GAM Run 17-001: Brush Country Groundwater Conservation District Groundwater Management Plan

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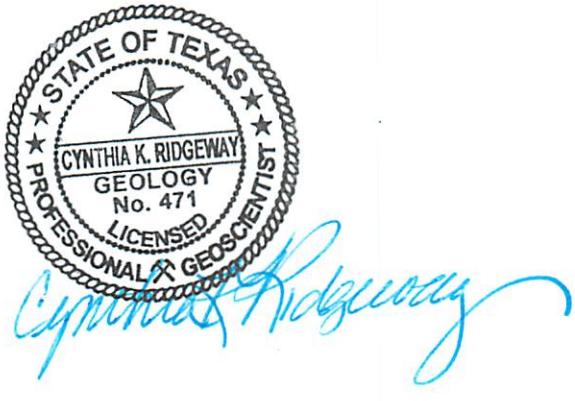
Groundwater Division
Groundwater Availability Modeling Department
512-463-2779
October 4, 2017



Cynthia K. Ridgeway is the Manager of the Groundwater Availability Modeling Section and is responsible for oversight of work performed by Natalie Ballew under her direct supervision. The seal appearing on this document was authorized by Cynthia K. Ridgeway, P.G. 471 on October 4, 2017.

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EXECUTIVE SUMMARY:

Texas State Water Code, Section 36.1071, Subsection (h) (Texas Water Code, 2015), 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.

The TWDB provides data and information to the Brush Country Groundwater Conservation District in two parts. Part 1 is the Estimated Historical Water Use/State Water Plan dataset report, which will be provided to you separately by the TWDB Groundwater Technical Assistance Department. Please direct questions about the water data report to Mr. Stephen Allen at 512-463-7317 or stephen.allen@twdb.texas.gov. Part 2 is the required groundwater availability modeling information and this information includes:

1. the annual amount of recharge from precipitation, if any, to the groundwater resources within the district;

2. 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

3. the annual volume of flow into and out of the district within each aquifer and between aquifers in the district.

The groundwater management plan for the Brush Country Groundwater Conservation District should be adopted by the district on or before January 8, 2018, and submitted to the Executive Administrator of the TWDB on or before February 7, 2018. The current

management plan for the Brush Country Groundwater Conservation District expires on April 8, 2018.

We used one groundwater model to estimate the management plan information for the aquifers within the Brush Country Groundwater Conservation District. Information for the Gulf Coast and Yegua-Jackson aquifers is from version 1.01 of the alternative numerical groundwater flow model for the Gulf Coast Aquifer in Groundwater Management Area 16 (Hutchison and others, 2011). This model was used because it encompasses the entire district whereas the groundwater availability models for the central portion and southern portion of the Gulf Coast Aquifer System only contain portions of the district.

This report replaces the results of GAM Run 12-013 (Wade, 2012). GAM Run 17-001 meets current standards set after the release of GAM Run 12-013. Tables 1 and 2 summarize the groundwater availability model data required by statute and Figures 1 and 2 show the area of the model from which the values in the tables were extracted. If, after review of the figures, the Brush Country Groundwater Conservation District determines that the district boundaries used in the assessment do not reflect current conditions, please notify the TWDB at your earliest convenience.

METHODS:

In accordance with the provisions of the Texas State Water Code, Section 36.1071, Subsection (h), version 1.01 of the alternative numerical groundwater flow model for the Gulf Coast Aquifer in Groundwater Management Area 16 was used to estimate information for the Brush Country Groundwater Conservation District management plan. Water budgets were extracted for the historical model periods 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 for the aquifers within the district, and flow between each aquifer in the district are summarized in this report.

PARAMETERS AND ASSUMPTIONS:

Gulf Coast and Yegua-Jackson aquifers

- We used version 1.01 of the alternative numerical groundwater flow model for the Gulf Coast Aquifer in Groundwater Management Area 16. See Hutchison and others (2011) for assumptions and limitations of the model.
- The alternative numerical groundwater flow model for the Gulf Coast Aquifer in Groundwater Management Area 16 contains 6 layers: Layers 1 through 4 (the Gulf

Coast Aquifer System, comprised of the Chicot Aquifer, Evangeline Aquifer, Burkeville Confining System, and Jasper Aquifer), Layer 5 (Yegua-Jackson Aquifer), and Layer 6 (Queen City, Sparta, and Carrizo-Wilcox aquifers).

- Layer 5, representing the Yegua-Jackson Aquifer, includes parts of the Catahoula Formation. Because layers 1 through 4 do not include the full extent of the official Gulf Coast Aquifer boundary, model cells representing the outcrop area of the Gulf Coast Aquifer in Layer 5 were included in budget calculations for the Gulf Coast Aquifer.
- The model was run with MODFLOW-2000 (Harbaugh and others, 2000).

RESULTS:

A groundwater budget summarizes the amount of water entering and leaving the aquifers according to the groundwater availability model. Selected groundwater budget components listed below were extracted from the groundwater model results for the Gulf Coast and Yegua-Jackson aquifers located within Brush Country Groundwater Conservation District and averaged over the historical calibration periods, as shown in Tables 1 and 2.

1. 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.
2. Surface-water outflow—the total water discharging from the aquifer (outflow) to surface-water features such as streams, reservoirs, and springs.
3. Flow into and out of district—the lateral flow within the aquifer between the district and adjacent counties.
4. Flow between aquifers—the net vertical flow between the aquifer and adjacent aquifers or confining units. This flow is controlled by the relative water levels in each aquifer and aquifer properties of each aquifer or confining unit that define the amount of leakage that occurs.

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.

TABLE 1. SUMMARIZED INFORMATION FOR THE GULF COAST AQUIFER FOR BRUSH COUNTRY GROUNDWATER 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 or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Gulf Coast Aquifer	8,291
Estimated annual volume of water that discharges from the aquifer to springs and any surface-water body including lakes, streams, and rivers	Gulf Coast Aquifer	2,633
Estimated annual volume of flow into the district within each aquifer in the district	Gulf Coast Aquifer	26,724
Estimated annual volume of flow out of the district within each aquifer in the district	Gulf Coast Aquifer	43,886
Estimated net annual volume of flow between each aquifer in the district	From the Gulf Coast Aquifer into the underlying Yegua-Jackson Aquifer	401

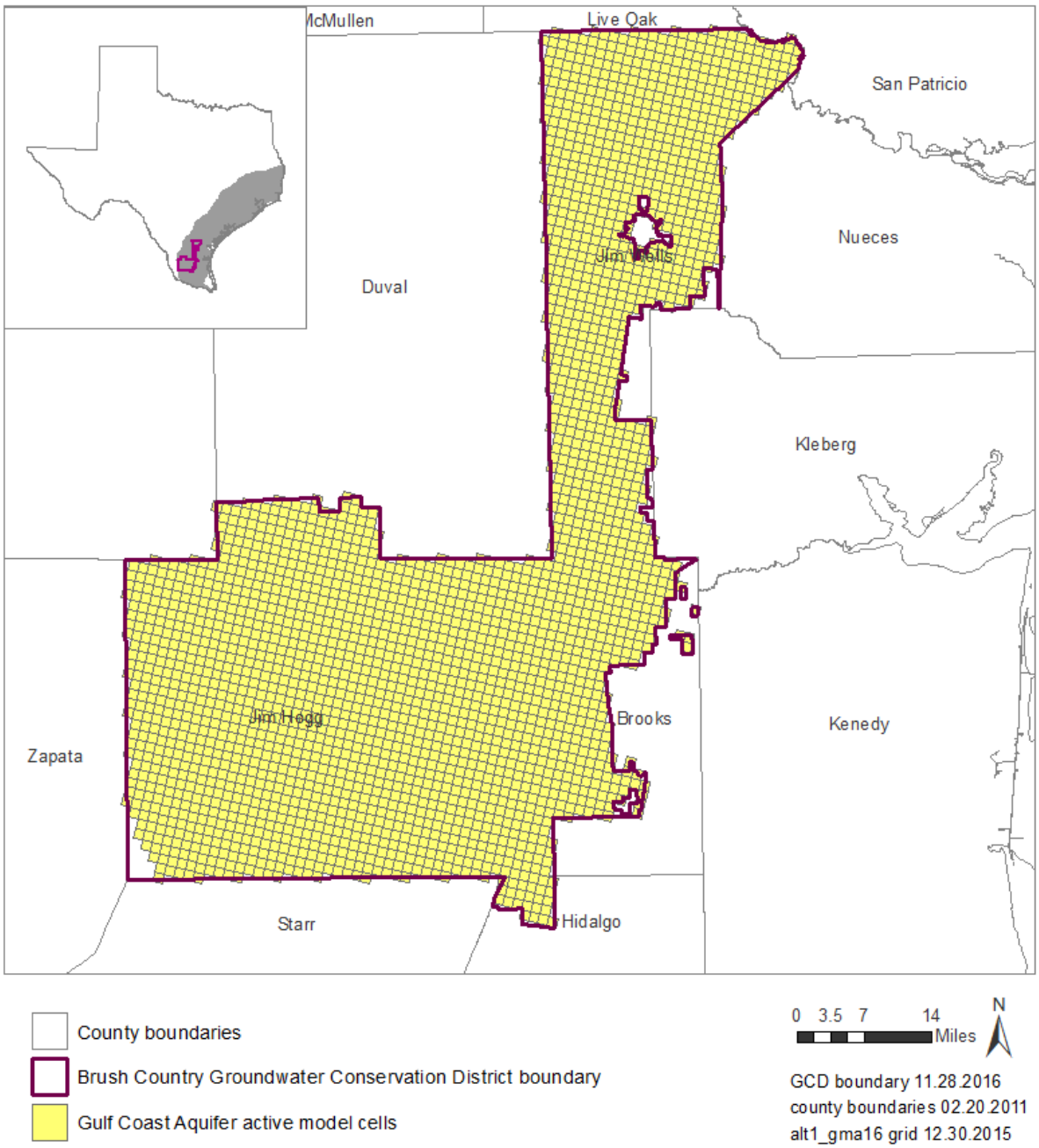

FIGURE 1. AREA OF THE ALTERNATIVE NUMERICAL GROUNDWATER FLOW MODEL FOR THE GULF COAST AQUIFER IN GROUNDWATER MANAGEMENT AREA 16 FROM WHICH THE INFORMATION IN TABLE 1 WAS EXTRACTED (THE GULF COAST AQUIFER SYSTEM EXTENT WITHIN THE DISTRICT BOUNDARY).

TABLE 2. SUMMARIZED INFORMATION FOR THE YEGUA-JACKSON AQUIFER FOR BRUSH COUNTRY GROUNDWATER 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 or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Yegua-Jackson Aquifer	60
Estimated annual volume of water that discharges from the aquifer to springs and any surface-water body including lakes, streams, and rivers	Yegua-Jackson Aquifer	0
Estimated annual volume of flow into the district within each aquifer in the district	Yegua-Jackson Aquifer	455
Estimated annual volume of flow out of the district within each aquifer in the district	Yegua-Jackson Aquifer	834
Estimated net annual volume of flow between each aquifer in the district	From the overlying Gulf Coast Aquifer into the Yegua-Jackson Aquifer	401

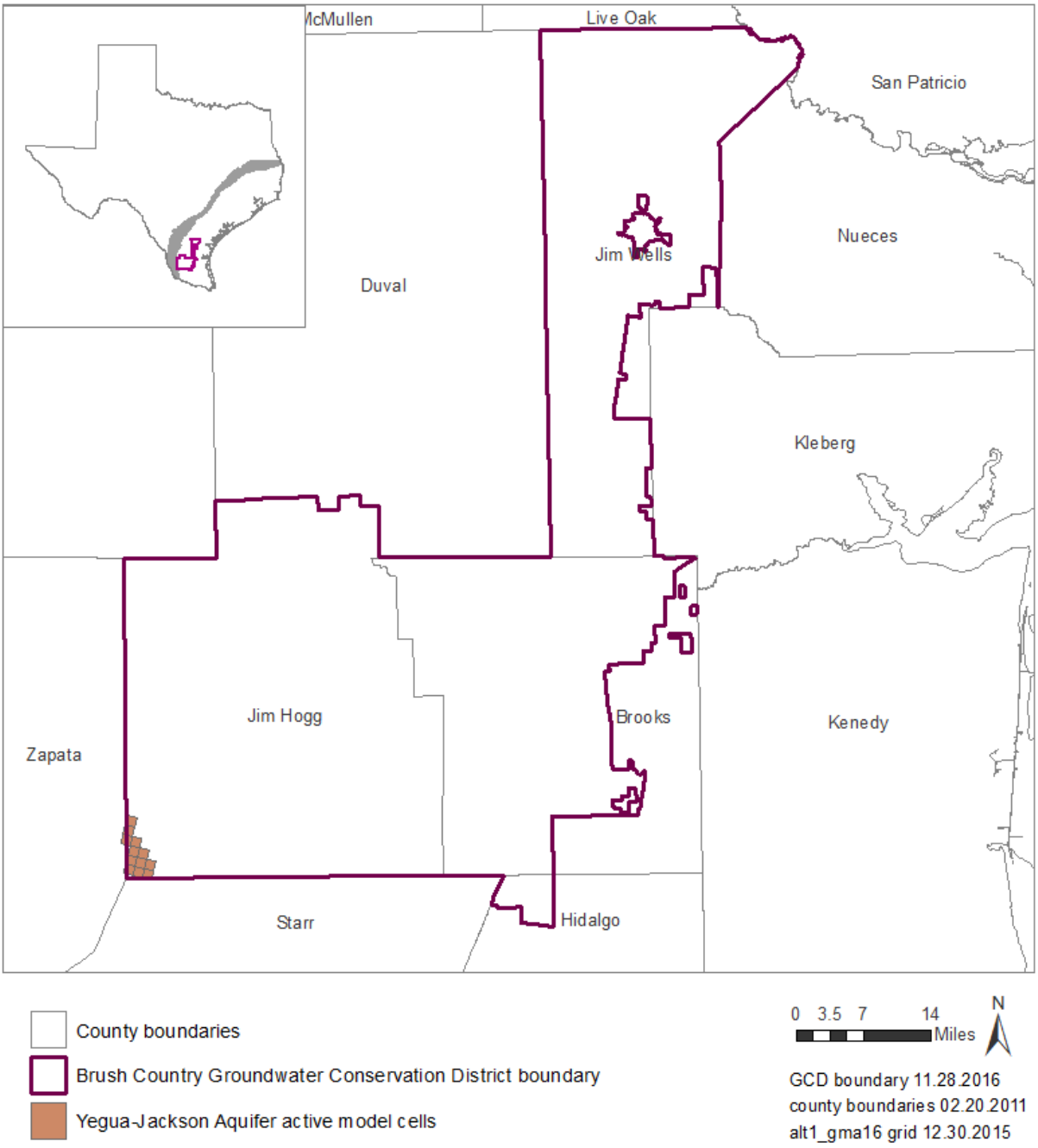

FIGURE 2. AREA OF THE ALTERNATIVE NUMERICAL GROUNDWATER FLOW MODEL FOR THE GULF COAST AQUIFER IN GROUNDWATER MANAGEMENT AREA 16 FROM WHICH THE INFORMATION IN TABLE 2 WAS EXTRACTED (THE YEGUA-JACKSON AQUIFER SYSTEM EXTENT WITHIN THE DISTRICT BOUNDARY).

LIMITATIONS:

The groundwater models used in completing this analysis are the best available scientific tools 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 interaction with streams are specific to particular historic time periods.

Because the application of the groundwater models 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.

REFERENCES:

Harbaugh, A. W., 2009, Zonebudget Version 3.01, A computer program for computing subregional water budgets for MODFLOW ground-water flow models: U.S. Geological Survey Groundwater Software.

Harbaugh, A. W., Banta, E. R., Hill, M. C., and McDonald, M. G., 2000, MODFLOW-2000, the U.S. Geological Survey modular ground-water model -- User guide to modularization concepts and the Ground-Water Flow Process: U.S. Geological Survey Open-File Report 00-92, 121 p.

Hutchison, W. R., Hill, M. E., Anaya, R., Hassan, M. M., Oliver, W., Jigmond, M., Wade, S., and Aschenbach, E., 2011, Groundwater Management Area 16 Groundwater Flow Model, 306 p. http://www.twdb.texas.gov/groundwater/models/alt/gma16/GMA16_Model_Report_DRAFT.pdf.

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., http://www.nap.edu/catalog.php?record_id=11972.

Wade, S. C., 2012, GAM Run 12-013: Brush Country Groundwater Conservation District Management Plan, 12 p., http://www.twdb.texas.gov/groundwater/docs/GCD/brushgcd/brushgcd_mgmt_plan2013.pdf.