McMULLEN GROUNDWATER

CONSERVATION DISTRICT

GROUNDWATER

DISTRICT MANAGEMENT

PLAN

McMullen GCD
PO Box 232
Tilden, TX 78072
mcmullengcd@yahoo.com
361-449-7017
Lonnie Stewart, General Manager

MCMULLEN GROUNDWATER
CONSERVATION DISTRICT
MANAGEMENT PLAN
Adopted October 26, 2018

District Mission

The McMullen 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 October 26, 2023, 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 McMullen County through an election, January 2001. The current Board of Directors are Harold Jambers, Jr. - Chairman, Steven MaFrige- Vice-Chairman, David Longan – Secretary-Treasurer, Scott Dilworth, and Michael Miles, McMullen Groundwater Conservation District (MGCD) has the same aerial extent as that of McMullen County. The county has a vibrant economy dominated by agriculture and petroleum. The agriculture income is derived primarily from McMullen County is cattle production, wheat, corn, sorghum, and some sheep and goat ranching.

Location and Extent

McMullen County, consisting of 1,159 square miles, is located in South Texas. The county is bounded on the east by Live Oak County, on the north by Atascosa County, on the west by La Salle County, and on the south by Duval County. Tilden, which is centrally located in the county, is the county seat.

Topography, Drainage and Groundwater Recharge

McMullen County is on the Gulf Coastal Plain in southern Texas. Most the 1,159 square miles of the county are devoted to farming and ranching, which provide the principal income for the 851 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, Queen City, and the Sparta Aquifers.

Some livestock supplies were obtained from surface-water sources. Most of McMullen County is rolling to moderately hilly, although some areas are nearly flat. The altitude ranges from about 460 feet in the southwestern part of the county to about 90 feet near the south end of the county. The county is drained by the Nueces River and the Frio River.

Recharge could be enhanced by several methods: brush control, more precipitation, and more tanks to catch runoff from excessive precipitation.

Surface Water Resources of McMullen County

Limited surface water rights are available within the county, mainly on the Nueces and Frio Rivers. The remaining surface water is impounded in stock tanks for livestock and domestic use.

The following can be found in the index:MAG values, GAM run 17-027 MAG, GAM run 17-025 MAG, Estimated Historical Water Use/ 2017 and Groundwater Availability Model Run, and GAM run 17-011.

The District rules are available at our website: www.mcmullengcd.org.

The McMullen Groundwater Conservation District Management Plan data is provided in Appendix A.

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

The District manager will prepare and present an annual report to the District 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 District Board of directors meeting each fiscal year. 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 has 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 District considered the water supply needs and the water management strategies included in the adopted State Water Plan. The District considered the water management strategies for all projects and determined that the projects were within the District rules and MAG.

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 and are on the website www.mcmullengcd.org. 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 District rules are available at our website: www.mcmullengcd.org.

McMULLEN GROUNDWATER CONSERVATION DISTRICT
MANAGEMENT GOALS AND OBJECTIVES

MISSION STATEMENT

The mission of the McMullen 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 for the District.

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 available 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 Association. 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 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 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 measures 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 10/26/2018

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

Whereas, the District has presented the management plan to the county officials and the Nueces River Authority;

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

Now, Therefore be it Resolved, that the McMullen Groundwater Conservation District has approved the District management plan.

In favor____ Against_____ Not Present _______

Passed and Approved the 26th day of October, 2018.

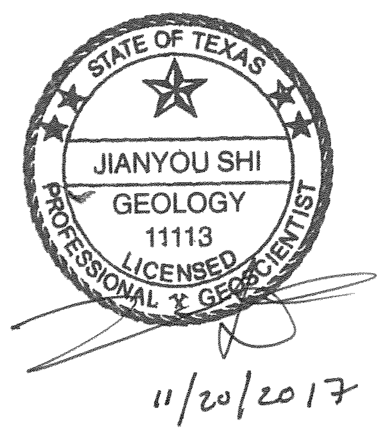
________________________ Attest by :________________________

Harold Jambers Jr., President David Longan, Secretary

Appendix A

GAM RUN 17-011: MCMULLEN GROUNDWATER CONSERVATION DISTRICT GROUNDWATER MANAGEMENT PLAN

Jerry Shi, Ph.D., P.G.
Texas Water Development Board
Groundwater Division
Groundwater Availability Modeling Department
(512) 463-5076
November 20, 2017



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GAM RUN 17-011: MCMULLEN GROUNDWATER CONSERVATION DISTRICT GROUNDWATER MANAGEMENT PLAN

Jerry Shi, Ph.D., P.G.
Texas Water Development Board
Groundwater Division
Groundwater Availability Modeling Department
(512) 463-5076
November 20, 2017

EXECUTIVE SUMMARY:

Texas State Water Code, Section 36.1071, Subsection (h) (Texas Water Code, 2015), states that, in developing its groundwater management plan, a groundwater conservation district shall use groundwater availability modeling information provided by the Executive Administrator of the Texas Water Development Board (TWDB) in conjunction with any available site-specific information provided by the district for review and comment to the Executive Administrator.

The TWDB provides data and information to the McMullen 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 Section. Please direct questions about the water data report to Mr. Stephen Allen at (512) 463-7317 or stephen.allen@twdb.texas.gov. Part 2 is the required groundwater availability modeling information and this information includes:

1. the annual amount of recharge from precipitation, if any, to the groundwater resources within the district;
2. for each aquifer within the district, the annual volume of water that discharges from the aquifer to any surface-water bodies, including lakes, streams, rivers, and springs; 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 McMullen Groundwater Conservation District should be adopted by the district on or before May 11, 2018, and submitted to the Executive Administrator of the TWDB on or before June 10, 2018. The current management plan for the McMullen Groundwater Conservation District expires on August 9, 2018.

The management plan information for the aquifers within McMullen Groundwater Conservation District was extracted from three groundwater availability models:

1. the groundwater availability model for the central Gulf Coast Aquifer System (Chowdhury and others, 2004);
2. the groundwater availability model for the southern part of the Carrizo-Wilcox, Queen-City, and Sparta aquifers (Deeds and others, 2003; Kelley and others, 2004); and
3. the groundwater availability model for the Yegua-Jackson Aquifer (Deeds and others, 2010).

This report replaces the results of GAM Run 12-011 (Kohlrenken, 2012). GAM Run 17-011 meets current standards set after the release of GAM Run 12-011. Tables 1 through 5 summarize the groundwater availability model data required by statute and Figures 1 through 5 show the area of the models from which the values in the table were extracted. If after review of the figures, the McMullen Groundwater Conservation District determines that the district boundaries used in the assessment do not reflect current conditions, please notify the TWDB at your earliest convenience.

METHODS:

In accordance with the provisions of the Texas State Water Code, Section 36.1071, Subsection (h), groundwater availability models for the central portion of the Gulf Coast Aquifer System (1981 through 1999); the Queen City and Sparta aquifers, which includes the Carrizo-Wilcox Aquifer (1980 through 1999); and the Yegua-Jackson Aquifer (1980 through 1997) were run for this analysis. Water budgets for each year of the transient model periods were extracted using ZONEBUDGET Version 3.01 (Harbaugh, 2009). The average annual water budget values for recharge, surface water outflow, inflow to the district, outflow from the district, net cross-formational flow between aquifers, and net flow between aquifers and its brackish portion located within the district are summarized in this report.

PARAMETERS AND ASSUMPTIONS:

Carrizo-Wilcox, Queen City, and Sparta Aquifers

- 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.

- 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.

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

Yegua-Jackson Aquifer

- Version 1.01 of the groundwater availability model for the Yegua-Jackson Aquifer was used for this analysis. See Deeds and others (2010) for assumptions and limitations of the groundwater availability model.

- This groundwater availability model includes five layers, which generally correspond to (from top to bottom):

  1. the outcrop section of the Yegua-Jackson Aquifer and younger overlying units;
  2. the upper portion of the Jackson Group;
  3. the lower portion of the Jackson Group;
  4. the upper portion of the Yegua Group; and
  5. the lower portion of the Yegua Group.

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

- All five model layers were used to estimate the water budgets for the Yegua-Jackson Aquifer within the district.

Gulf Coast Aquifer System

- Version 1.01 of the groundwater availability model for the central section of the Gulf Coast Aquifer System was used for this analysis. See Chowdhury and others (2004) and Waterstone and others (2003) for assumptions and limitations of the groundwater availability model.
- 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 model was run with MODFLOW-96 (Harbaugh and McDonald, 1996).
- All four model layers were used to estimate the water budgets for the Gulf Coast Aquifer System within the district.

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. The components of the modified budget shown in tables 1 through 5 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 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 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. May also include flows between the fresh/brackish portion of the geologic formation (official aquifer extent) and the downdip brackish to saline portions of the flow system.

The information needed for the district's management plan is summarized in tables 1 through 5. 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 district or county boundaries, 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 through 5).

TABLE 1: SUMMARIZED INFORMATION FOR THE CARRIZO-WILCOX AQUIFER THAT IS NEEDED FOR MCMULLEN GROUNDWATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT.

Management Plan requirement	*Aquifer or confining unit*	*Results*
Estimated annual amount of recharge from precipitation to the district	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	3,704
Estimated annual volume of flow out of the district within each aquifer in the district	Carrizo-Wilcox Aquifer	3,016
Estimated net annual volume of flow between each aquifer in the district	Estimated net annual volume of flow from the brackish portion to the Carrizo-Wilcox Aquifer	5
	From the Reklaw Confining Unit to the Carrizo-Wilcox Aquifer	699

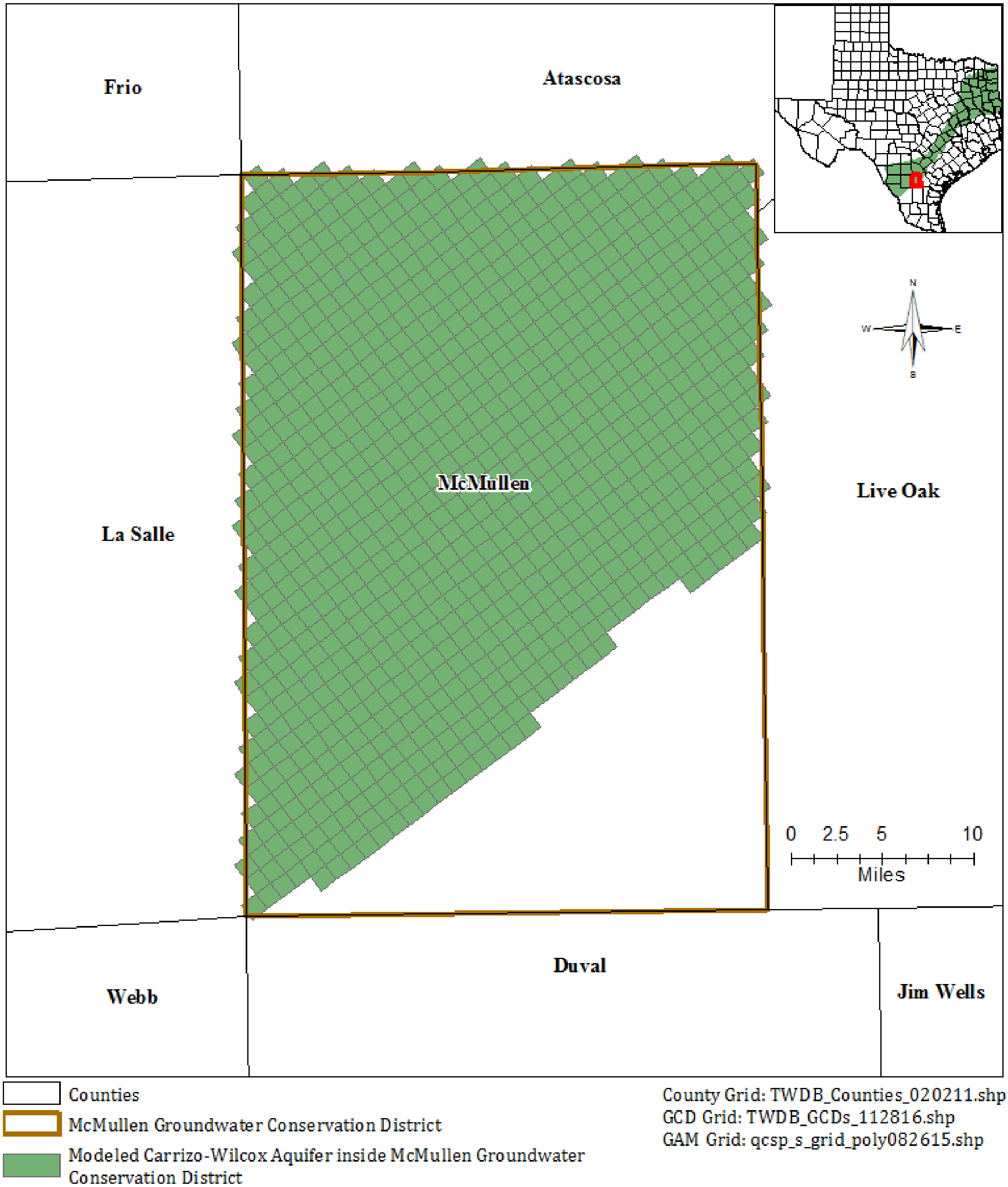

FIGURE 1: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE SOUTHERN PORTION OF THE CARRIZO-WILCOX, QUEEN CITY, AND SPARTA AQUIFERS FROM WHICH THE INFORMATION IN TABLE 1 WAS EXTRACTED (THE CARRIZO-WILCOX AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).

TABLE 2: SUMMARIZED INFORMATION FOR THE QUEEN CITY AQUIFER THAT IS NEEDED FOR MCMULLEN GROUNDWATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT.

Management Plan requirement	*Aquifer or confining unit*	*Results*
Estimated annual amount of recharge from precipitation to the district	Queen City Aquifer	0
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Queen City Aquifer	0
Estimated annual volume of flow into the district within each aquifer in the district	Queen City Aquifer	614
Estimated annual volume of flow out of the district within each aquifer in the district	Queen City Aquifer	133
Estimated net annual volume of flow between each aquifer in the district	Estimated net annual volume of flow from the brackish portion to the Queen City Aquifer	54
	From the Queen City Aquifer to the Weches Confining Unit	899
	From the Queen City Aquifer to the Reklaw Confining Unit	151

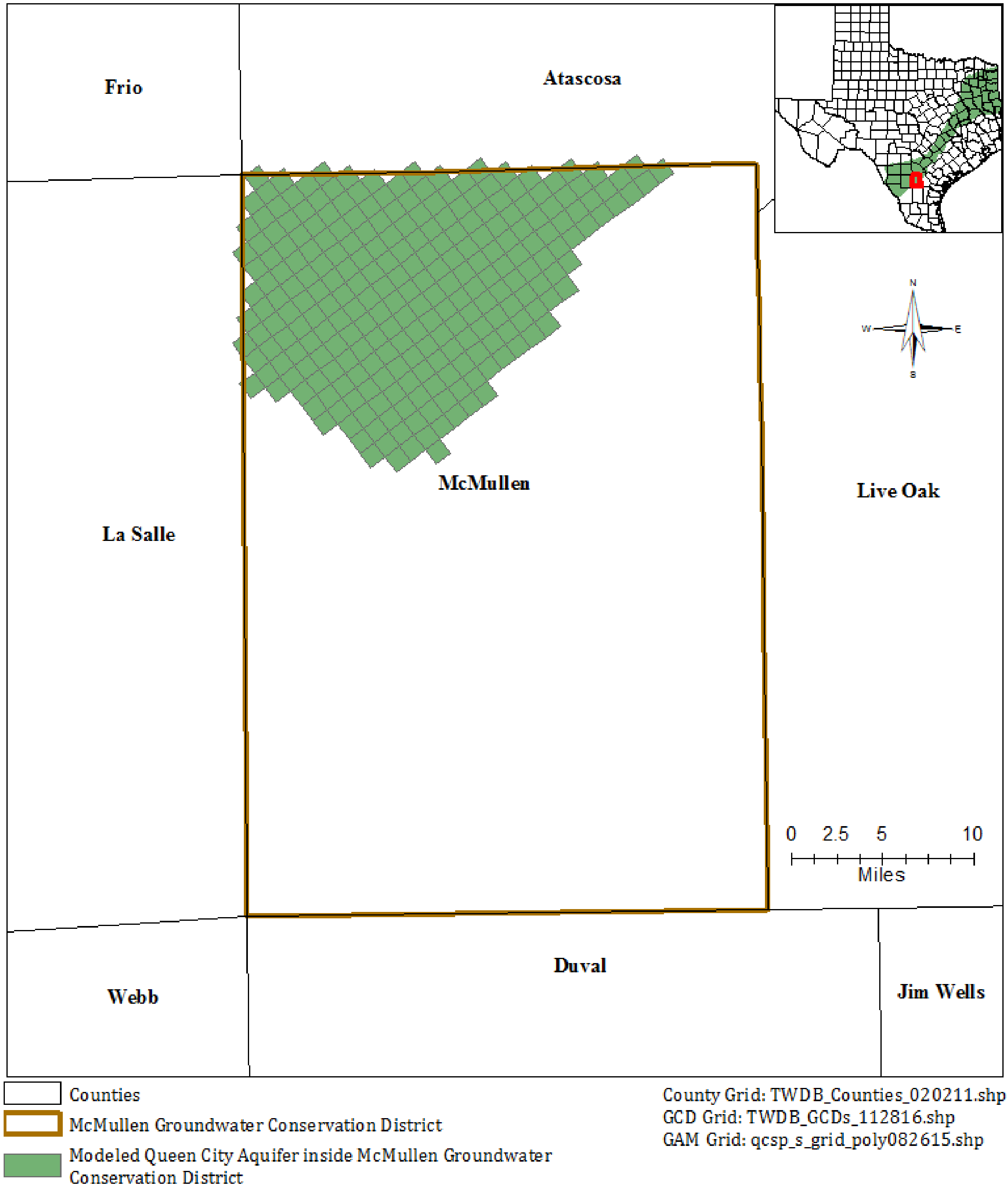

FIGURE 2: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE SOUTHERN PORTION OF THE CARRIZO-WILCOX, QUEEN CITY, AND SPARTA AQUIFERS FROM WHICH THE INFORMATION IN TABLE 2 WAS EXTRACTED (THE QUEEN CITY AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).

TABLE 3: SUMMARIZED INFORMATION FOR THE SPARTA AQUIFER THAT IS NEEDED FOR MCMULLEN GROUNDWATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT.

Management Plan requirement	*Aquifer*	*Results*
Estimated annual amount of recharge from precipitation to the district	Sparta Aquifer	0
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Sparta Aquifer	0
Estimated annual volume of flow into the district within each aquifer in the district	Sparta Aquifer	217
Estimated annual volume of flow out of the district within each aquifer in the district	Sparta Aquifer	91
Estimated net annual volume of flow between each aquifer in the district	Estimated net annual volume of flow from the Sparta Aquifer to its brackish portion	147
	From the Sparta Aquifer into the overlying younger units	103
	From the Weches Confining Unit into the Sparta Aquifer	96

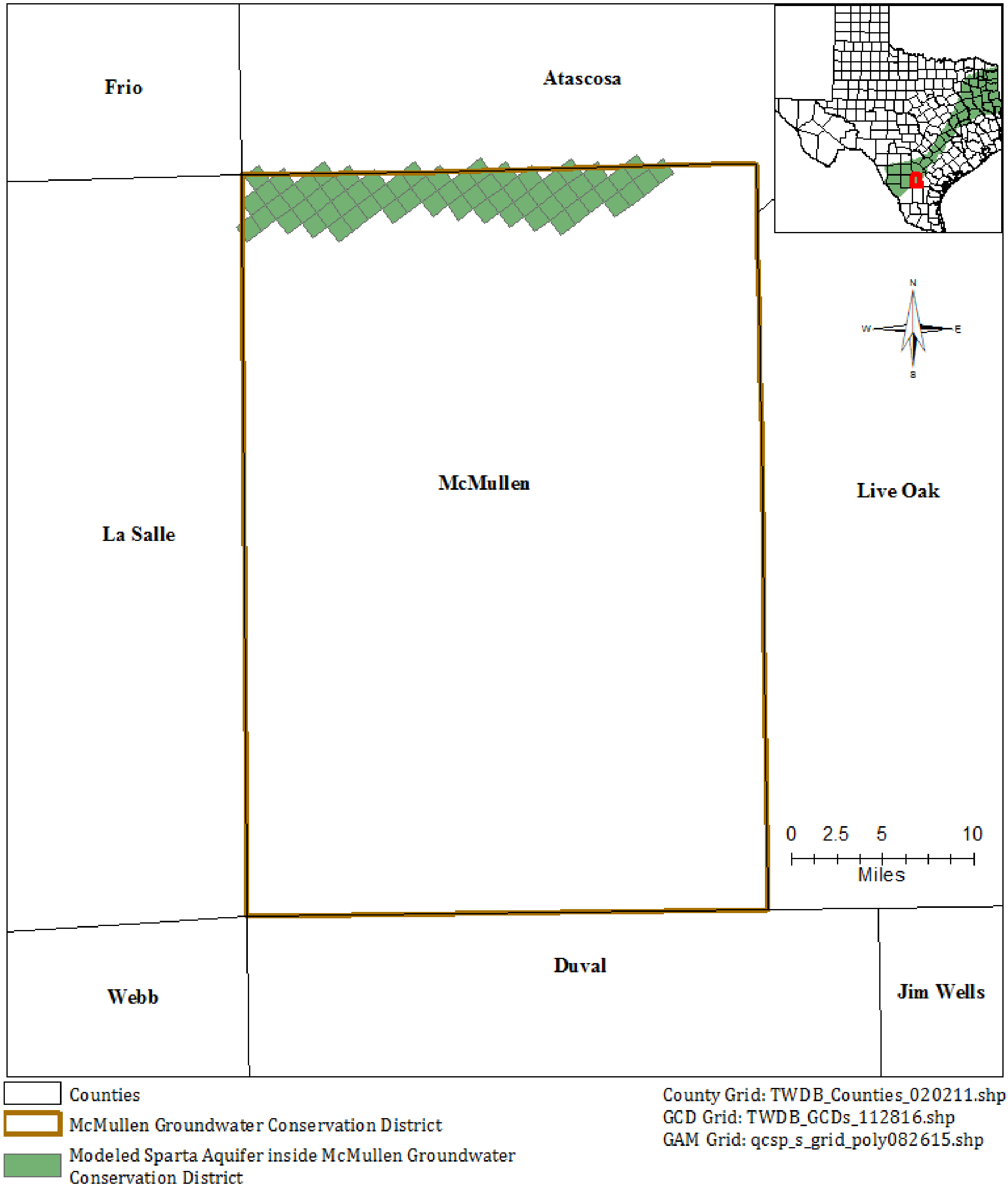

FIGURE 3: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE SOUTHERN PORTION OF THE CARRIZO-WILCOX, QUEEN CITY, AND SPARTA AQUIFERS FROM WHICH THE INFORMATION IN TABLE 3 WAS EXTRACTED (THE SPARTA AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).

TABLE 4: SUMMARIZED INFORMATION FOR THE YEGUA-JACKSON AQUIFER THAT IS NEEDED FOR MCMULLEN GROUNDWATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT.

Management Plan requirement	*Aquifer or confining unit*	*Results*
Estimated annual amount of recharge from precipitation to the district	Yegua-Jackson Aquifer	7,034
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Yegua-Jackson Aquifer	13,081
Estimated annual volume of flow into the district within each aquifer in the district	Yegua-Jackson Aquifer	4,996
Estimated annual volume of flow out of the district within each aquifer in the district	Yegua-Jackson Aquifer	3,699
Estimated net annual volume of flow between each aquifer in the district	Estimated net annual volume of flow from the brackish portion to the Yegua-Jackson Aquifer	579
	From the Catahoula Formation into the Yegua-Jackson Aquifer	309

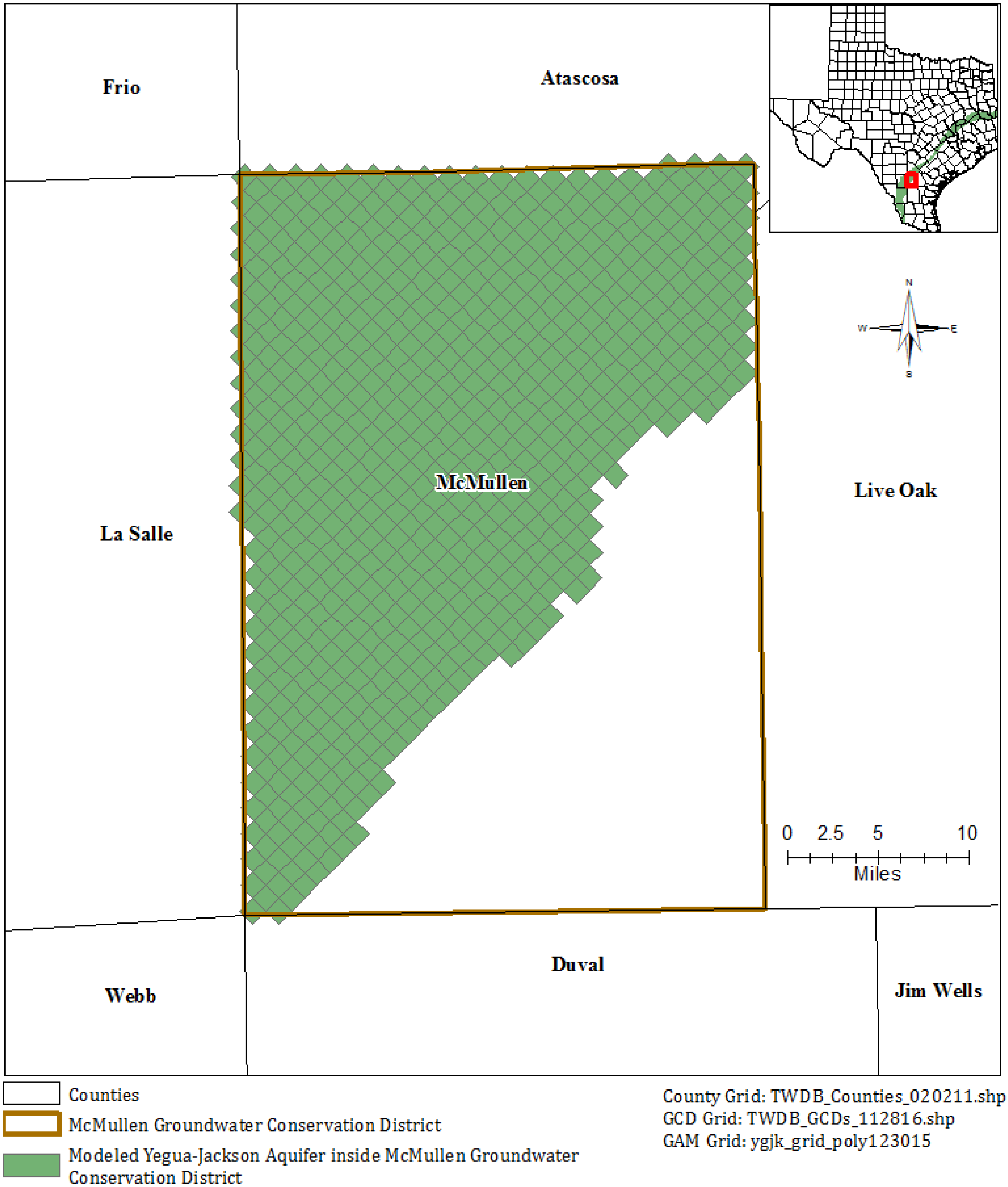

FIGURE 4: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE YEGUA-JACKSON AQUIFER FROM WHICH THE INFORMATION IN TABLE 4 WAS EXTRACTED (THE AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).

TABLE 5: SUMMARIZED INFORMATION FOR THE GULF COAST AQUIFER SYSTEM THAT IS NEEDED FOR MCMULLEN GROUNDWATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT.

Management Plan requirement	*Aquifer or confining unit*	*Results*
Estimated annual amount of recharge from precipitation to the district	Gulf Coast Aquifer System	244
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	809
Estimated annual volume of flow into the district within each aquifer in the district	Gulf Coast Aquifer System	242
Estimated annual volume of flow out of the district within each aquifer in the district	Gulf Coast Aquifer System	594
Estimated net annual volume of flow between each aquifer in the district	Not Applicable*	Not Applicable*

*Model assumes no-flow conditions at the base

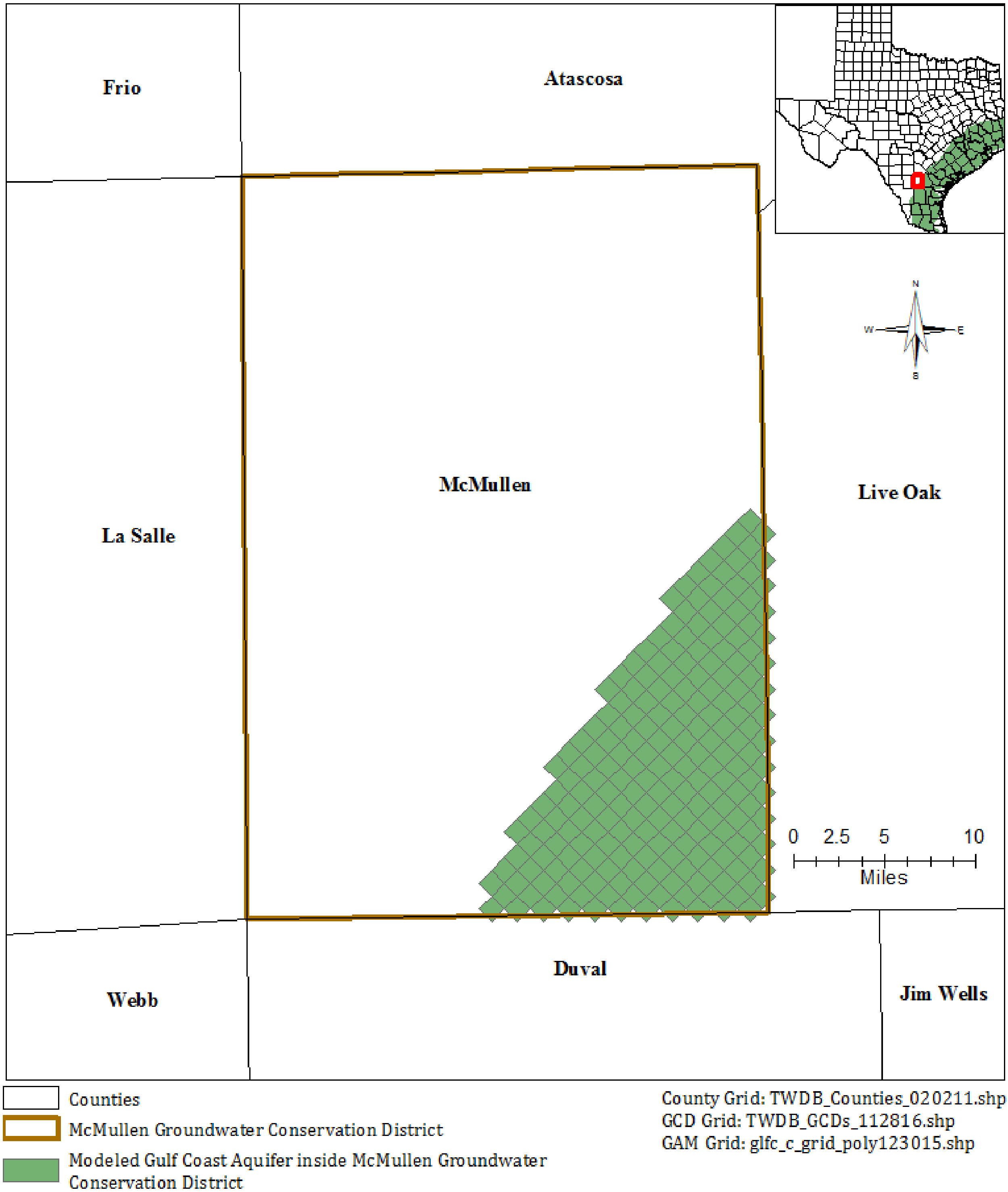

FIGURE 5: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE GULF COAST AQUIFER SYSTEM FROM WHICH THE INFORMATION IN TABLE 5 WAS EXTRACTED (THE AQUIFER SYSTEM EXTENT WITHIN THE DISTRICT BOUNDARY).

LIMITATIONS:

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

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

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

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

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

REFERENCES:

Chowdhury, Ali. H., Wade, S., Mace, R.E., and Ridgeway, C., 2004, Groundwater Availability Model of the Central Gulf Coast Aquifer System: Numerical Simulations through 1999- Model Report, 114 p., http://www.twdb.texas.gov/groundwater/models/gam/glfc_c/TWDB_Recalibration_Report.pdf.

Deeds, N., Kelley, V., Fryar, D., Jones, T., Whallon, A.J., and Dean, K.E., 2003, Groundwater Availability Model for the Southern Carrizo-Wilcox Aquifer: Contract report to the Texas Water Development Board, 452 p., http://www.twdb.texas.gov/groundwater/models/gam/czwx_s/CZWX_S_Full_Report.pdf.

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GAM RUN 17-025 MAG: MODELED AVAILABLE GROUNDWATER FOR THE GULF COAST AQUIFER SYSTEM IN GROUNDWATER MANAGEMENT AREA 16

Rohit Raj Goswami, Ph.D., P.E.
Texas Water Development Board
Groundwater Division
Groundwater Availability Modeling Section
(512) 463-0495
May 19, 2017

STATE OF TEXAS
ROHIT R. GOSWAMI
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GAM RUN 17-025 MAG:
MODELED AVAILABLE GROUNDWATER FOR THE GULF COAST AQUIFER SYSTEM IN GROUNDWATER MANAGEMENT AREA 16

Rohit Raj Goswami, Ph.D., P.E.
Texas Water Development Board
Groundwater Division
Groundwater Availability Modeling Section
(512) 463-0495
May 19, 2017

EXECUTIVE SUMMARY:

The modeled available groundwater for Groundwater Management Area 16 (Figure 1) for the Gulf Coast Aquifer System is summarized by decade for the groundwater conservation districts and counties (Table 1) and for use in the regional water planning process (Table 2). The modeled available groundwater estimates range from approximately 233,000 acre-feet per year in 2020 to 312,000 acre-feet per year in 2060 (Tables 1 and 2). The estimates were extracted from results of a model run using the alternative groundwater availability model for Groundwater Management Area 16 (version 1.01). The model run files, which meet the desired future conditions of Groundwater Management Area 16, were submitted to the Texas Water Development Board (TWDB) as part of the Desired Future Conditions Explanatory Report for Groundwater Management Area 16. The explanatory report and other materials submitted to the TWDB were determined to be administratively complete on April 19, 2017.

REQUESTOR:

Mr. David O'Rourke, consultant for Groundwater Management Area 16.

DESCRIPTION OF REQUEST:

In a letter dated January 25, 2017, Mr. David O'Rourke, 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. All other aquifers in Groundwater Management Area 16 (Carrizo-Wilcox and Yegua-Jackson) were declared non-relevant for joint planning purposes. The Gulf Coast Aquifer System includes the Chicot Aquifer, Evangeline Aquifer, and the Jasper Aquifer. Clarifications to the submitted materials were received by TWDB on April 4, 2017. The desired future conditions for the Gulf Coast Aquifer System, as described in Resolution No. 2017-01 and adopted January 17, 2017, by the groundwater conservation districts within Groundwater Management Area 16, are described below:

Groundwater Management Area 16 [all counties]

Drawdown of the Gulf Coast Aquifer System shall not exceed an average of 62 feet in December 2060 from estimated year 2010 conditions.

Bee Groundwater Conservation District

Drawdown of the Gulf Coast Aquifer System shall not exceed an average of 76 feet in December 2060 from estimated year 2010 conditions.

Live Oak Underground Water Conservation District

Drawdown of the Gulf Coast Aquifer System shall not exceed an average of 34 feet in December 2060 from estimated year 2010 conditions.

McMullen Groundwater Conservation District

Drawdown of the Gulf Coast Aquifer System shall not exceed an average of 9 feet in December 2060 from estimated year 2010 conditions.

Red Sands Groundwater Conservation District

Drawdown of the Gulf Coast Aquifer System shall not exceed an average of 40 feet in December 2060 from estimated year 2010 conditions.

Kenedy County Groundwater Conservation District

Drawdown of the Gulf Coast Aquifer System shall not exceed an average of 40 feet in December 2060 from estimated year 2010 conditions.

Brush Country Groundwater Conservation District

Drawdown of the Gulf Coast Aquifer System shall not exceed an average of 69 feet in December 2060 from estimated year 2010 conditions.

Duval County Groundwater Conservation District

Drawdown of the Gulf Coast Aquifer System shall not exceed an average of 104 feet in December 2060 from estimated year 2010 conditions.

San Patricio County Groundwater Conservation District

Drawdown of the Gulf Coast Aquifer System shall not exceed an average of 48 feet in December 2060 from estimated year 2010 conditions.

Starr County Groundwater Conservation District

Drawdown of the Gulf Coast Aquifer System shall not exceed an average of 69 feet in December 2060 from estimated year 2010 conditions.

No District - Cameron County

Drawdown of the Gulf Coast Aquifer System shall not exceed an average of 70 feet in December 2060 from estimated year 2010 conditions.

No District - Hidalgo County

Drawdown of the Gulf Coast Aquifer System shall not exceed an average of 118 feet in December 2060 from estimated year 2010 conditions.

No District - Kleberg County

Drawdown of the Gulf Coast Aquifer System shall not exceed an average of 28 feet in December 2060 from estimated year 2010 conditions.

No District - Nueces County

Drawdown of the Gulf Coast Aquifer System shall not exceed an average of 21 feet in December 2060 from estimated year 2010 conditions.

No District - Webb County

Drawdown of the Gulf Coast Aquifer System shall not exceed an average of 113 feet in December 2060 from estimated year 2010 conditions.

No District - Willacy County

Drawdown of the Gulf Coast Aquifer System shall not exceed an average of 40 feet in December 2060 from estimated year 2010 conditions.

METHODS:

The alternative groundwater availability model for Groundwater Management Area 16 (Hutchison and others, 2011) was run using the model files submitted with the explanatory report (O'Rourke, 2017). Model-calculated water levels were extracted for the years 2010 and 2060, and drawdown was calculated as the difference between water levels at the beginning of 2010 and water levels at the end of 2060. Drawdown averages were calculated for the Gulf Coast Aquifer System by county, groundwater conservation districts, and the entire groundwater management area. As specified in the explanatory report (O'Rourke, 2017), drawdown for model cells that became dry during the simulation (water level dropped below the base of the cell) were excluded from the averaging. The calculated drawdown averages were compared with the desired future conditions to verify that the pumping scenario specified by the district representatives achieved the desired future conditions within a one-foot variance.

The modeled available groundwater values were determined by extracting pumping rates by decade from the model results using ZONEBUDGET Version 3.01 (Harbaugh, 2009). Table 1 presents the annual pumping rates by county and groundwater conservation district, subtotaled by groundwater conservation district, and then summed for Groundwater Management Area 16. Table 2 presents the annual pumping rates by county, river basin, regional water planning area, and groundwater conservation district within Groundwater Management Area 16.

Modeled Available Groundwater and Permitting

As defined in Chapter 36 of the Texas Water Code, "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 groundwater availability are described below:

- The analysis used version 1.01 of the alternate groundwater availability model for Groundwater Management Area 16. See Hutchison and others (2011) for assumptions and limitations of the model.

- 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).

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

- Groundwater Division checked the validity of the assertion that starting water levels in the model were comparable to the measured water-level conditions at the end of year 2010. Water-level values were averaged over the entire area of Groundwater Management Area 16 for the measured and modeled conditions between the years 2000 and 2010. These averaged water-level values are reported in Table 3. As presented in Table 3, the average water-levels indicate that conditions in the field did not change significantly, however, model estimated values differ significantly (by over 12 feet). Such a difference in the model estimates can be explained by the difference in values of pumping and recharge used in the model and those occurring in the field for the period between the years 2000 and 2010. It is important to note here that the groundwater availability model for Groundwater Management Area 16 was constructed using the confined aquifer assumption (and LAYCON=0 option) available within MODFLOW-96. Such an assumption leads to an almost linear response between pumping and drawdown. The Groundwater Division checked and verified the validity of the assumption by taking out the pumping input in the model from the years 2000 to 2010 and obtaining equivalent drawdown values in the year 2060. Based on the analysis, we conclude that the submitted model files are acceptable for developing estimates 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 averages and modeled available groundwater values are based on official aquifer boundaries (Figures 1 and 2).

- Drawdown values for cells with water levels below the base elevation of the cell ("dry" cells) were excluded from the averaging. However, pumping values from those cells were included in the calculation of modeled available groundwater.

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

- Average drawdown per county may include some model cells that represent portions of surface water such as bays, reservoirs, and the Gulf of Mexico.

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 233,000 acre-feet per year in 2020 to 312,000 acre-feet per year in 2060 (Tables 1 and 2). The modeled available groundwater is summarized by groundwater conservation district and county (Table 1) and by county, river basin, and regional water planning area for use in the regional water planning process (Table 2). Small differences of values between table summaries are due to rounding errors.

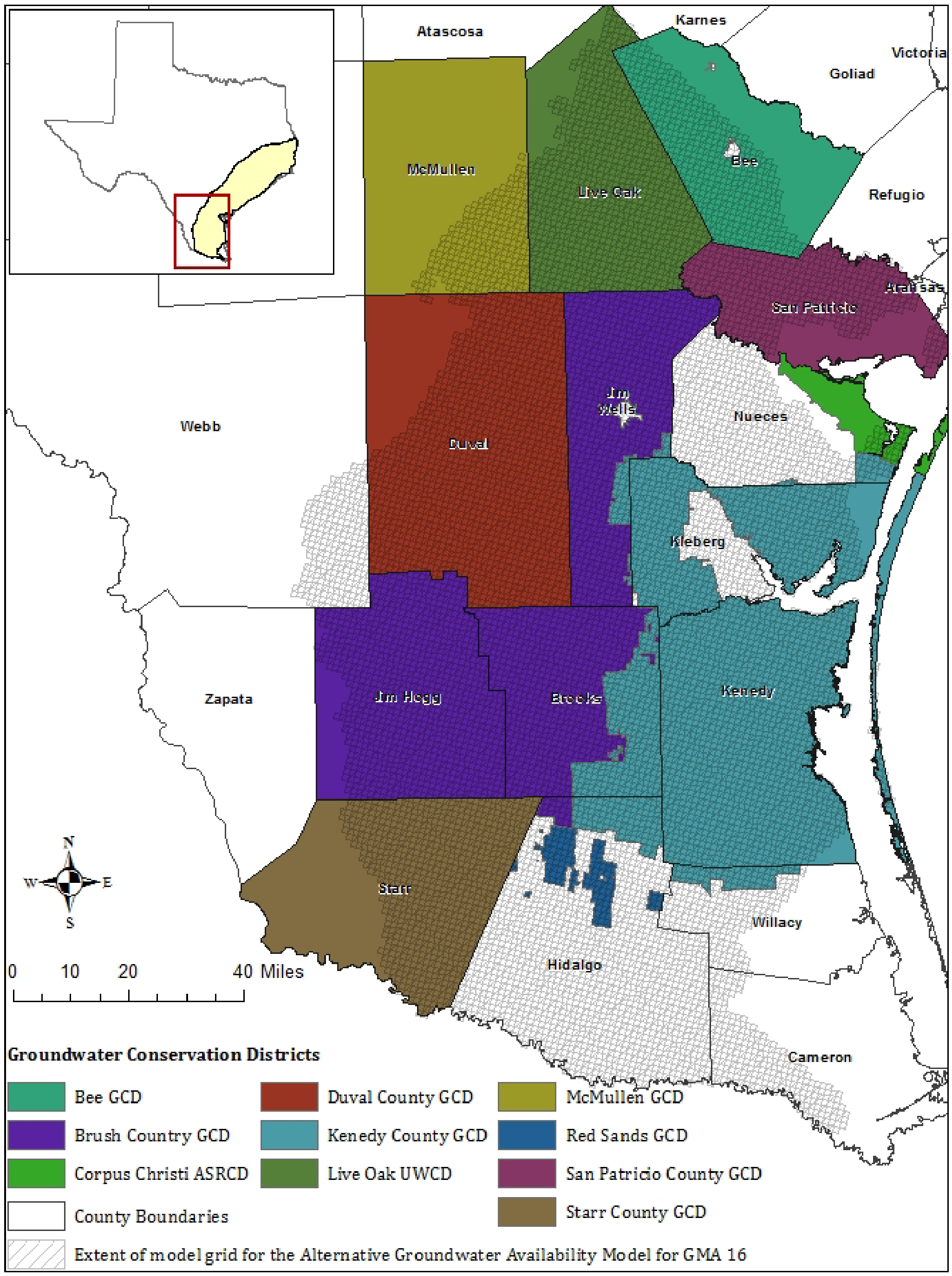

FIGURE 1. MAP SHOWING GROUNDWATER CONSERVATION DISTRICTS (GCDS), COUNTIES, AND GULF COAST AQUIFER SYSTEM EXTENT IN GROUNDWATER MANAGEMENT AREA 16 OVERLAIN ON THE EXTENT OF THE ALTERNATIVE GROUNDWATER AVAILABILITY MODEL FOR GROUNDWATER MANAGEMENT AREA 16.

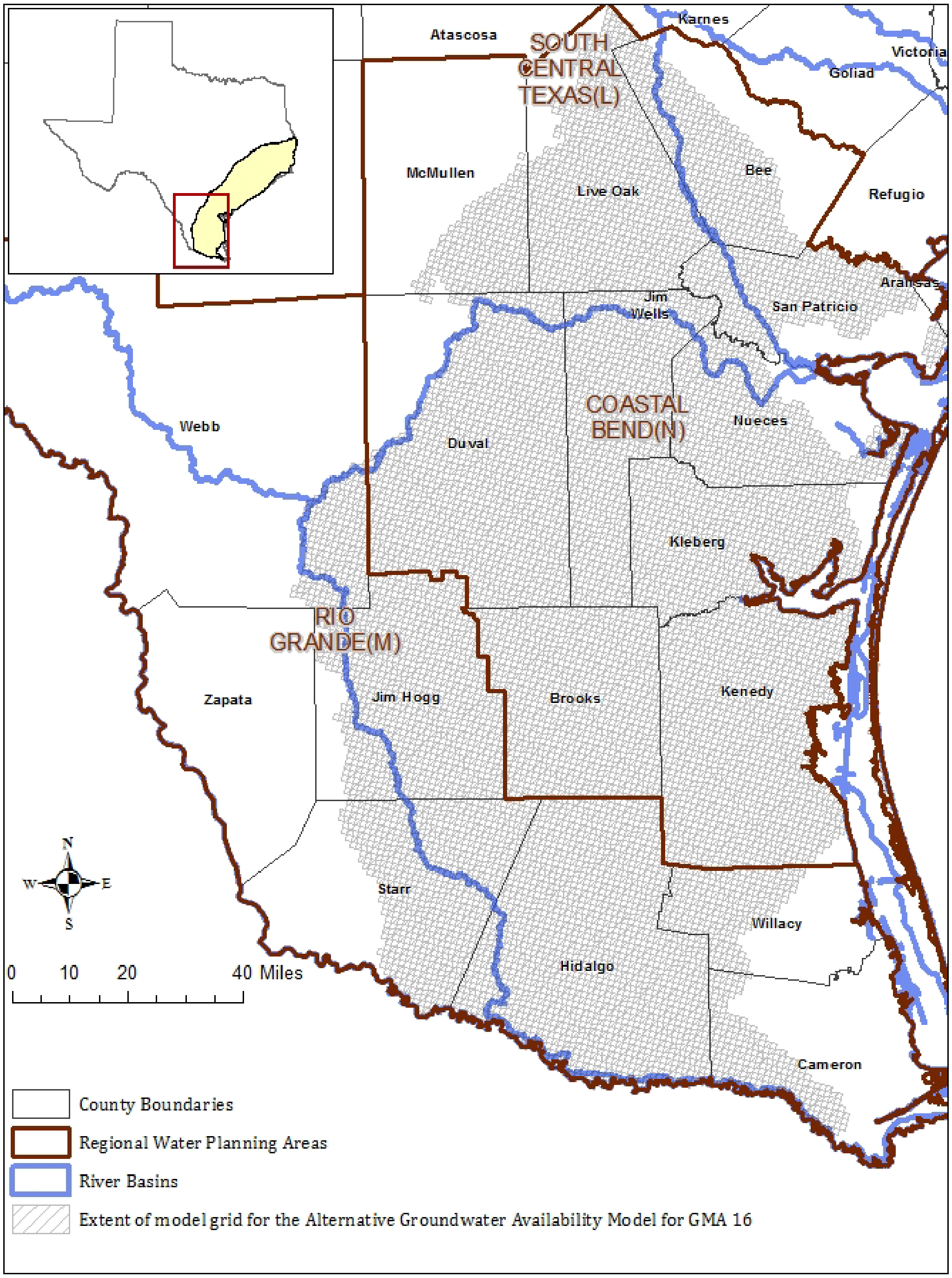

FIGURE 2. MAP SHOWING THE EXTENT OF THE GULF COAST AQUIFER SYSTEM, REGIONAL WATER PLANNING AREAS, COUNTIES, AND RIVER BASINS IN GROUNDWATER MANAGEMENT AREA 16 OVERLAIN ON THE EXTENT OF THE ALTERNATIVE GROUNDWATER AVAILABILITY MODEL FOR GROUNDWATER MANAGEMENT AREA 16.

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 2010 AND 2060. VALUES ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District (GCD)	County	Aquifer	2010	2020	2030	2040	2050	2060
Bee GCD	**Bee**	**Gulf Coast Aquifer System**	**7,689**	**8,971**	**10,396**	**11,061**	**11,392**	**11,584**
Brush Country GCD	Brooks	Gulf Coast Aquifer System	3,657	3,657	3,657	3,657	3,657	3,657
Brush Country GCD	Hidalgo	Gulf Coast Aquifer System	131	131	131	131	131	131
Brush Country GCD	Jim Hogg	Gulf Coast Aquifer System	6,174	6,174	6,174	6,174	6,174	6,174
Brush Country GCD	Jim Wells	Gulf Coast Aquifer System	4,220	8,710	9,075	9,403	9,768	10,060
Brush Country GCD		**Gulf Coast Aquifer System**	**14,182**	**18,672**	**19,037**	**19,365**	**19,730**	**20,022**
Corpus Christi ASRCD	**Nueces**	**Gulf Coast Aquifer System**	**328**	**342**	**356**	**370**	**384**	**398**
Duval County GCD	**Duval**	**Gulf Coast Aquifer System**	**18,973**	**20,571**	**22,169**	**23,764**	**25,363**	**26,963**
Kenedy County GCD	Brooks	Gulf Coast Aquifer System	1,155	1,925	2,695	3,465	4,235	4,235
Kenedy County GCD	Willacy	Gulf Coast Aquifer System	289	482	674	867	1,060	1,060
Kenedy County GCD	Hidalgo	Gulf Coast Aquifer System	364	607	849	1,092	1,335	1,335
Kenedy County GCD	Jim Wells	Gulf Coast Aquifer System	261	434	608	783	957	957
Kenedy County GCD	Nueces	Gulf Coast Aquifer System	151	251	351	452	552	552
Kenedy County GCD	Kenedy	Gulf Coast Aquifer System	7,981	13,301	18,621	23,941	29,261	29,261
Kenedy County GCD	Kleberg	Gulf Coast Aquifer System	3,788	6,314	8,839	11,364	13,889	13,889
Kenedy County GCD		**Gulf Coast Aquifer System**	**13,989**	**23,314**	**32,637**	**41,964**	**51,289**	**51,289**
Live Oak UWCD	**Live Oak**	**Gulf Coast Aquifer System**	**6,556**	**8,338**	**9,343**	**8,564**	**8,441**	**8,441**
McMullen GCD	**McMullen**	**Gulf Coast Aquifer System**	**510**	**510**	**510**	**510**	**510**	**510**
Red Sands GCD	**Hidalgo**	**Gulf Coast Aquifer System**	**1,368**	**1,667**	**1,966**	**2,265**	**2,563**	**2,863**
San Patricio County GCD	**San Patricio**	**Gulf Coast Aquifer System**	**14,201**	**43,611**	**45,016**	**46,422**	**47,828**	**49,234**
Starr County GCD	**Starr**	**Gulf Coast Aquifer System**	**2,742**	**3,722**	**4,701**	**5,681**	**6,659**	**7,639**
No District-Bee	Bee	Gulf Coast Aquifer System	0	0	0	0	0	0
No District-Cameron	Cameron	Gulf Coast Aquifer System	5,378	6,688	7,999	9,311	10,620	11,932
No District-Hidalgo	Hidalgo	Gulf Coast Aquifer System	15,908	85,634	90,905	96,175	101,445	106,715

Groundwater Conservation District (GCD)	County	Aquifer	2010	2020	2030	2040	2050	2060
No District-Jim Wells	Jim Wells	Gulf Coast Aquifer System	0	0	0	0	0	0
No District-Kleberg	Kleberg	Gulf Coast Aquifer System	3,857	4,051	4,243	4,436	4,629	4,822
No District-Nueces	Nueces	Gulf Coast Aquifer System	5,753	5,996	6,240	6,487	6,731	6,974
No District-Webb	Webb	Gulf Coast Aquifer System	450	620	789	959	1,129	1,299
No District-Willacy	Willacy	Gulf Coast Aquifer System	544	664	785	905	1,024	1,145
No District-Total		**Gulf Coast Aquifer System**	**31,890**	**103,653**	**110,961**	**118,273**	**125,578**	**132,887**
GMA 16 Total		**Gulf Coast Aquifer System**	**112,428**	**233,371**	**257,092**	**278,239**	**299,737**	**311,830**

TABLE 2. MODELED AVAILABLE GROUNDWATER BY DECADE 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), RIVER BASIN, AND AQUIFER.

County	RWPA	River Basin	Aquifer	2020	2030	2040	2050	2060
Bee	N	Nueces	Gulf Coast Aquifer System	770	893	949	978	995
Bee	N	San Antonio-Nueces	Gulf Coast Aquifer System	8,201	9,503	10,112	10,414	10,589
Brooks	N	Nueces-Rio Grande	Gulf Coast Aquifer System	5,582	6,352	7,122	7,892	7,892
Cameron	M	Nueces-Rio Grande	Gulf Coast Aquifer System	6,301	7,536	8,771	10,005	11,241
Cameron	M	Rio Grande	Gulf Coast Aquifer System	387	463	540	615	691
Duval	N	Nueces	Gulf Coast Aquifer System	326	351	376	401	428
Duval	N	Nueces-Rio Grande	Gulf Coast Aquifer System	20,245	21,818	23,388	24,962	26,535
Hidalgo	M	Nueces-Rio Grande	Gulf Coast Aquifer System	86,405	91,810	97,216	102,620	107,784
Hidalgo	M	Rio Grande	Gulf Coast Aquifer System	1,634	2,041	2,447	2,854	3,260
Jim Hogg	M	Nueces-Rio Grande	Gulf Coast Aquifer System	5,236	5,236	5,236	5,236	5,236
Jim Hogg	M	Rio Grande	Gulf Coast Aquifer System	938	938	938	938	938
Jim Wells	N	Nueces	Gulf Coast Aquifer System	593	593	593	593	593
Jim Wells	N	Nueces-Rio Grande	Gulf Coast Aquifer System	8,551	9,090	9,593	10,132	10,424
Kenedy	N	Nueces-Rio Grande	Gulf Coast Aquifer System	13,301	18,621	23,941	29,261	29,261
Kleberg	N	Nueces-Rio Grande	Gulf Coast Aquifer System	10,365	13,082	15,800	18,518	18,711
Live Oak	N	Nueces	Gulf Coast Aquifer System	8,297	9,297	8,522	8,400	8,400
Live Oak	N	San Antonio-Nueces	Gulf Coast Aquifer System	41	46	42	41	41
McMullen	N	Nueces	Gulf Coast Aquifer System	510	510	510	510	510
Nueces	N	Nueces-Rio Grande	Gulf Coast Aquifer System	5,862	6,191	6,522	6,851	7,079
Nueces	N	Nueces	Gulf Coast Aquifer System	727	756	787	816	845
Nueces	N	San Antonio-Nueces	Gulf Coast Aquifer System	0	0	0	0	0
San Patricio	N	Nueces	Gulf Coast Aquifer System	4,130	4,502	4,874	5,247	5,619
San Patricio	N	San Antonio-Nueces	Gulf Coast Aquifer System	39,481	40,514	41,548	42,581	43,615
Starr	M	Nueces-Rio Grande	Gulf Coast Aquifer System	1,497	1,891	2,285	2,678	3,072

County	RWPA	River Basin	Aquifer	2020	2030	2040	2050	2060
Starr	M	Rio Grande	Gulf Coast Aquifer System	2,225	2,810	3,396	3,981	4,567
Webb	M	Rio Grande	Gulf Coast Aquifer System	98	125	152	179	206
Webb	M	Nueces	Gulf Coast Aquifer System	18	22	27	32	37
Webb	M	Nueces-Rio Grande	Gulf Coast Aquifer System	504	642	780	918	1,056
Willacy	M	Nueces-Rio Grande	Gulf Coast Aquifer System	1,146	1,459	1,772	2,084	2,205
GMA 16-Total			**Gulf Coast Aquifer System**	**233,371**	**257,092**	**278,239**	**299,737**	**311,830**

TABLE 3. COMPARISON OF MEASURED AND MODELED WATER-LEVELS AVERAGED OVER GROUNDWATER MANAGEMENT AREA 16 FROM THE DECADAL YEARS 2000 AND 2010. VALUES OF FIELD MEASURED WATER-LEVELS WERE OBTAINED FROM THE TWDB GROUNDWATER DATABASE (GWDB).

Average water levels in Groundwater Management Area 16 (in feet above mean sea level)		
	Year 2000	**Year 2010**
Field measurements (GWDB)	114.1	114.4
Model estimated	119.5	107.1

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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GAM RUN 17-027 MAG:
MODELED AVAILABLE GROUNDWATER FOR THE CARRIZO-WILCOX, QUEEN CITY, SPARTA, AND YEGUA-JACKSON AQUIFERS IN GROUNDWATER MANAGEMENT AREA 13

Shirley C. Wade, Ph.D., P.G.
Texas Water Development Board
Groundwater Division
Groundwater Availability Modeling Department
(512) 936-0883
October 27, 2017

Shirley C. Wade
10/27/17

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GAM RUN 17-027 MAG: MODELED AVAILABLE GROUNDWATER FOR THE CARRIZO-WILCOX, QUEEN CITY, SPARTA, AND YEGUA-JACKSON AQUIFERS IN GROUNDWATER MANAGEMENT AREA 13

Shirley C. Wade, Ph.D., P.G.
Texas Water Development Board
Groundwater Division
Groundwater Availability Modeling Department
(512) 936-0883
October 27, 2017

EXECUTIVE SUMMARY:

The modeled available groundwater for Groundwater Management Area 13 for the Carrizo-Wilcox, Queen City, Sparta, and Yegua-Jackson aquifers is summarized by decade for the groundwater conservation districts (Tables 1 through 4 respectively) and for use in the regional water planning process (Tables 5 through 8 respectively). The modeled available groundwater estimates for the Carrizo-Wilcox Aquifer range from approximately 626,000 acre-feet per year in 2012 to approximately 589,000 acre-feet per year in 2070 (Table 1). The modeled available groundwater estimates for the Queen City Aquifer range from approximately 19,000 acre-feet per year in 2012 to approximately 15,000 acre-feet per year in 2070 (Table 2). The modeled available groundwater estimates for the Sparta Aquifer range from approximately 7,000 acre-feet per year in 2012 to approximately 6,000 acre-feet per year in 2070 (Table 3). The estimates were extracted from results of a model run using the groundwater availability model for the southern part of the Carrizo-Wilcox, Queen City, and Sparta aquifers (version 2.01). The model run files, which meet the secondary desired future condition adopted by district representatives of Groundwater Management Area 13 for the Carrizo-Wilcox, Queen City, and Sparta Aquifers, were submitted to the Texas Water Development Board (TWDB) on February 28, 2017, as part of the Desired Future Conditions Explanatory Report for Groundwater Management Area 13. The modeled available groundwater estimates for the Yegua-Jackson Aquifer are approximately 7,000 acre-feet per year from 2010 to 2070 (Table 4). The estimates were extracted from results of a model run using the groundwater availability model for the

Yegua-Jackson Aquifer version 1.01. The model run files, which meet the desired future conditions adopted by district representatives of Groundwater Management Area 13 for the Yegua-Jackson Aquifer, were submitted to the TWDB on March 29, 2017 as supplemental information for the original February 28, 2017 submittal. The explanatory reports and other materials submitted to the TWDB were determined to be administratively complete on September 8, 2017.

REQUESTOR:

Mr. Greg Sengelmann, coordinator of Groundwater Management Area 13.

DESCRIPTION OF REQUEST:

In a letter dated February 24, 2017, Dr. William R. Hutchison, on behalf of Groundwater Management Area 13, provided the TWDB with the desired future conditions of the Carrizo-Wilcox, Queen City, Sparta, and Yegua-Jackson aquifers adopted by the groundwater conservation districts in Groundwater Management Area 13. The desired future conditions for the Carrizo-Wilcox, Queen City, and Sparta aquifers described in Resolution 16-01 from Groundwater Management Area 13, adopted November 21, 2016 are:

- *"The first proposed desired future condition for the Carrizo-Wilcox, Queen City and Sparta aquifers in Groundwater Management Area 13 is that 75 percent of the saturated thickness in the outcrop at the end of 2012 remains in 2070. This desired future condition is considered feasible despite model predictions to the contrary as detailed in GMA 13 Technical Memorandum 16-08", and*
- *"In addition, a secondary proposed desired future condition for the Carrizo-Wilcox, Queen City, and Sparta aquifers in Groundwater Management Area 13 is an average drawdown of 48 feet for all of GMA 13. The drawdown is calculated from the end of 2012 conditions to the year 2070. This desired future condition is consistent with Scenario 9 as detailed in GMA 13 Technical Memorandum 16-01 and GMA 13 Technical Memorandum 16-08."*

The desired future conditions for the Yegua-Jackson Aquifer described in Resolution 16-02 from Groundwater Management Area 13, adopted November 21, 2016 are:

- *"For Gonzales County, the average drawdown from 2010 to 2070 is 3 feet*
- *For Karnes County, the average drawdown from 2010 to 2070 is 1 foot*
- *For all other counties in GMA 13, the Yegua-Jackson is classified as not relevant for purposes of joint planning."*

TWDB staff reviewed the model files associated with the desired future conditions and received clarification on procedures and assumptions from the Groundwater Management Area 13 Technical Coordinator on April 4, 2017, and on September 21, 2017. Groundwater Management Area 13 adopted two desired future conditions for the Carrizo-Wilcox, Queen City, and Sparta Aquifers and they were not mutually compatible in the groundwater availability model. The technical coordinator for the groundwater management area confirmed that their intention was for the modeled available groundwater values to be based on the secondary desired future condition and Pumping Scenario 9 (Hutchison, 2017a). The first proposed desired future condition was not intended for the calculation of modeled available groundwater. Other questions included whether drawdown averages and modeled available groundwater values were based on official aquifer extent or model extent, whether to include dry cells in drawdown averaging, which stress periods to use for drawdown calculation, and whether to provide modeled available groundwater separately for the Carrizo-Wilcox, Queen City, and Sparta aquifers or as a combined value for all three aquifers .

In addition, TWDB staff requested and received supplemental model files for the Yegua-Jackson Aquifer on March 29, 2017, and supplemental documentation (Hutchison, 2017d) related to initial conditions for modeling the Carrizo-Wilcox, Queen City, and Sparta aquifers from Dr. William R. Hutchison on August 25, 2017, on behalf of Groundwater Management Area 13. All clarifications are included in the Parameters and Assumptions Section of this report.

METHODS:

The groundwater availability model for the southern part of the Carrizo-Wilcox, Queen City, and Sparta aquifers (Figures 1 through 4) was run using the model files submitted with the explanatory reports (Hutchison, 2017c). Model-calculated drawdowns were extracted for the year 2070. An overall drawdown average was calculated for the entire Groundwater Management Area 13 using all aquifer layers in the average. Based on clarifications, the reference year for drawdown calculations was the end of 2011 (or the beginning of 2012). As specified in the clarifications, drawdowns for cells that became dry during the simulation (water level dropped below the base of the cell) were excluded from the averaging. The calculated drawdown average was compared with the desired future condition of 48 feet to verify that the pumping scenario (Hutchison, 2017a) achieved the desired future conditions within one foot.

The groundwater availability model for the Yegua-Jackson Aquifer (Figures 5 and 6) was run using the model files submitted on March 29, 2017, as supplemental information and drawdowns were calculated for the year 2070. County-wide average drawdowns were calculated for Gonzales and Karnes counties within Groundwater Management Area 13 using all model layers in the average. Based on clarifications, the reference year for drawdown calculation was the end of 2009 (or the beginning of 2010). As specified in the clarifications, drawdowns for cells that became dry during the simulation (water level dropped below the base of the cell) were excluded from the averaging. The calculated drawdown averages were compared with the desired future conditions for Gonzales and Karnes counties to verify that the pumping scenario (Hutchison, 2017b) achieved the desired future conditions within one foot.

The 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 by county and groundwater conservation district, subtotaled by groundwater conservation district, and then summed for Groundwater Management Area 13 (Tables 1 through 4). Annual pumping rates by aquifer are also presented by county, river basin, and regional water planning area within Groundwater Management Area 13 (Tables 5 through 8). Additional tables are provided in Appendix A which summarize the total modeled available groundwater for the Carrizo-Wilcox, Queen City, and Sparta aquifers by regional water planning area, county, river basin, and groundwater conservation district. Tables are provided in Appendix B which split the Carrizo-Wilcox, Queen City, and Sparta aquifers modeled pumping by model layer for each groundwater conservation district.

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:

Carrizo-Wilcox, Queen City, and Sparta aquifers

- We used Version 2.01 of the groundwater availability model for the southern part of the Carrizo-Wilcox, Queen City, and Sparta aquifers. 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, Queen City, and Sparta aquifers.
- This groundwater availability model includes eight layers, which generally represent the Sparta Aquifer (Layer 1), the Weches Confining Unit (Layer 2), the Queen City Aquifer (Layer 3), the Reklaw Confining Unit (Layer 4), the Carrizo (Layer 5), the Upper Wilcox (Layer 6), the Middle Wilcox (Layer 7), and the Lower Wilcox (Layer 8). Parts of the Upper Wilcox do not exist in Groundwater Management Area 13 and the official extent of the Queen City and Sparta aquifers end around the Frio River. Layers represent equivalent geologic units outside of the official aquifer extents.
- The model was run with MODFLOW-96 (Harbaugh and others, 1996).
- The end of the calibration period was extended from 1999 to 2011 (Hutchison, 2017e) and the reference year for drawdown calculations was the end of 2011.
- Drawdown averages and modeled available groundwater values were based on the extent of the model area rather than the official aquifer boundaries.
- Drawdowns for cells where water levels dropped below the base elevation of the cell causing the cell to become inactive (dry cells) were excluded from the averaging.
- A tolerance of one foot was assumed when comparing desired future conditions (Table 1, average drawdown values per county) to model drawdown results.
- Estimates of modeled available groundwater from the model simulation were rounded to whole numbers.
- Although the desired future condition for the Carrizo-Wilcox, Queen City, and Sparta aquifers is a combined value for all three aquifers, the modeled available groundwater values will be provided individually for each aquifer per clarification from the Groundwater Management Area 13 Technical Coordinator on September 21, 2017.

Yegua-Jackson Aquifer

- We used version 1.01 of the groundwater availability model for the Yegua-Jackson Aquifer. See Deeds and others (2010) for assumptions and limitations of the groundwater availability model.
- This groundwater availability model includes five layers which represent the outcrop of the Yegua-Jackson Aquifer and younger overlying units—the Catahoula Formation (Layer 1), the upper portion of the Jackson Group (Layer 2), the lower portion of the Jackson Group (Layer 3), the upper portion of the Yegua Group (Layer 4), and the lower portion of the Yegua Group (Layer 5).
- The model was run with MODFLOW-2000 (Harbaugh and others, 2000).
- The end of the calibration period was extended from 1997 to 2009 (Oliver, 2010) and the reference year for drawdown calculations was the end of 2009.
- Drawdown averages and modeled available groundwater values were based on the extent of the model area rather than the official aquifer boundaries.
- Drawdown for cells where water levels dropped below the base elevation of the cell causing the cell to become inactive (dry cells) were excluded from the averaging.
- A tolerance of one foot was assumed when comparing desired future conditions (Table 1, average drawdown values per county) to model drawdown results.
- Estimates of modeled available groundwater from the model simulation were rounded to whole numbers.

RESULTS:

The modeled available groundwater estimates for the Carrizo-Wilcox Aquifer range from approximately 626,000 acre-feet per year in 2012 to approximately 589,000 acre-feet per year in 2070 (Table 1). The modeled available groundwater estimates for the Queen City Aquifer range from approximately 19,000 acre-feet per year in 2012 to approximately 15,000 acre-feet per year in 2070 (Table 2). The modeled available groundwater estimate for the Sparta Aquifer ranges from approximately 7,000 acre-feet per year in 2012 to approximately 6,000 acre-feet per year in 2070 (Table 3). The modeled available groundwater is summarized by groundwater conservation district and county for the Carrizo-Wilcox, Queen City, and Sparta aquifers (Tables 1, 2, and 3 respectively). The modeled available groundwater has also been summarized by county, river basin, and regional water planning area for use in the regional water planning process for the Carrizo-Wilcox, Queen City, and Sparta aquifers (Tables 5, 6, and 7 respectively). Small differences in values between table summaries are due to rounding. Additional tables are provided in Appendix A which summarize the total modeled available groundwater for all three aquifers by regional water planning area, county, river basin, and groundwater conservation district. Tables are provided in Appendix B which split the modeled pumping by each model aquifer layer for each groundwater conservation district.

The modeled available groundwater estimate for the Yegua-Jackson Aquifer is approximately 7,000 acre-feet per year from 2010 to 2070 (Table 4). The modeled available groundwater for the Yegua-Jackson Aquifer is summarized by groundwater conservation district and county (Table 4) and by county, river basin, and regional water planning area for use in the regional water planning process (Table 8). Small differences of values between table summaries are due to rounding.

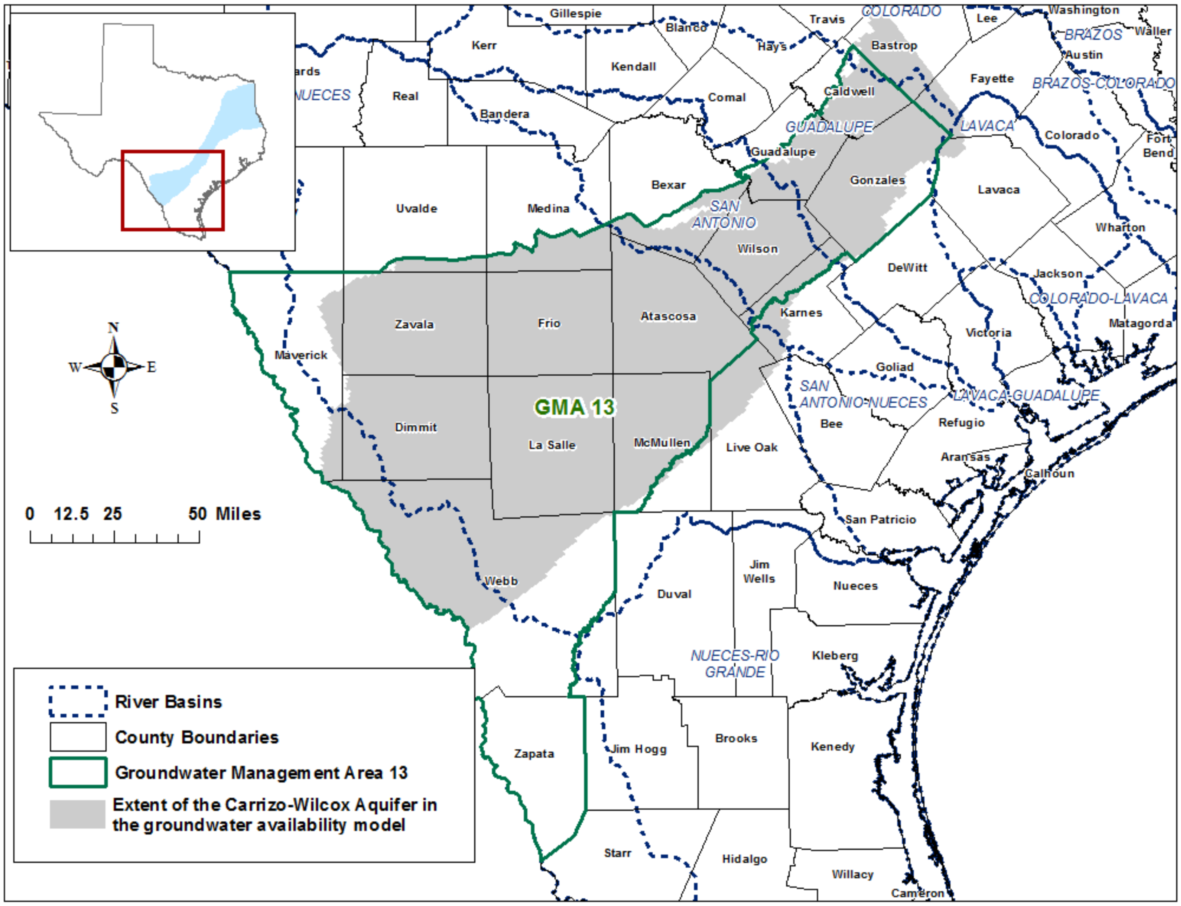

FIGURE 1. GROUNDWATER MANAGEMENT AREA (GMA) 13 BOUNDARY, RIVER BASINS, AND COUNTIES OVERLAIN ON THE EXTENT OF THE CARRIZO-WILCOX AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL FOR THE SOUTHERN PORTION OF THE CARRIZO-WILCOX, QUEEN CITY, AND SPARTA AQUIFERS.

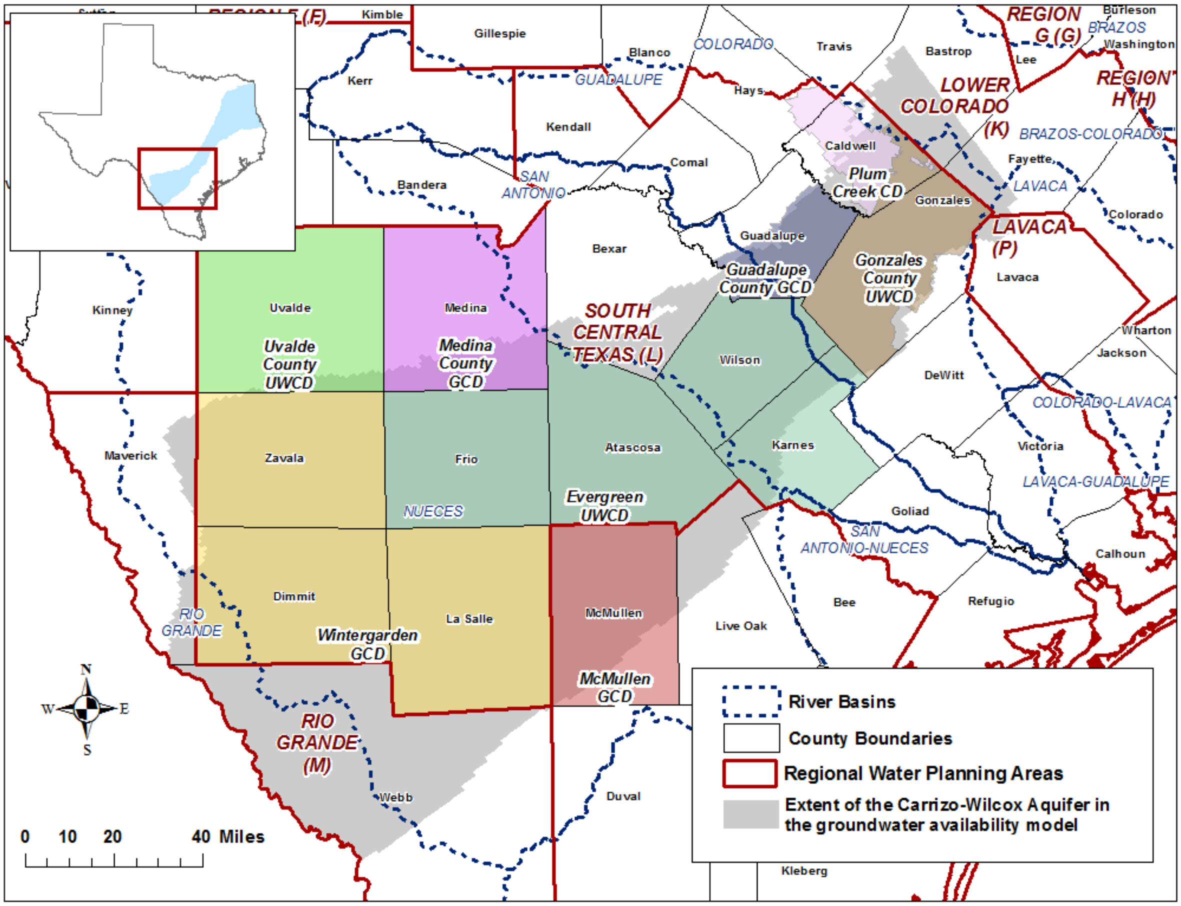

FIGURE 2. **REGIONAL WATER PLANNING AREAS (RWPAS), RIVER BASINS, GROUNDWATER CONSERVATION DISTRICTS (GCDS), AND COUNTIES OVERLAIN ON THE EXTENT OF THE CARRIZO-WILCOX AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL FOR THE SOUTHERN PORTION OF THE CARRIZO-WILCOX, QUEEN CITY, AND SPARTA AQUIFERS.**

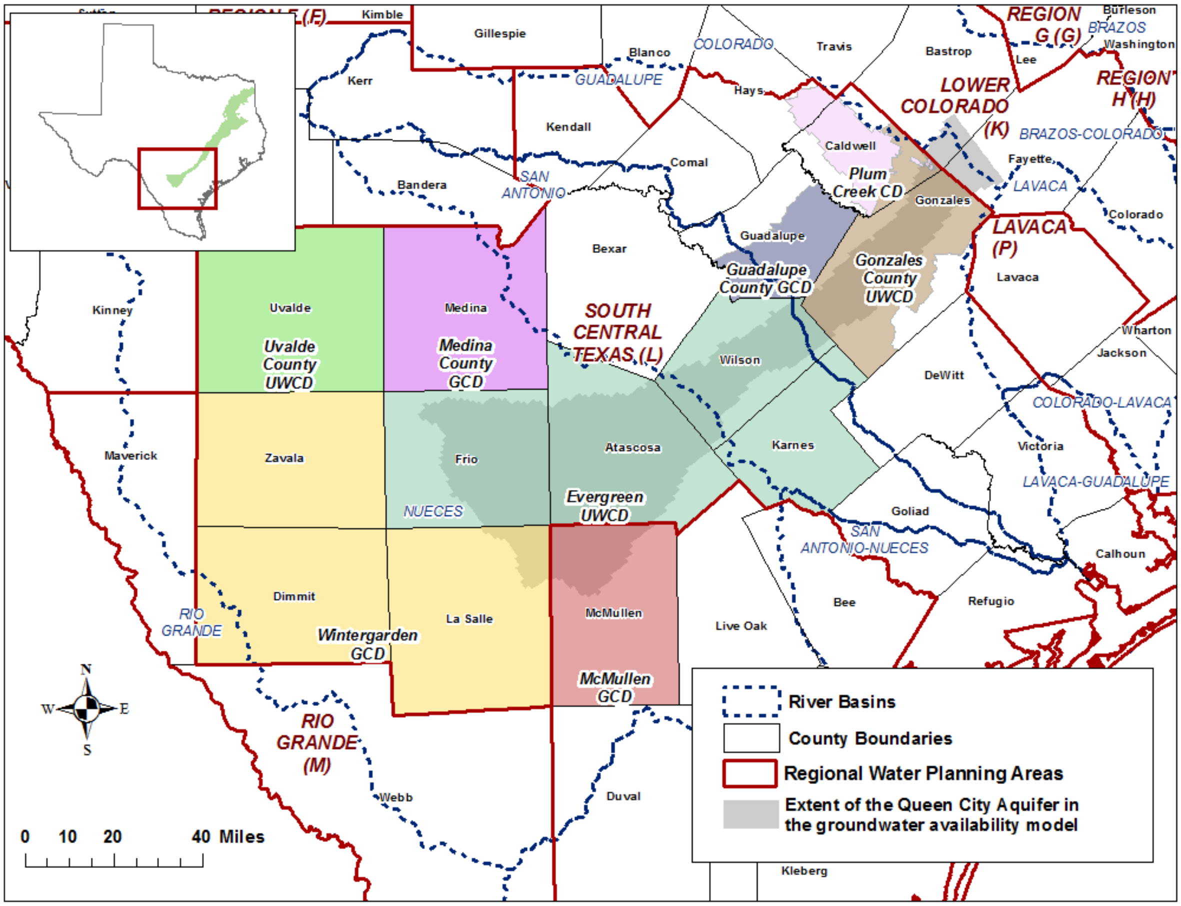

FIGURE 3. **REGIONAL WATER PLANNING AREAS (RWPAS), RIVER BASINS, GROUNDWATER CONSERVATION DISTRICTS (GCDS), AND COUNTIES OVERLAIN ON THE EXTENT OF THE QUEEN CITY AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL FOR THE SOUTHERN PORTION OF THE CARRIZO-WILCOX, QUEEN CITY, AND SPARTA AQUIFERS.**

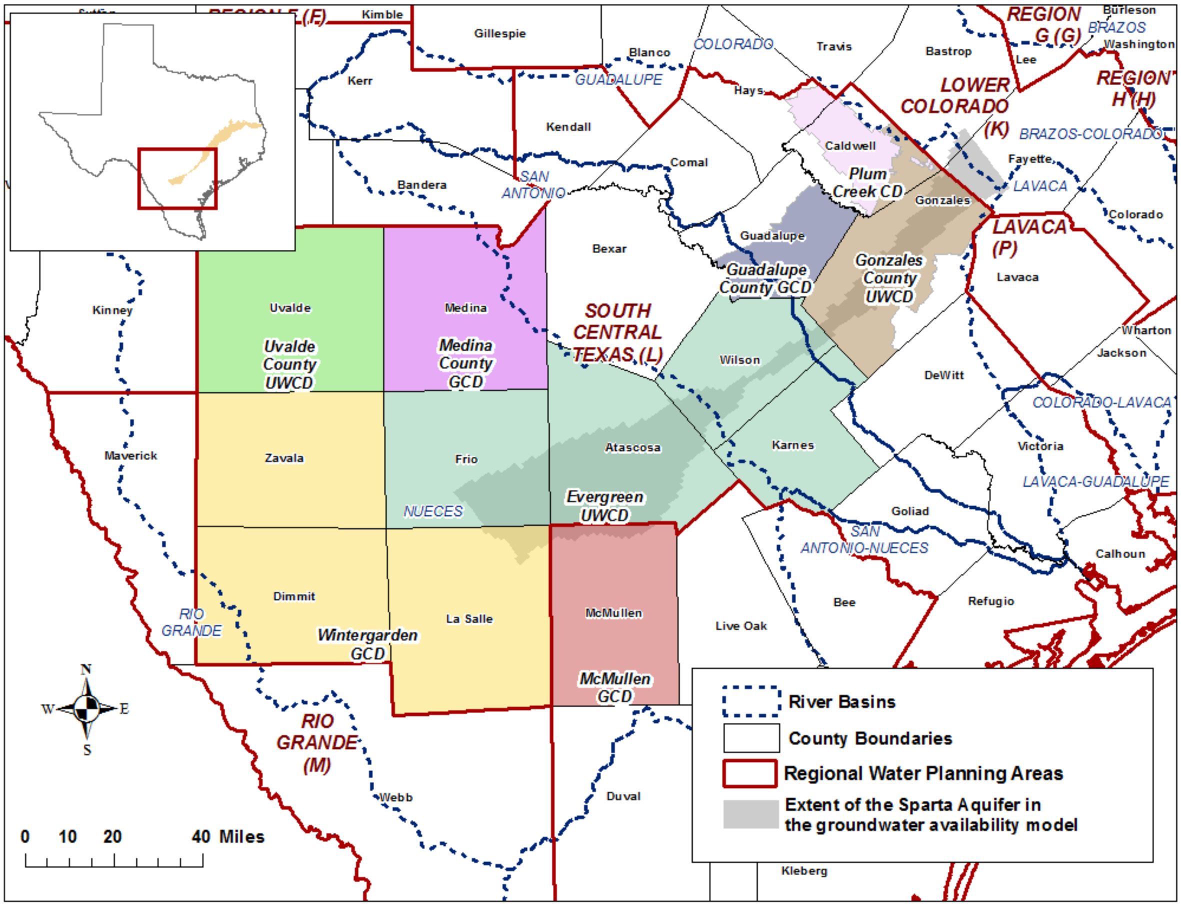

FIGURE 4. **REGIONAL WATER PLANNING AREAS (RWPAS), RIVER BASINS, GROUNDWATER CONSERVATION DISTRICTS (GCDS), AND COUNTIES OVERLAIN ON THE EXTENT OF THE SPARTA AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL FOR THE SOUTHERN PORTION OF THE CARRIZO-WILCOX, QUEEN CITY, AND SPARTA AQUIFERS.**

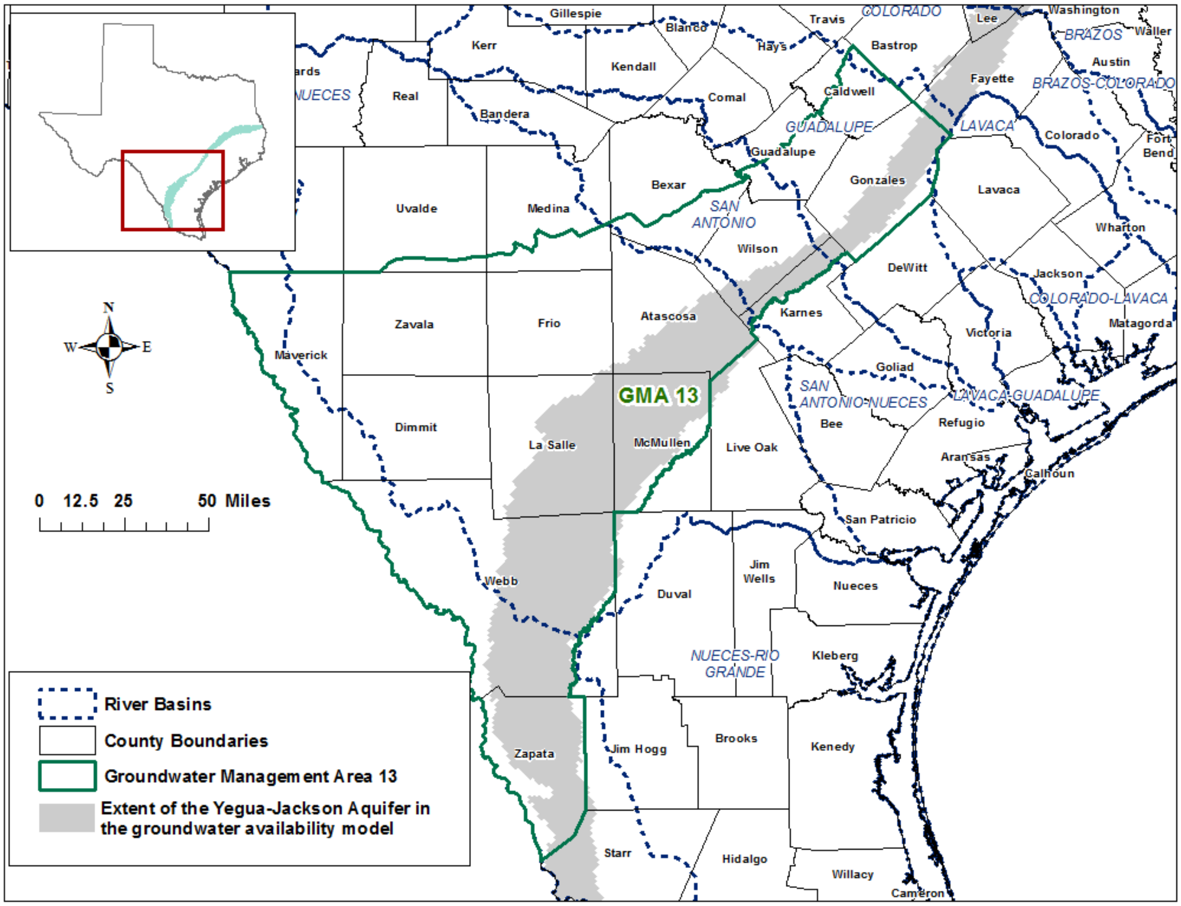

FIGURE 5. **GROUNDWATER MANAGEMENT AREA (GMA) 13 BOUNDARY, RIVER BASINS, AND COUNTIES OVERLAIN ON THE EXTENT OF THE YEGUA-JACKSON AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL.**

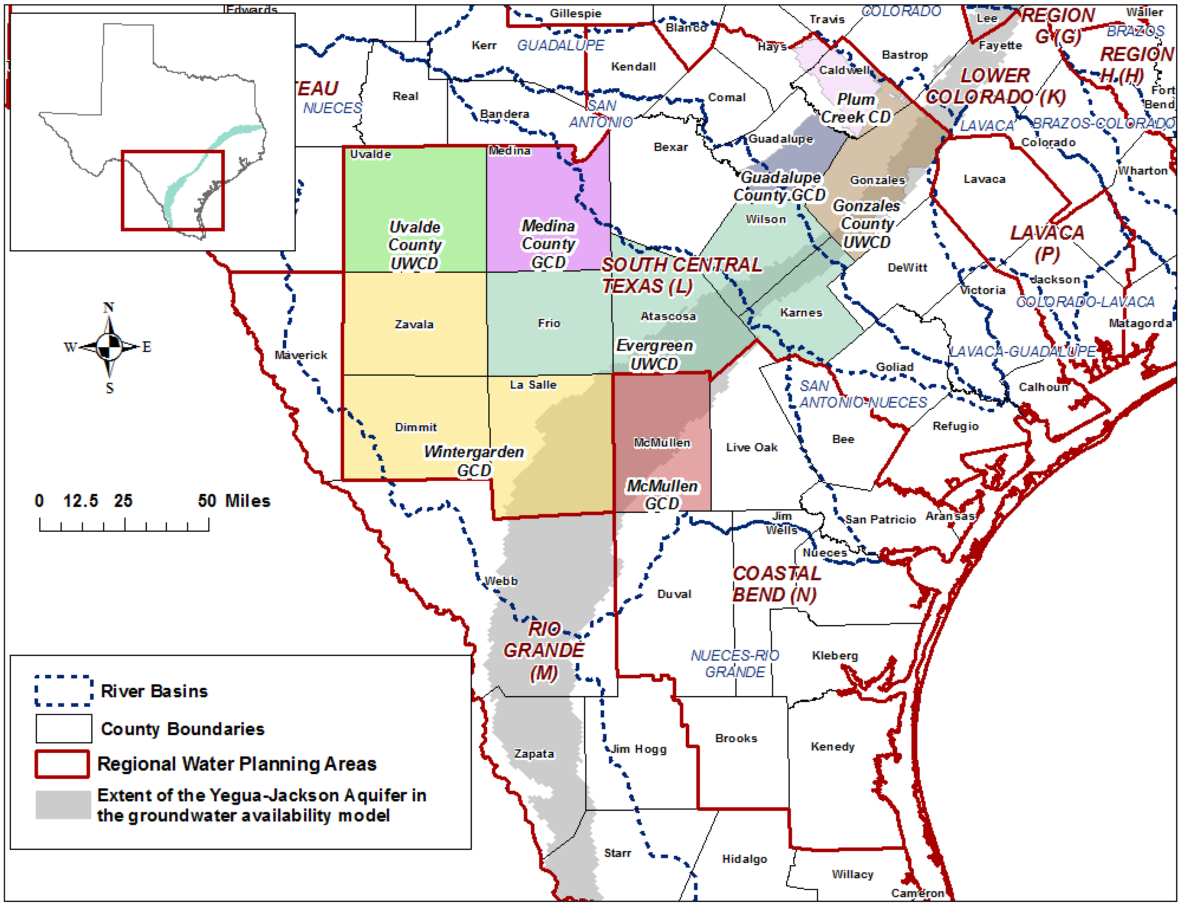

FIGURE 6. REGIONAL WATER PLANNING AREAS (RWPAS), RIVER BASINS, GROUNDWATER CONSERVATION DISTRICTS (GCDS), AND COUNTIES OVERLAIN ON THE EXTENT OF THE YEGUA-JACKSON AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL.

TABLE 1. MODELED AVAILABLE GROUNDWATER FOR THE CARRIZO-WILCOX AQUIFER IN GROUNDWATER MANAGEMENT AREA 13 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2012 AND 2070. VALUES ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District	County	Aquifer	2012	2020	2030	2040	2050	2060	2070
Evergreen UWCD	Atascosa	Carrizo-Wilcox	67,668	67,668	70,286	71,066	72,718	74,298	75,874
Evergreen UWCD	Frio	Carrizo-Wilcox	111,920	111,920	85,036	82,999	81,083	79,197	77,353
Evergreen UWCD	Karnes	Carrizo-Wilcox	1,042	1,042	1,085	1,146	1,212	1,264	1,296
Evergreen UWCD	Wilson	Carrizo-Wilcox	108,465	108,465	104,918	106,196	107,653	109,358	111,093
Evergreen UWCD Total		**Carrizo-Wilcox**	**289,096**	**289,096**	**261,325**	**261,406**	**262,666**	**264,116**	**265,616**
Gonzales County UWCD	Caldwell	Carrizo-Wilcox	39,713	39,713	39,713	36,678	36,678	33,643	33,643
Gonzales County UWCD	Gonzales	Carrizo-Wilcox	81,594	81,594	81,594	85,371	85,735	85,987	85,996
Gonzales County UWCD Total		**Carrizo-Wilcox**	**121,307**	**121,307**	**121,307**	**122,049**	**122,413**	**119,630**	**119,638**
Guadalupe County GCD	**Guadalupe**	**Carrizo-Wilcox**	**48,032**	**52,528**	**47,844**	**45,776**	**47,995**	**47,965**	**47,833**
McMullen GCD	**McMullen**	**Carrizo-Wilcox**	**7,002**	**7,056**	**7,056**	**4,405**	**4,405**	**4,405**	**4,405**
Medina County GCD	**Medina**	**Carrizo-Wilcox**	**2,657**	**2,657**	**2,648**	**2,647**	**2,647**	**2,646**	**2,646**
Plum Creek CD	**Caldwell**	**Carrizo-Wilcox**	**21,073**	**20,610**	**20,610**	**20,202**	**20,202**	**19,625**	**19,625**
Uvalde County UWCD	**Uvalde**	**Carrizo-Wilcox**	**4,451**	**2,975**	**1,231**	**828**	**828**	**828**	**828**

Groundwater Conservation District	County	Aquifer	2012	2020	2030	2040	2050	2060	2070
Wintergarden GCD	Dimmit	Carrizo-Wilcox	4,129	4,129	4,129	4,129	4,129	4,129	4,129
Wintergarden GCD	La Salle	Carrizo-Wilcox	6,863	6,863	6,863	6,863	6,863	6,863	6,863
Wintergarden GCD	Zavala	Carrizo-Wilcox	35,653	35,653	35,305	35,171	35,071	34,750	34,695
Wintergarden GCD Total		**Carrizo-Wilcox**	**46,645**	**46,645**	**46,297**	**46,163**	**46,063**	**45,742**	**45,687**
No District-County	Bexar	Carrizo-Wilcox	81,992	81,474	80,817	80,348	79,470	78,977	78,807
No District-County	Caldwell	Carrizo-Wilcox	921	921	921	921	921	921	921
No District-County	Gonzales	Carrizo-Wilcox	59	59	59	59	59	59	59
No District-County	Maverick	Carrizo-Wilcox	2,203	2,042	2,042	2,001	1,914	1,570	1,531
No District-County	Webb	Carrizo-Wilcox	916	916	916	916	916	916	916
No District-County Total		**Carrizo-Wilcox**	**86,091**	**85,412**	**84,755**	**84,245**	**83,280**	**82,443**	**82,235**
Total for GMA 13		**Carrizo-Wilcox**	**626,354**	**628,284**	**593,072**	**587,722**	**590,498**	**587,400**	**588,514**

TABLE 2. MODELED AVAILABLE GROUNDWATER FOR THE QUEEN CITY AQUIFER IN GROUNDWATER MANAGEMENT AREA 13 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2012 AND 2070. VALUES ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District	County	Aquifer	2012	2020	2030	2040	2050	2060	2070
Evergreen UWCD	Atascosa	Queen City	4,075	4,075	4,543	4,543	4,513	4,407	4,302
Evergreen UWCD	Frio	Queen City	6,759	6,759	4,745	4,573	4,429	4,257	4,113
Evergreen UWCD	Wilson	Queen City	2,780	2,780	1,508	1,339	1,191	1,059	945
Evergreen UWCD Total		**Queen City**	**13,614**	**13,614**	**10,797**	**10,455**	**10,133**	**9,723**	**9,359**
Gonzales County UWCD	**Caldwell**	**Queen City**	284	284	284	284	284	284	284
Gonzales County UWCD	**Gonzales**	**Queen City**	5,067	5,067	5,067	5,067	5,067	5,067	5,067
Gonzales County UWCD Total		**Queen City**	**5,351**	**5,351**	**5,351**	**5,351**	**5,351**	**5,351**	**5,351**
Guadalupe County GCD	**Guadalupe**	**Queen City**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
McMullen GCD	**McMullen**	**Queen City**	**134**	**134**	**134**	**134**	**134**	**134**	**134**
Plum Creek CD	**Caldwell**	**Queen City**	**22**	**22**	**22**	**22**	**22**	**22**	**22**
Wintergarden GCD	**La Salle**	**Queen City**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
Total for GMA 13		**Queen City**	**19,123**	**19,123**	**16,307**	**15,965**	**15,643**	**15,233**	**14,869**

TABLE 3. MODELED AVAILABLE GROUNDWATER FOR THE SPARTA AQUIFER IN GROUNDWATER MANAGEMENT AREA 13 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2012 AND 2070. VALUES ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District	County	Aquifer	2012	2020	2030	2040	2050	2060	2070
Evergreen UWCD	Atascosa	Sparta	1,219	1,215	1,188	1,129	1,083	1,044	1,013
Evergreen UWCD	Frio	Sparta	1,045	1,045	728	702	674	651	624
Evergreen UWCD	Wilson	Sparta	462	462	251	224	198	176	156
Evergreen UWCD Total		**Sparta**	**2,726**	**2,723**	**2,166**	**2,056**	**1,955**	**1,870**	**1,792**
Gonzales County UWCD	**Gonzales**	**Sparta**	**3,554**	**3,554**	**3,554**	**3,554**	**3,554**	**3,554**	**3,554**
McMullen GCD	**McMullen**	**Sparta**	**89**	**89**	**89**	**89**	**89**	**89**	**89**
Wintergarden GCD	**La Salle**	**Sparta**	**983**	**983**	**983**	**983**	**983**	**983**	**983**
Total for GMA 13		**Sparta**	**7,353**	**7,349**	**6,793**	**6,682**	**6,582**	**6,497**	**6,419**

TABLE 4. MODELED AVAILABLE GROUNDWATER FOR THE YEGUA-JACKSON AQUIFER IN GROUNDWATER MANAGEMENT AREA 13 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2010 AND 2070. VALUES ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District	County	Aquifer	2010	2020	2030	2040	2050	2060	2070
Evergreen UWCD	Karnes	Yegua-Jackson	2,059	2,059	2,059	2,059	2,059	2,059	2,059
Gonzales County UWCD	Gonzales	Yegua-Jackson	4,140	4,140	4,140	4,140	4,140	4,140	4,140
No District-County	Gonzales	Yegua-Jackson	573	573	573	573	573	573	573
Total for GMA 13		**Yegua-Jackson**	**6,771**	**6,771**	**6,771**	**6,771**	**6,771**	**6,771**	**6,771**

TABLE 5. MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE CARRIZO-WILCOX AQUIFER IN GROUNDWATER MANAGEMENT AREA 13. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), RIVER BASIN, AND AQUIFER.

County	RWPA	River Basin	Aquifer	2020	2030	2040	2050	2060	2070
Atascosa	L	Nueces	Carrizo-Wilcox	67,548	70,166	70,946	72,598	74,178	75,754
Atascosa	L	San Antonio	Carrizo-Wilcox	120	120	120	120	120	120
Bexar	L	Nueces	Carrizo-Wilcox	48,152	48,152	48,152	48,152	48,152	48,176
Bexar	L	San Antonio	Carrizo-Wilcox	33,322	32,665	32,196	31,318	30,825	30,631
Caldwell	L	Colorado	Carrizo-Wilcox	593	593	593	593	593	593
Caldwell	L	Guadalupe	Carrizo-Wilcox	60,652	60,652	57,208	57,208	53,596	53,596
Dimmit	L	Nueces	Carrizo-Wilcox	4,022	4,022	4,022	4,022	4,022	4,022
Dimmit	L	Rio Grande	Carrizo-Wilcox	107	107	107	107	107	107
Frio	L	Nueces	Carrizo-Wilcox	111,920	85,036	82,999	81,083	79,197	77,353
Gonzales	L	Guadalupe	Carrizo-Wilcox	81,438	81,438	85,216	85,579	85,832	85,840
Gonzales	L	Lavaca	Carrizo-Wilcox	215	215	215	215	215	215
Guadalupe	L	Guadalupe	Carrizo-Wilcox	36,180	32,150	29,767	31,569	31,793	31,744
Guadalupe	L	San Antonio	Carrizo-Wilcox	16,347	15,693	16,008	16,426	16,172	16,089
Karnes	L	Guadalupe	Carrizo-Wilcox	177	185	195	207	215	220
Karnes	L	Nueces	Carrizo-Wilcox	83	87	92	97	101	103
Karnes	L	San Antonio	Carrizo-Wilcox	783	813	859	909	948	972
La Salle	L	Nueces	Carrizo-Wilcox	6,863	6,863	6,863	6,863	6,863	6,863
Medina	L	Nueces	Carrizo-Wilcox	2,652	2,643	2,643	2,642	2,641	2,641
Medina	L	San Antonio	Carrizo-Wilcox	5	5	5	5	5	5
Uvalde	L	Nueces	Carrizo-Wilcox	2,975	1,231	828	828	828	828
Wilson	L	Guadalupe	Carrizo-Wilcox	20,287	20,186	20,340	20,452	20,783	20,923

County	RWPA	River Basin	Aquifer	2020	2030	2040	2050	2060	2070
Wilson	L	Nueces	Carrizo-Wilcox	7,652	7,154	7,317	7,510	7,709	7,938
Wilson	L	San Antonio	Carrizo-Wilcox	80,526	77,577	78,538	79,691	80,865	82,232
Zavala	L	Nueces	Carrizo-Wilcox	35,653	35,305	35,171	35,071	34,750	34,695
Maverick	M	Nueces	Carrizo-Wilcox	777	777	777	777	472	472
Maverick	M	Rio Grande	Carrizo-Wilcox	1,265	1,265	1,224	1,137	1,097	1,059
Webb	M	Nueces	Carrizo-Wilcox	92	92	92	92	92	92
Webb	M	Rio Grande	Carrizo-Wilcox	824	824	824	824	824	824
McMullen	N	Nueces	Carrizo-Wilcox	7,056	7,056	4,405	4,405	4,405	4,405
GMA 13 Total			**Carrizo-Wilcox**	**628,284**	**593,072**	**587,722**	**590,498**	**587,400**	**588,514**

TABLE 6. MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE QUEEN CITY AQUIFER IN GROUNDWATER MANAGEMENT AREA 13. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), RIVER BASIN, AND AQUIFER.

County	RWPA	River Basin	Aquifer	2020	2030	2040	2050	2060	2070
Atascosa	L	Nueces	Queen City	4,075	4,543	4,543	4,513	4,407	4,302
Caldwell	L	Guadalupe	Queen City	307	307	307	307	307	307
Frio	L	Nueces	Queen City	6,759	4,745	4,573	4,429	4,257	4,113
Gonzales	L	Guadalupe	Queen City	5,032	5,032	5,032	5,032	5,032	5,032
Gonzales	L	Lavaca	Queen City	35	35	35	35	35	35
Guadalupe	L	Guadalupe	Queen City	0	0	0	0	0	0
La Salle	L	Nueces	Queen City	2	2	2	2	2	2
Wilson	L	Guadalupe	Queen City	236	128	114	101	90	80
Wilson	L	Nueces	Queen City	273	148	132	117	104	93
Wilson	L	San Antonio	Queen City	2,271	1,232	1,094	973	865	772
McMullen	N	Nueces	Queen City	134	134	134	134	134	134
GMA 13 Total			**Queen City**	**19,123**	**16,307**	**15,965**	**15,643**	**15,233**	**14,869**

TABLE 7. MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE SPARTA AQUIFER IN GROUNDWATER MANAGEMENT AREA 13. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), RIVER BASIN, AND AQUIFER.

County	RWPA	River Basin	Aquifer	2020	2030	2040	2050	2060	2070
Atascosa	L	Nueces	Sparta	1,215	1,188	1,129	1,083	1,044	1,013
Frio	L	Nueces	Sparta	1,045	728	702	674	651	624
Gonzales	L	Guadalupe	Sparta	3,531	3,531	3,531	3,531	3,531	3,531
Gonzales	L	Lavaca	Sparta	23	23	23	23	23	23
La Salle	L	Nueces	Sparta	983	983	983	983	983	983
Wilson	L	Guadalupe	Sparta	42	23	20	18	16	14
Wilson	L	Nueces	Sparta	102	55	49	44	39	34
Wilson	L	San Antonio	Sparta	319	173	154	137	121	108
McMullen	N	Nueces	Sparta	89	89	89	89	89	89
GMA 13 Total			**Sparta**	**7,349**	**6,793**	**6,682**	**6,582**	**6,497**	**6,419**

TABLE 8. MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE YEGUA-JACKSON AQUIFER IN GROUNDWATER MANAGEMENT AREA 13. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), RIVER BASIN, AND AQUIFER.

County	RWPA	River Basin	Aquifer	2020	2030	2040	2050	2060	2070
Atascosa	L	Nueces	Yegua-Jackson	NULL	NULL	NULL	NULL	NULL	NULL
Frio	L	Nueces	Yegua-Jackson	NULL	NULL	NULL	NULL	NULL	NULL
Gonzales	L	Guadalupe	Yegua-Jackson	4,694	4,694	4,694	4,694	4,694	4,694
Gonzales	L	Lavaca	Yegua-Jackson	19	19	19	19	19	19
Karnes	L	Guadalupe	Yegua-Jackson	327	327	327	327	327	327
Karnes	L	Nueces	Yegua-Jackson	91	91	91	91	91	91
Karnes	L	San Antonio	Yegua-Jackson	1,641	1,641	1,641	1,641	1,641	1,641
La Salle	L	Nueces	Yegua-Jackson	NULL	NULL	NULL	NULL	NULL	NULL
Wilson	L	Guadalupe	Yegua-Jackson	NULL	NULL	NULL	NULL	NULL	NULL
Wilson	L	Nueces	Yegua-Jackson	NULL	NULL	NULL	NULL	NULL	NULL
Wilson	L	San Antonio	Yegua-Jackson	NULL	NULL	NULL	NULL	NULL	NULL
Webb	M	Nueces	Yegua-Jackson	NULL	NULL	NULL	NULL	NULL	NULL
Webb	M	Rio Grande	Yegua-Jackson	NULL	NULL	NULL	NULL	NULL	NULL
Zapata	M	Rio Grande	Yegua-Jackson	NULL	NULL	NULL	NULL	NULL	NULL
McMullen	N	Nueces	Yegua-Jackson	NULL	NULL	NULL	NULL	NULL	NULL
GMA 13 Total			**Yegua-Jackson**	**6,771**	**6,771**	**6,771**	**6,771**	**6,771**	**6,771**

NULL: Groundwater Management Area 13 declared the Yegua-Jackson Aquifer not relevant in these areas.

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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Appendix A

Modeled Available Groundwater for the Carrizo-Wilcox, Queen City, and Sparta Aquifers Summarized by County, River Basin, Regional Water Planning Area, and Groundwater Conservation District in Groundwater Management Area 13

TABLE A.1 MODELED AVAILABLE GROUNDWATER FOR THE CARRIZO-WILCOX, QUEEN CITY, AND SPARTA AQUIFERS SUMMARIZED BY COUNTY IN GROUNDWATER MANAGEMENT AREA 13. RESULTS ARE IN ACRE-FEET PER YEAR.

County	2020	2030	2040	2050	2060	2070
Atascosa	72,959	76,017	76,739	78,315	79,749	81,189
Bexar	81,474	80,817	80,348	79,470	78,977	78,807
Caldwell	61,551	61,551	58,108	58,108	54,495	54,495
Dimmit	4,129	4,129	4,129	4,129	4,129	4,129
Frio	119,724	90,509	88,274	86,185	84,104	82,089
Gonzales	90,273	90,273	94,051	94,415	94,667	94,675
Guadalupe	52,528	47,844	45,776	47,995	47,965	47,833
Karnes	1,042	1,085	1,146	1,212	1,264	1,296
La Salle	7,848	7,848	7,848	7,848	7,848	7,848
Maverick	2,042	2,042	2,001	1,914	1,570	1,531
McMullen	7,279	7,279	4,629	4,629	4,629	4,629
Medina	2,657	2,648	2,647	2,647	2,646	2,646
Uvalde	2,975	1,231	828	828	828	828
Webb	916	916	916	916	916	916
Wilson	111,707	106,677	107,759	109,041	110,593	112,193
Zavala	35,653	35,305	35,171	35,071	34,750	34,695
GMA 13 Total	**654,757**	**616,172**	**610,369**	**612,723**	**609,130**	**609,802**

TABLE A.2 MODELED AVAILABLE GROUNDWATER FOR THE CARRIZO-WILCOX, QUEEN CITY, AND SPARTA AQUIFERS SUMMARIZED BY RIVER BASIN IN GROUNDWATER MANAGEMENT AREA 13. RESULTS ARE IN ACRE-FEET PER YEAR.

River Basin	2020	2030	2040	2050	2060	2070
Colorado	593	593	593	593	593	593
Guadalupe	207,880	203,631	201,729	204,002	201,193	201,286
Lavaca	273	273	273	273	273	273
Nueces	310,122	281,200	276,645	276,208	275,121	274,730
Rio Grande	2,196	2,196	2,155	2,068	2,028	1,990
San Antonio	133,693	128,278	128,974	129,578	129,922	130,929
GMA 13 Total	**654,757**	**616,172**	**610,369**	**612,723**	**609,130**	**609,802**

TABLE A.3 MODELED AVAILABLE GROUNDWATER FOR THE CARRIZO-WILCOX, QUEEN CITY, AND SPARTA AQUIFERS SUMMARIZED BY REGIONAL WATER PLANNING AREA IN GROUNDWATER MANAGEMENT AREA 13. RESULTS ARE IN ACRE-FEET PER YEAR.

Regional Water Planning Area	2020	2030	2040	2050	2060	2070
L	644,520	605,934	602,823	605,264	602,016	602,726
M	2,958	2,958	2,917	2,829	2,485	2,447
N	7,279	7,279	4,629	4,629	4,629	4,629
GMA 13 Total	**654,757**	**616,172**	**610,369**	**612,723**	**609,130**	**609,802**

TABLE A.4 MODELED AVAILABLE GROUNDWATER FOR THE CARRIZO-WILCOX, QUEEN CITY, AND SPARTA AQUIFERS SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT IN GROUNDWATER MANAGEMENT AREA 13. RESULTS ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District	2020	2030	2040	2050	2060	2070
Evergreen UWCD	305,432	274,288	273,917	274,754	275,710	276,768
Gonzales County UWCD	130,212	130,212	130,954	131,318	128,535	128,543
Guadalupe County GCD	52,528	47,844	45,776	47,995	47,965	47,833
McMullen GCD	7,279	7,279	4,629	4,629	4,629	4,629
Medina County GCD	2,657	2,648	2,647	2,647	2,646	2,646
Plum Creek CD	20,633	20,633	20,224	20,224	19,647	19,647
Uvalde County UWCD	2,975	1,231	828	828	828	828
Wintergarden GCD	47,630	47,282	47,149	47,048	46,727	46,673
No District-Bexar County	81,474	80,817	80,348	79,470	78,977	78,807
No District-Caldwell County	921	921	921	921	921	921
No District-Gonzales County	59	59	59	59	59	59
No District-Maverick County	2,042	2,042	2,001	1,914	1,570	1,531
No District-Webb County	916	916	916	916	916	916
GMA 13 Total	**654,757**	**616,172**	**610,369**	**612,723**	**609,130**	**609,802**

Appendix B

Total Pumping Associated with Modeled Available Groundwater Run for the Carrizo-Wilcox, Queen City, and Sparta Aquifers Split by Model Layers for Groundwater Conservation Districts in Groundwater Management Area 13

TABLE B.1 TOTAL PUMPING BY MODEL LAYER ASSOCIATED WITH THE MODELED AVAILABLE GROUNDWATER RUN FOR THE CARRIZO-WILCOX, QUEEN CITY, AND SPARTA AQUIFERS IN GROUNDWATER MANAGEMENT AREA 13 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD).

Groundwater Conservation District	Model Layer (Aquifer)	2012	2020	2030	2040	2050	2060	2070
Evergreen UWCD	1 (Sparta)	2,726	2,723	2,166	2,056	1,955	1,870	1,792
Evergreen UWCD	3 (Queen City)	13,614	13,614	10,797	10,455	10,133	9,723	9,359
Evergreen UWCD	5 (Carrizo)	199,165	199,165	171,394	171,475	172,735	174,186	175,686
Evergreen UWCD	6 (Upper Wilcox)	374	374	374	374	374	374	374
Evergreen UWCD	7 (Middle Wilcox)	370	370	370	370	370	370	370
Evergreen UWCD	8 (Lower Wilcox)	89,186	89,186	89,186	89,186	89,186	89,186	89,186
Evergreen UWCD Total		**305,436**	**305,432**	**274,288**	**273,917**	**274,754**	**275,710**	**276,768**
Gonzales County UWCD	1 (Sparta)	3,554	3,554	3,554	3,554	3,554	3,554	3,554
Gonzales County UWCD	3 (Queen City)	5,351	5,351	5,351	5,351	5,351	5,351	5,351
Gonzales County UWCD	5 (Carrizo)	83,284	83,284	83,284	84,026	84,390	81,607	81,615
Gonzales County UWCD	6 (Upper Wilcox)	0	0	0	0	0	0	0
Gonzales County UWCD	7 (Middle Wilcox)	12,187	12,187	12,187	12,187	12,187	12,187	12,187
Gonzales County UWCD	8 (Lower Wilcox)	25,836	25,836	25,836	25,836	25,836	25,836	25,836
Gonzales County UWCD Total		**130,212**	**130,212**	**130,212**	**130,954**	**131,318**	**128,535**	**128,543**

Groundwater Conservation District	Model Layer (Aquifer)	2012	2020	2030	2040	2050	2060	2070
Guadalupe County GCD	5 (Carrizo)	25,143	25,143	20,771	16,367	16,470	16,783	16,862
Guadalupe County GCD	6 (Upper Wilcox)	0	0	0	0	0	0	0
Guadalupe County GCD	7 (Middle Wilcox)	3,299	6,290	5,978	7,377	8,700	8,435	8,224
Guadalupe County GCD	8 (Lower Wilcox)	19,590	21,094	21,094	22,031	22,825	22,747	22,747
Guadalupe County GCD Total		**48,032**	**52,528**	**47,844**	**45,776**	**47,995**	**47,965**	**47,833**
McMullen GCD	1 (Sparta)	89	89	89	89	89	89	89
McMullen GCD	3 (Queen City)	134	134	134	134	134	134	134
McMullen GCD	5 (Carrizo)	7,002	7,056	7,056	4,405	4,405	4,405	4,405
McMullen GCD	6 (Upper Wilcox)	0	0	0	0	0	0	0
McMullen GCD	7 (Middle Wilcox)	0	0	0	0	0	0	0
McMullen GCD	8 (Lower Wilcox)	0	0	0	0	0	0	0
McMullen GCD Total		**7,226**	**7,279**	**7,279**	**4,629**	**4,629**	**4,629**	**4,629**
Medina County GCD	5 (Carrizo)	545	545	537	536	535	535	534
Medina County GCD	6 (Upper Wilcox)	0	0	0	0	0	0	0
Medina County GCD	7 (Middle Wilcox)	1,248	1,248	1,248	1,248	1,248	1,248	1,248

Groundwater Conservation District	Model Layer (Aquifer)	2012	2020	2030	2040	2050	2060	2070
Medina County GCD	8 (Lower Wilcox)	864	864	864	864	864	864	864
Medina County GCD Total		**2,657**	**2,657**	**2,648**	**2,647**	**2,647**	**2,646**	**2,646**
Plum Creek CD	3 (Queen City)	22	22	22	22	22	22	22
Plum Creek CD	5 (Carrizo)	6,057	6,057	6,057	6,057	6,057	6,057	6,057
Plum Creek CD	6 (Upper Wilcox)	0	0	0	0	0	0	0
Plum Creek CD	7 (Middle Wilcox)	5,301	4,838	4,838	4,838	4,838	4,261	4,261
Plum Creek CD	8 (Lower Wilcox)	9,714	9,714	9,714	9,306	9,306	9,306	9,306
Plum Creek CD Total		**21,095**	**20,633**	**20,633**	**20,224**	**20,224**	**19,647**	**19,647**
Uvalde County UWCD	5 (Carrizo)	828	828	828	828	828	828	828
Uvalde County UWCD	6 (Upper Wilcox)	3,622	2,147	402	0	0	0	0
Uvalde County UWCD	7 (Middle Wilcox)	0	0	0	0	0	0	0
Uvalde County UWCD	8 (Lower Wilcox)	0	0	0	0	0	0	0
Uvalde County UWCD Total		**4,451**	**2,975**	**1,231**	**828**	**828**	**828**	**828**
Wintergarden GCD	1 (Sparta)	983	983	983	983	983	983	983
Wintergarden GCD	3 (Queen City)	2	2	2	2	2	2	2
Wintergarden GCD	5 (Carrizo)	32,962	32,962	32,615	32,481	32,381	32,060	32,005
Wintergarden GCD	6 (Upper Wilcox)	9,261	9,261	9,261	9,261	9,261	9,261	9,261

Groundwater Conservation District	Model Layer (Aquifer)	2012	2020	2030	2040	2050	2060	2070
Wintergarden GCD	7 (Middle Wilcox)	4,006	4,006	4,006	4,006	4,006	4,006	4,006
Wintergarden GCD	8 (Lower Wilcox)	416	416	416	416	416	416	416
Wintergarden GCD Total		**47,630**	**47,630**	**47,282**	**47,149**	**47,048**	**46,727**	**46,673**

Estimated Historical Groundwater Use And 2017 State Water Plan Datasets:

McMullen Groundwater Conservation District

by Stephen Allen
Texas Water Development Board
Groundwater Division
Groundwater Technical Assistance Section
stephen.allen@twdb.texas.gov
(512) 463-7317
September 17, 2018

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 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)

   from the 2017 Texas 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 2017 SWP data available as of 9/17/2018. 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 2017 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 2017 SWP dataset can be verified by contacting Sabrina Anderson (sabrina.anderson@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 conditions within district boundaries. The multiplier used in 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 SWP 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 entity locations).

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

In the WUS 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 can add those data to the plan with an explanation of how the data were derived. Apportioning percentages that the TWDB used 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).

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

Groundwater and surface water historical use estimates are currently unavailable for calendar year 2017. TWDB staff anticipates the calculation and posting of these estimates at a later date.

MCMULLEN COUNTY *100% (multiplier)* All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2016	GW	142	200	2,769	0	0	56	3,167
	SW	0	0	308	0	0	222	530
2015	GW	147	269	4,254	0	0	55	4,725
	SW	0	0	473	0	0	218	691
2014	GW	145	168	6,380	0	0	54	6,747
	SW	0	0	709	0	0	215	924
2013	GW	149	218	5,734	0	0	54	6,155
	SW	0	0	637	0	0	216	853
2012	GW	160	219	3,499	0	0	64	3,942
	SW	0	0	291	0	0	254	545
2011	GW	159	219	1,350	0	0	71	1,799
	SW	0	0	450	0	0	285	735
2010	GW	156	219	330	0	0	93	798
	SW	0	0	110	0	0	371	481
2009	GW	164	0	417	0	0	82	663
	SW	0	0	66	0	0	329	395
2008	GW	173	0	286	0	0	79	538
	SW	0	0	22	0	0	316	338
2007	GW	167	0	219	0	0	89	475
	SW	0	0	0	0	0	357	357
2006	GW	178	0	219	0	0	89	486
	SW	0	0	0	0	0	357	357
2005	GW	166	0	219	0	0	93	478
	SW	0	0	0	0	0	370	370
2004	GW	275	0	219	0	0	48	542
	SW	0	0	0	0	0	431	431
2003	GW	212	0	220	0	0	48	480
	SW	0	0	0	0	0	431	431
2002	GW	283	0	218	0	0	48	549
	SW	0	0	0	0	0	431	431
2001	GW	214	0	220	0	0	82	516
	SW	0	0	0	0	0	738	738

Projected Surface Water Supplies
TWDB 2017 State Water Plan Data

MCMULLEN COUNTY *100% (multiplier)* All values are in acre-feet

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070
N	LIVESTOCK, MCMULLEN	NUECES	NUECES LIVESTOCK LOCAL SUPPLY	262	262	262	262	262	262
	Sum of Projected Surface Water Supplies (acre-feet)			**262**	**262**	**262**	**262**	**262**	**262**

Projected Water Demands
TWDB 2017 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.

MCMULLEN COUNTY

100% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
N	COUNTY-OTHER, MCMULLEN	NUECES	97	94	91	90	90	90
N	IRRIGATION, MCMULLEN	NUECES	40	42	44	46	49	51
N	LIVESTOCK, MCMULLEN	NUECES	355	355	355	355	355	355
N	MINING, MCMULLEN	NUECES	4,268	4,804	4,754	2,622	1,850	1,305
		Sum of Projected Water Demands (acre-feet)	**4,760**	**5,295**	**5,244**	**3,113**	**2,344**	**1,801**

Projected Water Supply Needs
TWDB 2017 State Water Plan Data

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

MCMULLEN COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
N	COUNTY-OTHER, MCMULLEN	NUECES	449	452	455	456	456	456
N	IRRIGATION, MCMULLEN	NUECES	-40	-42	-44	-46	-49	-51
N	LIVESTOCK, MCMULLEN	NUECES	0	0	0	0	0	0
N	MINING, MCMULLEN	NUECES	-2,733	-3,269	-3,219	-1,087	-315	230
		Sum of Projected Water Supply Needs (acre-feet)	**-2,773**	**-3,311**	**-3,263**	**-1,133**	**-364**	**-51**

Projected Water Management Strategies
TWDB 2017 State Water Plan Data

MCMULLEN COUNTY

WUG, Basin (RWPG)

All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
IRRIGATION, MCMULLEN, NUECES (N)							
GULF COAST AQUIFER SUPPLIES - MCMULLEN IRRIGATION	GULF COAST AQUIFER [MCMULLEN]	43	43	43	43	43	43
IRRIGATION WATER CONSERVATION	DEMAND REDUCTION [MCMULLEN]	1	2	3	5	6	8
		44	**45**	**46**	**48**	**49**	**51**
MINING, MCMULLEN, NUECES (N)							
ADDITIONAL GULF COAST AQUIFER - MCMULLEN MINING	GULF COAST AQUIFER [MCMULLEN]	112	112	112	112	112	112
MCMULLEN COUNTY SUPPLY REDUCTION - MINING	CARRIZO-WILCOX AQUIFER [MCMULLEN]	449	449	449	449	449	449
MCMULLEN MINING MINOR AQUIFER DEVELOPMENT	QUEEN CITY AQUIFER [MCMULLEN]	136	136	136	136	136	136
MCMULLEN MINING MINOR AQUIFER DEVELOPMENT	SPARTA AQUIFER [MCMULLEN]	90	90	90	90	90	90
MCMULLEN MINING MINOR AQUIFER DEVELOPMENT	YEGUA-JACKSON AQUIFER [MCMULLEN]	179	179	179	179	179	179
MINING WATER CONSERVATION	DEMAND REDUCTION [MCMULLEN]	106	240	357	262	231	196
		1,072	**1,206**	**1,323**	**1,228**	**1,197**	**1,162**
Sum of Projected Water Management Strategies (acre-feet)		**1,116**	**1,251**	**1,369**	**1,276**	**1,246**	**1,213**