Jeff Walker
Executive Administrator
Texas Water Development Board
1700 N. Congress Avenue
Austin, Texas 78711-3231
January, 25, 2024

Dear Mr. Walker,

The Bee Groundwater Conservation District (BGCD) is pleased to submit to the Texas Water Development Board (TWDB) a copy of our Management Plan in accordance with chapter 36.1073 as mandated by Senate Bill 2 of the 77th Texas Legislature. The Bee Groundwater Conservation District Management Plan (BGCD MP) was adopted by the BGCD Board of Directors at their quarterly meeting on January 25, 2024, by unanimous consent. In addition, a copy of the BGCD Board of Directors resolution adopting the plan is attached.
The BGCD, established in 2001, has historically had an excellent working relationship with the TWDB and it is our hope that we can count on your support as we implement the enclosed plan; it is the intent of our Board of Directors that we will begin implementation of this plan immediately to facilitate the success of our efforts.
The BGCD MP was developed during open meetings of the Board of Directors in accordance with all notice and hearing requirements. Documentation that notice and hearing requirements were followed is included in the packet.

During preparation of the BGCD Management Plan, (BGCD MP) all planning efforts were coordinated with the Nueces River Authority, as mandated by 36.1071 (a) and TAC 356.6(a)(4). Documentation of this coordinated effort, including the resolution acknowledging this coordination, is included in this packet for your review.

The District rules are available on our website: www.beegcd.com.

This plan is not in conflict with the approved regional water plan.

The BGCD MP will be in force for 10 years from the date of certification. If there is any other documentation we can provide to the TWDB that will ensure the prompt certification of the Bee Groundwater Conservation District Management Plan, please do not hesitate to call my staff or me.

Sincerely,

Tryné W. Mengers

Tryné Mengers
President

BEE GROUNDWATER CONSERVATION DISTRICT GROUNDWATER MANAGEMENT PLAN

Bee Groundwater Conservation District
PO Box 682
Beeville, TX 78104
beegcd@yahoo.com
361-449-7017
Lonnie Stewart, General Manager

Bee Groundwater Conservation District
Management Plan
Adopted 01/25/2024

DISTRICT MISSION

The Bee Groundwater Conservation District will strive to develop, promote, and implement water conservation, augmentation, and management strategies to protect water resources for the benefit of the citizens, economy, and environment of the district.

TIME PERIOD FOR THIS PLAN

This plan becomes effective upon approval by the Texas Water Development Board and remains in effect until a revised plan is approved or 01/25/2024, whichever is earlier.
The planning period for the management plan is ten (10) years, but the plan must be updated and approved every five (5) years.

STATEMENT OF GUIDING PRINCIPLES

The district recognizes that the groundwater resources of the region are of vital importance. The preservation of this most valuable resource can be managed in a prudent and cost effective manner through regulation and permitting. This management document is intended as a tool to focus the thoughts and actions of those given the responsibility for the execution of district activities.

General Description

The District was created by the citizens of Bee County through an election, January 2001. The current Board of Directors are Tryne Mengers - Chairman, Ellis McKiney-Vice-Chairman, Mark Sugarek - Secretary, David Baker - Treasurer, Robbie Peters, Doug Arnold, and Bill Fox, Bee Groundwater Conservation District (BGCD) has the same areal extent as that of Bee County except that the Pettus Water Supply Corporation, the Tynan Water Supply Corporation, and the city of Beeville as the boundaries existed on January 1, 1997 for each of these entities is excluded. The county has a vibrant economy dominated by agriculture and petroleum. The agriculture income is derived primarily from beef cattle production, wheat, corn, sorghum, and cotton, with some sheep and goat ranching.

Location and Extent

Bee County, consisting of 880 square miles, is located in South Texas. The county is bounded on the east by Karnes, and Goliad Counties, on the north by Karnes County, on the west by Live Oak County, and on the south by San Patricio County. Beeville,

which is centrally located in the county, is the county seat. There are not any municipalities in the county except Beeville which is not within the district's boundaries.

Topography, Drainage, Recharge, and Groundwater Resources of Bee County

Bee County is on the Gulf Coastal Plain in southern Texas. Most the 880 square miles of the county are devoted to farming and ranching, which provide the principal income for the 19,230 inhabitants. The production of oil is also an important industry.

The principal water-bearing formations underlying the county are the Carrizo Sand, Oakville Sandstone, Lagarto Clay, and Goliad Sand formations, and range in age from Eocene to Pliocene. The formation dip toward the coast at rates ranging from less than 20 to about 140 feet to the mile.

Some livestock supplies were obtained from surface-water sources. In Bee County the water-bearing sands above a depth of 2,000 feet contain approximately 20 million acre-feet of fresh and slightly saline water. Even though it may be impractical to recover much of the stored water, the rate of withdrawal could be increased several times more than the 1957 rate without appreciably depleting the water available from storage for many decades. A large but unestimated amount of fresh to slightly saline water occurs in the Carrizo sand in the northern and northwestern parts of the county at depths as much as 6,000 feet. Most of the water in the Carrizo sand in Bee County is more than 4,000 feet below land surface and therefore is too deeply buried to be economically developed for most uses.

Most of the ground water in Bee County is substandard in quality for municipal, industrial, and irrigation uses. However, because better water is not available in most areas in the county, users of all three categories have used substandard water successfully. Generally the Goliad Sand contains water of better quality than that in any formation except the Carrizo Sand. In favorable areas properly constructed wells in the Carrizo, Oakville, Lagarto, and Goliad may yield 1,000 gallons per minute or more. Yields from wells tapping the other water-bearing formations generally are small and the water commonly is suitable only for livestock.
The GAM run for the Carrizo-Wilcox indicates that does not have any direct infiltration recharge in Bee County due to no surficial exposure of the aquifer units. All of the recharge in the District occurs in the Gulf Coast Aquifer System and is reported to be 57,398 acre feet per year in GAM run 23-016 report. According to TWDB Report 17, **Ground-Water Resources of Bee County, Texas,** by B.N. Meyers and O.C. Dale, U.S. Geological Survey, February 1966, the approximate recharge to the Gulf Coast Aquifer System in Bee County is 9,000 acre-feet per year. Enhanced precipitation would improve recharge. However, most of the precipitation that falls in the county runs off in steams, evaporates, or is transpired by plants. The remaining water, probably less than five percent, may reach the zone of saturation where it moves slowly toward an area of discharge such as a well, natural outlet, or, under artesian pressure, it may seep or

percolate slowly upward into overlying beds. Recharge could be enhanced by several methods: brush control, additional precipitation, and additional tanks to catch runoff from excessive precipitation.

Data Procurement

All of the data relating to water usage was derived from the Texas Water Development Board. The data includes the entire county whereas the District excludes the Tynan Water Supply Corp. , Pettus Water Supply Corporation, and the City of Beeville. **These fiqures do not represent the District amount, but rather the total for Bee County. Given the District encompasses all of Bee County except the City of Beeville, the data included in the following section are the best available estimates.**

Bee G.C.D. Areal Extent Estimation

County	County TOTAL Area (acres)	Bee G.C.D. Area (acres)	Percent of Total County Area (%)	Percent of Total County Area
Bee	562337.001	557743.2	**99.18**	**0.9918**

The Bee Groundwater Conservation District Management Plan Estimated Historical Water Use and 2017 State Water Plan Datasets is provided in Appendix A provided by the Texas Water Development Board.

The MAG values from GAM run 21-020 MAG and GAM run 21-021 MAG can be found in Appendix A.

Actions, Procedures, Performance and Avoidance for Plan Implementation

The District will implement the provisions of this plan and will utilize the provisions of this plan as a guidepost for determining the direction or priority for all District activities. All operations of the District, all agreements entered into by the District and any additional planning efforts in which the District may participate will be consistent with the provisions of this plan.

The District adopted rules relating to the permitting of wells and the production of groundwater. The rules adopted by the District shall be pursuant to TWC Chapter 36 and the provisions of this plan. All rules will be adhered to and enforced. The promulgation and enforcement of the rules will be based on the best technical evidence available. The rules are available on our website www.beegcd.com.

Methodology for Tracking the District's Progress in Achieving Management Goals

The District manager will prepare and present an annual report to the Board of Directors on District performance in regards to achieving management goals and objectives. The presentation of the report will occur during the last monthly Board meeting each fiscal year, beginning December 31, 2003. The report will include the number of instances in which each of the activities specified in the District's management objectives was engaged in during the fiscal year. The District Board will maintain the report on file, for public inspection at the District's offices upon adoption. This methodology will apply to all management goals contained within this plan.

Management of Groundwater Supplies

The District will manage the supply of groundwater within the District in order to conserve the resource while seeking to maintain the economic viability of all resource user groups, public and private. In consideration of the economic and cultural activities occurring within the District, the District will identify and engage in such activities and practices that, if implemented, would result in a reduction of groundwater use. A monitor well observation network shall be established and maintained in order to evaluate changing conditions of groundwater supplies (water in storage) within the District. The District will undertake, as necessary and cooperate with investigations of the groundwater resources within the District and will make the results of investigations available to the public upon adoption by the District Board.

The District adopted rules to regulate groundwater withdrawals by means of well spacing and production limits. The District may deny a well construction permit or limit groundwater withdrawals in accordance with the guidelines stated in the rules of the District. In making a determination to deny a permit or limit groundwater withdrawals, the District will consider the public benefit against individual hardship after considering all appropriate testimony.

In pursuit of the Districts mission of protecting the resource, the District may require reduction of groundwater withdrawals to amounts, which will not cause harm to the aquifer. To achieve this purpose, the District may, at the District Boards discretion, amend or revoke any permits after notice and hearing. The determination to seek the amendment or revocation of a permit by the District will be based on aquifer conditions observed by the District. The District will enforce the terms and conditions of permits and the rules of the District by enjoining the permit holder in a court of competent jurisdiction as provided for in Texas Water Code (TWC) 36.102.

The estimate of annual amount of recharge from precipitation, annual volume of discharge and other data can be found in Appendix A under Groundwater Availability Model Run 23-016. The District considered the water supply needs and water management strategies included in the state water plan. The District considered the water management strategies for several proposed projects and determined the projects were within the District rules and MAG.

The rules for Bee GCD can be found at our website: www.beegcd.com.

Water Management Strategies to Meet Water User Group Needs

The District considered the water management strategies included in the state water plan. The District considered the management strategies identified in the State Water Plan including development of supplies from the Gulf Coast Aquifer System, the Gulf of Mexico, direct reuse, demand reduction, and treatment plant improvement for irrigation, mining, and manufacturing.

The estimated projected water management strategies are available in Appendix A.

Projected Water Supply Needs

The projected water supply needs identified for Bee County are in the following categories: irrigation, mining, and manufacturing. The need are estimated to be 2,477 acre-feet/year in 2020 and 2,361 acre-feet/year in 2070. The District has considered the projected water supply needs identified.

The estimated projected water supply needs are available in Appendix A.

BEE GROUNDWATER CONSERVATION DISTRICT MANAGEMENT PLAN

MISSION STATEMENT

The mission of the Bee Groundwater Water Conservation District is to protect and assure a sufficient quantity and quality of groundwater for our constituents use.
We value:

*Collection and maintenance of data on water quantity and quality
*Efficient use of groundwater
*Conjunctive water management issues
*Development and enforcement of water district rules concerning conservation of ground water.

Management Goals, Objectives, and Performance Standards

Resource Goals

Goal 1.0: Addressing the most efficient use of groundwater

Management Objective:

Each year the District will provide education materials concerning the efficient use of groundwater.

Performance standard:

Provide educational materials to at least one school annually.

Goal 2.0: Addressing Controlling and preventing waste of groundwater

Management Objective:

Measure water levels from the land surface on strategic wells on an annual basis and report waste to the District Board.
The District will investigate instances of suspect waste of groundwater within 72 hours of receiving complaints.

Performance standard:

(a) Report to the District Board annually the number of water level measurements.
(b) District Staff will report to the Board of Directors as needed regarding potential waste of groundwater and include the number of investigations in the annual report.

Goal 3.0: Addressing Controlling and preventing subsidence

The District has reviewed the report: Identification of the Vulnerability of the Major and Minor Aquifers in Texas to Subsidence with regard to Groundwater Pumping – TWDB Contract Number 1648302062 by LRE Water: http://www.twdb.texas.gov/groundwater/models/research/subsidence/subsidence.asp. Figure 4.23 of the subsidence report illustrates that the major aquifer subsidence risk within the District boundaries ranges from medium to the high range. Due to the amount of current pumping, subsidence is not expected to occur, but the District will monitor any potential pumping that may affect subsidence. This goal is currently not applicable.

Goal 4.0: Addressing Conjunctive surface water management issues

Management Objective:

The District will participate in the regional planning process by attending the Region N regional water planning group meetings to encourage the development of surface water supplies to meet the needs of water user groups within the District.

Performance Standard:

The District or District representative will attend, at least, one meeting of the Region N regional water planning group and report to the board in the Annual Report.

Goal 5.0: Addressing Natural Resource Issues

Management Objective:

The District will investigate issues related to environmental and other concerns that may be affected by a district's groundwater management plan and rules, such as impacts on endangered species, soils, oil and gas production, mining, air and water quality degradation, agriculture, and plant and animal life.

Performance Standard:

The District will investigate reports of any issues related to environmental and other concerns that may be affected by a district's groundwater management plan and rules, such as impacts on endangered species, soils, oil and gas production, mining, air and water quality degradation, agriculture, and plant and animal life within 120 days of receiving the report. Any reports will be presented to the board at the next scheduled meeting. The annual report will include the number of wells plugged.

Goal 6.0: Addressing Drought Conditions

Management Objective:

The District will monitor the Palmer Drought Severity Index (PDSI). The link to the Drought index is www.waterdatafortexas.org/drought

Performance Standard:

A report of the U S Drought Monitor will be presented to the District board on an annual basis: https://droughtmonitor.unl.edu . This link and additional links to important information on drought can be accessed at the TWDB's Water Data for Texas website: www.waterdatafortexas.org/drought
The District will cooperate with other interested parties and appropriate agencies to develop additional information on aquifer recharge.

Goal 7.0: Addressing Conservation

Management Objective:

Each year the District will make educational material to the public promoting conservation methods and concepts.

Performance Objective:

The District will make at least one educational brochure available per year through service organizations, and on a continuing basis at the District office.

Goal 8.0: Addressing Precipitation Enhancement

Management Objective:

The District will participate in the South Texas Weather Modification Program.

Performance Standard:

A district representative will attend a meeting of the South Texas Weather Modification Association annually. The representative to STWMA will report to the board on the annual evaluation that performed by a consultant yearly.

Goal 9.0: Addressing Recharge Enhancement

This goal is not applicable to the District because, at the current time, it is cost prohibitive.

Goal 10.0: Addressing Rainwater Harvesting

This goal is not applicable to the District because, at the current time, it is cost prohibitive.

Goal 11.0: Addressing Brush Control

This goal is not applicable to the District because, at the current time, it is cost prohibitive.

Goal 12.0: Addressing Desired future condition of the groundwater resource

Management Objective:

The District will review and calculate its permit and well registration totals in light of the Desired Future Conditions of the groundwater resources within the boundaries of the District to assess whether the District is on target to meet the Desired Future Conditions estimates submitted to the TWDB.

Performance Standard:

The District's Annual Report will include a discussion of the District's permit and well registration totals and will evaluate the District's progress in achieving the Desired Future Conditions of the groundwater resources within the boundaries of the District and whether the District is on track to maintain the Desired Future Conditions estimates over the 50-year planning period.

Management Objective:

The District will annually measure the water levels in at least three monitoring wells within the District and will determine the five-year water level averages based on the measures taken.
The District will compare the five-year water level averages to the corresponding five-year increment of its Desired Future Conditions in order to track its progress in achieving the Desired Future Conditions.

Performance Standard:

The District's Annual Report will include the water level measure taken each year for the purpose of measuring water levels to assess the District's progress towards achieving its Desired Future Conditions. The District will include a discussion of its comparison of water level averages to the corresponding five-year increment of its Desired Future Conditions in order to track its progress in achieving its Desired Future Conditions. Any water measurements taken by the TWDB or USGS will, also, be considered.

RESOLUTION 01/25/2024

Whereas, the Bee Groundwater Conservation District has held the appropriate public hearings, and;

Whereas, the District has presented the management plan to the county officials, the Nueces River Authority, the San Antonio River Authority, and Region N Water Planning Group.

Whereas, the District has followed the rules set forth by the statutes in Chapter 36 of the Texas Water Code and the TWDB.

Now, Therefore be it Resolved, that the Bee Groundwater Conservation District voted to approve the District management plan.

Ayes 5 Nays 0 Not Present 2

Passed and Approved this the 25th day of January 2024.

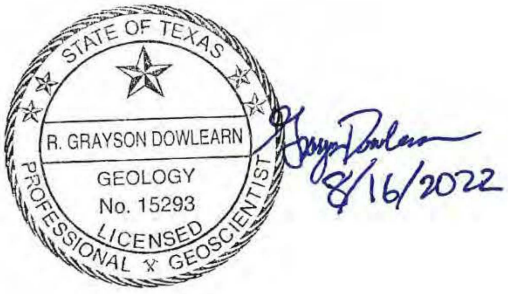
Tryne Mengers, President

Attest by: Mark Sugarek, Secretary

Appendix A

GAM Run 21-020 MAG: Modeled Available Groundwater for the Gulf Coast Aquifer System in Groundwater Management Area 15

Grayson Dowlearn, P.G.
Texas Water Development Board
Groundwater Division
Groundwater Modeling Section
512-475-1552
August 16, 2022



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GAM RUN 21-020 MAG: MODELED AVAILABLE GROUNDWATER FOR THE GULF COAST AQUIFER SYSTEM IN GROUNDWATER MANAGEMENT AREA 15

Grayson Dowlearn, P.G.
Texas Water Development Board
Groundwater Division
Groundwater Modeling Section
512-475-1552
August 16, 2022

EXECUTIVE SUMMARY:

Groundwater Management Area 15 adopted the desired future conditions listed in Table 1 for the Gulf Coast Aquifer System on October 14, 2021. The Carrizo-Wilcox, Queen City, Sparta, and Yegua-Jackson aquifers were declared not relevant by Groundwater Management Area 15 for the purpose of joint planning. Groundwater Management Area 15 submitted model files as part of the Desired Future Conditions Explanatory Report for Groundwater Management Area 15 (Keester and others, 2021), which meet the desired future conditions adopted by the district representatives of Groundwater Management Area 15, to the Texas Water Development Board (TWDB) on December 13, 2021. The TWDB determined that the explanatory report and other materials submitted by the district representatives were administratively complete on April 22, 2022.

The modeled available groundwater values that meet the adopted desired future conditions for the Gulf Coast Aquifer System and its associated aquifers within Groundwater Management Area 15 are summarized by decade from 2020 to 2080 in Table 2 by groundwater conservation district and county. Figure 1 provides the groundwater conservation district and county boundaries within GMA 15. Table 3 provides modeled available groundwater values by decade from 2030 to 2080 summarized by county, regional water planning area, and river basin, for use in the regional water planning process. Figure 2 provides the county, regional water planning area, and river basin boundaries within Groundwater Management Area 15. Modeled available groundwater values fluctuate within Groundwater Management Area 15 over time, ranging from a maximum of 529,006 acre-feet per year in 2030 to a minimum of 522,307 acre-feet per year in 2040. The estimates were extracted from results of a model run using the groundwater availability model for the central portion of the Gulf Coast Aquifer System (Version 1.01; Chowdhury and others, 2004).

REQUESTOR:

Mr. Tim Andruss, Chair and Administrator of Groundwater Management Area 15.

DESCRIPTION OF REQUEST:

Mr. Tim Andruss provided the TWDB with the desired future conditions of the Gulf Coast Aquifer System on behalf of Groundwater Management Area (GMA) 15 in a letter dated December 10, 2021. Groundwater conservation district representatives in Groundwater Management Area 15 adopted desired future conditions for the Gulf Coast Aquifer System on October 14, 2021, as described in Resolution No. 2021-01 (Appendix 2 in Keester and others, 2021). The desired future conditions included in Table 1 are average water level drawdowns by county between January 2000 and December 2080 based on the predictive groundwater flow Scenario GMA15_2019_001_v1 (Keester and others, 2021). The predictive simulations were developed from the groundwater availability model for the Gulf Coast Aquifer System (Version 1.01; Chowdhury and others, 2004).

TABLE 1. DESIRED FUTURE CONDITIONS FOR EACH COUNTY WITHIN GROUNDWATER MANAGEMENT AREA 15 EXPRESSED AS AVERAGE DRAWDOWN BETWEEN JANUARY 2000 AND DECEMBER 2080 IN FEET SUBMITTED BY GROUNDWATER MANAGEMENT AREA 15. (ADAPTED FROM SUBMITTED RESOLUTION)

County	Aquifer	Desired future condition
Aransas	Gulf Coast Aquifer System	0
Bee	Gulf Coast Aquifer System	7
Calhoun	Gulf Coast Aquifer System	5
Colorado	Chicot and Evangeline	17
	Jasper	25
De Witt	Gulf Coast Aquifer System	17
Fayette	Gulf Coast Aquifer System	44
Goliad	Chicot	-4
	Evangeline	-2
	Burkeville	7
	Jasper	14
Jackson	Gulf Coast Aquifer System	15
Karnes	Gulf Coast Aquifer System	22
Lavaca	Gulf Coast Aquifer System	18
Matagorda	Chicot and Evangeline	11
Refugio	Gulf Coast Aquifer System	5
Victoria	Gulf Coast Aquifer System	5
Wharton	Chicot and Evangeline	15
Groundwater Management Area 15	Gulf Coast Aquifer System	13

After review of the explanatory report and model files, the TWDB was able to confirm that the submitted model files satisfactorily met the desired future conditions and did not require additional clarifications from Groundwater Management Area 15.

METHODS:

The TWDB ran the central portion of the Gulf Coast Aquifer System groundwater availability model (Version 1.01; Chowdhury and others, 2004) using the predictive model files submitted with the explanatory report (Keester and others, 2021) to calculate the drawdown and modeled available groundwater values for the Gulf Coast Aquifer System within Groundwater Management Area 15. The submitted predictive model files included the Scenario GMA15_2019_001_v1 (Keester and others, 2021) pumping file and the GAM Run 10-008 Addendum (Wade, 2010) model files extended to the year 2080. Drawdown was calculated for each county and model layer by first excluding model cells that went dry and model cells that fall outside of the official aquifer footprint, and then summing the drawdown (difference between the water levels from January 2000 [initial heads] to December 2080 [stress period 81]) in the remaining cells of each county and dividing by the number of model cells within that county. Drawdown values were compared to the desired future conditions and were determined to fall within the accepted tolerance for Groundwater Management Area 15.

Modeled available groundwater values 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 from 2020 to 2080 by county and groundwater conservation district, subtotaled by groundwater conservation district, and summed for Groundwater Management Area 15 (Table 2). Annual pumping rates are also presented from 2030 to 2080 by county, river basin, and regional water planning area within Groundwater Management Area 15 for use in regional water planning (Table 3).

Modeled Available Groundwater and Permitting

As defined in Chapter 36 of the Texas Water Code (2011), "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:

The parameters and assumptions for the modeled available groundwater estimates are described below:

- Version 1.01 of the groundwater availability model for the central portion of the Gulf Coast Aquifer System by Chowdhury and others (2004) was the base model for this analysis. See Chowdhury and others (2004) for assumptions and limitations of the historical calibrated model. Keester and others (2021) constructed a predictive

model simulation to extend the base model to 2080 for planning purposes. See Keester and others (2021) for assumptions of the predictive model simulation.

- The model has four layers representing the Chicot aquifer (Layer 1), the Evangeline aquifer (Layer 2), the Burkeville Confining Unit (Layer 3), and the Jasper aquifer and parts of the Catahoula Formation in direct hydrologic communication with the Jasper aquifer (Layer 4). Figures 3 to 6 show the extent of these active model layers within GMA 15.

- Pumping was not modeled in the Burkeville Confining Unit within Colorado, Matagorda, and Wharton counties and as such, this layer is excluded from the modeled available groundwater calculation in these counties.

- Pumping was not modeled in the Jasper aquifer within Matagorda and Wharton counties and as such this layer is excluded from the modeled available groundwater calculations in these counties.

- The model was run with MODFLOW-96 (Harbaugh and McDonald, 1996).

- Pumping volumes are reduced to zero if a cell becomes dry during the predictive model run. For this reason, the modeled available groundwater values from the ZONEBUDGET output may not match the pumping values in the input well file.

- Drawdown averages and modeled available groundwater volumes were calculated based on the extent of the official TWDB aquifer boundary. The most recent TWDB model grid file dated June 26, 2020 (glfc_c_grid_poly062620.csv) was used to determine model cell entity assignment (county, groundwater management area, groundwater conservation district, river basin, regional water planning area).

- Drawdowns for cells that became dry during the simulation were excluded from the drawdown averages. Pumping in dry cells was excluded from the modeled available groundwater calculations.

- To be consistent with Groundwater Management Area 15's assumptions (see Keester and others, 2021), a tolerance of three feet was assumed when comparing desired future conditions to modeled drawdown results for all counties except Goliad County. Goliad County was given a tolerance of ±17 feet for the Chicot aquifer, ±36 feet for the Evangeline aquifer, ±14 feet for the Burkeville Confining Unit, and ±7 feet for the Jasper aquifer. Goliad County Groundwater Conservation District plans to monitor achievement of their desired future conditions within these tolerances because they rely more heavily on their extensive monitoring program rather than modeled results.

- Estimates of modeled drawdown and available groundwater from the model simulation were rounded to whole numbers.

RESULTS:

The modeled available groundwater values for the Gulf Coast Aquifer System that achieve the desired future conditions adopted by Groundwater Management Area 15 fluctuate over time, ranging from 529,006 acre-feet per year in 2030 to 522,307 acre-feet per year in 2040. The modeled available groundwater values are summarized by groundwater conservation district and county in Table 2. Table 3 summarizes the modeled available groundwater values by county, river basin, and regional water planning area for use in the regional water planning process.

The Carrizo-Wilcox, Queen City, Sparta, and Yegua-Jackson aquifers were declared not relevant for the purpose of joint planning by Groundwater Management Area 15; therefore, modeled available groundwater values were not calculated for those aquifers.

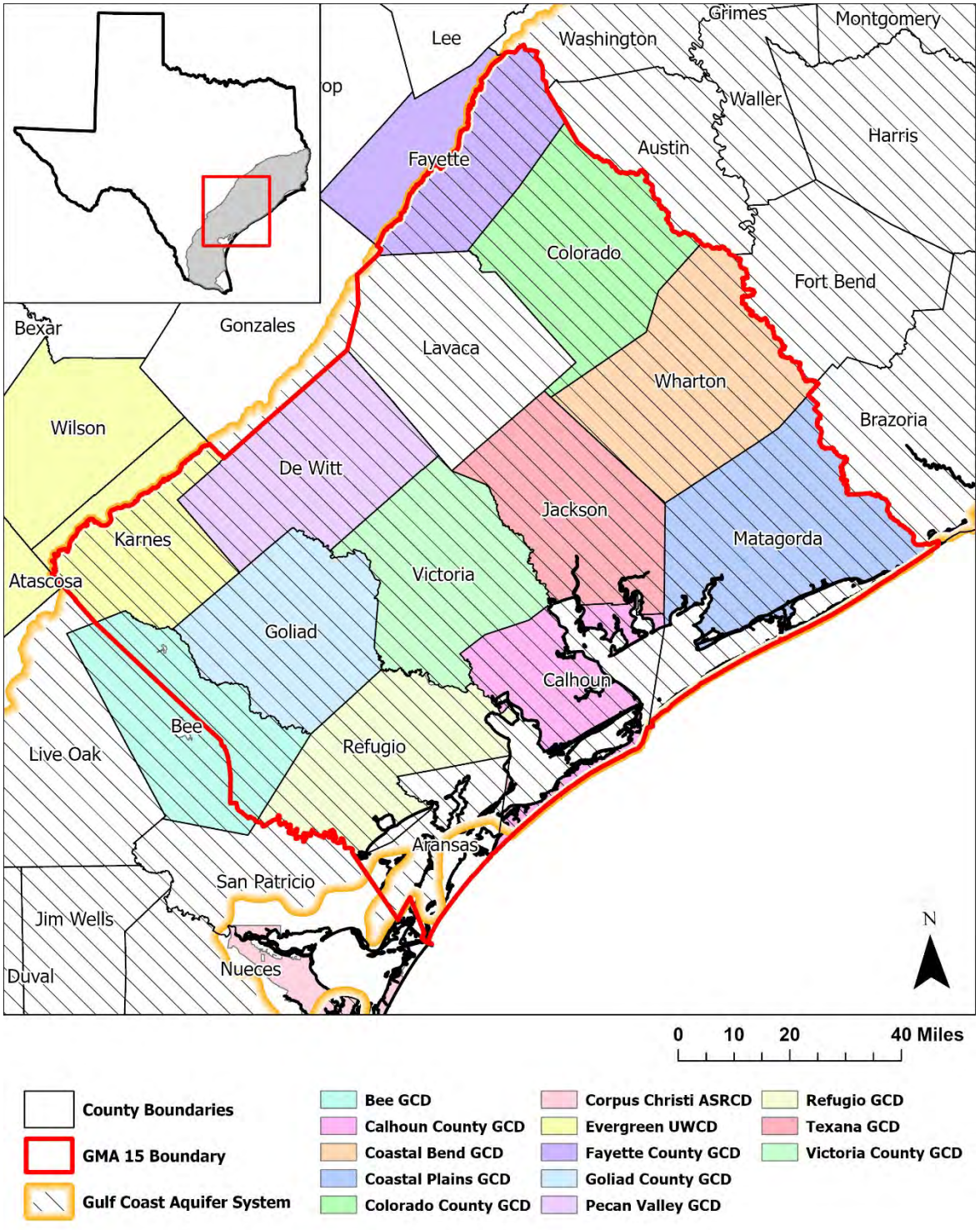

FIGURE 1. MAP SHOWING GROUNDWATER MANAGEMENT AREA (GMA) 15, GROUNDWATER CONSERVATION DISTRICTS (GCD), COUNTIES, AND THE EXTENT OF ACTIVE MODEL CELLS. (UWCD = UNDERGROUND WATER CONSERVATION DISTRICT)

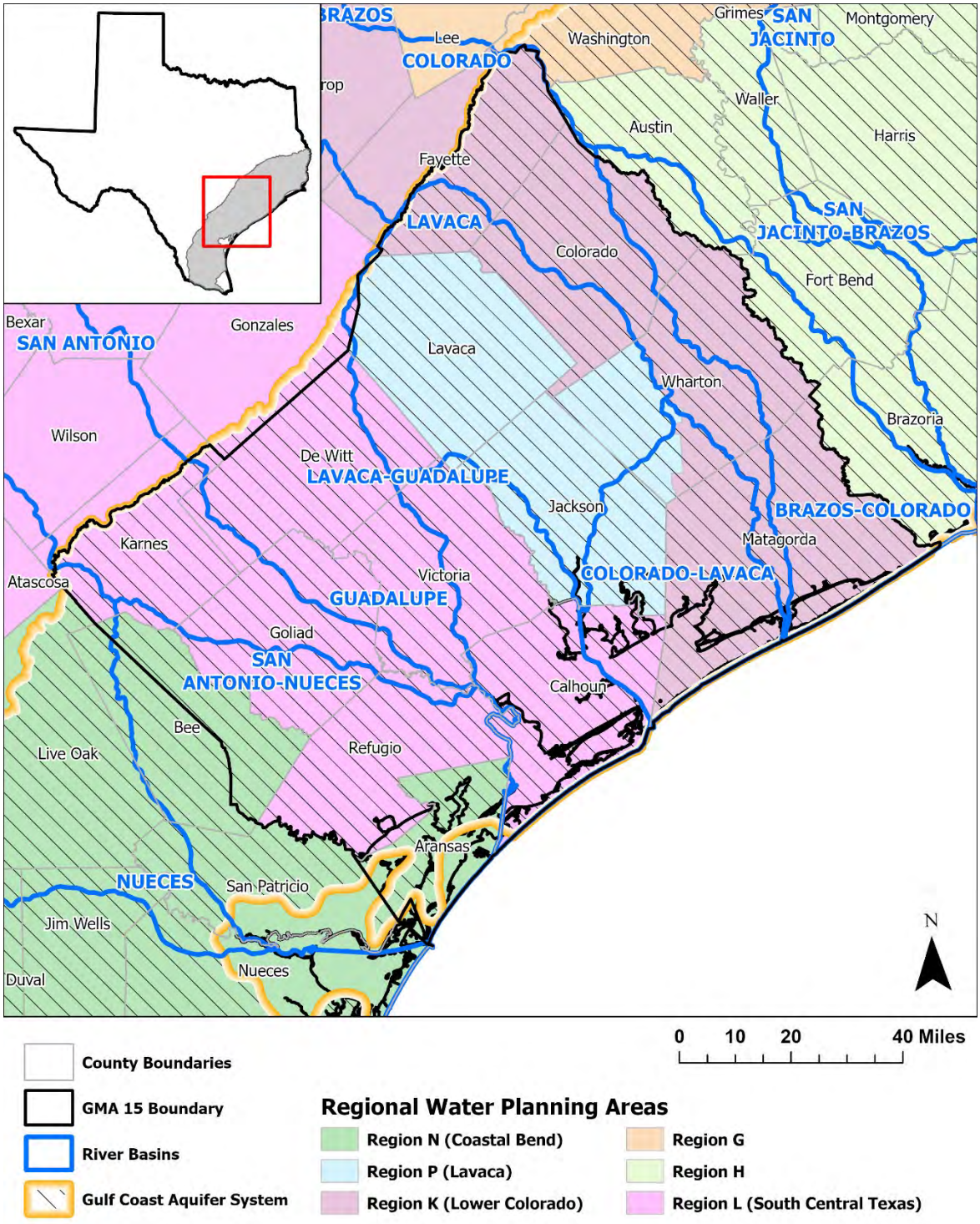

FIGURE 2. MAP SHOWING GROUNDWATER MANAGEMENT AREA (GMA) 15, REGIONAL WATER PLANNING AREAS, RIVER BASINS, COUNTIES, AND EXTENT OF ACTIVE MODEL CELLS.

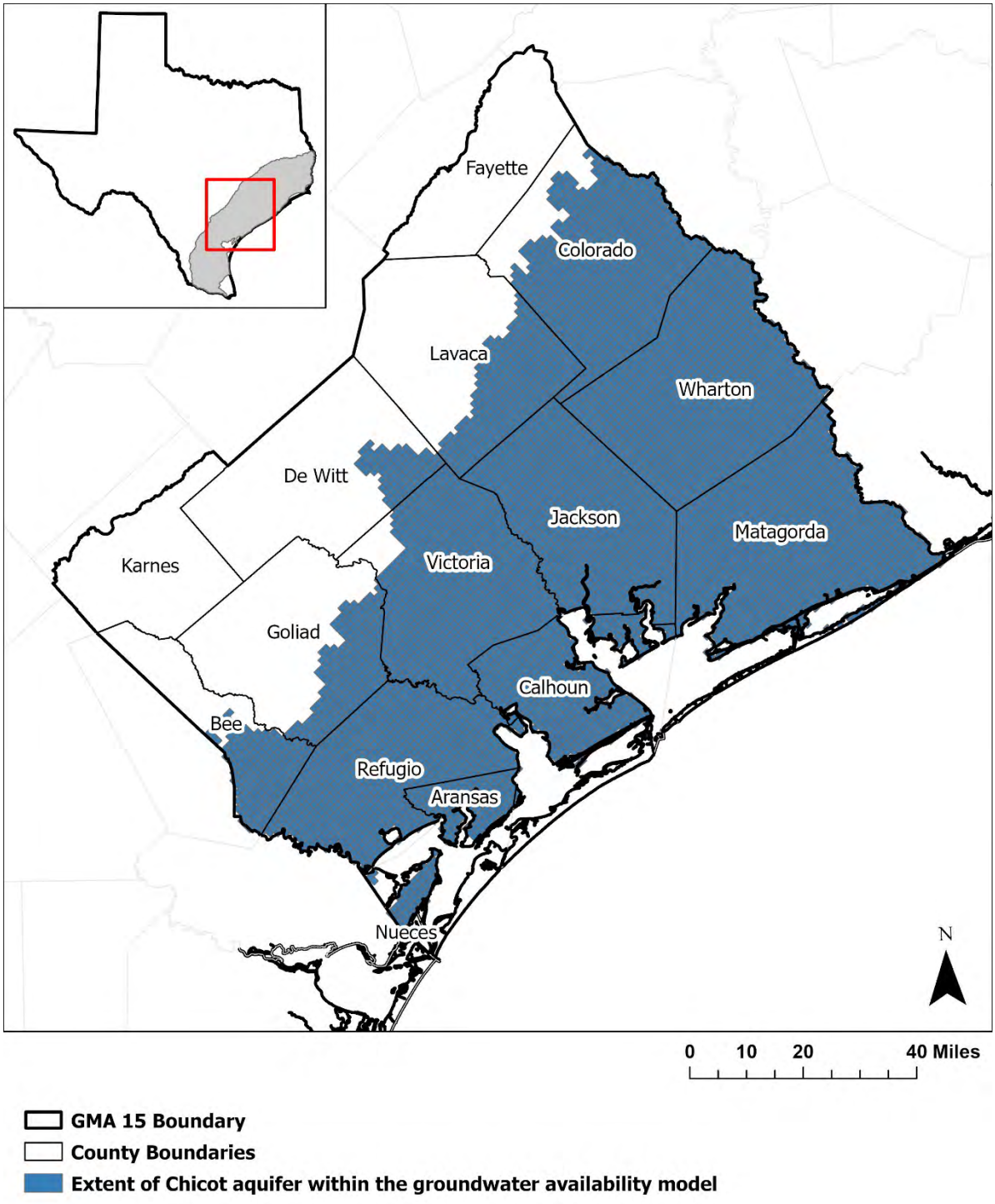

FIGURE 3. MAP SHOWING THE ACTIVE MODEL CELLS WITHIN GROUNDWATER MANAGEMENT AREA (GMA) 15 REPRESENTING THE CHICOT AQUIFER IN LAYER 1 OF THE CENTRAL GULF COAST AQUIFER SYSTEM GROUNDWATER AVAILABILITY MODEL.

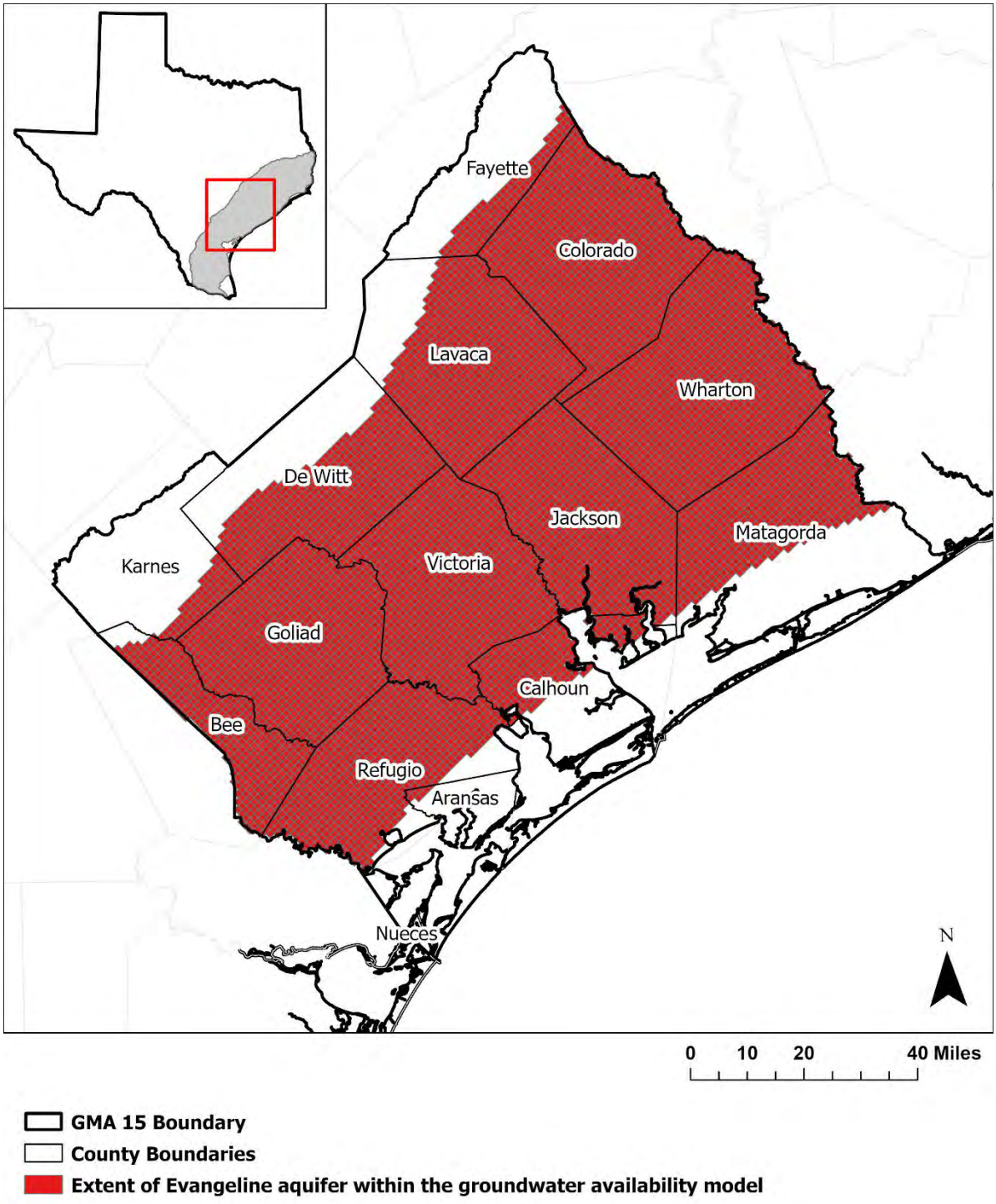

FIGURE 4. MAP SHOWING THE ACTIVE MODEL CELLS WITHIN GROUNDWATER MANAGEMENT AREA (GMA) 15 REPRESENTING THE EVANGELINE AQUIFER IN LAYER 2 OF THE CENTRAL GULF COAST AQUIFER SYSTEM GROUNDWATER AVAILABILITY MODEL.

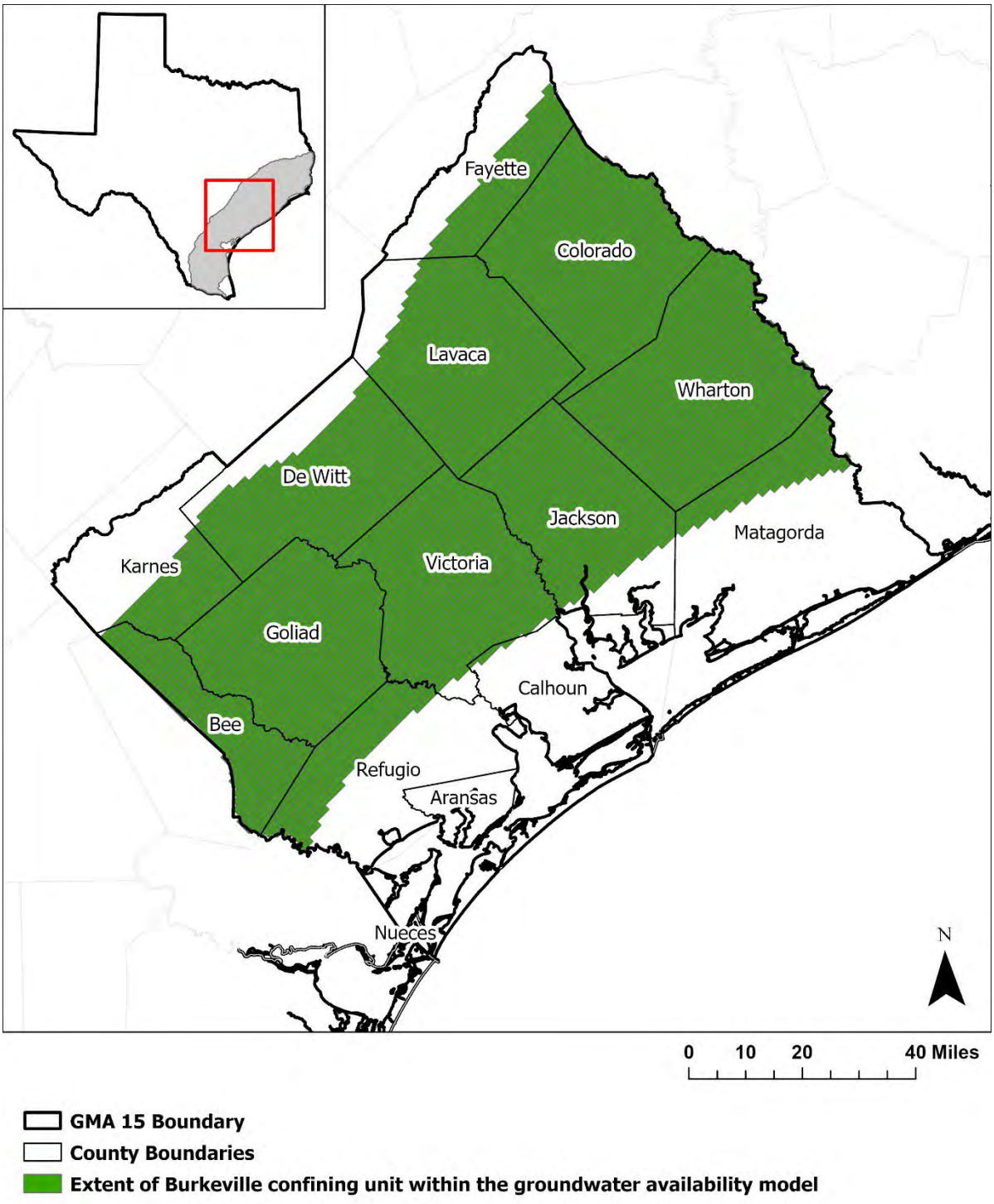

FIGURE 5. MAP SHOWING THE ACTIVE MODEL CELLS WITHIN GROUNDWATER MANAGEMENT AREA (GMA) 15 REPRESENTING THE BURKEVILLE CONFINING UNIT IN LAYER 3 OF THE CENTRAL GULF COAST AQUIFER SYSTEM GROUNDWATER AVAILABILITY MODEL.

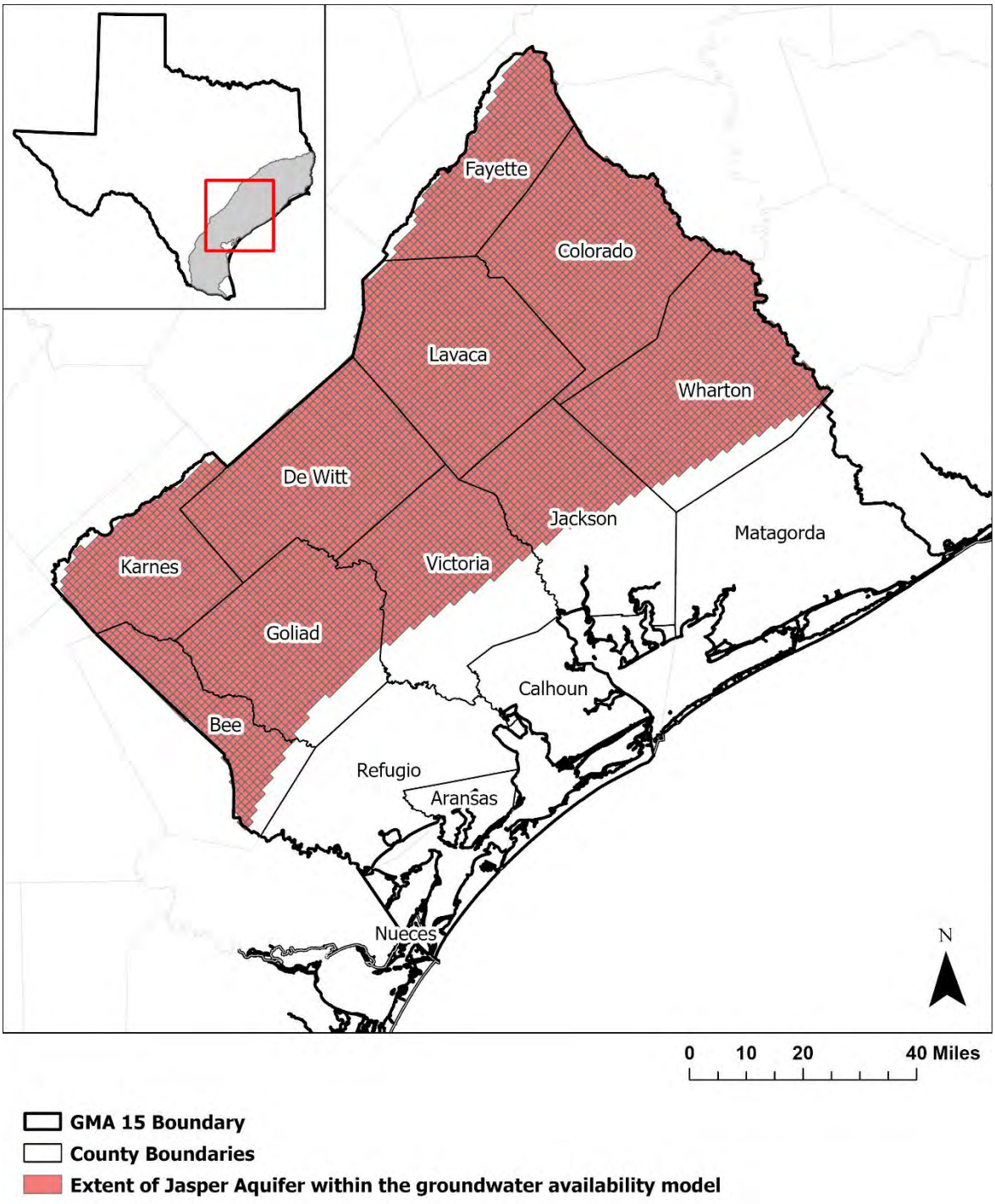

FIGURE 6. MAP SHOWING THE ACTIVE MODEL CELLS WITHIN GROUNDWATER MANAGEMENT AREA (GMA) 15 REPRESENTING THE JASPER AQUIFER AND CATAHOULA FORMATION IN DIRECT HYDROLOGIC CONNECTION WITH THE JASPER AQUIFER IN LAYER 4 OF THE CENTRAL GULF COAST AQUIFER SYSTEM GROUNDWATER AVAILABILITY MODEL.

TABLE 2. MODELED AVAILABLE GROUNDWATER FOR THE GULF COAST AQUIFER SYSTEM IN GROUNDWATER MANAGEMENT AREA 15 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2080. VALUES ARE IN ACRE-FEET PER YEAR. (UWCD = UNDERGROUND WATER CONSERVATION DISTRICT; ND = NO DISTRICT))

Groundwater Conservation District	County	Portion of Gulf Coast Aquifer System	2020	2030	2040	2050	2060	2070	2080
Bee GCD	Bee	Total	8,017	8,018	8,020	8,000	8,002	8,003	7,989
Calhoun County GCD	Calhoun	Total	7,611	7,611	7,611	7,611	7,611	7,611	7,611
Coastal Bend GCD	Wharton	Chicot and Evangeline	181,446	181,446	181,446	181,446	181,446	181,446	181,446
Coastal Plains GCD	Matagorda	Chicot and Evangeline	38,892	38,892	38,892	38,892	38,892	38,892	38,892
Colorado County GCD	Colorado	Chicot and Evangeline	71,665	71,665	71,665	71,665	71,665	71,665	71,665
	Colorado	Jasper	918	918	918	918	918	918	918
Colorado County GCD Total	**Colorado**	**Total**	**72,583**	**72,583**	**72,583**	**72,583**	**72,583**	**72,583**	**72,583**
Evergreen UWCD	Karnes	Total	10,694	10,525	3,404	3,399	3,227	2,952	2,949
Fayette County GCD	Fayette	Total	7,168	7,394	7,683	8,011	8,387	8,660	8,590
Goliad County GCD	Goliad	Chicot	418	421	426	430	432	436	436
	Goliad	Evangeline	4,983	5,044	5,105	5,165	5,225	5,287	5,287
	Goliad	Burkeville	425	451	478	505	532	559	559
	Goliad	Jasper	250	338	427	515	602	690	690
Goliad County GCD Total	**Goliad**	**Total**	**6,076**	**6,254**	**6,436**	**6,615**	**6,791**	**6,972**	**6,972**
Pecan Valley GCD	DeWitt	Total	17,993	17,958	17,912	17,827	17,806	17,784	17,772
Refugio GCD	Refugio	Total	5,858	5,858	5,858	5,858	5,858	5,858	5,858
Texana GCD	Jackson	Total	90,571	90,571	90,571	90,571	90,571	90,571	90,571
Victoria County GCD	Victoria	Total	59,948	59,948	59,948	59,948	59,948	59,948	59,948
Total (GCDs)		**Total**	**506,857**	**507,058**	**500,364**	**500,761**	**501,122**	**501,280**	**501,181**

TABLE 2. CONTINUED: MODELED AVAILABLE GROUNDWATER FOR THE GULF COAST AQUIFER SYSTEM IN GROUNDWATER MANAGEMENT AREA 15 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2080. VALUES ARE IN ACRE-FEET PER YEAR. (UWCD = UNDERGROUND WATER CONSERVATION DISTRICT; ND = NO DISTRICT))

Groundwater Conservation District	County	Portion of Gulf Coast Aquifer System	2020	2030	2040	2050	2060	2070	2080
ND Aransas	Aransas	Total	1,547	1,547	1,547	1,547	1,547	1,547	1,547
ND Bee	Bee	Total	9	9	9	9	9	9	9
ND Lavaca	Lavaca	Total	20,384	20,384	20,379	20,379	20,372	20,368	20,350
ND Refugio	Refugio	Total	8	8	8	8	8	8	8
No District-County Total		**Total**	**21,948**	**21,948**	**21,943**	**21,943**	**21,936**	**21,932**	**21,914**
GMA 15 Total		**Total**	**528,805**	**529,006**	**522,307**	**522,704**	**523,058**	**523,212**	**523,095**

TABLE 3. MODELED AVAILABLE GROUNDWATER FOR THE GULF COAST AQUIFER SYSTEM IN GROUNDWATER MANAGEMENT AREA 15. RESULTS ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN FOR EACH DECADE FROM 2030 TO 2080. VALUES ARE IN ACRE-FEET PER YEAR.

County	RWPA	River Basin	Portion of Gulf Coast Aquifer System	2030	2040	2050	2060	2070	2080
Aransas	N	San Antonio-Nueces	Total	1,547	1,547	1,547	1,547	1,547	1,547
Bee	N	Nueces	Total	26	26	26	26	26	26
	N	San Antonio-Nueces	Total	8,001	8,003	7,983	7,985	7,986	7,972
Calhoun	L	Colorado-Lavaca	Total	5,221	5,221	5,221	5,221	5,221	5,221
	L	Guadalupe	Total	18	18	18	18	18	18
	L	Lavaca-Guadalupe	Total	2,365	2,365	2,365	2,365	2,365	2,365
	L	San Antonio-Nueces	Total	7	7	7	7	7	7
Colorado	K	Brazos-Colorado	Chicot and Evangeline	15,352	15,352	15,352	15,352	15,352	15,352
	K	Colorado	Chicot and Evangeline	20,079	20,079	20,079	20,079	20,079	20,079
	K	Lavaca	Chicot and Evangeline	36,234	36,234	36,234	36,234	36,234	36,234
	K	Brazos-Colorado	Jasper	49	49	49	49	49	49
	K	Colorado	Jasper	273	273	273	273	273	273
	K	Lavaca	Jasper	596	596	596	596	596	596
DeWitt	L	Guadalupe	Total	14,055	14,042	13,966	13,946	13,927	13,917
	L	Lavaca	Total	2,638	2,626	2,620	2,620	2,620	2,620
	L	Lavaca-Guadalupe	Total	298	298	298	298	298	298
	L	San Antonio	Total	967	946	943	942	939	937
Fayette	K	Brazos	Total	19	21	22	24	26	26
	K	Colorado	Total	4,894	5,041	5,196	5,370	5,406	5,392
	K	Lavaca	Total	2,481	2,621	2,793	2,993	3,228	3,172

TABLE 3. CONTINUED: MODELED AVAILABLE GROUNDWATER FOR THE GULF COAST AQUIFER SYSTEM IN GROUNDWATER MANAGEMENT AREA 15. RESULTS ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN FOR EACH DECADE FROM 2030 TO 2080. VALUES ARE IN ACRE-FEET PER YEAR.

County	RWPA	River Basin	Portion of Gulf Coast Aquifer System	2030	2040	2050	2060	2070	2080
Goliad	L	Guadalupe	Chicot	10	11	11	11	11	11
	L	San Antonio	Chicot	136	137	139	140	141	141
	L	San Antonio-Nueces	Chicot	275	278	280	281	284	284
	L	Guadalupe	Evangeline	2,056	2,081	2,105	2,129	2,155	2,155
	L	San Antonio	Evangeline	2,660	2,692	2,724	2,755	2,788	2,788
	L	San Antonio-Nueces	Evangeline	328	332	336	341	344	344
	L	Guadalupe	Burkeville	0	0	0	0	0	0
	L	San Antonio	Burkeville	451	478	505	532	559	559
	L	San Antonio-Nueces	Burkeville	0	0	0	0	0	0
	L	Guadalupe	Jasper	0	1	1	1	1	1
	L	San Antonio	Jasper	338	426	514	601	689	689
	L	San Antonio-Nueces	Jasper	0	0	0	0	0	0
Jackson	P	Colorado-Lavaca	Total	28,157	28,157	28,157	28,157	28,157	28,157
	P	Lavaca	Total	49,484	49,484	49,484	49,484	49,484	49,484
	P	Lavaca-Guadalupe	Total	12,930	12,930	12,930	12,930	12,930	12,930
Karnes	L	Guadalupe	Total	18	18	18	18	18	18
	L	Nueces	Total	1,059	79	79	79	79	79
	L	San Antonio	Total	9,362	3,221	3,217	3,050	2,781	2,780
	L	San Antonio-Nueces	Total	86	86	85	80	74	72
Lavaca	P	Guadalupe	Total	41	41	41	41	41	41
	P	Lavaca	Total	19,942	19,937	19,937	19,930	19,926	19,908
	P	Lavaca-Guadalupe	Total	401	401	401	401	401	401

TABLE 3. CONTINUED: MODELED AVAILABLE GROUNDWATER FOR THE GULF COAST AQUIFER SYSTEM IN GROUNDWATER MANAGEMENT AREA 15. RESULTS ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN FOR EACH DECADE FROM 2030 TO 2080. VALUES ARE IN ACRE-FEET PER YEAR.

County	RWPA	River Basin	Portion of Gulf Coast Aquifer System	2030	2040	2050	2060	2070	2080
Matagorda	K	Brazos-Colorado	Chicot and Evangeline	15,321	15,321	15,321	15,321	15,321	15,321
	K	Colorado	Chicot and Evangeline	3,219	3,219	3,219	3,219	3,219	3,219
	K	Colorado-Lavaca	Chicot and Evangeline	20,352	20,352	20,352	20,352	20,352	20,352
Refugio	L	San Antonio	Total	329	329	329	329	329	329
	L	San Antonio-Nueces	Total	5,537	5,537	5,537	5,537	5,537	5,537
Victoria	L	Guadalupe	Total	27,611	27,611	27,611	27,611	27,611	27,611
	L	Lavaca	Total	234	234	234	234	234	234
	L	Lavaca-Guadalupe	Total	30,421	30,421	30,421	30,421	30,421	30,421
	L	San Antonio	Total	1,682	1,682	1,682	1,682	1,682	1,682
Wharton	K	Brazos-Colorado	Chicot and Evangeline	50,560	50,560	50,560	50,560	50,560	50,560
	K	Colorado	Chicot and Evangeline	35,934	35,934	35,934	35,934	35,934	35,934
	K	Colorado-Lavaca	Chicot and Evangeline	16,207	16,207	16,207	16,207	16,207	16,207
	K	Lavaca	Chicot and Evangeline	579	579	579	579	579	579
	P	Colorado	Chicot and Evangeline	874	874	874	874	874	874
	P	Colorado-Lavaca	Chicot and Evangeline	14,100	14,100	14,100	14,100	14,100	14,100
	P	Lavaca	Chicot and Evangeline	63,193	63,193	63,193	63,193	63,193	63,193
GMA 15 Total				**529,007**	**522,308**	**522,705**	**523,059**	**523,213**	**523,096**

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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Wade, S., 2010, GAM Run 10-008 Addendum: Texas Water Development Board, 8 p., https://www.twdb.texas.gov/groundwater/docs/GAMruns/GR10-08addendum.pdf

GAM RUN 21-021 MAG:
MODELED AVAILABLE GROUNDWATER FOR THE GULF COAST AQUIFER SYSTEM IN GROUNDWATER MANAGEMENT AREA 16

Ki Cha, Ph.D., EIT
Texas Water Development Board
Groundwater Division
Groundwater Modeling Department
512-463-5604
October 31, 2022

Natalie Ballew, P.G. 15090, is the Director of the Groundwater Division and is responsible for oversight of work performed by Ki Cha under her supervision.

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Texas Water Development Board
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512-463-5604
October 31, 2022

EXECUTIVE SUMMARY:

The modeled available groundwater for Groundwater Management Area 16 for the Gulf Coast Aquifer System is summarized by decade by groundwater conservation district and county (Table 1) and for use in the regional water planning process by county, regional water planning area, and river basin (Table 2). The modeled available groundwater estimates range from approximately 229,000 acre-feet per year in 2020 to approximately 294,000 acre-feet per year in 2080 (Tables 1 and 2). The estimates are based on the desired future conditions for the Gulf Coast Aquifer System adopted by groundwater conservation districts in Groundwater Management Area 16 on November 23, 2021 and re-adopted with minor clerical corrections on June 28, 2022. The explanatory report and other materials submitted to the TWDB were determined to be administratively complete on August 26, 2022.

REQUESTOR:

Mr. Scott Bledsoe, III, coordinator for Groundwater Management Area 16.

DESCRIPTION OF REQUEST:

In a letter dated January 22, 2022, Dr. Steve C. Young, consultant for Groundwater Management Area 16, provided the TWDB with the desired future conditions of the Gulf Coast Aquifer System adopted by the groundwater conservation district representatives in Groundwater Management Area 16. The Carrizo-Wilcox and Yegua-Jackson aquifers were declared non-relevant for joint planning purposes by Groundwater Management Area 16.

On June 2, 2022, TWDB requested clarifications about the wording of the desired future conditions, as some were unachievable based on TWDB analysis of the submitted model files during administrative review. In response, the Groundwater Management Area 16 consultant and groundwater conservation district representatives submitted an amended explanatory report (Young, 2022) on July 4, 2022. Groundwater Management Area 16

adopted a revised version of the desired future conditions for the Gulf Coast Aquifer System. The final desired future conditions adopted by the groundwater conservation district representatives in Groundwater Management Area 16 as described in Resolution No. 2022-01, on June 28, 2022 (Young, 2022; Appendix C), are presented below:

> *"Groundwater Management Area 16 adopts Desired Future Conditions for each county within the groundwater management area (county-specific DFC's) and adopts a Desired Future Condition for the counties in the groundwater management area (gma-specific DFC's). The Desired Future Condition for the counties in the groundwater management area shall not exceed an average drawdown of 78 feet for the Gulf Coast Aquifer System at December 2080. Desired Future Conditions for each county within the groundwater management area (county-specific DFC's) shall not exceed the values specified in Scenario 2 at December 2080.*
>
> *Table A-1: Desired Future Conditions for GMA 16 expressed as an Average Drawdown between January 2010 and December 2079.*
>
> *Bee GCD: 93 feet of drawdown of the Gulf Coast Aquifer System;*
>
> *Live Oak UWCD: 45 feet of drawdown of the Gulf Coast Aquifer System;*
>
> *McMullen GCD: 12 feet of drawdown of the Gulf Coast Aquifer System;*
>
> *Red Sands GCD: 60 feet of drawdown of the Gulf Coast Aquifer System;*
>
> *Kenedy County GCD: 27 feet of drawdown of the Gulf Coast Aquifer System;*
>
> *Brush Country GCD: 89 feet of drawdown of the Gulf Coast Aquifer System;*
>
> *Duval County GCD: 137 feet of drawdown of the Gulf Coast Aquifer System;*
>
> *San Patricio County GCD: 69 feet of drawdown of the Gulf Coast Aquifer System;*
>
> *Starr County GCD: 94 feet of drawdown of the Gulf Coast Aquifer System;*
>
> *Cameron: 119 feet of drawdown of the Gulf Coast Aquifer System;*
>
> *Hidalgo: 138 feet of drawdown of the Gulf Coast Aquifer System;*
>
> *Kleberg: 21 feet of drawdown of the Gulf Coast Aquifer System;*
>
> *Nueces: 26 feet of drawdown of the Gulf Coast Aquifer System;*
>
> *Webb: 161 feet of drawdown of the Gulf Coast Aquifer System;*
>
> *Willacy: 44 feet of drawdown of the Gulf Coast Aquifer System."*

METHODS:

The alternative groundwater availability model for Groundwater Management Area 16 (version 1.01; Hutchison and others, 2011) was run using the predictive model files ("Pumping Scenario #2") submitted with the desired future condition explanatory report (Young, 2022). Model-calculated water levels were extracted for January 2010 (stress period 11) and December 2079 (stress period 81), and drawdown was calculated as the difference between these water levels. Drawdown averages were calculated for the Gulf Coast Aquifer System by county, groundwater conservation district, and the entire groundwater management area. The calculated drawdown averages were compared with the desired future conditions to verify that the submitted pumping scenario can achieve the desired future conditions within the three-foot tolerance specified by Groundwater Management Area 16.

The modeled available groundwater values were determined by extracting pumping rates by decade from the model results using ZONEBUDGET Version 3.01 (Harbaugh, 2009). The modeled available groundwater can be presented by groundwater conservation district and county within Groundwater Management Area 16 (Figure 1) and by county, regional water planning area, and river basin within Groundwater Management Area 16 (Figure 2)

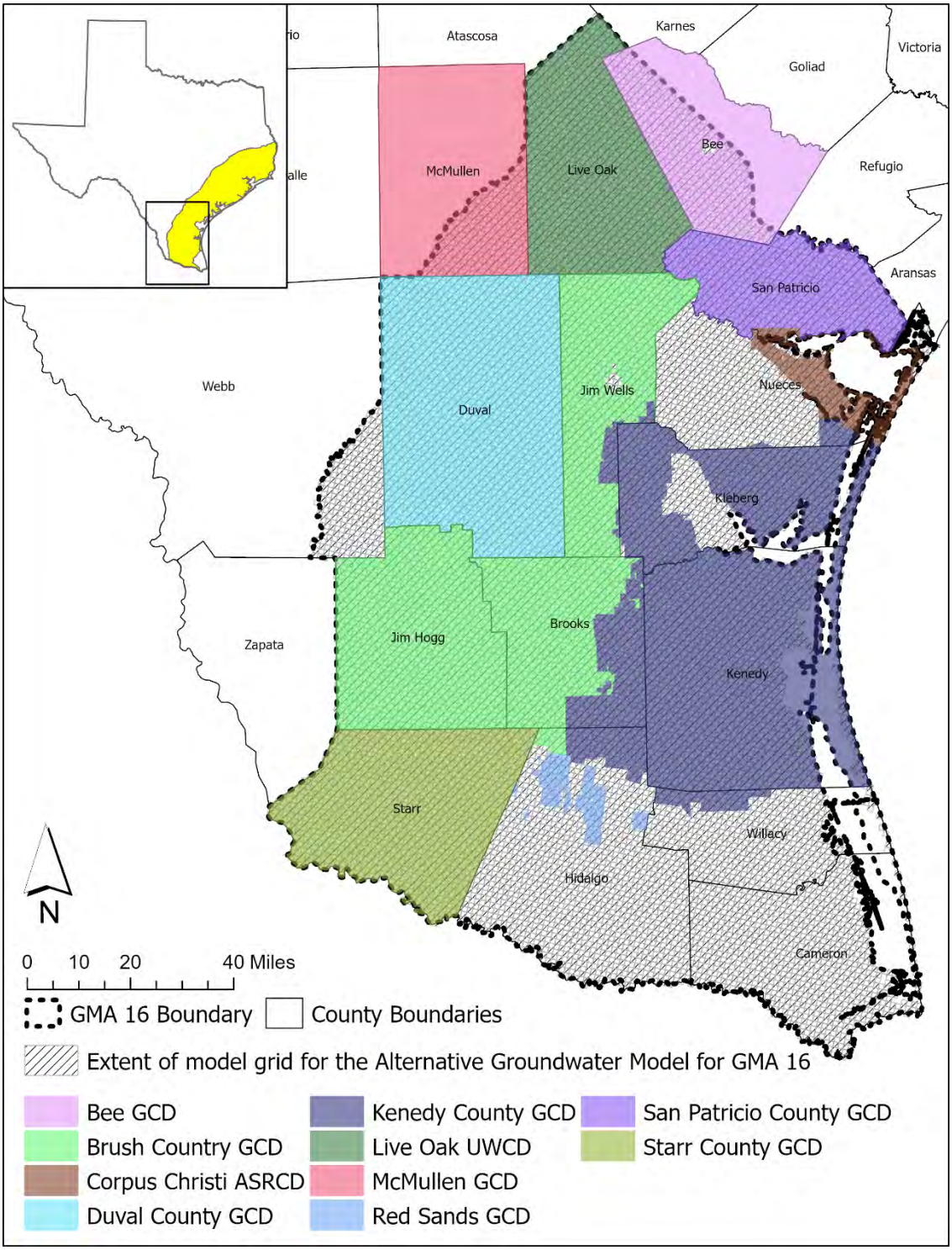

FIGURE 1. MAP SHOWING GROUNDWATER CONSERVATION DISTRICTS (GCDS) AND COUNTIES IN GROUNDWATER MANAGEMENT AREA 16, OVERLAIN ON THE EXTENT OF THE ALTERNATIVE GROUNDWATER AVAILABILITY MODEL FOR GROUNDWATER MANAGEMENT AREA 16.

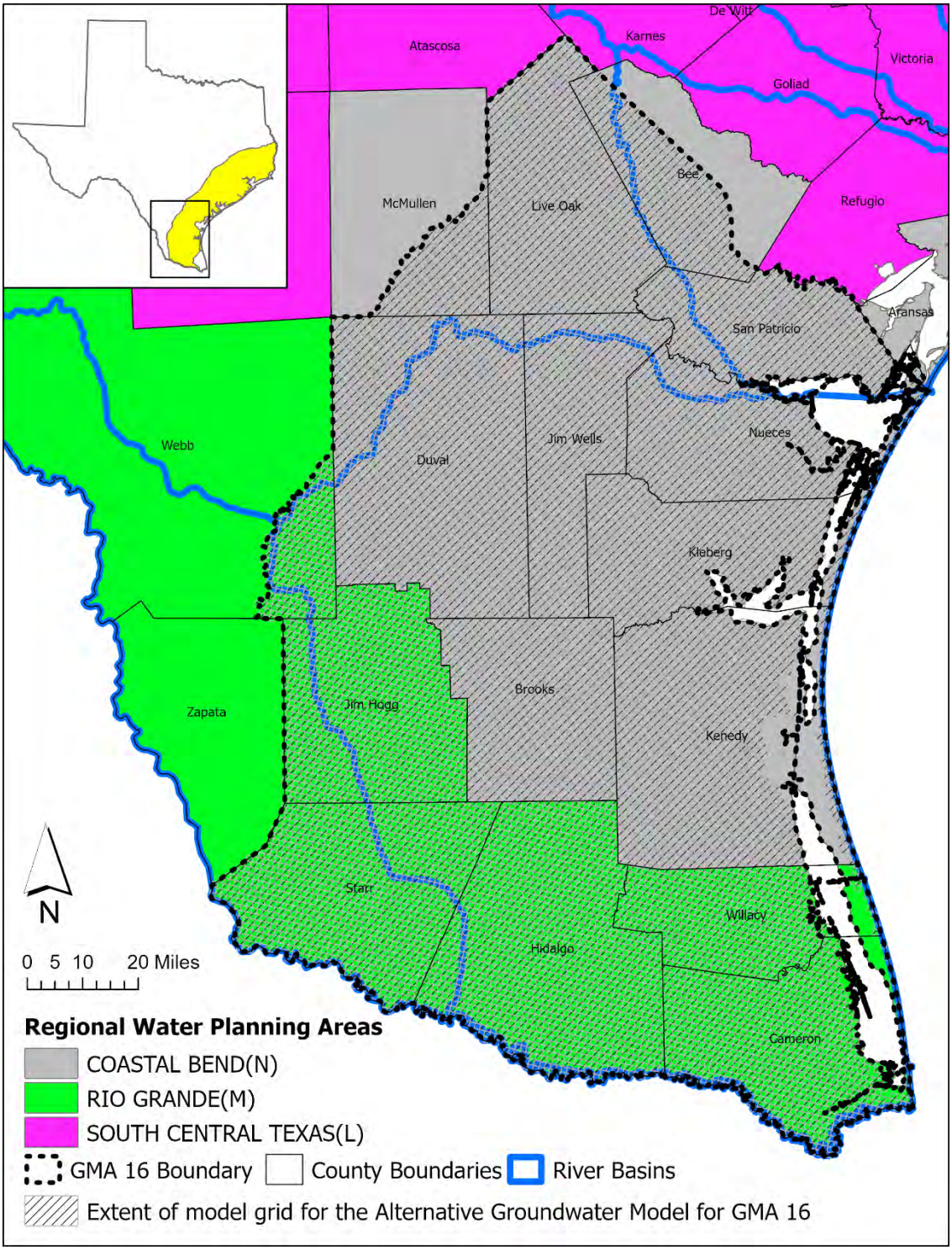

FIGURE 2. MAP SHOWING THE REGIONAL WATER PLANNING AREAS, COUNTIES, AND RIVER BASINS IN GROUNDWATER MANAGEMENT AREA 16, OVERLAIN ON THE EXTENT OF THE ALTERNATIVE GROUNDWATER AVAILABILITY MODEL FOR GROUNDWATER MANAGEMENT AREA 16.

Modeled Available Groundwater and Permitting

As defined in Chapter 36 of the Texas Water Code (2011), "modeled available groundwater" is the estimated average amount of water that may be produced annually to achieve a desired future condition. Groundwater conservation districts must consider modeled available groundwater when issuing permits in order to manage groundwater production to achieve the desired future condition(s). Districts must also consider 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:

The parameters and assumptions for the modeled available groundwater estimates are described below:

- Version 1.01 of the alternate groundwater availability model for Groundwater Management Area 16 was the base model for this analysis. See Hutchison and others (2011) for assumptions and limitations of the model. Groundwater Management Area 16 constructed a predictive model simulation to extend the base model to 2080 for planning purposes. See Young (2022) for the assumptions of this predictive model simulation.

- The model has six layers that represent the Chicot aquifer (Layer 1), the Evangeline aquifer (Layer 2), the Burkeville confining unit (Layer 3), the Jasper aquifer (Layer 4), the Yegua-Jackson Aquifer (Layer 5), and the Queen-City, Sparta and Carrizo-Wilcox Aquifer System (Layer 6). Layers 1 through 4 were lumped to calculate modeled available groundwater for the Gulf Coast Aquifer System.

- The model was run with MODFLOW-2000 (Harbaugh and others, 2000).

- To be consistent with Groundwater Management Area 16, the TWDB model grid file dated May 1, 2014 (alt1_gma16) was used to determine model cell entity assignment (county, groundwater management area, groundwater conservation district, river basin, regional water planning area).

- Although the original groundwater availability model was only calibrated to the end of 1999, an analysis during the previous round of joint planning verified that the measured water levels did not change significantly for the period from 2000 to 2010 (Goswami, 2017). For this reason, TWDB considers it acceptable to use 2010 as the reference year for drawdown calculations.

- Drawdown averages and modeled available groundwater values are based on the official TWDB boundary for the groundwater conservation district, county, regional water planning area, river basin, and Regional Water Planning Areas within Groundwater Management Area 16 (Figures 1 and 2).

- Drawdown values for cells with water levels below the base elevation of the cell ("dry" cells) were included in the average drawdown calculations. The groundwater availability model for Groundwater Management Area 16 was constructed using the confined aquifer assumption (and LAYCON=0 option), meaning the transmissivity of "dry" cells remains constant and pumping from those cells continues. The desired future conditions adopted by Groundwater Management Area 16 are based on the average drawdowns that include "dry" cells. Therefore, pumping values from "dry" cells were also included in the calculation of modeled available groundwater. Please note that the confined aquifer assumption may also lead to physically unrealistic conditions, with pumping in a model cell continuing even when water levels have dropped below the base of the model cell.

- Drawdown was calculated as the difference in modeled water levels between the baseline date January 2010 (stress period 11) and the final date December 2079 (stress period 81). Average drawdowns were calculated as the sum of drawdowns for all model cells within a specified area divided by the number of cells in that specified area.

- Estimates of modeled available groundwater from the model simulation were rounded to whole numbers.

RESULTS:

The modeled available groundwater for the Gulf Coast Aquifer System that achieves the desired future conditions adopted by Groundwater Management Area 16 increases from approximately 229,000 acre-feet per year in 2020 to 294,000 acre-feet per year in 2080. The modeled available groundwater is summarized by groundwater conservation district and county (Table 1) and by county, regional water planning area, and river basin (Table 2) for use in the regional water planning process.

TABLE 1. MODELED AVAILABLE GROUNDWATER FOR THE GULF COAST AQUIFER SYSTEM IN GROUNDWATER MANAGEMENT AREA 16 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2080. VALUES ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District (GCD)	County	2020	2030	2040	2050	2060	2070	2080
Bee GCD	**Bee**	10,338	11,849	12,593	12,944	13,146	13,146	13,146
Brush Country GCD	Brooks	3,660	3,660	3,660	3,660	3,660	4,205	4,205
Brush Country GCD	Hidalgo	131	131	131	131	131	150	150
Brush Country GCD	Jim Hogg	6,167	6,167	6,167	6,167	6,167	7,084	7,084
Brush Country GCD	Jim Wells	8,701	9,065	9,393	9,758	10,050	11,544	11,544
Brush Country GCD Total		**18,659**	**19,023**	**19,351**	**19,716**	**20,008**	**22,983**	**22,983**
Duval County GCD	**Duval**	**20,571**	**22,169**	**23,764**	**25,363**	**26,963**	**26,963**	**26,963**
Kenedy County GCD	Brooks	1,308	1,463	1,693	1,847	2,078	2,232	2,232
Kenedy County GCD	Hidalgo	412	460	534	582	654	703	703
Kenedy County GCD	Jim Wells	296	330	383	417	469	505	505
Kenedy County GCD	Kenedy	9,040	10,104	11,698	12,762	14,358	15,421	15,421
Kenedy County GCD	Kleberg	4,291	4,796	5,553	6,058	6,815	7,320	7,320
Kenedy County GCD	Nueces	171	191	221	241	271	291	291
Kenedy County GCD	Willacy	328	365	424	462	520	558	558
Kenedy County GCD Total		**15,846**	**17,709**	**20,506**	**22,369**	**25,165**	**27,030**	**27,030**
Live Oak UWCD	**Live Oak**	**10,169**	**11,394**	**10,444**	**10,294**	**10,294**	**10,294**	**10,294**
McMullen GCD	**McMullen**	**510**	**510**	**510**	**510**	**510**	**510**	**510**
Red Sands GCD	**Hidalgo**	**1,667**	**1,966**	**2,265**	**2,563**	**2,863**	**2,863**	**2,863**
San Patricio County GCD	**San Patricio**	**43,611**	**45,016**	**46,422**	**47,828**	**49,234**	**49,234**	**49,234**
Starr County GCD	**Starr**	**3,798**	**4,797**	**5,797**	**6,794**	**7,795**	**7,795**	**7,795**

TABLE 1. CONTINUED

Groundwater Conservation District (GCD)	County	2020	2030	2040	2050	2060	2070	2080
No District-Cameron	Cameron	6,688	7,999	9,311	10,620	11,932	11,932	11,932
No District-Hidalgo	Hidalgo	85,634	90,905	96,175	101,445	106,715	106,715	106,715
No District-Kleberg	Kleberg	4,051	4,243	4,436	4,629	4,822	4,822	4,822
No District-Nueces	Nueces	6,339	6,596	6,857	7,115	7,372	7,372	7,372
No District-Webb	Webb	620	789	959	1,129	1,299	1,299	1,299
No District-Willacy	Willacy	664	785	905	1,024	1,145	1,145	1,145
No District-Total		**103,996**	**111,317**	**118,643**	**125,962**	**133,285**	**133,285**	**133,285**
GMA 16 Total		**229,165**	**245,750**	**260,295**	**274,343**	**289,263**	**294,103**	**294,103**

TABLE 2. MODELED AVAILABLE GROUNDWATER FOR THE GULF COAST AQUIFER SYSTEM IN GROUNDWATER MANAGEMENT AREA 16. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN FOR EACH DECADE BETWEEN 2030 AND 2080.

County	RWPA	River Basin	2030	2040	2050	2060	2070	2080
Bee	N	Nueces	981	1,043	1,072	1,089	1,089	1,089
Bee	N	San Antonio-Nueces	10,868	11,550	11,872	12,057	12,057	12,057
Brooks	N	Nueces-Rio Grande	5,123	5,353	5,507	5,738	6,437	6,437
Cameron	M	Nueces-Rio Grande	7,536	8,771	10,005	11,241	11,241	11,241
Cameron	M	Rio Grande	463	540	615	691	691	691
Duval	N	Nueces	351	376	401	428	428	428
Duval	N	Nueces-Rio Grande	21,818	23,388	24,962	26,535	26,535	26,535
Hidalgo	M	Nueces-Rio Grande	91,421	96,658	101,867	107,103	107,171	107,171
Hidalgo	M	Rio Grande	2,041	2,447	2,854	3,260	3,260	3,260
Jim Hogg	M	Nueces-Rio Grande	5,230	5,230	5,230	5,230	6,008	6,008
Jim Hogg	M	Rio Grande	937	937	937	937	1,076	1,076
Jim Wells	N	Nueces	593	593	593	593	681	681
Jim Wells	N	Nueces-Rio Grande	8,802	9,183	9,582	9,926	11,368	11,368
Kenedy	N	Nueces-Rio Grande	10,104	11,698	12,762	14,358	15,421	15,421
Kleberg	N	Nueces-Rio Grande	9,039	9,989	10,687	11,637	12,142	12,142
Live Oak	N	Nueces	11,326	10,382	10,233	10,233	10,233	10,233
Live Oak	N	San Antonio-Nueces	68	62	61	61	61	61
McMullen	N	Nueces	510	510	510	510	510	510
Nueces	N	Nueces	756	787	816	845	845	845
Nueces	N	Nueces-Rio Grande	6,031	6,291	6,540	6,798	6,818	6,818
San Patricio	N	Nueces	4,502	4,874	5,247	5,619	5,619	5,619
San Patricio	N	San Antonio-Nueces	40,514	41,548	42,581	43,615	43,615	43,615

TABLE 2. CONTINUED

County	RWPA	River Basin	2030	2040	2050	2060	2070	2080
Starr	M	Nueces-Rio Grande	1,958	2,366	2,772	3,180	3,180	3,180
Starr	M	Rio Grande	2,839	3,431	4,022	4,615	4,615	4,615
Webb	M	Nueces	22	27	32	37	37	37
Webb	M	Nueces-Rio Grande	642	780	918	1,056	1,056	1,056
Webb	M	Rio Grande	125	152	179	206	206	206
Willacy	M	Nueces-Rio Grande	1,150	1,329	1,486	1,665	1,703	1,703
GMA 16 Total			**245,750**	**260,295**	**274,343**	**289,263**	**294,103**	**294,103**

*GCAS: Gulf Coast Aquifer System

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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Estimated Historical Water Use And 2022 State Water Plan Datasets:

Bee Groundwater Conservation District

by Stephen Allen
Texas Water Development Board
Groundwater Division
Groundwater Technical Assistance Section
stephen.allen@twdb.texas.gov
(512) 463-7317
August 7, 2023

GROUNDWATER MANAGEMENT PLAN DATA:

This package of water data reports (part 1 of a 2-part package of information) is being provided to groundwater conservation districts to help them meet the requirements for approval of their five-year groundwater management plan. Each report in the package addresses a specific numbered requirement in the Texas Water Development Board's groundwater management plan checklist. The checklist can be viewed and downloaded from this web address:

http://www.twdb.texas.gov/groundwater/docs/GCD/GMPChecklist0113.pdf

The five reports included in this part are:

1. Estimated Historical Water Use (checklist item 2)

   from the TWDB Historical Water Use Survey (WUS)

2. Projected Surface Water Supplies (checklist item 6)
3. Projected Water Demands (checklist item 7)
4. Projected Water Supply Needs (checklist item 8)
5. Projected Water Management Strategies (checklist item 9)

   from the 2022Texas State Water Plan (SWP)

Part 2 of the 2-part package is the groundwater availability model (GAM) report for the District (checklist items 3 through 5). The District should have received, or will receive, this report from the Groundwater Availability Modeling Section. Questions about the GAM can be directed to Dr. Shirley Wade, shirley.wade@twdb.texas.gov, (512) 936-0883.

DISCLAIMER:

The data presented in this report represents the most up-to-date WUS and 2022 SWP data available as of 8/7/2023. Although it does not happen frequently, either of these datasets are subject to change pending the availability of more accurate WUS data or an amendment to the 2022 SWP. District personnel must review these datasets and correct any discrepancies in order to ensure approval of their groundwater management plan.

The WUS dataset can be verified at this web address:

http://www.twdb.texas.gov/waterplanning/waterusesurvey/estimates/

The 2022 SWP dataset can be verified by contacting Sabrina Anderson (sabrina.anderson@twdb.texas.gov or 512-936-0886).

For additional questions regarding this data, please contact Stephen Allen (stephen.allen@twdb.texas.gov or 512-463-7317).

Estimated Historical Water Use

TWDB Historical Water Use Survey (WUS) Data

Groundwater and surface water historical use estimates are currently unavailable for calendar year 2020. TWDB staff anticipates the calculation and posting of these estimates at a later date.

BEE COUNTY

All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2019	GW	2,254	0	24	0	2,287	444	5,009
	SW	2,617	0	3	0	0	111	2,731
2018	GW	2,603	0	0	0	2,729	444	5,776
	SW	2,331	0	0	0	0	111	2,442
2017	GW	2,663	0	0	0	2,848	428	5,939
	SW	2,078	0	0	0	0	107	2,185
2016	GW	2,781	0	0	0	2,684	472	5,937
	SW	2,522	0	0	0	0	118	2,640
2015	GW	2,622	0	20	0	1,939	464	5,045
	SW	2,937	0	2	0	0	116	3,055
2014	GW	2,831	0	36	0	2,531	455	5,853
	SW	2,668	0	4	0	0	114	2,786
2013	GW	2,992	0	29	0	2,979	458	6,458
	SW	3,797	0	3	0	8	114	3,922
2012	GW	3,198	0	12	0	4,068	545	7,823
	SW	4,285	0	1	0	16	136	4,438
2011	GW	3,428	0	73	0	2,846	941	7,288
	SW	3,860	0	8	0	1	235	4,104
2010	GW	2,896	0	206	0	4,389	910	8,401
	SW	3,118	0	175	0	0	227	3,520
2009	GW	2,743	0	200	0	2,975	625	6,543
	SW	2,513	0	169	0	0	156	2,838
2008	GW	2,656	0	193	0	6,220	680	9,749
	SW	2,529	0	164	0	0	170	2,863
2007	GW	2,513	0	0	0	2,759	1,054	6,326
	SW	2,572	0	0	0	0	264	2,836
2006	GW	2,925	0	0	0	5,269	654	8,848
	SW	3,557	0	0	0	0	164	824
2005	GW	2,977	0	0	0	4,114	680	7,771
	SW	2,670	0	0	0	0	170	2,840
2004	GW	2,797	0	0	0	3,430	68	6,295
	SW	2,251	0	0	0	0	800	3,051

Projected Surface Water Supplies
TWDB 2022 State Water Plan Data

BEE COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070
N	Beeville	San Antonio-Nueces	Corpus Christi-Choke Canyon Lake/Reservoir System	1,925	1,986	1,983	1,966	1,964	1,965
N	Irrigation, Bee	San Antonio-Nueces	San Antonio-Nueces Run-of-River	0	0	0	0	0	0
	Sum of Projected Surface Water Supplies (acre-feet)			**1,925**	**1,986**	**1,983**	**1,966**	**1,964**	**1,965**

Projected Water Demands
TWDB 2022 State Water Plan Data

Please note that the demand numbers presented here include the plumbing code savings found in the Regional and State Water Plans.

BEE COUNTY

All values are in acre-feet

WUG	RWPG	WUG Basin	2020	2030	2040	2050	2060	2070
N	Beeville	San Antonio-Nueces	3,336	3,397	3,394	3,377	3,375	3,376
N	County-Other, Bee	Nueces	2	2	2	2	2	2
N	County-Other, Bee	San Antonio-Nueces	1,873	1,898	1,891	1,872	1,870	1,870
N	El Oso WSC	Nueces	94	94	94	94	90	90
N	El Oso WSC	San Antonio-Nueces	6	7	7	7	6	6
N	Irrigation, Bee	Nueces	220	220	220	220	220	220
N	Irrigation, Bee	San Antonio-Nueces	4,205	4,205	4,205	4,205	4,205	4,205
N	Livestock, Bee	Nueces	80	80	80	80	80	80
N	Livestock, Bee	San Antonio-Nueces	754	754	754	754	754	754
N	Mining, Bee	Nueces	57	55	52	45	41	38
N	Mining, Bee	San Antonio-Nueces	415	403	376	327	297	280
N	Pettus MUD	San Antonio-Nueces	104	105	104	103	103	103
N	TDCJ Chase Field	San Antonio-Nueces	1,024	1,050	1,055	1,051	1,050	1,050
	Sum of Projected Water Demands (acre-feet)		**12,170**	**12,270**	**12,234**	**12,137**	**12,093**	**12,074**

Projected Water Supply Needs
TWDB 2022 State Water Plan Data

Negative values (in red) reflect a projected water supply need, positive values a surplus.

BEE COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
N	Beeville	San Antonio-Nueces	0	0	0	0	0	0
N	County-Other, Bee	Nueces	0	0	0	0	0	0
N	County-Other, Bee	San Antonio-Nueces	-1,657	-1,682	-1,675	-1,656	-1,654	-1,654
N	El Oso WSC	Nueces	-94	-94	-94	-94	-90	-90
N	El Oso WSC	San Antonio-Nueces	0	0	0	0	0	0
N	Irrigation, Bee	Nueces	0	0	0	0	0	0
N	Irrigation, Bee	San Antonio-Nueces	-352	-352	-352	-352	-352	-352
N	Livestock, Bee	Nueces	0	0	0	0	0	0
N	Livestock, Bee	San Antonio-Nueces	0	0	0	0	0	0
N	Mining, Bee	Nueces	0	0	0	0	0	0
N	Mining, Bee	San Antonio-Nueces	-197	-185	-158	-109	-79	-62
N	Pettus MUD	San Antonio-Nueces	0	0	0	0	0	0
N	TDCJ Chase Field	San Antonio-Nueces	-177	-203	-208	-204	-203	-203
	Sum of Projected Water Supply Needs (acre-feet)		**-2,477**	**-2,516**	**-2,487**	**-2,415**	**-2,378**	**-2,361**

Projected Water Management Strategies
TWDB 2022 State Water Plan Data

BEE COUNTY

WUG, Basin (RWPG) All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
Beeville, San Antonio-Nueces (N)							
Municipal Conservation - Beeville	DEMAND REDUCTION [Bee]	0	254	502	757	806	806
		0	**254**	**502**	**757**	**806**	**806**
County-Other, Bee, San Antonio-Nueces (N)							
Gulf Coast Supplies - Bee County Other	Gulf Coast Aquifer System [Bee]	1,682	1,682	1,682	1,682	1,682	1,682
		1,682	**1,682**	**1,682**	**1,682**	**1,682**	**1,682**
El Oso WSC, Nueces (N)							
Drought Management - El Oso WSC	DEMAND REDUCTION [Bee]	2	0	0	0	0	0
Gulf Coast Aquifer Supplies - Region N El Oso WSC	Gulf Coast Aquifer System [Bee]	92	86	81	79	75	73
Municipal Water Conservation - Region N El Oso WSC	DEMAND REDUCTION [Bee]	0	8	13	15	15	17
		94	**94**	**94**	**94**	**90**	**90**
El Oso WSC, San Antonio-Nueces (N)							
Gulf Coast Aquifer Supplies - Region N El Oso WSC	Gulf Coast Aquifer System [Bee]	1	1	1	1	0	0
Municipal Water Conservation - Region N El Oso WSC	DEMAND REDUCTION [Bee]	0	1	1	1	1	1
		1	**2**	**2**	**2**	**1**	**1**
Irrigation, Bee, Nueces (N)							
Irrigation Conservation - Bee County	DEMAND REDUCTION [Bee]	5	10	16	21	26	31
		5	**10**	**16**	**21**	**26**	**31**
Irrigation, Bee, San Antonio-Nueces (N)							
Gulf Coast Supplies - Bee Irrigation	Gulf Coast Aquifer System [Bee]	352	352	352	352	352	352
Irrigation Conservation - Bee County	DEMAND REDUCTION [Bee]	100	200	299	400	500	600
		452	**552**	**651**	**752**	**852**	**952**
Mining, Bee, Nueces (N)							
Mining Water Conservation	DEMAND REDUCTION [Bee]	1	2	3	4	4	5
		1	**2**	**3**	**4**	**4**	**5**

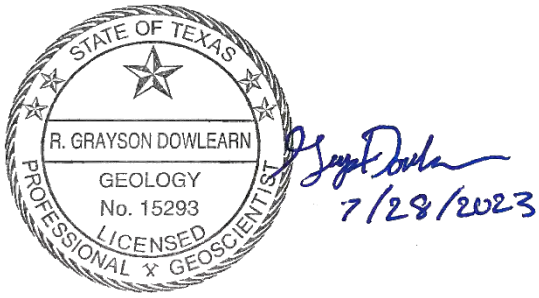
Projected Water Management Strategies
TWDB 2022 State Water Plan Data

WUG, Basin (RWPG) All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
Mining, Bee, San Antonio-Nueces (N)							
Gulf Coast Supplies - Bee Mining	Gulf Coast Aquifer System [Bee]	197	197	197	197	197	197
Mining Water Conservation	DEMAND REDUCTION [Bee]	9	18	25	29	33	37
		206	**215**	**222**	**226**	**230**	**234**
TDCJ Chase Field, San Antonio-Nueces (N)							
Gulf Coast Supplies - TDCJ Chase Field	Gulf Coast Aquifer System [Bee]	208	208	208	208	208	208
Municipal Conservation - TDCJ Chase Field	DEMAND REDUCTION [Bee]	0	85	167	247	322	391
		208	**293**	**375**	**455**	**530**	**599**
Sum of Projected Water Management Strategies (acre-feet)		**2,649**	**3,104**	**3,547**	**3,993**	**4,221**	**4,400**

GAM RUN 23-016: BEE GROUNDWATER CONSERVATION DISTRICT MANAGEMENT PLAN

Sofia Avendaño and Grayson Dowlearn, P. G.
Texas Water Development Board
Groundwater Division
Groundwater Modeling Department
512-936-6079
July 28, 2023



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GAM RUN 23-016: BEE GROUNDWATER CONSERVATION DISTRICT MANAGEMENT PLAN

Sofia Avendaño and Grayson Dowlearn, P. G.
Texas Water Development Board
Groundwater Division
Groundwater Modeling Department
512-936-6079
July 28, 2023

EXECUTIVE SUMMARY:

Texas Water Code § 36.1071 (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.

The TWDB provides data and information to the Bee 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, which includes:

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

2. the annual volume of water that discharges from the aquifer to springs and any surface-water bodies, including lakes, streams, and rivers, for each aquifer within the district; 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 Bee Groundwater Conservation District should be adopted by the district on or before August 2, 2023 and submitted to the executive administrator of the TWDB on or before September 1, 2023. The current management plan for the Bee Groundwater Conservation District expires on October 31, 2023.

We used the groundwater availability models for the southern portion of the Carrizo-Wilcox, Queen City and Sparta aquifers (Panday and others, 2023) and the central and southern portions of the Gulf Coast Aquifer System (Shi and Boghici, 2023) to estimate the management plan information for the Carrizo-Wilcox Aquifer and Gulf Coast Aquifer System within the Bee Groundwater Conservation District.

This report replaces the results of GAM Run 17-015 (Wade, 2017). Values may differ from the previous report since this report uses two new groundwater availability models that replace both groundwater availability models from the previous report. Tables 1 and 2 summarize the groundwater availability model data required by statute. Figures 1 and 3 show the area of the model from which the values in Tables 1 and 2 were extracted. Figures 2 and 4 provide a generalized diagram of the groundwater flow components provided in Tables 1 and 2. If the Bee Groundwater Conservation District determines that the district boundaries used in the assessment do not reflect current conditions after reviewing the figures, please notify the TWDB Groundwater Modeling Department at your earliest convenience.

The flow components presented in this report do not represent the full groundwater budget. If additional inflow and outflow information would be helpful for planning purposes, the district may submit a request in writing to the TWDB Groundwater Modeling Department for the full groundwater budget.

METHODS:

In accordance with the provisions of the Texas Water Code § 36.1071 (h), the groundwater availability models mentioned above were used to estimate information for the Bee Groundwater Conservation District management plan. Water budgets were extracted for the historical calibration period for the Carrizo-Wilcox Aquifer (1981 through 2017) using ZONEBUDGET for MODFLOW 6 (Langevin and others, 2021). Water budgets were extracted for the historical calibration period for the Gulf Coast Aquifer System (1981 through 2015) using ZONEBUDGET for MODFLOW USG Version 1.0 (Panday and others, 2013). The average annual water budget values for recharge, surface-water outflow, inflow to the district, outflow from the district, and the flow between aquifers within the district are summarized in this report.

PARAMETERS AND ASSUMPTIONS:

Carrizo-Wilcox Aquifer

- We used version 3.01 of the groundwater availability model for the southern portion of the Carrizo-Wilcox, Queen City and Sparta aquifers (Panday and others, 2023) to analyze the Carrizo-Wilcox Aquifer. See Panday and others (2023) for assumptions and limitations of the model.
- The groundwater availability model for the southern Carrizo-Wilcox, Queen City and Sparta aquifers includes the following nine layers:
    - Layer 1 represents Quaternary Alluvium
    - Layer 2 represents Younger Units
    - Layer 3 represents the Sparta Aquifer and equivalent units
    - Layer 4 represents the Weches confining unit
    - Layer 5 represents the Queen City Aquifer and equivalent units
    - Layer 6 represents the Reklaw confining unit
    - Layer 7 through 9 represent the Carrizo-Wilcox Aquifer and equivalent units
- The model was run with MODFLOW 6 (Langevin and others, 2017)
- Individual water budgets for the district were determined for the Carrizo-Wilcox Aquifer (Layers 7 through 9, collectively). The Sparta Aquifer and Queen City Aquifer do not exist within the district boundaries.
- Water budget terms were averaged for the period 1981 through 2017 (stress periods 3 through 39)

Gulf Coast Aquifer System

- We used version 1.01 of the groundwater availability model for the central and southern portions of the Gulf Coast Aquifer System (Shi and Boghici, 2023) to analyze the Gulf Coast Aquifer System. See Shi and Boghici (2023) for assumptions and limitations of the model.

- The groundwater availability model for the central and southern portions of the Gulf Coast Aquifer System includes the following four layers in the Bee Groundwater Conservation District:
    - Layer 1 represents Chicot Aquifer and younger units
    - Layer 2 represents the Evangeline Aquifer
    - Layer 3 represents the Burkeville Unit
    - Layer 4 represents the Jasper Aquifer and the upper sandy portion of the Catahoula Formation in direct hydrologic communication with the Jasper Aquifer
- The model was run with MODFLOW-USG (Panday and others, 2013).
- Water budgets for the district were determined for the Gulf Coast Aquifer System (layers 1 through 4, collectively).
- Water budget terms were averaged for the period 1981 through 2015 (stress periods 2 through 36).

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 groundwater availability model results for the Carrizo-Wilcox Aquifer and the Gulf Coast Aquifer System located within the Bee Groundwater Conservation District and averaged over the historical calibration period, 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. Figures 1 and 3 show the area of the model from which the values in Tables 1 and 2 were extracted. Figures 2 and 4 provide a generalized diagram of the groundwater flow components provided 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 Carrizo-Wilcox Aquifer that is needed for the Bee Groundwater Conservation District 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	Carrizo-Wilcox Aquifer	0
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Carrizo-Wilcox Aquifer	0
Estimated annual volume of flow into the district within each aquifer in the district	Carrizo-Wilcox Aquifer	38
Estimated annual volume of flow out of the district within each aquifer in the district	Carrizo-Wilcox Aquifer	121
Estimated net annual volume of flow between each aquifer in the district	To Carrizo-Wilcox Aquifer from Reklaw confining unit	13
	To Carrizo-Wilcox Aquifer from Carrizo-Wilcox equivalent units	115

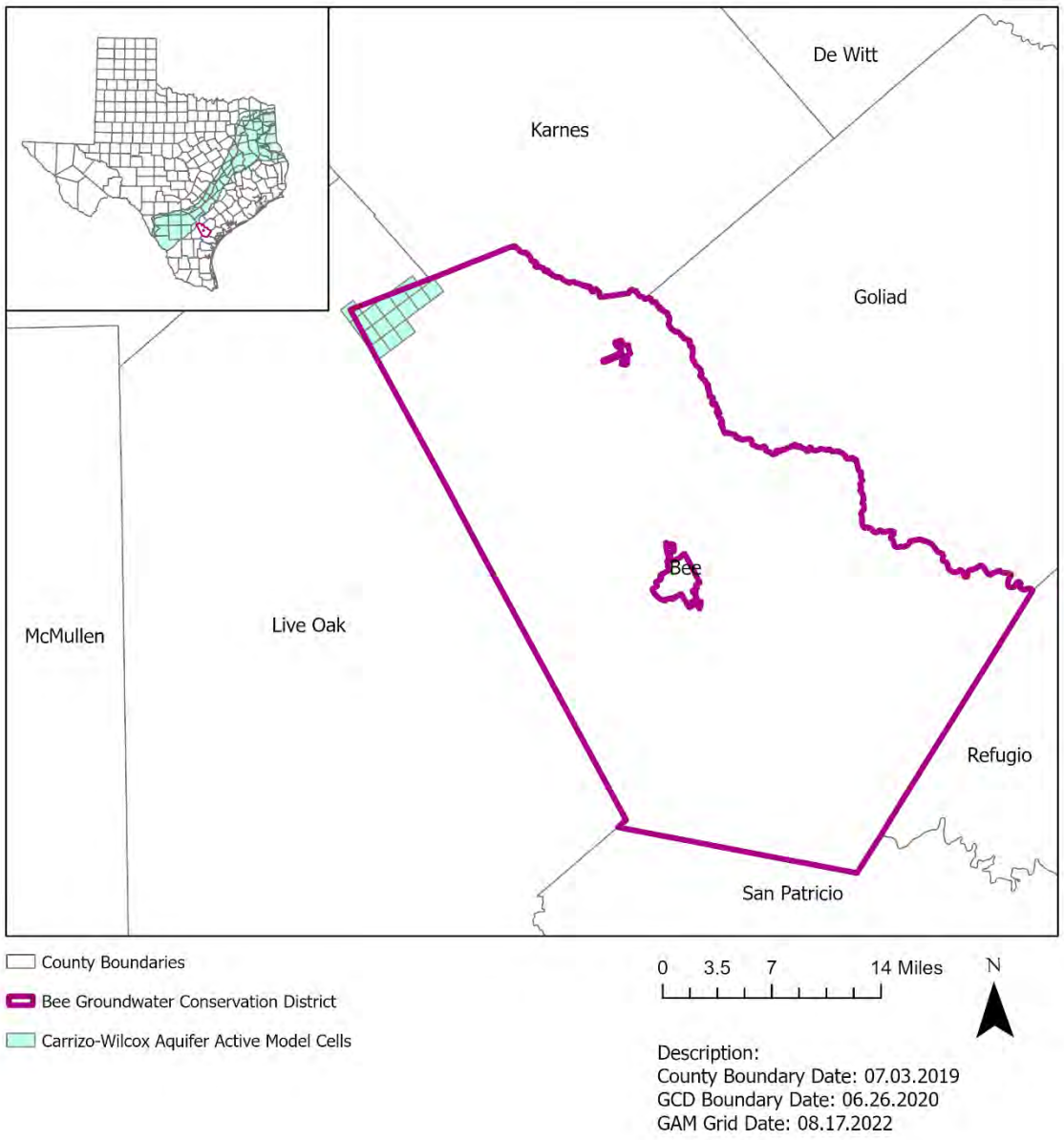
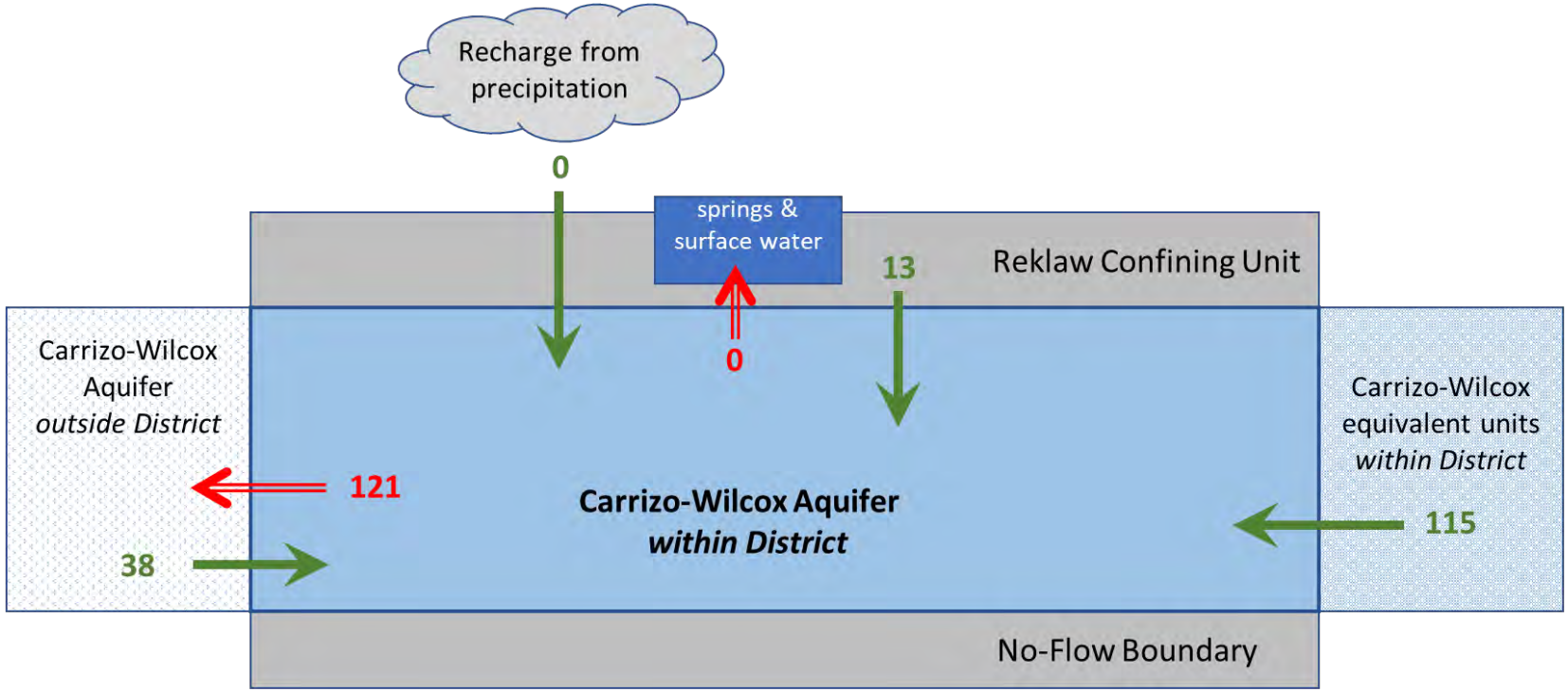


Figure 1: Area of the groundwater availability model for the southern portion of the Carrizo-Wilcox, Queen City, and Sparta aquifers from which the information in Table 1 was extracted (the Carrizo-Wilcox Aquifer extent within the district boundary).



Caveat: This diagram only includes the water budget items provided in Table 1. A complete water budget would include additional inflows and outflows. For a full groundwater budget, please submit a request in writing to the Groundwater Modeling Department.

Figure 2: Generalized diagram of the summarized budget information from Table 1, representing directions of flow for the Carrizo-Wilcox Aquifer within the Bee Groundwater Conservation District. Flow values are expressed in acre-feet per year.

Table 2: Summarized information for the Gulf Coast Aquifer System that is needed for the Bee Groundwater Conservation District 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 System	57,398
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 System	110,114
Estimated annual volume of flow into the district within each aquifer in the district	Gulf Coast Aquifer System	138,135
Estimated annual volume of flow out of the district within each aquifer in the district	Gulf Coast Aquifer System	271,733
Estimated net annual volume of flow between each aquifer in the district	From Gulf Coast Aquifer System to underlying older units	110,179

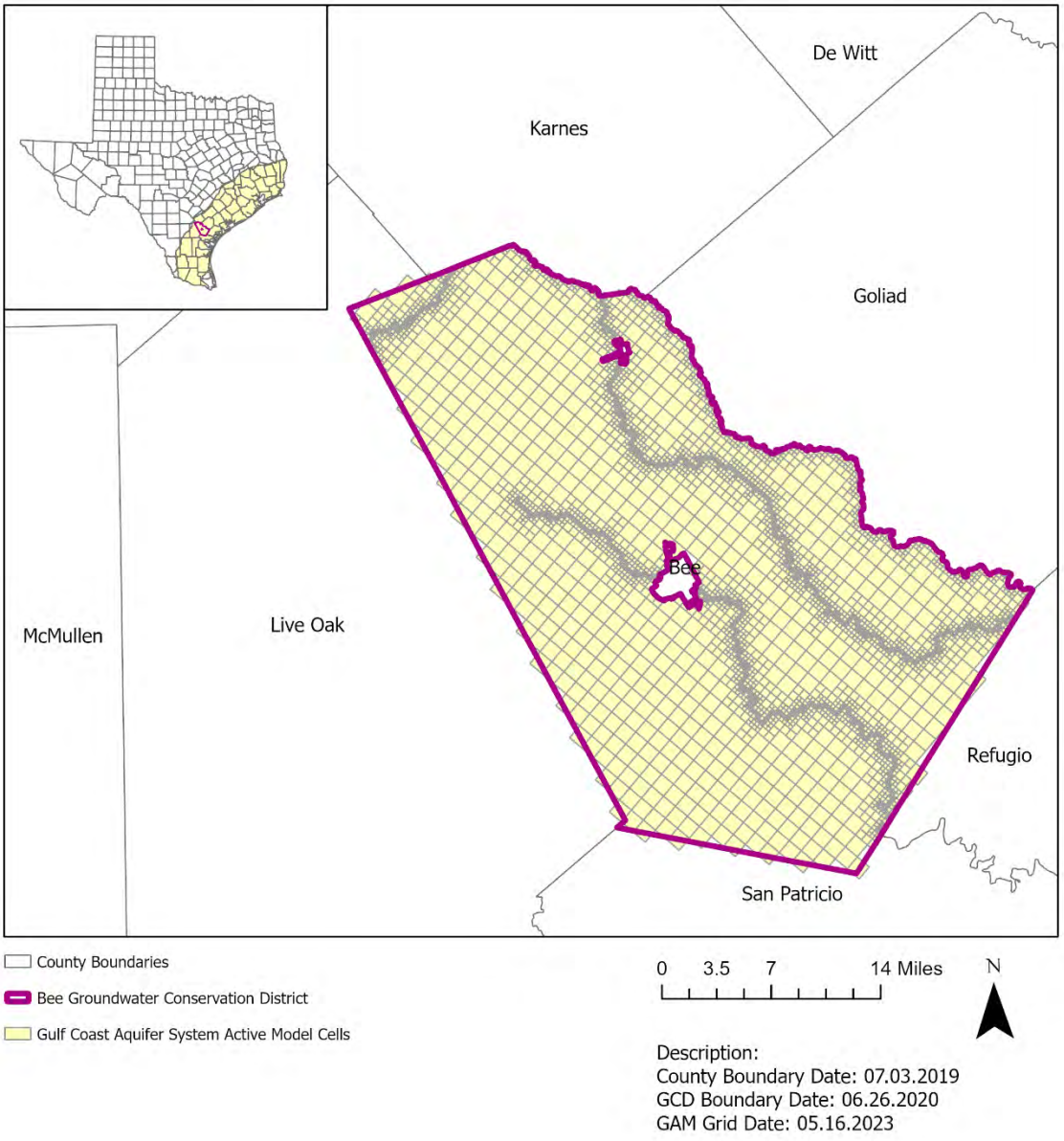
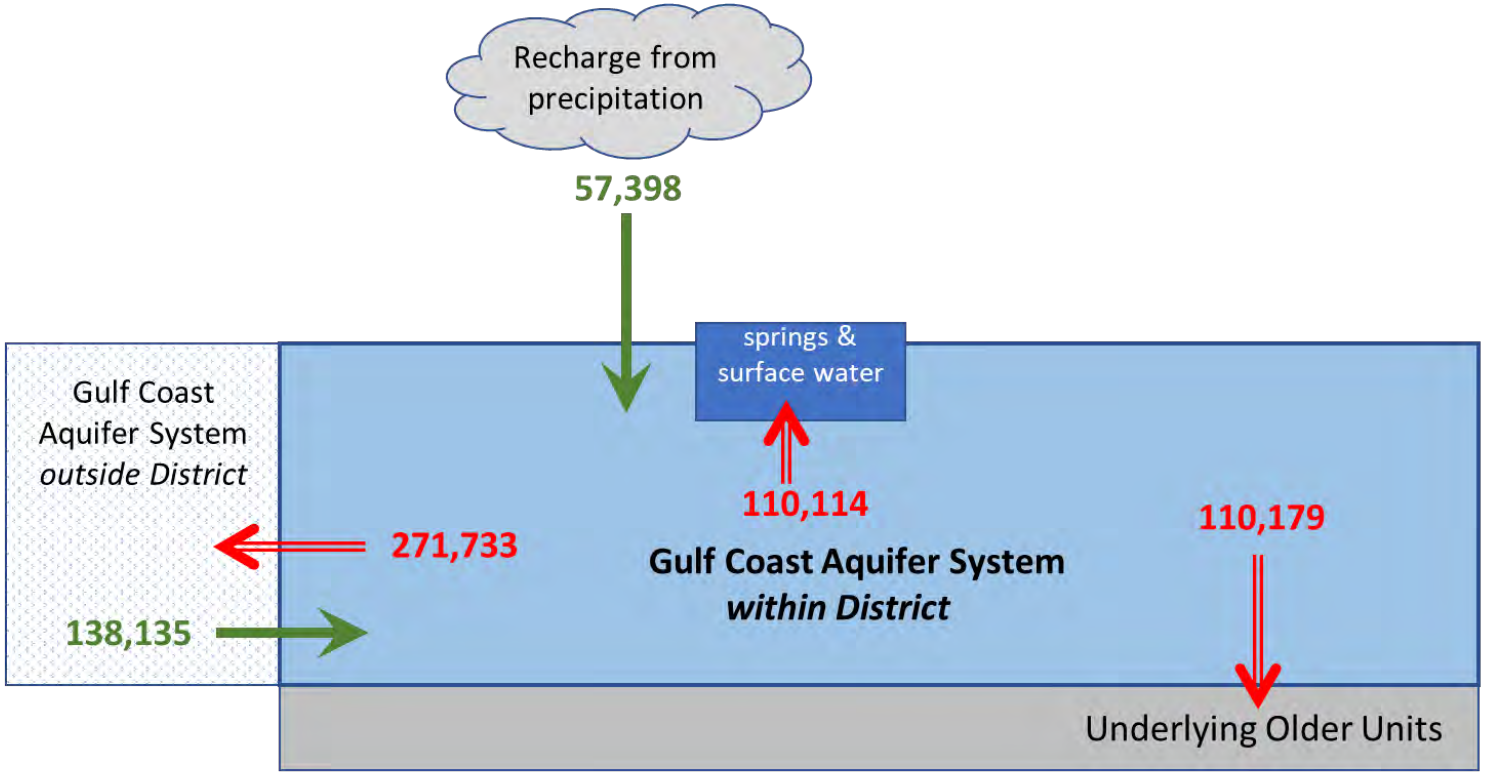


Figure 3: Area of the groundwater availability model for the central and southern portions of the Gulf Coast Aquifer System from which the information in Table 2 was extracted (the Gulf Coast Aquifer System extent within the district boundary).



Caveat: This diagram only includes the water budget items provided in Table 2. A complete water budget would include additional inflows and outflows. For a full groundwater budget, please submit a request in writing to the Groundwater Modeling Department.

Figure 4: Generalized diagram of the summarized budget information from Table 2, representing directions of flow for the Gulf Coast Aquifer System within the Bee Groundwater Conservation District. Flow values are expressed in acre-feet per year.

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 historical 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.

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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.

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Panday, S., Wyckoff, R., Martell, G., Schorr, S., Zivic, M., Hutchinson, W. R., and Rumbaugh, J., 2023, Final Numerical Model Report: Update to the Groundwater Availability Model fo the Southern Portion of the Queen City, Sparta, and Carrizo-Wilcox Aquifers by GSI Environmental Inc., 387 p., https://www.twdb.texas.gov/groundwater/models/gam/czwx_s/South_QCSCW_ModelRpt_Final_w_appendicies.pdf?d=10187

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Texas Water Code § 36.1071

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VG-5184-2024-6

Bee County
Michele Bridge
Bee County Clerk

Instrument Number: 6

Public Notice

Recorded On: January 19, 2024 08:41 AM

Number of Pages: 2

" Examined and Charged as Follows: "

Total Recording: $0.00

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Receipt Number:	20240119000004	
Recorded Date/Time:	January 19, 2024 08:41 AM	
User:	Brittani C	TX
Station:	172.16.14.9	

STATE OF TEXAS
Bee County
I hereby certify that this Instrument was filed in the File Number sequence on the date/time printed hereon, and was duly recorded in the Official Records of Bee County, Texas

Michele Bridge
Bee County Clerk
Bee County, TX

Michele Bridge

BEE
GROUNDWATER CONSERVATION DISTRICT
NOTICE OF MEETING

Notice is hereby given that a Regular Meeting of the Board of Directors of the Bee Groundwater Conservation District (BGCD) will be held on **THURSDAY, JANUARY 25, 2024** at **8:00 a.m.** at the Bee County Farm Bureau office.

Lonnie C. Stewart

Lonnie Stewart - Manager

Agenda

1. Declaration of Quorum and Call to Order
2. Public Comments: Public Hearing concerning the District Management Plan

Consider and /or Action On:

3. Minutes of previous meeting
4. Financial report
5. Expenses
6. Approve the District Management Plan
7. Appoint Noel Snedecker to perform the 2023 Audit
8. GMA 15 Update
9. Future agenda items and next meeting
10. Adjourn

POST OFFICE Box 682 * BEEVILLE, TEXAS 78104
361-358-2244

Approved District Management Plan for Bee GCD

From: Lonnie Stewart (louwcd@yahoo.com)

To: mcraggie77@aol.com; mariacr@cctexas.com; lpena@brushcountrygcd.com; trynefarm@aol.com; general_manager@kenedygcd.com; duvalgcd.gm@gmail.com; mcmullengcd@yahoo.com; estebanr2@cctexas.com; wsb3@aol.com; rguerra@co.starr.tx.us; durasnillo28@hotmail.com; nhudgins@cbgcd.com; jim@ccgcd.net; david@fayettecountygroundwater.com; director@pvgcd.org; melissa.gonzalez@evergreenuwcd.org; tim.andruss@vcgcd.org; tgraham192@gmail.com; gcgcd@goliadcogcd.org; louwcd@yahoo.com

Cc: jbyrum@nueces-ra.org; peggy.hunka@tceq.texas.gov; stephen.allen@twdb.texas.gov; robert.bradley@twdb.texas.gov

Date: Thursday, January 25, 2024 at 10:02 AM CST

Everyone, I am attaching the approved District Management Plan that was approved by the board this morning. Let me know if you have any questions.

Thanks,
Lonnie Stewart
LOUWCD: 361-449-1151
BGCD: 361-358-2244
Mobile Phone: 361-449-7017

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