BEE GROUNDWATER CONSERVATION DISTRICT MANAGEMENT PLAN

Bee Groundwater Conservation District
Management Plan
Adopted 08/21/2013

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 August 21, 2018, which ever 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, Bob Awalt- Vice-Chairman, Mark Sugarek - Secretary, David Baker - Treasurer, Ellis McKinney, Bob Gayle, 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, and range in age from Eocene to Pliocene. The formational 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 and is reported to be 21,094

acre feet per year in GAM 12-012 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 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 data is provided in Appendix A.

The Desired Future Conditions for GMA 15 is a drawdown of 8.9 feet overall, and the DFC for GMA 16 is a drawdown of 58 feet overall. The MAG for GMA 16 is 10,660 Ac/Ft according to GAM run 10-047 MAG. The MAG for GMA 15 is as follows according to GAM run 10-028 MAG:
2010: 9504 Ac/Ft.
2020: 9504 Ac/Ft.
2030: 9480 Ac/Ft.
2040: 9480 Ac/Ft.
2050: 9428 Ac/Ft.
2060: 9428 Ac/Ft.

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 make a regular assessment of water supply and groundwater

storage conditions and will report those conditions to the Board and to the public. 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 rules for Bee GCD can be found at our website: www.beegcd.com.

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: Providing 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: 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.

Performance standard:

(a) Report to the District Board annually the number of water level measurements.
(b) The District will investigate all reports of waste of groundwater within five working days. The number of reports of waste as well as the investigation findings will be reported to the District Board in the annual report.

Goal 3.0: Controlling and preventing subsidence

The geologic framework of the District Area precludes any significant subsidence from occurring. This management goal is not applicable to the operations of the District.

Goal 4.0: Conjunctive surface water management issues

Except as provided in Chapter 36 of the Texas Water Code, the District has no jurisdiction over surface water. The District shall consider the effects of surface water resources as required by Section 36.113 and other state law. This goal is not applicable.

Goal 5.0: Natural Resource Issues

Management Objective:

The District will cooperate with other interested parties and appropriate agencies to develop additional information on aquifer recharge.

Performance Standard:

A representative of the District will attend a meeting annually with interested parties and appropriate agencies.

Goal 6.0: Drought Conditions

Management Objective:

The District will monitor the Palmer Drought Severity Index (PDSI).

Performance Standard:

A report of the Palmer Drought Severity Index will be presented to the District board on an annual basis.

Goal 7.0: 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: 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 Assn. annually.

Goal 9.0: Recharge Enhancement

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

Goal 10.0: Rainwater Harvesting

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

Goal 11.0: Brush Control

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

Goal 12.0: 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 sample the water levels in at least three monitoring wells within the District and will determine the five-year water level averages based on the samples 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 samples taken each year for the purpose of measuring water levels to assess the District's progress towards achieving its Desired Future Conditions. Once the District has obtained water level samples for five consecutive years and is able to calculate water level averages over five-year periods thereafter, 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.

RESOLUTION 08/21/2013

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_____ Nays _____ Not Present _____

Passed and Approved this the 21st. day of August, 2013.

_____ Attest by:_____

Tryne Mengers, President Mark Sugarek, Secretary

Appendix A

Estimated Historical Groundwater Use And 2012 State Water Plan Datasets:

Bee Groundwater Conservation District

by Stephen Allen
Texas Water Development Board
Groundwater Resources Division
Groundwater Technical Assistance Section
stephen.allen@twdb.texas.gov
(512) 463-7317
August 5, 2013

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.state.tx.us/groundwater/doc/GCD/GMPChecklist0113.pdf

The five reports included in part 1 are:

1. Estimated Historical Groundwater 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)
   reports 2-5 are from the 2012 State Water Plan (SWP)

Part 2 of the 2-part package is the groundwater availability model (GAM) report. 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 updated Historical Groundwater Use and 2012 State Water Planning data available as of 8/5/2013. Although it does not happen frequently, neither of these datasets are static and are subject to change pending the availability of more accurate data (Historical Water Use Survey data) or an amendment to the 2012 State Water Plan (2012 State Water Planning data). District personnel must review these datasets and correct any discrepancies in order to ensure approval of their groundwater management plan.

The Historical Water Use dataset can be verified at this web address:

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

The 2012 State Water Planning dataset can be verified by contacting Wendy Barron (wendy.barron@twdb.texas.gov or 512-936-0886).

The values presented in the data tables of this report are county-based. In cases where groundwater conservation districts cover only a portion of one or more counties the data values are modified with an apportioning multiplier to create new values that more accurately represent district conditions. The multiplier used as part of the following formula is a land area ratio: (data value * (land area of district in county / land area of county)). For two of the four State Water Plan tables (Projected Surface Water Supplies and Projected Water Demands) only the county-wide water user group (WUG) data values (county other, manufacturing, steam electric power, irrigation, mining and livestock) are modified using the multiplier. WUG values for municipalities, water supply corporations, and utility districts are not apportioned; instead, their full values are retained when they are located within the district, and eliminated when they are located outside (we ask each district to identify these locations).

The two other SWP tables (Projected Water Supply Needs and Projected Water Management Strategies) are not apportioned because district-specific values are not statutorily required. Each district needs only "consider" the county values in those tables.

In the Historical Groundwater Use table every category of water use (including municipal) is apportioned. Staff determined that breaking down the annual municipal values into individual WUGs was too complex.

TWDB recognizes that the apportioning formula used is not perfect but it is the best available process with respect to time and staffing constraints. If a district believes it has data that is more accurate it has the option of including those data in the plan with an explanation of how the data were derived. Apportioning percentages are listed above each applicable table.

For additional questions regarding this data, please contact Stephen Allen (stephen.allen@twdb.texas.gov or 512-463-7317) or Rima Petrossian (rima.petrossian@twdb.texas.gov or 512-936-2420).

Estimated Historical Groundwater Use
TWDB Historical Water Use Survey (WUS) Data

Groundwater historical use estimates are currently unavailable for calendar years 2005, 2011 and 2012. TWDB staff anticipates the calculation and posting of these estimates at a later date.

BEE COUNTY *99.20 % (multiplier)* All values are in acre-feet/year

Year	Source	Municipal	Manufacturing	Steam Electric	Irrigation	Mining	Livestock	Total
1974	GW	3,827	32	0	1,598	123	1,147	6,727
1980	GW	3,605	74	0	1,984	383	94	6,140
1984	GW	3,988	1	0	1,324	143	119	5,575
1985	GW	2,531	1	0	712	120	102	3,466
1986	GW	1,636	1	0	972	0	108	2,717
1987	GW	1,625	1	0	649	20	102	2,397
1988	GW	1,661	1	0	972	21	111	2,766
1989	GW	1,741	1	0	2,214	20	108	4,084
1990	GW	1,623	1	0	3,274	20	107	5,025
1991	GW	1,608	1	0	3,523	29	110	5,271
1992	GW	1,593	1	0	2,242	29	83	3,948
1993	GW	1,856	1	0	675	29	87	2,648
1994	GW	1,860	0	0	705	29	94	2,688
1995	GW	2,191	1	0	210	29	98	2,529
1996	GW	2,348	1	0	2,434	29	87	4,899
1997	GW	2,324	1	0	1,091	29	98	3,543
1998	GW	2,455	1	0	3,224	29	85	5,794
1999	GW	2,315	1	0	2,161	29	99	4,605
2000	GW	2,310	1	0	2,776	29	99	5,215
2001	GW	1,729	1	0	3,078	15	76	4,899
2002	GW	1,849	1	0	3,381	15	75	5,321
2003	GW	2,367	4	0	2,996	15	68	5,450
2004	GW	2,637	1	0	3,430	15	68	6,151
2006	GW	1,899	1	0	5,269	0	654	7,823
2007	GW	1,852	0	0	2,759	0	1,054	5,665
2008	GW	2,651	0	0	6,220	0	680	9,551
2009	GW	2,742	1	0	2,975	200	625	6,543
2010	GW	2,896	0	0	4,390	206	911	8,403

Projected Surface Water Supplies
TWDB 2012 State Water Plan Data

BEE COUNTY *99.20 % (multiplier)* All values are in acre-feet/year

RWPG	WUG	WUG Basin	Source Name	2010	2020	2030	2040	2050	2060
N	BEEVILLE	SAN ANTONIO-NUECES	CORPUS CHRISTI-CHOKE CANYON LAKE/RESERVOIR SYSTEM						
N	IRRIGATION	SAN ANTONIO-NUECES	SAN ANTONIO-NUECES RIVER COMBINED RUN-OF-RIVER IRRIGATION	42	42	42	42	42	42
N	LIVESTOCK	NUECES	LIVESTOCK LOCAL SUPPLY	106	106	106	106	106	106
N	LIVESTOCK	SAN ANTONIO-NUECES	LIVESTOCK LOCAL SUPPLY	794	794	794	794	794	794
	Sum of Projected Surface Water Supplies (acre-feet/year)			**942**	**942**	**942**	**942**	**942**	**942**

Projected Water Demands
TWDB 2012 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

99.20 % (multiplier)

All values are in acre-feet/year

RWPG	WUG	WUG Basin	2010	2020	2030	2040	2050	2060
N	COUNTY-OTHER	NUECES	16	17	17	17	16	16
N	MINING	NUECES	16	18	19	20	21	22
N	LIVESTOCK	NUECES	118	118	118	118	118	118
N	EL OSO WSC	NUECES	55	57	58	58	57	56
N	IRRIGATION	NUECES	377	416	459	509	559	617
N	COUNTY-OTHER	SAN ANTONIO-NUECES	1,632	1,671	1,674	1,644	1,620	1,580
N	BEEVILLE	SAN ANTONIO-NUECES						
N	MANUFACTURING	SAN ANTONIO-NUECES	1	1	1	1	1	1
N	MINING	SAN ANTONIO-NUECES	20	22	23	24	25	26
N	IRRIGATION	SAN ANTONIO-NUECES	3,389	3,744	4,136	4,566	5,047	5,576
N	LIVESTOCK	SAN ANTONIO-NUECES	869	869	869	869	869	869
N	EL OSO WSC	SAN ANTONIO-NUECES	7	8	8	8	8	8
	Sum of Projected Water Demands (acre-feet/year)		**6,500**	**6,941**	**7,382**	**7,834**	**8,341**	**8,889**

Projected Water Supply Needs
TWDB 2012 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/year

RWPG	WUG	WUG Basin	2010	2020	2030	2040	2050	2060
N	BEEVILLE	SAN ANTONIO-NUECES	0	1	0	0	0	0
N	COUNTY-OTHER	NUECES	0	0	1	0	0	0
N	COUNTY-OTHER	SAN ANTONIO-NUECES	0	0	0	0	0	0
N	EL OSO WSC	NUECES	0	0	0	0	0	0
N	EL OSO WSC	SAN ANTONIO-NUECES	0	0	0	0	0	0
N	IRRIGATION	NUECES	0	0	0	0	0	0
N	IRRIGATION	SAN ANTONIO-NUECES	0	0	0	0	-299	-890
N	LIVESTOCK	NUECES	0	0	0	0	0	0
N	LIVESTOCK	SAN ANTONIO-NUECES	0	0	0	0	0	0
N	MANUFACTURING	SAN ANTONIO-NUECES	0	0	0	0	0	0
N	MINING	NUECES	1	0	0	0	0	0
N	MINING	SAN ANTONIO-NUECES	0	0	0	0	0	0
	Sum of Projected Water Supply Needs (acre-feet/year)		**0**	**0**	**0**	**0**	**-299**	**-890**

Projected Water Management Strategies
TWDB 2012 State Water Plan Data

BEE COUNTY

WUG, Basin (RWPG)

All values are in acre-feet/year

Water Management Strategy	Source Name [Origin]	2010	2020	2030	2040	2050	2060
IRRIGATION, SAN ANTONIO-NUECES (N)							
GULF COAST AQUIFER SUPPLIES	GULF COAST AQUIFER [BEE]	0	0	0	0	2,016	2,016
Sum of Projected Water Management Strategies (acre-feet/year)		**0**	**0**	**0**	**0**	**2,016**	**2,016**

GAM Run 12-012: Bee Groundwater Conservation District Management Plan

by William Kohlrenken
Texas Water Development Board
Groundwater Resources Division
Groundwater Availability Modeling Section
(512) 463-8279
June 25, 2012

Cynthia K. Ridgeway is the Manager of the Groundwater Availability Modeling Section and is responsible for oversight of work performed by William Kohlrenken under her direct supervision. The seal appearing on this document was authorized by Cynthia K. Ridgeway, P.G. 471 on June 25, 2012.

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GAM RUN 12-012: BEE GROUNDWATER CONSERVATION DISTRICT MANAGEMENT PLAN

by William Kohlrenken
Texas Water Development Board
Groundwater Resources Division
Groundwater Availability Modeling Section
(512) 463-8279
June 25, 2012

EXECUTIVE SUMMARY:

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

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

The purpose of this report is to provide Part 2 of a two-part package of information from the TWDB to Bee Groundwater Conservation District management plan to fulfill the requirements noted above. The groundwater management plan for the Bee Groundwater Conservation District is due for approval by the executive administrator of the TWDB before September 25, 2013.

This report discusses the method, assumptions, and results from model runs using the groundwater availability model for the central portion of the Gulf Coast Aquifer and the southern portion of the Carrizo-Wilcox, Queen City, and Sparta aquifers. Tables 1 and 2 summarize the groundwater availability model data required by the statute, and Figures 1 and 2 show the area of the model from which the values in the tables were extracted. This model run replaces the results of GAM Run 08-01. If after review of the figure, Bee Groundwater Conservation District determines that the district boundaries used in the assessment do not reflect current conditions, please notify the Texas Water Development Board immediately.

METHODS:

The groundwater availability model for the central portion of the Gulf Coast Aquifer and the southern portion of the Carrizo-Wilcox, Queen City, and Sparta aquifers was run for this analysis. Water budgets for the Gulf Coast Aquifer (1981 through 1999) and for the Carrizo-Wilcox Aquifer (1980 through 1999) were extracted. The average annual water budget values for recharge, surface water outflow, inflow to the district, outflow from the district, net inter-aquifer flow (upper), and net inter-aquifer flow (lower) for the portions of the aquifers located within the district are summarized in this report.

PARAMETERS AND ASSUMPTIONS:

Gulf Coast Aquifer

- Version 1.01 of the groundwater availability model for the central section of the Gulf Coast Aquifer was used for this analysis. See Chowdhury and others (2004) and Waterstone and others (2003) for assumptions and limitations of the groundwater availability model.
- The model for the central section of the Gulf Coast Aquifer assumes partially penetrating wells in the Evangeline Aquifer due to a lack of data for aquifer properties in the lower section of the aquifer.
- This groundwater availability model includes four layers, which generally correspond to (from top to bottom):
    1. the Chicot Aquifer,
    2. the Evangeline Aquifer,
    3. the Burkeville Confining Unit, and

4. the Jasper Aquifer including parts of the Catahoula Formation.

- The mean absolute error (a measure of the difference between simulated and measured water levels) in the entire model for 1999 is 26 feet, which is 4.6 percent of the hydraulic head drop across the model area (Chowdhury and others, 2004).
- Processing Modflow for Windows (PMWIN) version 5.3 (Chiang and Kinzelbach, 2001) was used as the interface to process model output.

Carrizo-Wilcox Aquifer

- Version 2.01 of the groundwater availability model for the southern part of the Carrizo-Wilcox, Queen City, and Sparta aquifers was used for this analysis. See Deeds and others (2003) and Kelley and others (2004) for assumptions and limitations of the groundwater availability model for the southern part of the Carrizo-Wilcox Aquifer.
- This groundwater availability model includes eight layers, which generally correspond to (from top to bottom):

    1. the Sparta Aquifer,
    2. the Weches Confining Unit,
    3. the Queen City Aquifer,
    4. the Reklaw Confining Unit,
    5. the Carrizo Aquifer,
    6. the Upper Wilcox Aquifer,
    7. the Middle Wilcox Aquifer, and
    8. the Lower Wilcox Aquifer.

- Of the eight layers listed above, an individual water budget for the district was determined for the combined layers of the Carrizo-Wilcox Aquifer (Layers 5 through 8). The Queen City (layer 3) and Sparta (layer 1) aquifers lie outside the district boundaries and information from the corresponding model layers were not used for this report.
- The root mean square error (a measure of the difference between simulated and actual water levels during model calibration) in the groundwater

availability model is 33 feet for the calibration period (1980 to 1990) and 48 feet in the verification period (1991 to 1999) for the Carrizo-Wilcox Aquifer (Kelley and others, 2004). These root mean square errors are between seven and ten percent of the range of measured water levels (Kelley and others, 2004).

- Groundwater in the Carrizo-Wilcox Aquifer ranges from fresh to brackish in composition (Kelley and others, 2004). Groundwater with total dissolved solids concentrations of less than 1,000 milligrams per liter (mg/l) are considered fresh and total dissolved solids concentrations of 1,000 to 10,000 mg/l are considered brackish.

RESULTS:

A groundwater budget summarizes the amount of water entering and leaving the aquifer according to the groundwater availability model. Selected groundwater budget components listed below were extracted from the model results for the aquifers located within the district and averaged over the duration of the calibration and verification portion of the model runs in the district, as shown in Tables 1 and 2. The components of the modified budget shown in Tables 1 and 2 include:

- Precipitation recharge—The areally distributed recharge sourced from precipitation falling on the outcrop areas of the aquifers (where the aquifer is exposed at land surface) within the district.

- Surface water outflow—The total water discharging from the aquifer (outflow) to surface water features such as streams, reservoirs, and drains (springs).

- Flow into and out of district—The lateral flow within the aquifer between the district and adjacent counties.

- Flow between aquifers—The net vertical flow between aquifers or confining units. This flow is controlled by the relative water levels in each aquifer or confining unit and aquifer properties of each aquifer or confining unit that define the amount of leakage that occurs. “Inflow” to an aquifer from an overlying or underlying aquifer will always equal the “Outflow” from the other aquifer.

The information needed for the District’s management plan is summarized in Tables 1 and 2. It is important to note that sub-regional water budgets are not exact. This is due to the size of the model cells and the approach used to extract data from the

model. To avoid double accounting, a model cell that straddles a political boundary, such as a district or county boundary, is assigned to one side of the boundary based on the location of the centroid of the model cell. For example, if a cell contains two counties, the cell is assigned to the county where the centroid of the cell is located (Figures 1 and 2).

TABLE 1: SUMMARIZED INFORMATION FOR THE GULF COAST AQUIFER THAT IS NEEDED FOR BEE GROUNDWATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT. THESE FLOWS INCLUDE BRACKISH WATERS.

Management Plan requirement	*Aquifer or confining unit*	*Results*
Estimated annual amount of recharge from precipitation to the district	Gulf Coast Aquifer	21,094
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	13,066
Estimated annual volume of flow into the district within each aquifer in the district	Gulf Coast Aquifer	4,002
Estimated annual volume of flow out of the district within each aquifer in the district	Gulf Coast Aquifer	17,091
Estimated net annual volume of flow between each aquifer in the district	Not Applicable	Not Applicable

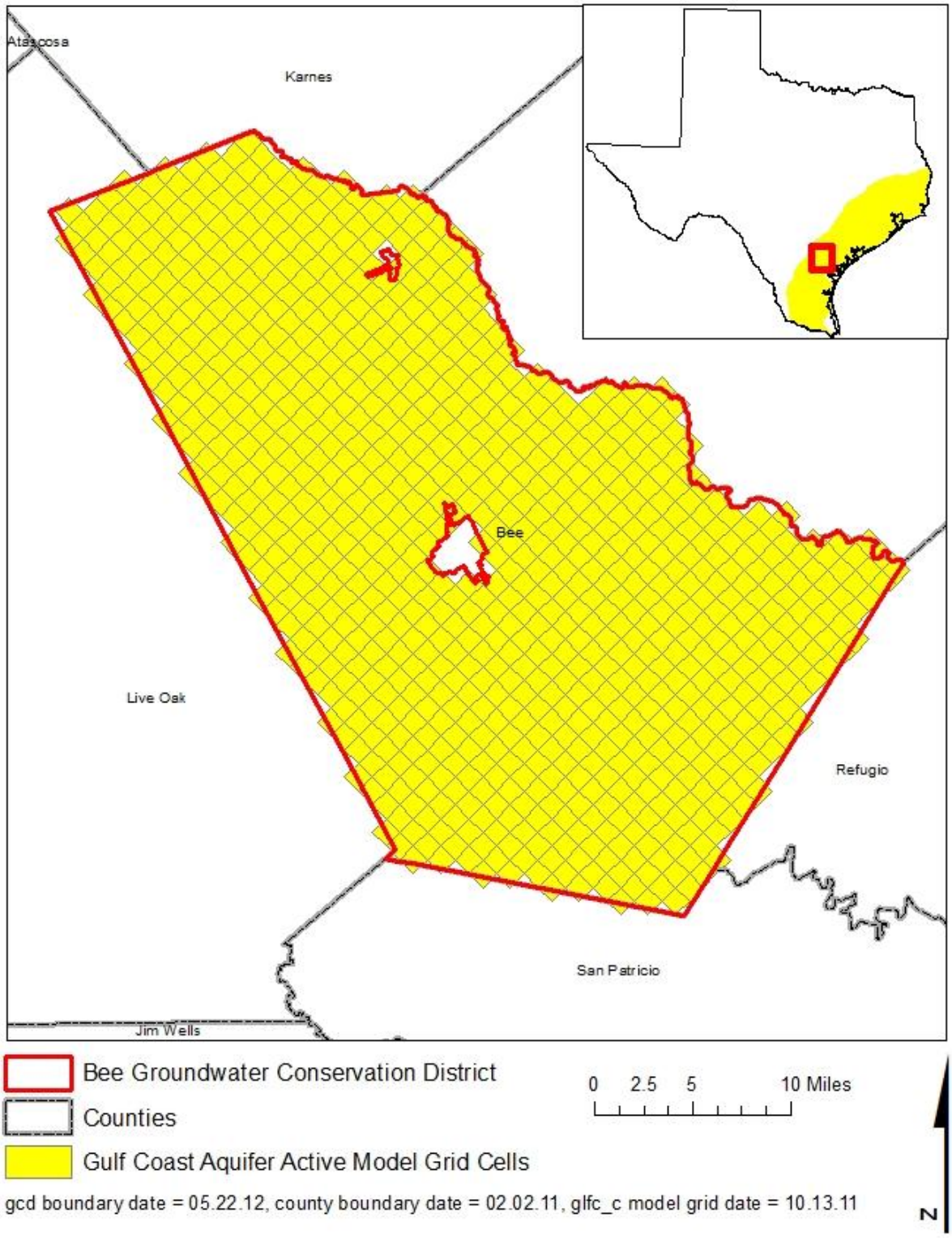

FIGURE 1: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE CENTRAL PORTION OF THE GULF COAST AQUIFER FROM WHICH THE INFORMATION IN TABLE 1 WAS EXTRACTED (THE GULF COAST AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).

TABLE 2: SUMMARIZED INFORMATION FOR THE CARRIZO-WILCOX AQUIFER THAT IS NEEDED FOR BEE GROUNDWATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT. THESE FLOWS MAY INCLUDE FRESH AND BRACKISH WATERS.

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	290
Estimated annual volume of flow out of the district within each aquifer in the district	Carrizo-Wilcox Aquifer	259
Estimated net annual volume of flow between each aquifer in the district	From the Reklaw Confining Unit into the Carrizo-Wilcox Aquifer	3

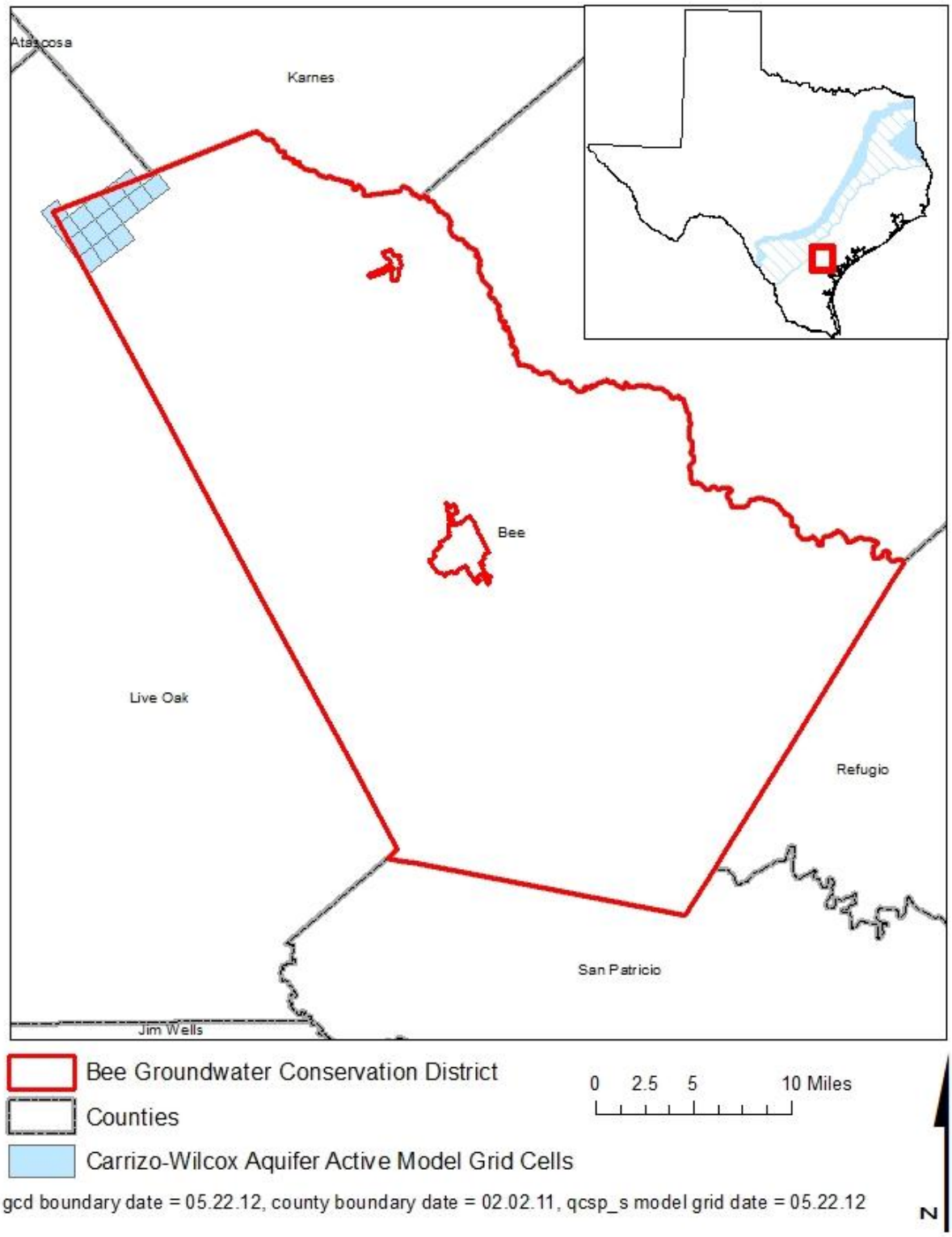

FIGURE 2: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE SOUTHERN PORTION OF THE CARRIZO-WILCOX AQUIFER FROM WHICH THE INFORMATION IN TABLE 2 WAS EXTRACTED (THE CARRIZO-WILCOX AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).

LIMITATIONS

The groundwater model(s) used in completing this analysis is the best available scientific tool that can be used to meet the stated objective(s). To the extent that this analysis will be used for planning purposes and/or regulatory purposes related to pumping in the past and into the future, it is important to recognize the assumptions and limitations associated with the use of the results. In reviewing the use of models in environmental regulatory decision making, the National Research Council (2007) noted:

> *"Models will always be constrained by computational limitations, assumptions, and knowledge gaps. They can best be viewed as tools to help inform decisions rather than as machines to generate truth or make decisions. Scientific advances will never make it possible to build a perfect model that accounts for every aspect of reality or to prove that a given model is correct in all respects for a particular regulatory application. These characteristics make evaluation of a regulatory model more complex than solely a comparison of measurement data with model results."*

A key aspect of using the groundwater model to evaluate historic groundwater flow conditions includes the assumptions about the location in the aquifer where historic pumping was placed. Understanding the amount and location of historic pumping is as important as evaluating the volume of groundwater flow into and out of the district, between aquifers within the district (as applicable), interactions with surface water (as applicable), recharge to the aquifer system (as applicable), and other metrics that describe the impacts of that pumping. In addition, assumptions regarding precipitation, recharge, and interaction with streams are specific to particular historic time periods.

Because the application of the groundwater model was designed to address regional scale questions, the results are most effective on a regional scale. The TWDB makes no warranties or representations related to the actual conditions of any aquifer at a particular location or at a particular time.

It is important for groundwater conservation districts to monitor groundwater pumping and overall conditions of the aquifer. Because of the limitations of the groundwater model and the assumptions in this analysis, it is important that the groundwater conservation districts work with the TWDB to refine this analysis in the future given the reality of how the aquifer responds to the actual amount and location of pumping now and in the future. Historic precipitation patterns also need to be placed in context as future climatic conditions, such as dry and wet year precipitation patterns, may differ and affect groundwater flow conditions.

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