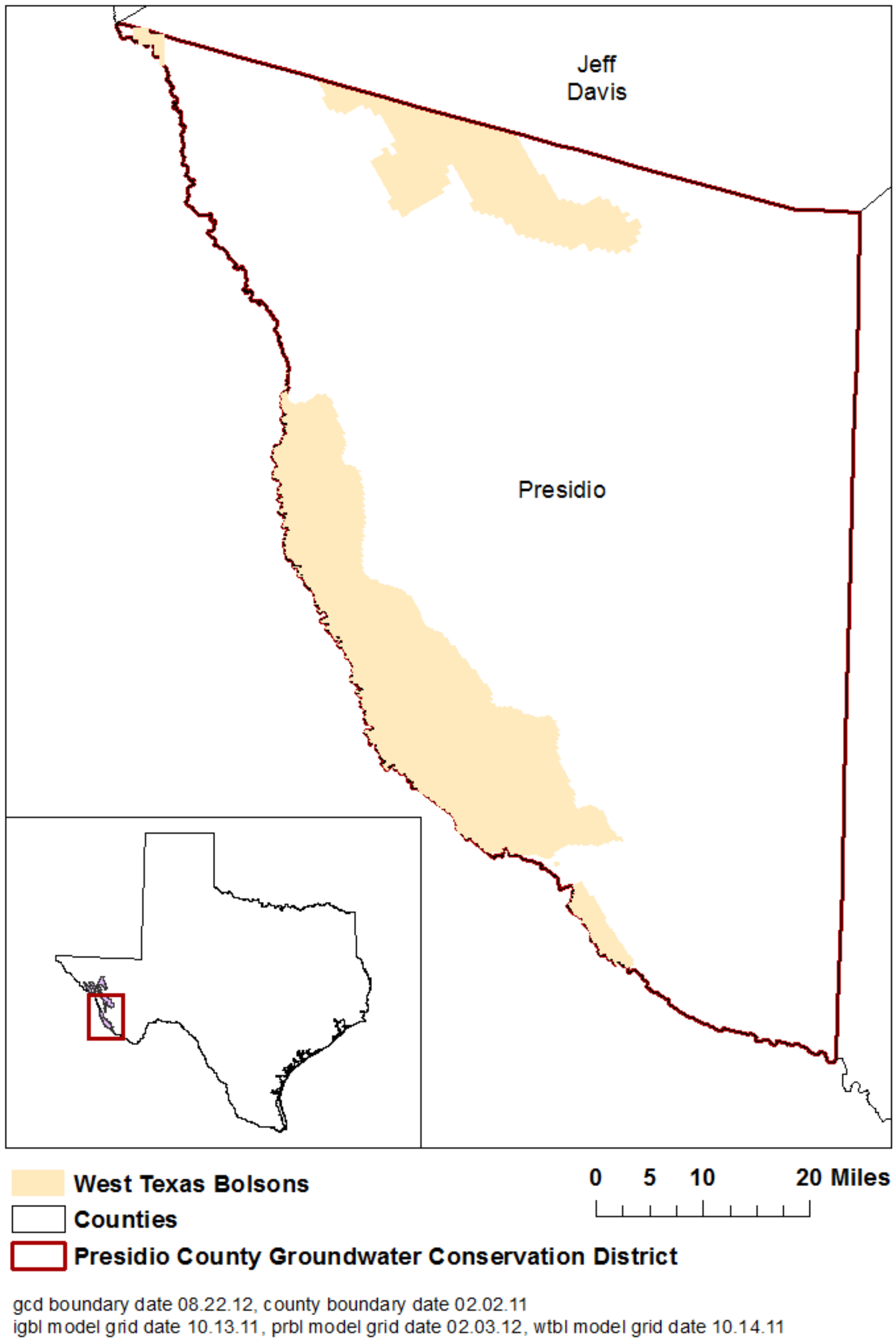

FIGURE 2: AREA OF THE GROUNDWATER AVAILABILITY MODELS FOR THE IGNEOUS AND PARTS OF THE WEST TEXAS BOLSONS (WILD HORSE FLAT, MICHIGAN FLAT, RYAN FLAT, AND LOBO FLAT) AQUIFERS, THE WEST TEXAS BOLSONS (RED LIGHT DRAW, GREEN RIVER VALLEY, AND EAGLE FLAT) AQUIFER, AND THE WEST TEXAS BOLSONS (PRESIDIO AND REDFORD) AQUIFER FROM WHICH THE INFORMATION IN TABLE 2 WAS EXTRACTED FOR THE WEST TEXAS BOLSONS AQUIFER.

LIMITATIONS:

The groundwater model(s) used in completing this analysis is the best available scientific tool that can be used to meet the stated objective(s). 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 interaction with streams are specific to particular historic time periods.

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 related 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 overall conditions of 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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