

# Refugio Groundwater Conservation District

## Groundwater Management Plan

Refugio Groundwater Conservation District Groundwater Management Plan Adoption:	April 17, 2023
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# Table of Contents

DISTRICT MISSION..... 4

PURPOSE OF THE GROUNDWATER MANAGEMENT PLAN ..... 4

DISTRICT INFORMATION..... 5

    Creation..... 5

    Directors..... 5

    Authority ..... 5

    Location and Extent..... 5

GROUNDWATER RESOURCES OF REFUGIO COUNTY ..... 6

STATEMENT OF GUIDING PRINCIPLES ..... 7

CRITERIA FOR PLAN APPROVAL ..... 7

    Planning Horizon ..... 7

    Notice and Hearing Related to Plan Adoption - TWC §36.1071(a) ..... 7

    Coordination with Regional Surface Water Management Entities - TWC §36.1071(a). 7

    Refugio Groundwater Conservation District Board of Director Resolution Adopting  
    Management Plan TWC §36.1071(a)..... 8

ESTIMATES OF TECHNICAL INFORMATION REQUIRED BY §36.1071 OF THE  
TEXAS WATER CODE AND RULE 356.52 OF TITLE 31 OF THE TEXAS  
ADMINISTRATIVE CODE..... 9

    Estimate of Modeled Available Groundwater in the district based on Desired Future  
    Conditions – TWC §36.1071(e)(3)(A) and 31 TAC 356.52(a)(5)(A) ..... 9

    Estimate of amount of groundwater being used within the district on an annual basis –  
    TWC §36.1071(e)(3)(B) and 31 TAC 356.52(a)(5)(B) ..... 10

    Estimate of annual amount of recharge from precipitation to the groundwater  
    resources within the district – TWC §36.1071(e)(3)(C) and 31 TAC 356.52(a)(5)(C). 10

    Estimate for each aquifer, annual volume of water that discharges from the aquifer to  
    springs and any surface water bodies, including lakes, streams, and rivers – TWC  
    §36.1071(e)(3)(D) and 31 TAC 356.52(a)(5)(D)..... 10

    Estimate of annual volume of flow into and out of the district within each aquifer and  
    between aquifers in the district – TWC §36.1071(e)(3)(E) and 31 TAC 356.52(a)(5)(E)  
    ..... 11

    Estimate of projected surface water supply in the district according to the most  
    recently adopted state water plan – TWC §36.1071(e)(3)(F) and 31 TAC  
    356.52(a)(5)(F) ..... 11

    Estimate of projected total demand for water in the district according to the most  
    recently adopted state water plan – TWC §36.1071(e)(3)(G) and 31 TAC  
    356.52(a)(5)(G) ..... 11

CONSIDER THE WATER SUPPLY NEEDS AND WATER MANAGEMENT  
STRATEGIES INCLUDED IN THE ADOPTED STATE WATER PLAN – TWC  
§36.1071(e)(4) ..... 12

DETAILS ON THE DISTRICT MANAGEMENT OF GROUNDWATER..... 13

ACTIONS, PROCEDURES, PERFORMANCE AND AVOIDANCE FOR PLAN IMPLEMENTATION – TWC §36.1071(e)(2)..... 15

METHODOLOGY FOR TRACKING DISTRICT PROGRESS IN ACHIEVING MANAGEMENT GOALS – 31TAC 356.52(a)(4) ..... 15

GOALS, MANAGEMENT OBJECTIVES AND PERFORMANCE STANDARDS..... 15

    Providing the most efficient use of groundwater – TWC §36.1071(a)(1) and 31 TAC 356.52(a)(1)(A)..... 15

    Controlling and preventing waste of groundwater – TWC §36.1071(a)(2) and 31 TAC 356.52(a)(1)(B)..... 16

    Controlling and preventing subsidence – TWC §36.1071(a)(3) and 31 TAC 356.52(a)(1)(C) ..... 16

    Addressing conjunctive surface water management issues – TWC §36.1071(a)(4) and 31 TAC 356.52(a)(1)(D) ..... 16

    Addressing natural resource issues which impact the use and availability of groundwater, and which are impacted by the use of groundwater – TWC §36.1071(a)(5) and 31 TAC §356.52(a)(1)(E) ..... 16

    Addressing drought conditions – TWC §36.1071(a)(6) and 31 TAC 356.52(a)(1)(F) . 17

    Addressing conservation, recharge enhancement, rainwater harvesting, precipitation enhancement, or brush control, where appropriate and cost-effective – TWC §36.1071(a)(7) and 31 TAC 356.52(a)(1)(G)..... 17

    Addressing the desired future conditions adopted by the district under Section 36.108 – TWC §36.1071(a)(8) and 31 TAC 356.52(a)(1)(H)..... 17

List of Appendices ..... 19

## **DISTRICT MISSION**

The mission of the Refugio Groundwater Conservation District is to develop sound water conservation and management strategies designed to conserve, preserve, protect, and prevent waste of groundwater resources for long-term sustainability within Refugio County for the benefit of the landowners, citizens, economy, and environment of Refugio County.

The district will implement these strategies through the acquisition and dissemination of hydrogeological information, the development of programs and incentives to conserve and protect groundwater resources, and the adoption and enforcement of fair and appropriate rules governing the production and use of the groundwater resources within the Refugio County.

## **PURPOSE OF THE GROUNDWATER MANAGEMENT PLAN**

Senate Bill 1, enacted by the 75th Texas Legislature in 1997, and Senate Bill 2, enacted by the 77th Texas Legislature in 2001, established a comprehensive statewide water resource planning process and the actions necessary for groundwater conservation districts to manage and conserve the groundwater resources of the state of Texas. These bills required all groundwater conservation districts to develop a management plan which defines the groundwater needs and groundwater supplies within each district and the goals each district has set to achieve its mission.

In addition, the 79th Texas Legislature enacted House Bill 1763 in 2005 that requires joint planning among districts that are in the same groundwater management area. These districts must jointly agree upon and establish the desired future conditions of the aquifers within their respective groundwater management areas. Through this process, the groundwater conservation districts will submit the desired future conditions to the Executive Administrator of the Texas Water Development Board who, in turn, will provide each district within the groundwater management area with estimates of modeled available groundwater within each district. The modeled available groundwater will be based on the desired future conditions jointly established for each aquifer within the groundwater management area.

Technical information, such as the desired future conditions within the jurisdiction of the district and the amount of modeled available groundwater from such aquifers is required by statute to be included in the management plan of the district and will guide the regulatory and management policies of the district. This management plan is intended to satisfy the requirements of Senate Bill 1, Senate Bill 2, House Bill 1763, the statutory requirements of Chapter 36 of the Texas Water Code, and the rules and requirements of the Texas Water Development Board.

## **DISTRICT INFORMATION**

### **Creation**

The district was created by Senate Bill 1911, 76th Legislature and codified as Chapter 8854, Special District and Local Laws Code. The citizens of Refugio County through a confirmation election held on November 6, 2001, ratified the district. The district was formed to protect, conserve, and prevent waste of the groundwater resources beneath the area of Refugio County. To manage the groundwater resources under its jurisdiction, the district is charged with the rights and responsibilities specified in its enabling legislation; the provisions of Chapter 36 of the Texas Water Code; this groundwater management plan, and the rules of the district.

### **Directors**

The Refugio Groundwater Conservation District Board of Directors consists of five members. These directors are elected by the voters of Refugio County and serve a four-year term. The district observes the same four precincts as the Refugio County Commissioners with an at-large positions. The terms of the director positions are staggered on a two-year election interval in even numbered years.

### **Authority**

The district has the rights and responsibilities provided in Chapter 36 of the Texas Water Code and Chapter 356 of Title 31 of the Texas Administrative Code. The district has the authority to undertake hydrogeological studies, adopt a groundwater management plan, provide for the permitting of certain water wells, and implement programs to achieve statutory requirements. The district has rulemaking authority to implement its policies and procedures to manage the groundwater resources of Refugio County.

### **Location and Extent**

The boundaries of the district are conterminous with those of Refugio County, Texas. This area encompasses approximately 818 square miles. The district is bounded by Aransas County, Bee County, Calhoun County, Goliad County, San Patricio County, and Victoria County

## GROUNDWATER RESOURCES OF REFUGIO COUNTY

Depositions from sediment-laden rivers, currents from the Gulf of Mexico, and storm waves have influenced the geologic formations in Refugio County. The fluctuation of the coastline over geologic eons contributed to the deposition of sediments within the Refugio County as well. The geologic formations in the Refugio County according to their depositional age are summarized in Figure 1. The Gulf Coast Aquifer underlies Refugio County.

Figure 1: Geologic and Hydrogeological Units of the Gulf Coast Aquifer in Refugio County.

Stratigraphic Unit		Hydrogeologic Unit
Alluvium		Chicot Aquifer
Beaumont Clay		
Montgomery Formation	Lissie Formation	
Bentley Formation		
Willis Sand		
Goliad Sand		Evangeline Aquifer
Fleming Formation		
Oakville Sandstone		Jasper Aquifer
Catahoula Sandstone (Tuff)		

The Gulf Coast Aquifer System is conceptualized to comprise of four distinct aquifer components: Chicot, Evangeline, Burkeville Confining Unit and the Jasper Aquifer (Baker, 1979). These aquifer components are included within the Central Gulf Coast Groundwater Availability Model developed by the Texas Water Development Board (Chowdhury and Mace, 2004).

The Chicot and the Evangeline aquifers are utilized the most within Refugio County. The Chicot Aquifer crops out across the entirety of Refugio County. The thickness of the Chicot Aquifer ranges up to approximately 1,000 feet in Refugio County. The thickness of the Evangeline Aquifer ranges from 1,000 feet to 1,500 feet in Refugio County. The Chicot and Evangeline aquifers consist of interbedded sands, silts and clays. The sand content is higher in the Evangeline Aquifer compared to the Chicot Aquifer. The water quality in the aquifer generally deteriorates along the coast.

## **STATEMENT OF GUIDING PRINCIPLES**

The district recognizes that the groundwater resources of Refugio County and the region are of vital importance to the many users who are dependent on these valuable resources. In addition, the district recognizes that landowners have an ownership right in the groundwater resources associated with their properties and are the primary stewards of the groundwater resources associated with their properties. The district will work with interested parties, especially landowners, in Refugio County to conserve, preserve, protect, and prevent waste of this most valuable resource, for the benefit of the landowners, the public, the local economy, and the environment.

The groundwater management plan of the district is intended to serve as a tool to focus the thoughts and actions of those given the responsibility for the execution of the activities of the district as well as to provide information to the staff of the district, landowners, and others responsible for the execution of, or compliance with, the policies and rules of the district. The district will carry out its programs and responsibilities in implementing this groundwater management plan in a prudent and cost-effective manner. The district, with public input, will adopt and enforce rules necessary to implement this groundwater management plan.

## **CRITERIA FOR PLAN APPROVAL**

### **Planning Horizon**

The planning period for this plan is ten years from the date of approval by the Texas Water Development Board. This plan will be reviewed within five years as required by §36.1072(e) of the Texas Water Code. The district will consider the necessity to amend the plan and re-adopt this groundwater management plan with or without amendments as required by §36.1072(e) of the Texas Water Code.

This groundwater management plan will remain in effect until replaced by a revised management plan approved by the Texas Water Development Board.

### **Notice and Hearing Related to Plan Adoption - TWC §36.1071(a)**

Public notices documenting that this plan was considered and adopted following appropriate public hearings are included in Appendix D.

### **Coordination with Regional Surface Water Management Entities - TWC §36.1071(a)**

Letters transmitting this plan to the surface water management entities of the Refugio County region for coordination purposes are included in Appendix E.

**Refugio Groundwater Conservation District Board of Director Resolution  
Adopting Management Plan TWC §36.1071(a)**

A copy of the resolution approved by the Board of Directors of the Refugio Groundwater Conservation District adopting this plan is included in Appendix F.



## **ESTIMATES OF TECHNICAL INFORMATION REQUIRED BY §36.1071 OF THE TEXAS WATER CODE AND RULE 356.52 OF TITLE 31 OF THE TEXAS ADMINISTRATIVE CODE**

### **Estimate of Modeled Available Groundwater in the district based on Desired Future Conditions – TWC §36.1071(e)(3)(A) and 31 TAC 356.52(a)(5)(A)**

Modeled available groundwater is defined in §36.001 of the Texas Water Code as "the amount of water that the executive administrator determines may be produced on an average annual basis to achieve a desired future condition established under Section 36.108." Desired future condition is defined in §36.001 of the Texas Water Code as "a quantitative description, adopted in accordance with §36.108 of the Texas Water Code, of the desired condition of the groundwater resources in a management area at one or more specified future times." The desired future condition of an aquifer may only be determined through joint planning with other groundwater conservation districts in the same groundwater management area as specified under §36.108 of the Texas Water Code.

The district is located in Groundwater Management Area 15. The representatives of the member districts of Groundwater Management Area 15 adopted, by resolution, the desired future condition for Gulf Coast Aquifer within Groundwater Management Area 15 on October 14, 2021.

The resolution adopting the desired future condition for Groundwater Management Area 15 states the gma-specific DFC "for the counties in the groundwater management area (gma-specific DFC) shall not exceed an average drawdown of 13 feet for the Gulf Coast Aquifer System at December 2080;"

The resolution adopting the desired future condition for Groundwater Management Area 15 states the county-specific DFC for Refugio County shall not exceed "5 feet of drawdown of the Gulf Coast Aquifer System."

The technical consultant of Groundwater Management Area 15 submitted the adopted desired future conditions and explanatory report for Groundwater Management Area 15 on December 13, 2021, to Texas Water Development Board.

The Texas Water Development Board reported the modeled available groundwater for Groundwater Management Area 15 in GAM Run 21-020 MAG which is incorporated into this management plan as Appendix C.

The modeled available groundwater, in acre-feet per year (AFY), of the Gulf Coast Aquifer within the district per Table 2 of the GAM Run 21-020 MAG specifies the following values for the district:

Year					
2020	2030	2040	2050	2060	2069
5,858	5,858	5,858	5,858	5,858	5,858

All values in acre-feet/year (AFY)

**Estimate of amount of groundwater being used within the district on an annual basis – TWC §36.1071(e)(3)(B) and 31 TAC 356.52(a)(5)(B)**

The district recognizes the estimate of the amount of groundwater being used within the district on an annual basis, according to information provided by the Texas Water Development Board, totals 2,291 acre-feet in year 2016. Refer to Appendix A and the 2017 State Water Plan Datasets for additional information.

**Estimate of annual amount of recharge from precipitation to the groundwater resources within the district – TWC §36.1071(e)(3)(C) and 31 TAC 356.52(a)(5)(C)**

The district recognizes the estimate of the amount of water recharging the groundwater resources within the district from precipitation, according to information provided by the Texas Water Development Board, totals 13,072 acre-feet. Refer to Appendix B for additional information.

**Estimate for each aquifer, annual volume of water that discharges from the aquifer to springs and any surface water bodies, including lakes, streams, and rivers – TWC §36.1071(e)(3)(D) and 31 TAC 356.52(a)(5)(D)**

The district recognizes the estimate of the annual volume of water that discharges from the aquifer to springs and any surface water bodies for each aquifer, including lakes, streams, and rivers within the district, according to information provided by the Texas Water Development Board, totals 40,891 acre-feet. Refer to Appendix B for additional information.

**Estimate of annual volume of flow into and out of the district within each aquifer and between aquifers in the district – TWC §36.1071(e)(3)(E) and 31 TAC 356.52(a)(5)(E)**

The district recognizes the estimate of the annual volume of groundwater flowing into the district within each aquifer, according to information provided by the Texas Water Development Board, totals 19,159 acre-feet. The district recognizes the estimate of the annual volume of groundwater flowing out of the district within each aquifer, according to information provided by the Texas Water Development Board, totals 15,103 acre-feet. The estimated net annual volume of flow between each aquifer in the district is not applicable because the model assumes a no flow barrier at the base of the Gulf Coast Aquifer System. Refer to Appendix B for additional information.

**Estimate of projected surface water supply in the district according to the most recently adopted state water plan – TWC §36.1071(e)(3)(F) and 31 TAC 356.52(a)(5)(F)**

The district recognizes the sum of projected surface water supplies, according to information provided by the Texas Water Development Board, is 318 acre-feet for year 2030 and 318 acre-feet for year 2070.

The district recognizes the projection of existing surface water supplies, according to the 2022 State Water Plan Interactive Site published by the Texas Water Development Board, is 237 acre-feet for year 2030 and 237 acre-feet for year 2070.

Refer to Appendix A and the 2022 State Water Plan for additional information.

**Estimate of projected total demand for water in the district according to the most recently adopted state water plan – TWC §36.1071(e)(3)(G) and 31 TAC 356.52(a)(5)(G)**

The district recognizes the sum of projected water demands, according to information provided by the Texas Water Development Board, is 3,038 acre-feet for year 2030 and 2,502 acre-feet for year 2070.

The district recognizes the projection of water demands, according to the 2022 State Water Plan Interactive Site published by the Texas Water Development Board, is 2,776 acre-feet for year 2030 and 2,724 acre-feet for year 2070.

Refer to Appendix A and the 2022 State Water Plan for additional information.

**CONSIDER THE WATER SUPPLY NEEDS AND WATER MANAGEMENT STRATEGIES INCLUDED IN THE ADOPTED STATE WATER PLAN – TWC §36.1071(e)(4)**

The district recognizes that there are no water supply needs within the district, according to information provided by the Texas Water Development Board and the 2022 State Water Plan Interactive Site published by the Texas Water Development Board. Refer to Appendix A and the 2022 State Water Plan for additional information.

The district recognizes that municipal water conservation water management strategies for the towns of Refugio and Woodsboro are projected to supply 68 acre-feet of water in the district in 2030 and 146 acre-feet of water in the district in 2070.

Refer to Appendix A and the 2022 State Water Plan for additional information.

The district recognizes that persons possessing groundwater rights may seek authorization to produce groundwater from within Refugio County for many purposes including supplying water to activities projected by TWDB to create water supply needs and the water management strategies identified in the 2022 State Water Plan.

## **DETAILS ON THE DISTRICT MANAGEMENT OF GROUNDWATER**

The Texas Legislature established that groundwater conservation districts are the preferred method of groundwater management in §36.0015 of the Texas Water Code. The district will manage the production of groundwater within Refugio County in order to protect, preserve, conserve, and prevent waste of the resource while seeking to maintain the economic viability of all resource user groups, public and private. The district seeks to manage the groundwater resources of Refugio County as practicably as possible as established in the plan. In consideration of the economic and cultural activities occurring within Refugio County, the district will identify and engage in such activities and practices, that if implemented may result in the reasonable and effective protection, preservation, conservation, waste prevention of groundwater in Refugio County. The district will manage groundwater resources through rules developed and implemented in accordance with Chapter 36 of the Texas Water Code and the provisions of the enabling legislation of the district.

For the purposes of this management plan, the following definitions are used:

- Protection of groundwater is the activity and practice of seeking to prevent harm or injury to a groundwater resource.
- Preservation of groundwater is the activity and practice of seeking to extend the useful longevity or life of a groundwater resource.
- Conservation of groundwater is the activity and practice of seeking to use a groundwater resource in a manner that appropriately balances the impacts associated with consuming the resource and preserving the resource for the future.
- Waste prevention of groundwater is the activity and practices seeking to prevent the use of groundwater in any manner defined as waste in §36.001 of the Texas Water Code.

The district will monitor aquifer conditions in and around Refugio County in order to monitor changing water levels and water quality of groundwater resources within Refugio County. The district will make periodic assessments of aquifer conditions and will report those conditions to the Board of Directors of the district and to the public. The district may undertake, as necessary, investigations of the groundwater resources within Refugio County and will make the results of investigations available to the public. The district will cooperate with investigations of the groundwater resources of Refugio County undertaken by other local political subdivisions or agencies of the State of Texas.

In order to better manage groundwater resources, the district may establish management zones for; and adopt different rules for:

1. Each aquifer, subdivision of an aquifer, or geologic strata located in whole or in part within Refugio County; or
2. Each geographic area overlying an aquifer or subdivision of an aquifer located in whole or in part within Refugio County.

For the purpose of managing the use of groundwater within Refugio County, the district

may define sustainable use as the use of an amount of groundwater in Refugio County as a whole or any management zone established by the district that does not exceed any of the following conditions:

1. the long-term average historical groundwater production from aquifers in Refugio County established by the district prior to the establishment of the desired future condition of aquifers in a groundwater management area in which the district is located; or
2. the desired future conditions of aquifers in Refugio County established by a groundwater management area in which the district is located; or
3. The amount of modeled available groundwater resulting from the establishment of a desired future aquifer condition by the district or a groundwater management area in which the district is located; or
4. the estimated long-term average historical amount of annual recharge of the aquifer or aquifer subdivision in which the use occurs as recognized by the district; or
5. any other criteria established by the district as being a threshold of use beyond which further use of the aquifer or aquifer subdivision may result in a specified undesirable or injurious condition.

The district may adopt rules that protect historic use of groundwater in Refugio County to the maximum extent practical and consistent with this plan and the goals and objectives set forth herein. The district may impose more restrictive conditions on non-historic-use permits and non-historic-use permit amendments to increase use by historic users if the limitations:

1. apply to all non-historic-use permits and non-historic-use permit amendments to increase use by historic users, regardless of the type or location of use;
2. bear a reasonable relationship to the Desired Future Condition of the district; and
3. are reasonably necessary to protect historic use.

The district may adopt rules to regulate groundwater withdrawals by means of spacing and production limits. The relevant factors to be considered in making a determination to grant or deny a permit or limit groundwater withdrawals shall include those set forth in the enabling legislation of the district, Chapter 36 of the Texas Water Code, and the rules of the district. The district may employ technical resources at its disposal, as needed, to evaluate the groundwater resources available within Refugio County and to determine the effectiveness of regulatory or conservation measures. In consideration of particular individual, localized, or district-wide conditions, including without limitation climatic conditions, the district may, by rule, allow an increase or impose a decrease in the total production in a management zone above or below the sustainable amount for a period of time considered necessary by the district in order to accomplish the purposes set forth in Chapter 36 of the Texas Water Code, or the enabling legislation of the district. The exercise of said discretion by the Board of Directors of the Refugio Groundwater Conservation District shall not be construed as limiting the power of the Board of Directors of the Refugio Groundwater Conservation District.

## **ACTIONS, PROCEDURES, PERFORMANCE AND AVOIDANCE FOR PLAN IMPLEMENTATION – TWC §36.1071(e)(2)**

The district will implement the provisions of this plan and will utilize the provisions of this plan as a guide for determining the direction or priority for all 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 Rules of the district adopted by the Board of Directors of the Refugio Groundwater Conservation District shall comply with Chapter 36 of the Texas Water Code, including §36.113 of the Texas Water Code, and the provisions of this management 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 to the district.

The rules of the district are available at the following website address:  
<https://rgcd.org/groundwater-policy.html>.

## **METHODOLOGY FOR TRACKING DISTRICT PROGRESS IN ACHIEVING MANAGEMENT GOALS – 31TAC 356.52(a)(4)**

The staff of the district will prepare and present an annual report to the members of the Board of Directors regarding the performance of the district in achieving management goals and objectives. The report will be presented within 180 days following the completion of each fiscal year. The district will maintain the report on file for public inspection at the office of the district upon adoption at a meeting of the Refugio Groundwater Conservation District Board of Directors.

## **GOALS, MANAGEMENT OBJECTIVES AND PERFORMANCE STANDARDS**

### **Providing the most efficient use of groundwater – TWC §36.1071(a)(1) and 31 TAC 356.52(a)(1)(A)**

**Objective:** Develop and maintain a program for processing permitting requests submitted to the district and tracking well registrations and permits issued by the district authorizing groundwater production during the fiscal year.

**Performance Standard:** The district will summarize within the annual report 1) the status of pending permitting requests and 2) the number of wells registered by the district, and 3) the volume of groundwater authorized to be produced under production permits issued by the district, as of the last day of the preceding fiscal year.

**Controlling and preventing waste of groundwater – TWC §36.1071(a)(2) and 31 TAC 356.52(a)(1)(B)**

**Objective:** Develop and maintain a program for inspecting at least twelve (12) water wells within the district during the fiscal year.

**Performance Standard:** The district will summarize within the annual report the number of wells inspected during the preceding fiscal year and those wells requiring corrective action.

**Controlling and preventing subsidence – TWC §36.1071(a)(3) and 31 TAC 356.52(a)(1)(C)**

This category of management goal is not applicable to the district at this time because no significant subsidence is occurring in Refugio County. The district will monitor geological conditions for evidence of subsidence, particularly in high groundwater production areas near the coast and take appropriate action should significant subsidence develop.

The district reviewed the technical report titled *Final Report: Identification of the Vulnerability of the Major and Minor Aquifers of Texas to Subsidence with Regard to Groundwater Pumping; TWDB Contract Number 1648302062*. The report, in Section 4.2.4, characterizes all portions of Refugio County as medium or higher risk of subsidence.

**Addressing conjunctive surface water management issues – TWC §36.1071(a)(4) and 31 TAC 356.52(a)(1)(D)**

**Objective:** Participate in the regional water planning process by attending and participating in at least one (1) South Central Texas Regional Water Planning Group (Region L) meeting held during the fiscal year.

**Performance Standard:** The district will summarize within the annual report the dates of meetings of the South Central Texas Regional Water Planning Group attended by representatives of the district during the preceding fiscal year.

**Addressing natural resource issues which impact the use and availability of groundwater, and which are impacted by the use of groundwater – TWC §36.1071(a)(5) and 31 TAC §356.52(a)(1)(E)**

**Objective:** Develop and maintain a program to monitor the water quality of at least twelve (12) water wells within the district per year.



**Performance Standard:** The district will summarize within the annual report 1) the number of wells monitored and 2) the water quality measurements collected during the preceding fiscal year.

**Addressing drought conditions – TWC §36.1071(a)(6) and 31 TAC 356.52(a)(1)(F)**

**Objective:** Review drought condition information related to the district and the surrounding region of Texas collected from the following website at least four meetings of the Board of Directors during the fiscal year: <https://www.waterdatafortexas.org/drought/> .

**Performance Standard:** The district will summarize within the annual report the number of instances drought condition information was considered by the Board of Directors during the preceding fiscal year.

**Addressing conservation, recharge enhancement, rainwater harvesting, precipitation enhancement, or brush control, where appropriate and cost-effective – TWC §36.1071(a)(7) and 31 TAC 356.52(a)(1)(G)**

**Objective:** Promote conservation, rainwater harvesting, or brush control within Refugio County at least once during the fiscal year.

**Performance Standard:** The district will summarize within the annual report the number of instances the district promoted conservation, rainwater harvesting, or brush control during the preceding fiscal year.

Addressing recharge enhancement and precipitation enhancement are deemed to be neither appropriate nor cost-effective activities for the district. The costs of operating a recharge enhancement or precipitation enhancement program are prohibitive and would require the district to increase taxes. Therefore, these goals are not considered applicable to the district at this time.

**Addressing the desired future conditions adopted by the district under Section 36.108 – TWC §36.1071(a)(8) and 31 TAC 356.52(a)(1)(H)**

**Objective:** Develop and maintain a program to monitor the water level of at least twelve (12) water wells within the district per year.

**Performance Standard:** The district will summarize within the annual report 1) the number of wells monitored and 2) the water level

measurements collected during the preceding fiscal year.

**Objective:** Analyze aquifer monitoring information to evaluate achievement of the desired future conditions of the district based on information available during the fiscal year.

**Performance Standard:** The district will summarize within the annual report 1) the aquifer monitoring information and 2) the conclusions regarding the achievement of the desired future conditions of the district during the preceding fiscal year.

## List of Appendices

- Appendix A.** Estimated Historical Water Use and State Water Plan Data
- Appendix B.** Groundwater Availability Model Run provided by Texas Water Development Board - GAM RUN 13-008: REFUGIO GROUNDWATER CONSERVATION DISTRICT MANAGEMENT PLAN
- Appendix C.** Modeled Available Groundwater GAM Run 21-020 MAG
- Appendix D.** Public Notices Regarding Hearings Related to Plan Adoption
- Appendix E.** Letters Coordinating with Regional Surface Water Management Entities
- Appendix F.** Refugio Groundwater Conservation District Board of Director Resolution Adopting Management Plan
- Appendix G.** Minutes of Refugio Groundwater Conservation District Board of Director Meeting related to the public hearings for and adoption of the Management Plan
- Appendix H.** Refugio Groundwater Conservation District Contact Information

**Appendix A.** Estimated Historical Water Use and State Water Plan Data

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# Estimated Historical Water Use And 2017 State Water Plan Datasets:

Refugio Groundwater Conservation District

by Stephen Allen  
Texas Water Development Board  
Groundwater Division  
Groundwater Technical Assistance Section  
stephen.allen@twdb.texas.gov  
(512) 463-7317  
March 18, 2019

## ***GROUNDWATER MANAGEMENT PLAN DATA:***

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

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

The five reports included in this part are:

1. Estimated Historical Water Use (checklist item 2)  
*from the TWDB Historical Water Use Survey (WUS)*
2. Projected Surface Water Supplies (checklist item 6)
3. Projected Water Demands (checklist item 7)
4. Projected Water Supply Needs (checklist item 8)
5. Projected Water Management Strategies (checklist item 9)  
*from the 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 3/18/2019. 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).

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.

### REFUGIO COUNTY

All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2016	GW	1,030	0	0	0	827	391	2,248
	SW	0	0	0	0	0	43	43
2015	GW	901	0	0	0	489	376	1,766
	SW	0	0	0	0	0	42	42
2014	GW	1,204	0	0	0	575	365	2,144
	SW	0	0	0	0	0	41	41
2013	GW	1,254	0	0	0	936	349	2,539
	SW	0	0	0	0	0	39	39
2012	GW	1,312	0	0	0	908	428	2,648
	SW	0	0	0	0	0	47	47
2011	GW	1,339	0	30	0	2,189	490	4,048
	SW	0	0	3	0	0	55	58
2010	GW	1,137	0	42	0	561	504	2,244
	SW	0	0	4	0	0	56	60
2009	GW	1,232	0	53	0	156	565	2,006
	SW	0	0	5	0	0	63	68
2008	GW	1,106	0	62	0	1,164	536	2,868
	SW	0	0	7	0	0	60	67
2007	GW	1,094	0	0	0	439	502	2,035
	SW	0	0	0	0	0	55	55
2006	GW	1,112	0	0	0	911	592	2,615
	SW	0	0	0	0	0	66	66
2005	GW	1,108	0	0	0	588	668	2,364
	SW	0	0	0	0	0	74	74
2004	GW	1,036	0	0	0	527	62	1,625
	SW	0	0	0	0	0	600	600
2003	GW	1,014	0	0	0	621	60	1,695
	SW	0	0	0	0	0	585	585
2002	GW	1,116	0	0	0	1,019	63	2,198
	SW	0	0	0	0	0	613	613
2001	GW	1,138	0	0	0	850	55	2,043
	SW	0	0	0	0	0	535	535

*Estimated Historical Water Use and 2017 State Water Plan Dataset:*

*Refugio Groundwater Conservation District*

*March 18, 2019*

*Page 3 of 8*





# Projected Surface Water Supplies

## TWDB 2017 State Water Plan Data

### REFUGIO COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070
L	LIVESTOCK, REFUGIO	SAN ANTONIO	SAN ANTONIO LIVESTOCK LOCAL SUPPLY	16	16	16	16	16	16
L	LIVESTOCK, REFUGIO	SAN ANTONIO-NUECES	SAN ANTONIO-NUECES LIVESTOCK LOCAL SUPPLY	302	302	302	302	302	302
<b>Sum of Projected Surface Water Supplies (acre-feet)</b>				<b>318</b>	<b>318</b>	<b>318</b>	<b>318</b>	<b>318</b>	<b>318</b>

# 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.

### REFUGIO COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
L	COUNTY-OTHER, REFUGIO	SAN ANTONIO	11	11	10	10	8	8
L	COUNTY-OTHER, REFUGIO	SAN ANTONIO-NUECES	507	501	488	490	351	352
L	IRRIGATION, REFUGIO	SAN ANTONIO-NUECES	652	652	652	652	652	652
L	LIVESTOCK, REFUGIO	SAN ANTONIO	32	32	32	32	32	32
L	LIVESTOCK, REFUGIO	SAN ANTONIO-NUECES	604	604	604	604	604	604
L	MINING, REFUGIO	SAN ANTONIO	3	3	3	2	1	1
L	MINING, REFUGIO	SAN ANTONIO-NUECES	63	66	48	36	23	14
L	REFUGIO	SAN ANTONIO-NUECES	803	808	797	805	578	580
L	WOODSBORO	SAN ANTONIO-NUECES	361	361	354	360	258	259
<b>Sum of Projected Water Demands (acre-feet)</b>			<b>3,036</b>	<b>3,038</b>	<b>2,988</b>	<b>2,991</b>	<b>2,507</b>	<b>2,502</b>

# Projected Water Supply Needs

## TWDB 2017 State Water Plan Data

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

### REFUGIO COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
L	COUNTY-OTHER, REFUGIO	SAN ANTONIO	1	1	2	2	4	4
L	COUNTY-OTHER, REFUGIO	SAN ANTONIO-NUECES	4	10	23	21	160	159
L	IRRIGATION, REFUGIO	SAN ANTONIO-NUECES	0	0	0	0	0	0
L	LIVESTOCK, REFUGIO	SAN ANTONIO	0	0	0	0	0	0
L	LIVESTOCK, REFUGIO	SAN ANTONIO-NUECES	0	0	0	0	0	0
L	MINING, REFUGIO	SAN ANTONIO	0	0	0	0	0	0
L	MINING, REFUGIO	SAN ANTONIO-NUECES	0	0	0	0	0	0
L	REFUGIO	SAN ANTONIO-NUECES	431	426	437	429	656	654
L	WOODSBORO	SAN ANTONIO-NUECES	245	245	252	246	348	347
<b>Sum of Projected Water Supply Needs (acre-feet)</b>			<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>

# Projected Water Management Strategies

## TWDB 2017 State Water Plan Data

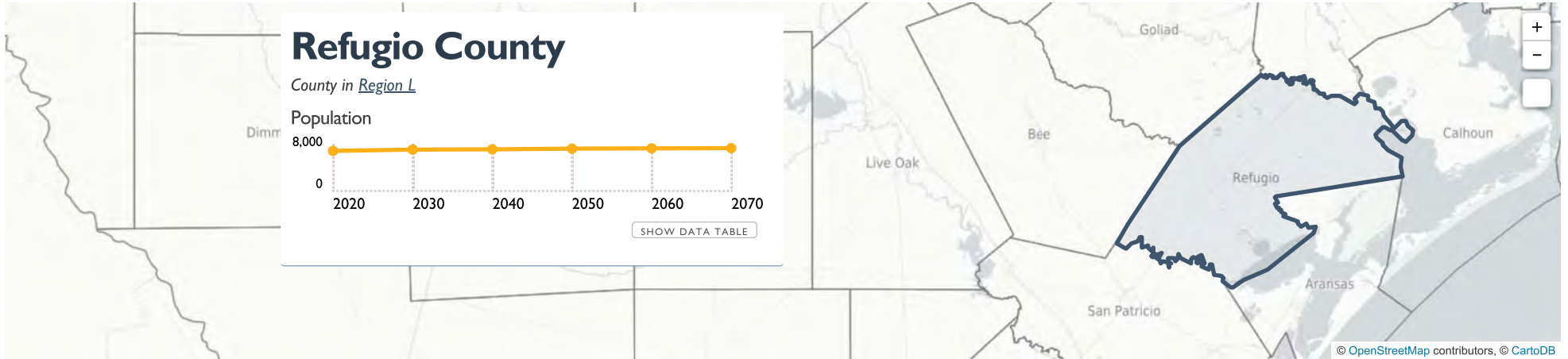
### REFUGIO COUNTY

WUG, Basin (RWPG)

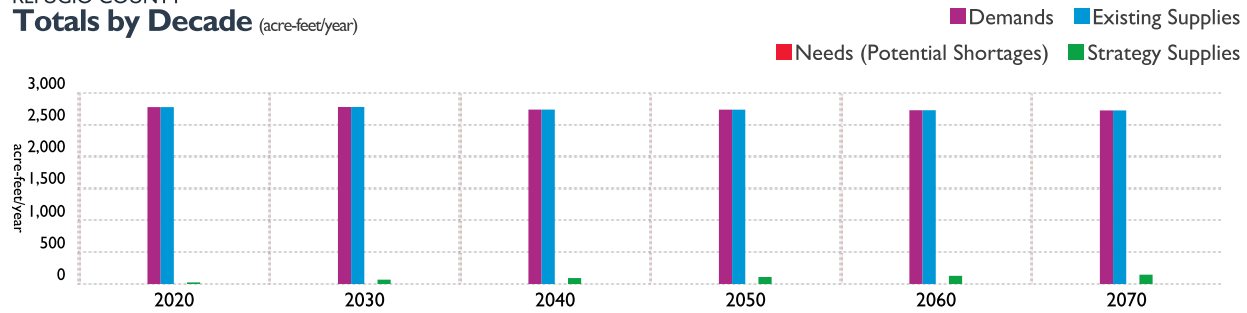
All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
<b>COUNTY-OTHER, REFUGIO, SAN ANTONIO (L )</b>							
MUNICIPAL WATER CONSERVATION (RURAL)	DEMAND REDUCTION [REFUGIO]	1	0	0	0	0	0
		<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>COUNTY-OTHER, REFUGIO, SAN ANTONIO-NUECES (L )</b>							
MUNICIPAL WATER CONSERVATION (RURAL)	DEMAND REDUCTION [REFUGIO]	57	5	0	0	0	0
		<b>57</b>	<b>5</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>REFUGIO, SAN ANTONIO-NUECES (L )</b>							
MUNICIPAL WATER CONSERVATION (RURAL)	DEMAND REDUCTION [REFUGIO]	157	147	112	69	109	120
		<b>157</b>	<b>147</b>	<b>112</b>	<b>69</b>	<b>109</b>	<b>120</b>
<b>WOODSBORO, SAN ANTONIO-NUECES (L )</b>							
MUNICIPAL WATER CONSERVATION (RURAL)	DEMAND REDUCTION [REFUGIO]	68	43	6	0	20	26
		<b>68</b>	<b>43</b>	<b>6</b>	<b>0</b>	<b>20</b>	<b>26</b>
<b>Sum of Projected Water Management Strategies (acre-feet)</b>		<b>283</b>	<b>195</b>	<b>118</b>	<b>69</b>	<b>129</b>	<b>146</b>

View data for



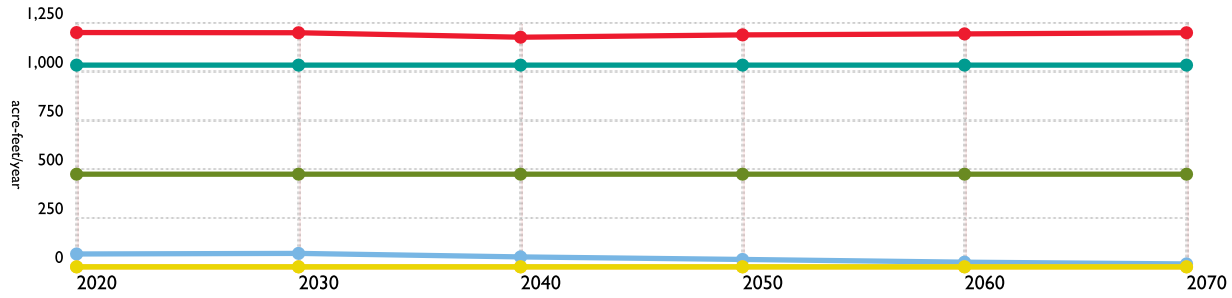
REFUGIO COUNTY  
**Totals by Decade** (acre-feet/year)



	2020	2030	2040	2050	2060	2070
<b>Demands</b>	2,776	2,778	2,737	2,736	2,727	2,724
<b>Existing Supplies</b>	2,776	2,778	2,737	2,736	2,727	2,724
<b>Needs (Potential Shortages)</b>	0	0	0	0	0	0
<b>Strategy Supplies</b>	25	68	93	110	128	146

REFUGIO COUNTY  
**Existing Supplies by Usage Type** (acre-feet/year)

- Irrigation
- Municipal
- Manufacturing
- Steam Electric Power
- Livestock
- Mining



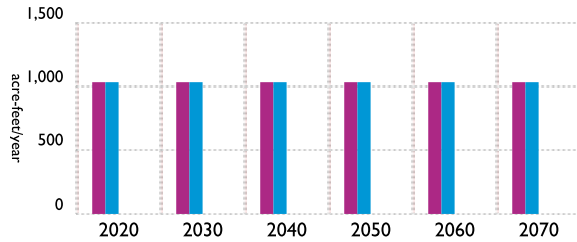
[HIDE DATA TABLE](#)

	2020	2030	2040	2050	2060	2070
<b>Mining</b>	66	69	51	38	24	15
<b>Livestock</b>	475	475	475	475	475	475
<b>Steam Electric Power</b>	0	0	0	0	0	0
<b>Manufacturing</b>	0	0	0	0	0	0
<b>Municipal</b>	1,201	1,200	1,177	1,189	1,194	1,200
<b>Irrigation</b>	1,034	1,034	1,034	1,034	1,034	1,034
<b>Total</b>	2,776	2,778	2,737	2,736	2,727	2,724

REFUGIO COUNTY  
**Data by Usage Type** (acre-feet/year)

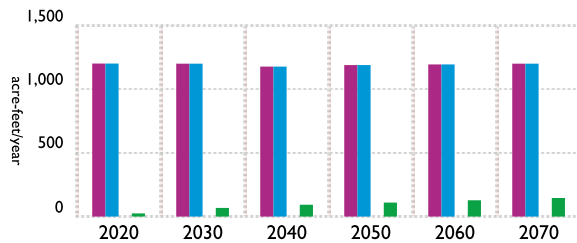
■ Demands ■ Existing Supplies  
 ■ Needs (Potential Shortages) ■ Strategy Supplies

Irrigation



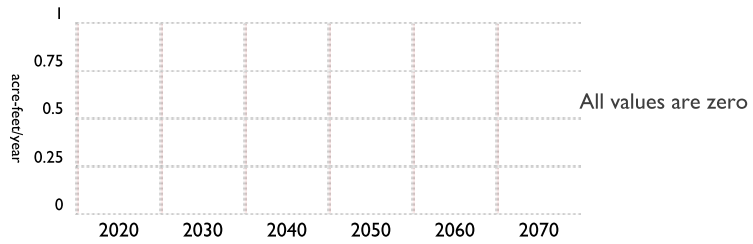
[SHOW DATA TABLE](#)

Municipal



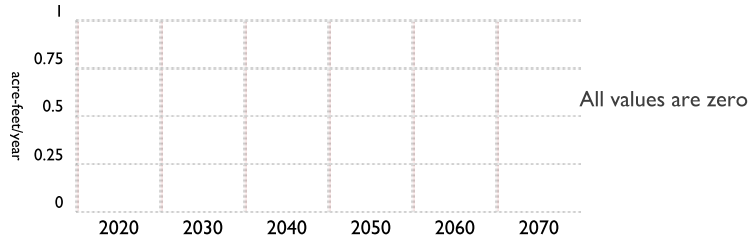
[SHOW DATA TABLE](#)

Manufacturing



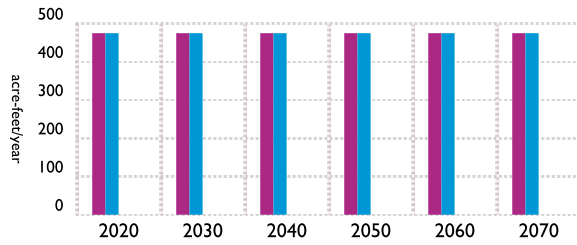
SHOW DATA TABLE

### Steam Electric Power



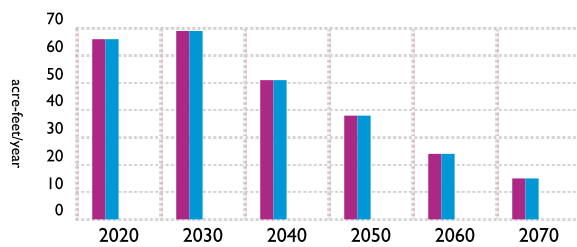
SHOW DATA TABLE

### Livestock



SHOW DATA TABLE

### Mining



SHOW DATA TABLE

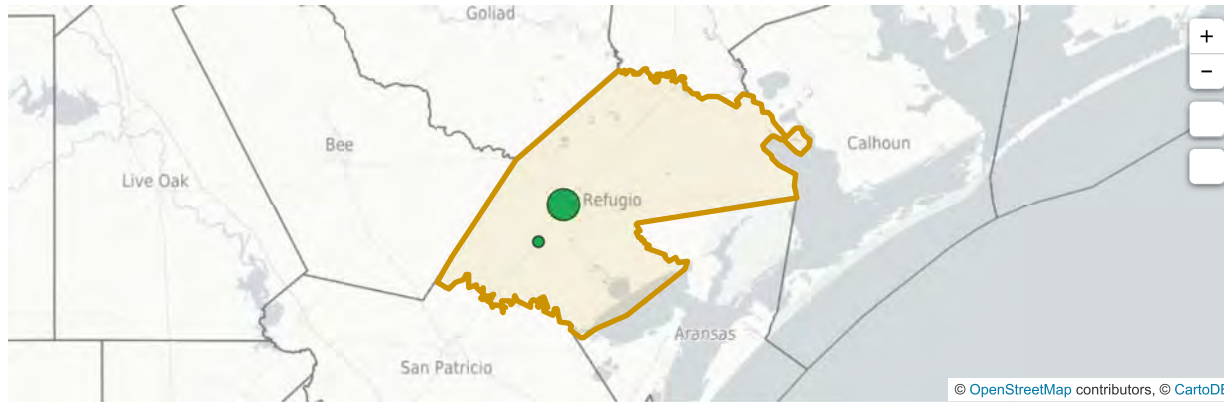
There are no recommended projects.

### Data by Planning Decade and Theme

Decade: 2020 | 2030 | 2040 | 2050 | 2060 | 2070

Theme: POPULATION | DEMANDS | EXISTING SUPPLIES | NEEDS (POTENTIAL SHORTAGES) | STRATEGY SUPPLIES

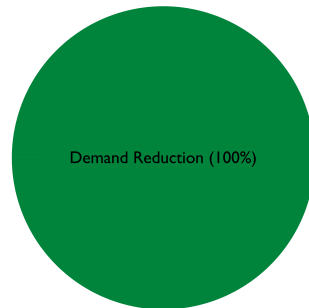
#### REFUGIO COUNTY Water User Groups - 2020 - Strategy Supplies (acre-feet/year)



Each water user group is mapped to a single point near its primary location; therefore, an entity with a large or multiple service areas may be displayed outside the specific area being queried. The following sources are not mapped to a specific location: 'Direct Reuse', 'Local Surface Water Supply', 'Atmosphere', and 'Rainwater Harvesting'. Red triangles indicate capital projects associated with strategy supplies that have been assigned to a Water User Group. [Hide Projects](#)

#### REFUGIO COUNTY Strategy Supplies Breakdown - 2020 (acre-feet/year)

Share by Water Resource



Share by Strategy Type

Strategy Type	Amount ▼
<a href="#">MUNICIPAL CONSERVATION</a>	100% (25)



REFUGIO COUNTY  
**Raw Data - 2020 - Strategy Supplies** (acre-feet/year)

▾
  ▾
  ▾
  ▾
  ▾
  ▾

Strategy	WMS Type	Source	Region	Entity ▲	2020 Strategy Supplies
<u>MUNICIPAL WATER</u>					25
<u>CONSERVATION</u>					25
	<u>MUNICIPAL</u>				25
	<u>CONSERVATION</u>				25
		DEMAND REDUCTION			25
			<u>L</u>		25
				<u>REFUGIO</u>	19
				<u>WOODSBORO</u>	6

**Download Data**

- [Download Refugio County Population data \(Comma-Separated Values\).](#)
- [Download Refugio County Demands data \(Comma-Separated Values\).](#)
- [Download Refugio County Existing Supplies data \(Comma-Separated Values\).](#)
- [Download Refugio County Needs \(Potential Shortages\) data \(Comma-Separated Values\).](#)
- [Download Refugio County Strategy Supplies data \(Comma-Separated Values\).](#)

EntityName	WugCounty	SourceName	WS2020	WS2030	WS2040	WS2050	WS2060	WS2070
COUNTY-OTHER, REFUGIO	REFUGIO	GULF COAST AQUIFER SYSTEM   REFUGIO	364	360	351	352	353	355
IRRIGATION, REFUGIO	REFUGIO	GULF COAST AQUIFER SYSTEM   REFUGIO	1034	1034	1034	1034	1034	1034
LIVESTOCK, REFUGIO	REFUGIO	GULF COAST AQUIFER SYSTEM   REFUGIO	238	238	238	238	238	238
MINING, REFUGIO	REFUGIO	GULF COAST AQUIFER SYSTEM   REFUGIO	66	69	51	38	24	15
REFUGIO	REFUGIO	GULF COAST AQUIFER SYSTEM   REFUGIO	568	571	562	569	572	574
WOODSBORO	REFUGIO	GULF COAST AQUIFER SYSTEM   REFUGIO	269	269	264	268	269	271
LIVESTOCK, REFUGIO	REFUGIO	LOCAL SURFACE WATER SUPPLY	237	237	237	237	237	237

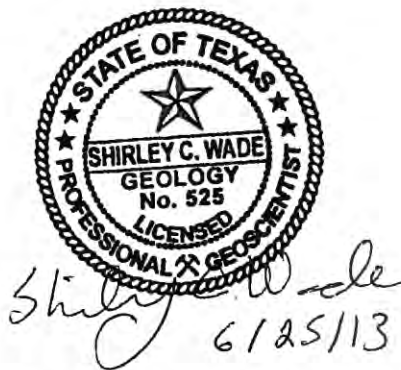
EntityName	WugCounty	WmsName	SS2020	SS2030	SS2040	SS2050	SS2060	SS2070
REFUGIO	REFUGIO	MUNICIPAL WATER CONSERVATION	19	59	85	96	108	119
WOODSBORO	REFUGIO	MUNICIPAL WATER CONSERVATION	6	9	8	14	20	27

**Appendix B.** Groundwater Availability Model Run provided by Texas Water  
Development Board - GAM RUN 13-008: REFUGIO  
GROUNDWATER CONSERVATION DISTRICT MANAGEMENT  
PLAN

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# GAM RUN 13-008: REFUGIO GROUNDWATER CONSERVATION DISTRICT MANAGEMENT PLAN

by Shirley Wade, Ph.D., P.G.  
Texas Water Development Board  
Groundwater Resources Division  
Groundwater Availability Modeling Section  
(512) 936-0883  
June 25, 2013



*The seal appearing on this document was authorized by Shirley Wade, P.G. 525, on June 25, 2013.*

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# GAM RUN 13-008: REFUGIO GROUNDWATER CONSERVATION DISTRICT MANAGEMENT PLAN

by Shirley Wade, Ph.D., P.G.  
Texas Water Development Board  
Groundwater Resources Division  
Groundwater Availability Modeling Section  
(512) 936-0883  
June 25, 2013

## ***EXECUTIVE SUMMARY:***

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

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

This report—Part 2 of a two-part package of information from the TWDB to Refugio Groundwater Conservation District management—fulfills the requirements noted above. Part 1 of the 2-part package is the Historical Water Use/State Water Plan data report. The District should have received, or will receive, this data report from the TWDB Groundwater Technical Assistance Section. Questions about the data report can be directed to Mr. Stephen Allen, Stephen.Allen@twdb.texas.gov, (512) 463-7317. The groundwater management plan for the Refugio Groundwater Conservation District should be adopted by the district on or before December 25, 2013 and submitted to the executive administrator of the TWDB on or before January 24, 2014. The current management plan for the Refugio Groundwater Conservation District expires on March 25, 2014.

This report discusses the method, assumptions, and results from model runs using the groundwater availability model for the central portion of the Gulf Coast Aquifer. This model run replaces the results of GAM Run 08-39. GAM Run 13-008 meets current standards set after the release of GAM Run 08-39. Table 1 summarizes the groundwater availability model data required by the statute, and Figure 1 shows the area of the model from which the values in the table was extracted. If after reviewing the figure, Refugio Groundwater Conservation District determines that the district boundaries used in the assessment do not reflect current conditions, please notify the Texas Water Development Board immediately. The TWDB has also approved, for planning purposes, alternative models that can have water budget information extracted for the district. These alternative models include the Groundwater Management Area 16 alternative model and the fully penetrating alternative model for the central portion of the Gulf Coast Aquifer. Please contact the author of this report if a comparison report using either of these models is desired.

### ***METHODS:***

In accordance with the provisions of the Texas State Water Code, Section 36.1071, Subsection (h), the groundwater availability model for the central portion of the Gulf Coast Aquifer was run for this analysis. Refugio Groundwater Conservation District Water budgets for 1981 through 1999 were extracted using ZONEBUDGET Version 3.01 (Harbaugh, 2009) The average annual water budget values for recharge, surface water outflow, inflow to the district, outflow from the district, net inter-aquifer flow (upper), and net inter-aquifer flow (lower) for the portions of the aquifers located within the district are summarized in this report.

### ***PARAMETERS AND ASSUMPTIONS:***

#### ***Gulf Coast Aquifer***

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



1. the Chicot Aquifer,
2. the Evangeline Aquifer,
3. the Burkeville Confining Unit, and
4. the Jasper Aquifer including parts of the Catahoula Formation.

## **RESULTS:**

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

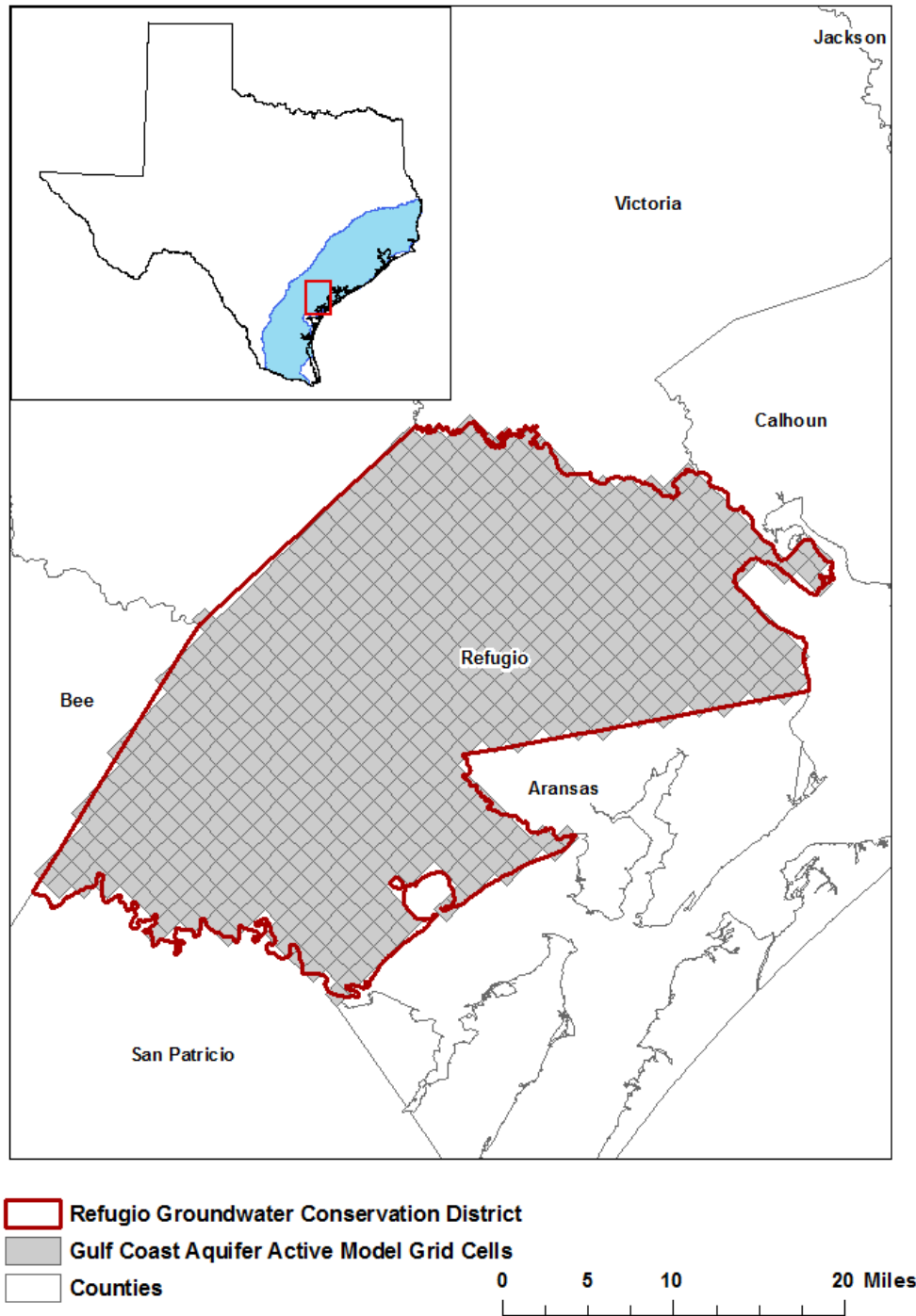
- Precipitation recharge—The areally distributed recharge sourced from precipitation falling on the outcrop areas of the aquifers (where the aquifer is exposed at land surface) within the district.
- Surface water outflow—The total water discharging from the aquifer (outflow) to surface water features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

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

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

<i>Management Plan requirement</i>	<i>Aquifer or confining unit</i>	<i>Results</i>
Estimated annual amount of recharge from precipitation to the district	Gulf Coast Aquifer	13,072
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	40,891 <sup>1)</sup>
Estimated annual volume of flow into the district within each aquifer in the district	Gulf Coast Aquifer	19,159
Estimated annual volume of flow out of the district within each aquifer in the district	Gulf Coast Aquifer	15,103
Estimated net annual volume of flow between each aquifer in the district	Not Applicable	Not Applicable

<sup>1)</sup> discharge amount includes 5,020 acre-feet per year of water leaving the district to bays.



gcd boundary date = 11.20.12, county boundary date = 02.02.11, glfc\_c model grid date = 10.13.11

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

## **LIMITATIONS**

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

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

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

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

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

## **REFERENCES:**

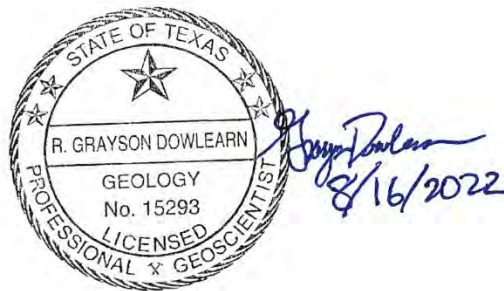
- Chowdhury, Ali. H., Wade, S., Mace, R.E., and Ridgeway, C., 2004, Groundwater Availability Model of the Central Gulf Coast Aquifer System: Numerical Simulations through 1999- Model Report, 114 p., [http://www.twdb.texas.gov/groundwater/models/gam/glfc\\_c/TWDB\\_Recalibration\\_Report.pdf](http://www.twdb.texas.gov/groundwater/models/gam/glfc_c/TWDB_Recalibration_Report.pdf).
- Harbaugh, A. W., 2009, Zonebudget Version 3.01, A computer program for computing subregional water budgets for MODFLOW ground-water flow models, U.S. Geological Survey Groundwater Software.
- National Research Council, 2007, Models in Environmental Regulatory Decision Making Committee on Models in the Regulatory Decision Process, National Academies Press, Washington D.C., 287 p.
- Ridgeway, Cynthia K., 2008, GAM Run 08-39: Texas Water Development Board, GAM Run 08-39 Report, 4 p., <http://www.twdb.texas.gov/groundwater/docs/GAMruns/GR08-39.pdf>.
- Waterstone Environmental Hydrology and Engineering Inc. and Parsons, 2003, Groundwater availability of the Central Gulf Coast Aquifer: Numerical Simulations to 2050, Central Gulf Coast, Texas Contract report to the Texas Water Development Board, 157 p.

**Appendix C.** Modeled Available Groundwater GAM Run 21-020 MAG

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

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



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

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

## ***EXECUTIVE SUMMARY:***

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

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

August 16, 2022

Page 4 of 21

***REQUESTOR:***

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

***DESCRIPTION OF REQUEST:***

Mr. Tim Andruss provided the TWDB with the desired future conditions of the Gulf Coast Aquifer System on behalf of Groundwater Management Area (GMA) 15 in a letter dated December 10, 2021. Groundwater conservation district representatives in Groundwater Management Area 15 adopted desired future conditions for the Gulf Coast Aquifer System on October 14, 2021, as described in Resolution No. 2021-01 (Appendix 2 in Keester and others, 2021). The desired future conditions included in Table 1 are average water level drawdowns by county between January 2000 and December 2080 based on the predictive groundwater flow Scenario GMA15\_2019\_001\_v1 (Keester and others, 2021). The predictive simulations were developed from the groundwater availability model for the Gulf Coast Aquifer System (Version 1.01; Chowdhury and others, 2004).

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

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

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

## ***METHODS:***

The TWDB ran the central portion of the Gulf Coast Aquifer System groundwater availability model (Version 1.01; Chowdhury and others, 2004) using the predictive model files submitted with the explanatory report (Keester and others, 2021) to calculate the drawdown and modeled available groundwater values for the Gulf Coast Aquifer System within Groundwater Management Area 15. The submitted predictive model files included the Scenario GMA15\_2019\_001\_v1 (Keester and others, 2021) pumping file and the GAM Run 10-008 Addendum (Wade, 2010) model files extended to the year 2080. Drawdown was calculated for each county and model layer by first excluding model cells that went dry and model cells that fall outside of the official aquifer footprint, and then summing the drawdown (difference between the water levels from January 2000 [initial heads] to December 2080 [stress period 81]) in the remaining cells of each county and dividing by the number of model cells within that county. Drawdown values were compared to the desired future conditions and were determined to fall within the accepted tolerance for Groundwater Management Area 15.

Modeled available groundwater values were determined by extracting pumping rates by decade from the model results using ZONEBUDGET Version 3.01 (Harbaugh, 2009). Annual pumping rates by aquifer are presented from 2020 to 2080 by county and groundwater conservation district, subtotaled by groundwater conservation district, and summed for Groundwater Management Area 15 (Table 2). Annual pumping rates are also presented from 2030 to 2080 by county, river basin, and regional water planning area within Groundwater Management Area 15 for use in regional water planning (Table 3).

### **Modeled Available Groundwater and Permitting**

As defined in Chapter 36 of the Texas Water Code (2011), “modeled available groundwater” is the estimated average amount of water that may be produced annually to achieve a desired future condition. Groundwater conservation districts are required to consider modeled available groundwater, along with several other factors, when issuing permits in order to manage groundwater production to achieve the desired future condition(s). The other factors districts must consider include annual precipitation and production patterns, the estimated amount of pumping exempt from permitting, existing permits, and a reasonable estimate of actual groundwater production under existing permits.

## ***PARAMETERS AND ASSUMPTIONS:***

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

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

August 16, 2022

Page 7 of 21

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

- The model has four layers representing the Chicot aquifer (Layer 1), the Evangeline aquifer (Layer 2), the Burkeville Confining Unit (Layer 3), and the Jasper aquifer and parts of the Catahoula Formation in direct hydrologic communication with the Jasper aquifer (Layer 4). Figures 3 to 6 show the extent of these active model layers within GMA 15.
- Pumping was not modeled in the Burkeville Confining Unit within Colorado, Matagorda, and Wharton counties and as such, this layer is excluded from the modeled available groundwater calculation in these counties.
- Pumping was not modeled in the Jasper aquifer within Matagorda and Wharton counties and as such this layer is excluded from the modeled available groundwater calculations in these counties.
- The model was run with MODFLOW-96 (Harbaugh and McDonald, 1996).
- Pumping volumes are reduced to zero if a cell becomes dry during the predictive model run. For this reason, the modeled available groundwater values from the ZONEBUDGET output may not match the pumping values in the input well file.
- Drawdown averages and modeled available groundwater volumes were calculated based on the extent of the official TWDB aquifer boundary. The most recent TWDB model grid file dated June 26, 2020 (glfc\_c\_grid\_poly062620.csv) was used to determine model cell entity assignment (county, groundwater management area, groundwater conservation district, river basin, regional water planning area).
- Drawdowns for cells that became dry during the simulation were excluded from the drawdown averages. Pumping in dry cells was excluded from the modeled available groundwater calculations.
- To be consistent with Groundwater Management Area 15's assumptions (see Keester and others, 2021), a tolerance of three feet was assumed when comparing desired future conditions to modeled drawdown results for all counties except Goliad County. Goliad County was given a tolerance of  $\pm 17$  feet for the Chicot aquifer,  $\pm 36$  feet for the Evangeline aquifer,  $\pm 14$  feet for the Burkeville Confining Unit, and  $\pm 7$  feet for the Jasper aquifer. Goliad County Groundwater Conservation District plans to monitor achievement of their desired future conditions within these tolerances because they rely more heavily on their extensive monitoring program rather than modeled results.

August 16, 2022

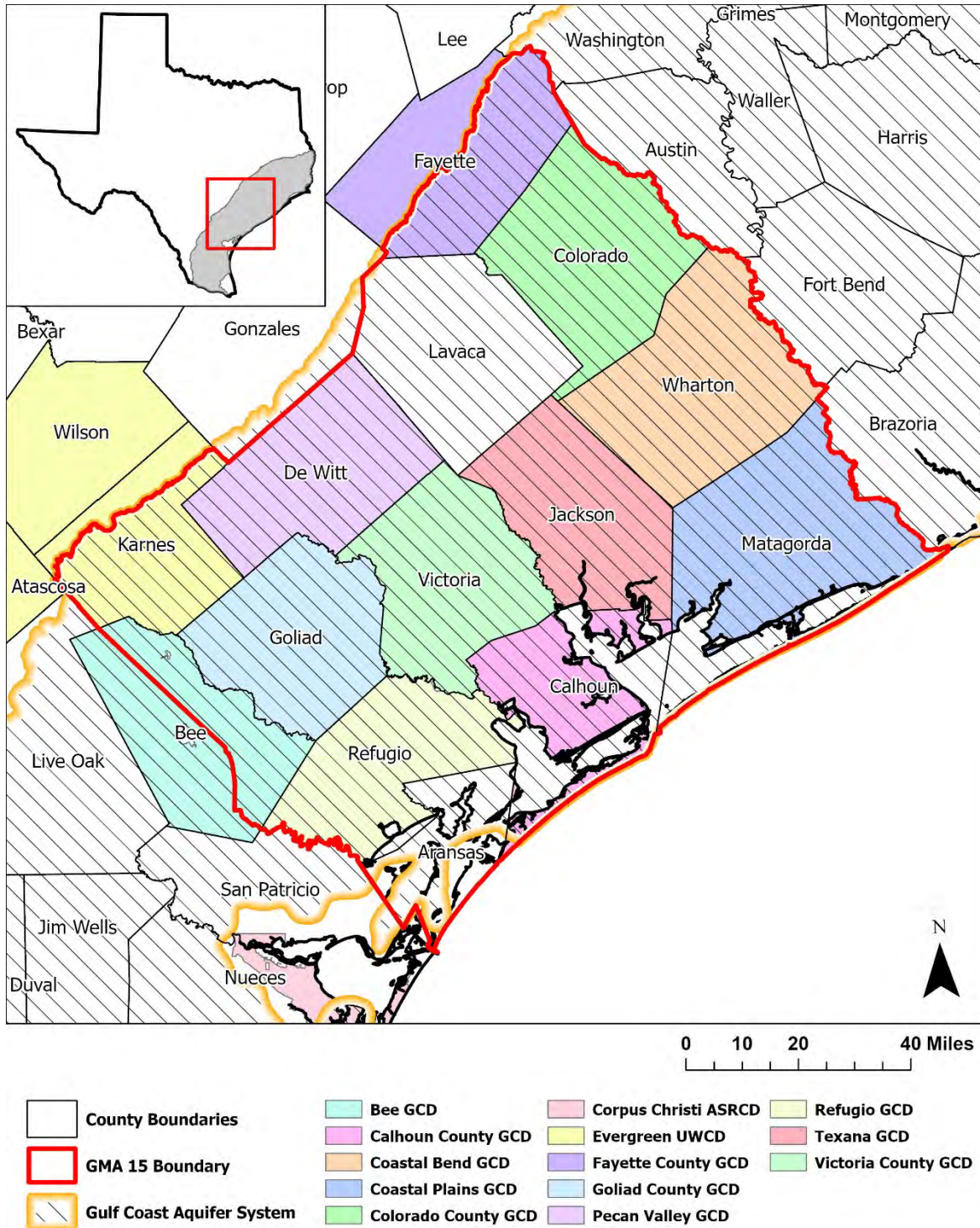
Page 8 of 21

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

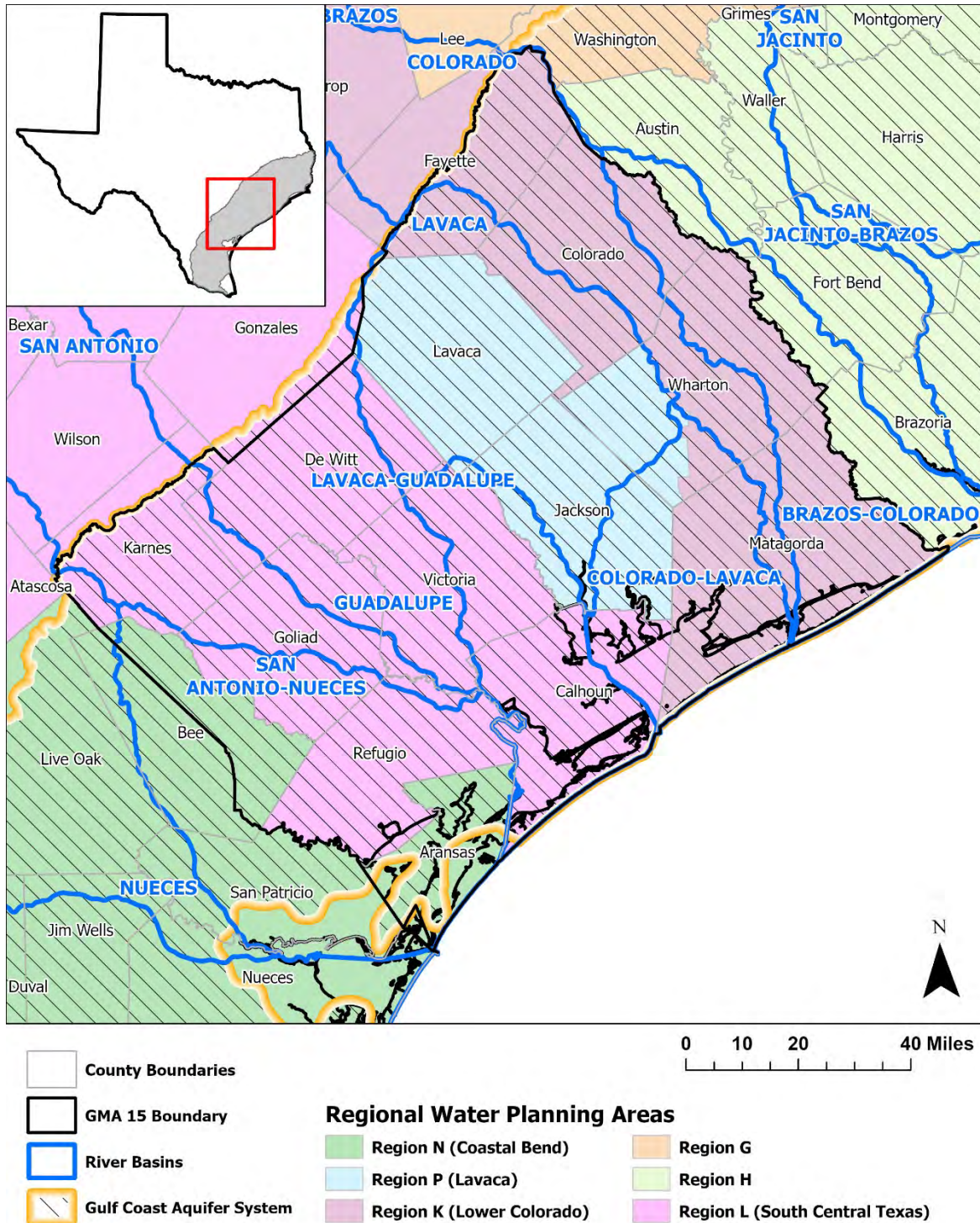
### ***RESULTS:***

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

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

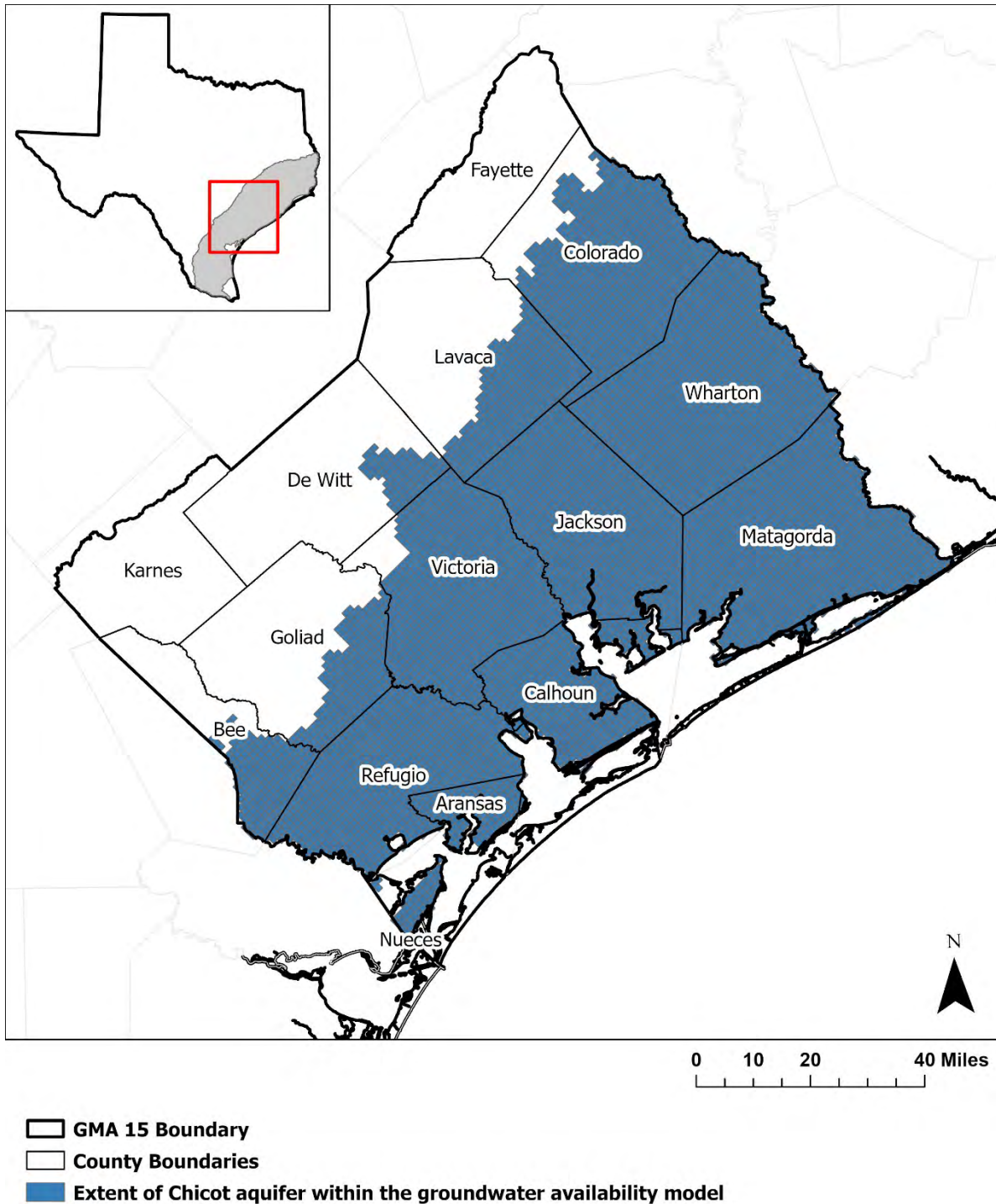


**FIGURE 1. MAP SHOWING GROUNDWATER MANAGEMENT AREA (GMA) 15, GROUNDWATER CONSERVATION DISTRICTS (GCD), COUNTIES, AND THE EXTENT OF ACTIVE MODEL CELLS. (UWCD = UNDERGROUND WATER CONSERVATION DISTRICT)**

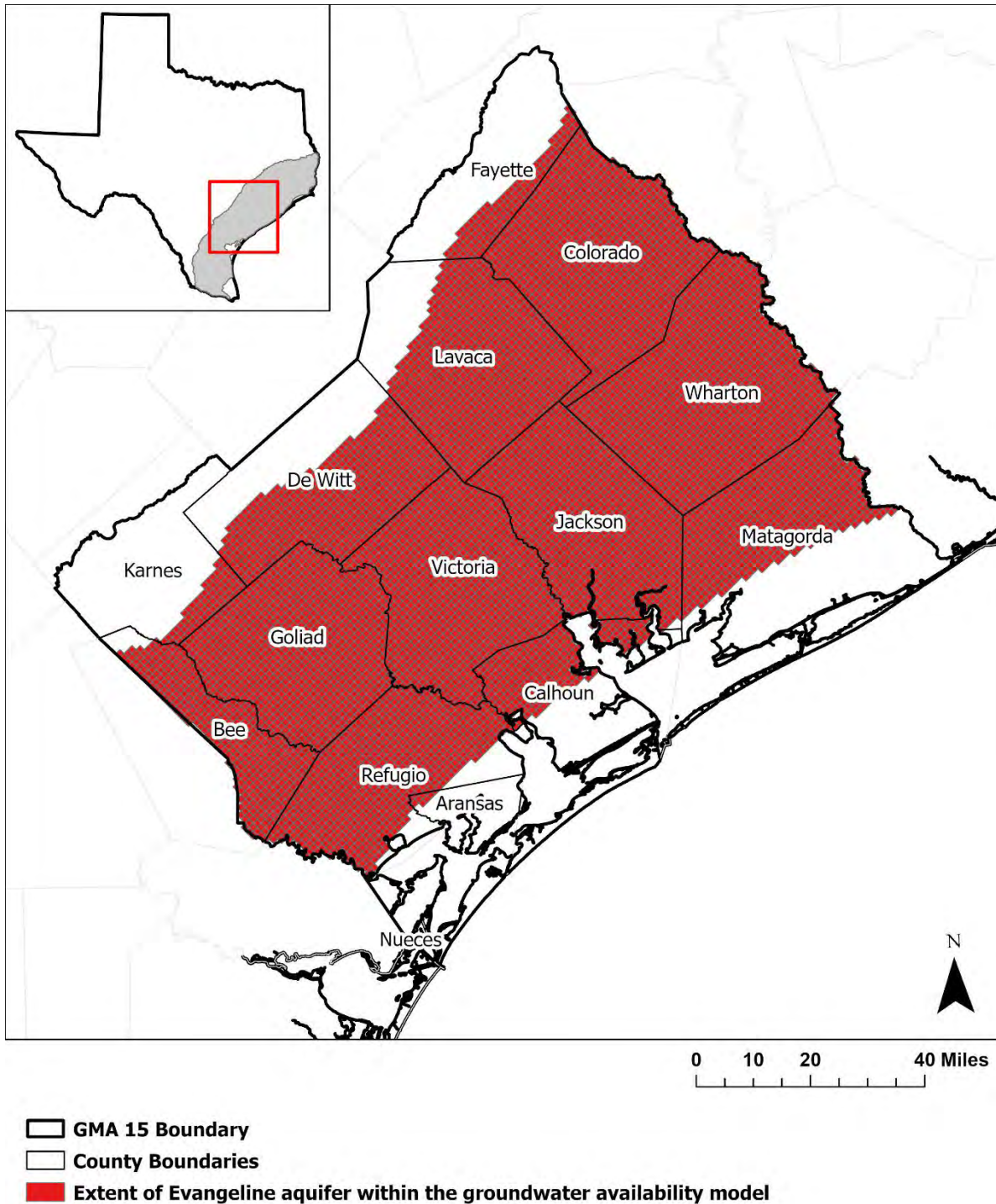


**FIGURE 2. MAP SHOWING GROUNDWATER MANAGEMENT AREA (GMA) 15, REGIONAL WATER PLANNING AREAS, RIVER BASINS, COUNTIES, AND EXTENT OF ACTIVE MODEL CELLS.**

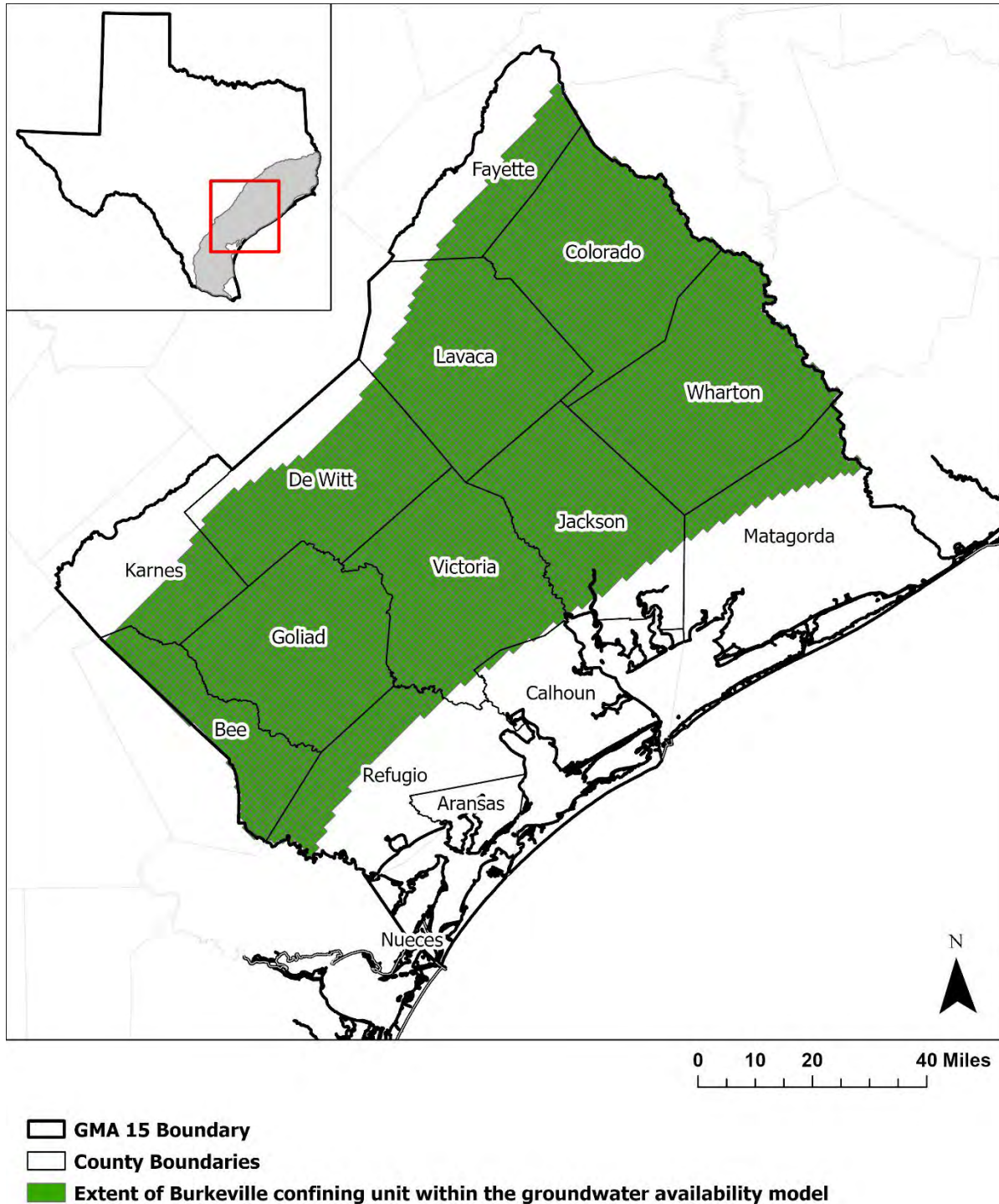




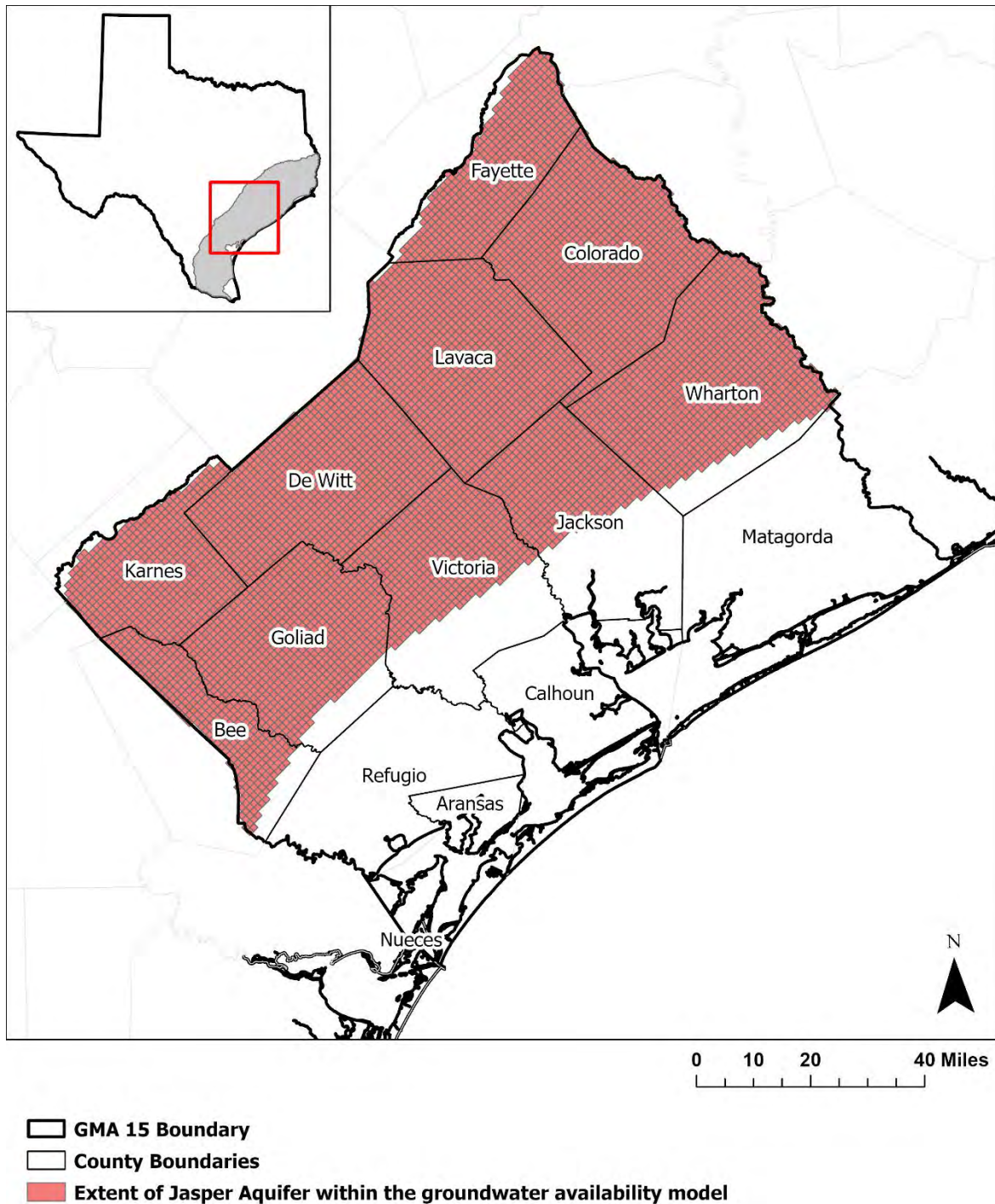
**FIGURE 3. MAP SHOWING THE ACTIVE MODEL CELLS WITHIN GROUNDWATER MANAGEMENT AREA (GMA) 15 REPRESENTING THE CHICOT AQUIFER IN LAYER 1 OF THE CENTRAL GULF COAST AQUIFER SYSTEM GROUNDWATER AVAILABILITY MODEL.**



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



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



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

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

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

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

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

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

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

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

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



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

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

### ***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.

**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>.

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

Harbaugh, A. W., and McDonald, M. G., 1996, User's documentation for MODFLOW-96, an update to the U.S. Geological Survey modular finite-difference groundwater-water flow model: U.S. Geological Survey Open-File Report 96-485, 56 p.

Keester, M., Danielson, V., Donnelly, A., 2021, GMA 15 2021 Joint Planning Desired Future Conditions Explanatory Report, 1047 p.

National Research Council, 2007, Models in Environmental Regulatory Decision Making Committee on Models in the Regulatory Decision Process, National Academies Press, Washington D.C., 287 p., [http://www.nap.edu/catalog.php?record\\_id=11972](http://www.nap.edu/catalog.php?record_id=11972).

Texas Water Code, 2011, <http://www.statutes.legis.state.tx.us/docs/WA/pdf/WA.36.pdf>.

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

**Appendix D.** Public Notices Regarding Hearings Related to Plan Adoption

**Refugio Groundwater Conservation District  
Meeting Notice and Agenda**

Notice is hereby given in accordance with the Open Meetings Act, Chapter 551, Government Code and Section 36.064 of the Texas Water Code that the Refugio Groundwater Conservation District Board of Directors will hold a meeting on April 17, 2023, at 6:00 PM at the First Baptist Church of Woodsboro Activity Center, 309 Johnson Street, Woodsboro, Texas 78393.

**AGENDA**

1. Call the meeting to order and welcome guests.
2. Receive public comments.
3. Consideration of and possible action on matters related to groundwater management including the efforts and activities of the District regarding permitting, complaints, investigations, violations, and enforcement cases associated with permitting.
4. Consideration of and possible action on matters related to groundwater protection including complaints, investigations, violations, and enforcement cases related to groundwater contamination and waste.
5. Consideration of and possible action on matters related to groundwater monitoring.
6. Consideration of and possible action on matters related to groundwater conservation.
7. Consideration of and possible action on matters related to groundwater resource planning including Groundwater Management Area 15 Joint Planning and regional water planning.
8. Consideration of and possible action on matters related to groundwater policy including the Management Plan of the District, the proposed Management Plan of the District, the Rules of the District, petitions to amend the Rules of the District, and fee schedule.
  - Hearing on proposed Management Plan of the District.
  - Hearing on petition to amend the rules of the district APAR-20230220-01.
  - Hearing on petition to amend the rules of the district APAR-20230223-01.
9. Consideration of and possible action on matters related to meeting management including minutes of previous meetings.
10. Consideration of and possible action on matters related to financial management including the annual budget of the district, financial audit of FY2023, bank accounts, investments, financial reports of the district, bills and invoices of the district.
11. Consideration of and possible action on matters related to office administration and management including management goals and objectives of the district, annual report of the district, administrative policies, staffing, consultant agreements, interlocal cooperation agreements, and support services provided to and from other groundwater conservation districts.
12. Consideration of and possible action on matters related to legal counsel report.
13. Adjourn.

The Refugio Groundwater Conservation District may close the meeting, if necessary, to conduct private consultation with legal counsel regarding matters protected by the attorney-client privilege pursuant to Section 551.071 of the Government Code or to discuss matters regarding personnel pursuant to Section 551.074 of the Government Code. The Refugio Groundwater Conservation District will return to open meeting, if necessary, to take any action deemed necessary based on discussion in closed meeting pursuant to Section 551.102 of the Government Code.

In Accordance with Title III of the Americans with Disabilities Act, the District invites all attendees to advise us of any special accommodations due to disability. Please submit your request as far as possible in advance of event you wish to attend.

Certificate of Posting

The above Notice of Meeting was posted March 29, 2023  
at a place convenient to the public on a bulletin board in the Refugio County  
Courthouse at Refugio, Texas.

WITNESS MY HAND AND SEAL of office on above date.



Ida Ramirez, Clerk County Court  
Refugio County, Texas

By Erin Allen Deputy  
Erin Allen

Public Hearing Notice

Pursuant to Chapter 36, Texas Water Code, the Refugio Groundwater Conservation District will conduct a public hearing on the Management Plan of the District with proposed revisions at 6:00 P.M. on April 17, 2023, at the First Baptist Church of Woodsboro Activity Center, 309 Johnson Street, Woodsboro, Texas 78393. The hearing will be conducted to receive comments and suggestions from the public concerning the proposed management plan.

The Management Plan of the District with proposed revisions was developed using the best available data and addresses the following management goals, as applicable: (1) providing the most efficient use of groundwater; (2) controlling and preventing waste of groundwater; (3) controlling and preventing subsidence; (4) addressing conjunctive surface water management issues; (5) addressing natural resource issues; (6) addressing drought conditions; (7) addressing conservation, recharge enhancement, rainwater harvesting, precipitation enhancement, or brush control, where appropriate and cost-effective; and (8) addressing the desired future conditions adopted by the district under Section 36.108.

The Management Plan of the District with proposed revisions (1) identifies the performance standards and management objectives under which the district will operate to achieve the management goals ; (2) specifies the actions, procedures, performance, and avoidance that are or may be necessary to effect the plan; (3) includes estimates of (A) modeled available groundwater in the district based on the desired future condition established under Section 36.108; (B) the amount of groundwater being used within the district on an annual basis; (C) the annual amount of recharge from precipitation, if any, to the groundwater resources within the district; (D) for each aquifer, the annual volume of water that discharges from the aquifer to springs and any surface water bodies, including lakes, streams, and rivers; (E) the annual volume of flow into and out of the district within each aquifer and between aquifers in the district, if a groundwater availability model is available; (F) the projected surface water supply in the district according to the most recently adopted state water plan; and (G) the projected total demand for water in the district according to the most recently adopted state water plan; and (4) considers the water supply needs and water management strategies included in the adopted state water plan.

A copy of the Management Plan of the District with proposed revisions may be reviewed or copied at the District's office located at 604 Commerce Street, Refugio, Texas 78377. The Management Plan of the District with proposed revisions is available on the District's website at [www.rgcd.org](http://www.rgcd.org). Questions or comments should be directed to Tim Andruss, General Manager at P.O. Box 116, Refugio, Texas 78377 or [admin@rgcd.org](mailto:admin@rgcd.org) or (361) 579 - 6863.

Certificate of Posting

The above Notice of Meeting was posted March 29, 2023  
at a place convenient to the public on a bulletin board in the Refugio County  
Courthouse at Refugio, Texas.

WITNESS MY HAND AND SEAL of office on above date.



Ida Ramirez, Clerk County Court  
Refugio County, Texas

By Erin Allen Deputy  
Erin Allen

**Appendix E.** Letters Coordinating with Regional Surface Water Management Entities

# Refugio Groundwater Conservation District

604 E. Commerce St., Refugio, Texas 78377

P.O. Box 116, Refugio, Texas 78377

Phone (361) 526-1483 | [www.rgcd.org](http://www.rgcd.org)

May 16, 2023

Via Certified Mail: 7021 0350 0000 2790 8130

Guadalupe Blanco River Authority,  
933 East Court Street,  
Seguin, Texas 78155

RE: Management Plan of the District

To whom it may concern,

On April 17, 2023, the Board of Directors of the Refugio Groundwater Conservation District adopted a revised management plan for the district. A copy of the adopted management plan is attached to this letter for your review.

If you have any questions or comments regarding the plan, please contact me at your convenience.

Regards,



Tim Andruss  
General Manager



# Refugio Groundwater Conservation District

604 E. Commerce St., Refugio, Texas 78377

P.O. Box 116, Refugio, Texas 78377

Phone (361) 526-1483 | [www.rgcd.org](http://www.rgcd.org)

May 16, 2023

Via Certified Mail: 7021 0350 0000 2790 8147

San Antonio River Authority

100 E. Guenther St.

San Antonio, Texas 78204

RE: Management Plan of the District

To whom it may concern,

On April 17, 2023, the Board of Directors of the Refugio Groundwater Conservation District adopted a revised management plan for the district. A copy of the adopted management plan is attached to this letter for your review.

If you have any questions or comments regarding the plan, please contact me at your convenience.

Regards,



Tim Andruss

General Manager

# Refugio Groundwater Conservation District

604 E. Commerce St., Refugio, Texas 78377

P.O. Box 116, Refugio, Texas 78377

Phone (361) 526-1483 | [www.rgcd.org](http://www.rgcd.org)

May 16, 2023

Via Certified Mail: 7021 0350 0000 2790 8154

South Central Texas Regional Water Planning Group

c/o San Antonio River Authority

P.O. Box 839980

San Antonio, Texas 78283

RE: Management Plan of the District

To whom it may concern,

On April 17, 2023, the Board of Directors of the Refugio Groundwater Conservation District adopted a revised management plan for the district. A copy of the adopted management plan is attached to this letter for your review.

If you have any questions or comments regarding the plan, please contact me at your convenience.

Regards,

A handwritten signature in black ink, appearing to read 'Tim Andruss', followed by a long horizontal line extending to the right.

Tim Andruss

General Manager

# Refugio Groundwater Conservation District

604 E. Commerce St., Refugio, Texas 78377

P.O. Box 116, Refugio, Texas 78377

Phone (361) 526-1483 | [www.rgcd.org](http://www.rgcd.org)

May 16, 2023

Via Certified Mail: 7021 0350 0000 2790 8161

Texas Water Development Board

P.O. Box 13231

Austin, Texas 78711-3231

RE: Management Plan of the District

To whom it may concern,

On April 17, 2023, the Board of Directors of the Refugio Groundwater Conservation District adopted a revised management plan for the district. A copy of the adopted management plan is attached to this letter for your review.

If you have any questions or comments regarding the plan, please contact me at your convenience.

Regards,

A handwritten signature in black ink, appearing to read 'Tim', with a long, sweeping horizontal line extending to the right.

Tim Andruss

General Manager

**Appendix F.** Refugio Groundwater Conservation District Board of Director  
Resolution Adopting Management Plan

RESOLUTION

Resolution Adopting the Refugio Groundwater Conservation  
District Management Plan

WHEREAS on March 29, 2023, a Notice of Hearing was posted with the County Clerk of Refugio County, regarding the public hearing on the Management Plan of the District with proposed revisions; and

WHEREAS on March 31, 2023, a Notice of Hearing was published in the Victoria Advocate, a newspaper paper with general circulation within Refugio County, regarding the public hearing on the Management Plan of the District with proposed revisions; and

WHEREAS on April 17, 2023, the Refugio Groundwater Conservation District Board of Directors with a quorum being present, conducted a public hearing regarding the adoption of the Refugio Groundwater Conservation District Management Plan; and

WHEREAS, the Refugio Groundwater Conservation District Management Plan had been developed in coordination with surface water management entities and other interested parties;

NOW THEREFORE BE IT RESOLVED that the Refugio Groundwater Conservation District Management Plan is ADOPTED as described in the Refugio Groundwater Conservation District Management Plan attached hereto and made part hereof for all purposes and that said management plan shall be submitted to the Executive Administrator of the Texas Water Development Board for review and approval with all necessary documentation.

Adopted by a vote of 4 ayes and 0 nays on this 17th day of April 2023.



\_\_\_\_\_  
President, Refugio Groundwater Conservation District

I, the undersigned, do hereby certify that the above resolution was adopted by the Board of Directors of the Refugio Groundwater Conservation District on the 17th day of April 2023.



\_\_\_\_\_  
Director, Refugio Groundwater Conservation District

**Appendix G.** Minutes of Refugio Groundwater Conservation District Board of Director Meeting related to the public hearings for and adoption of the Management Plan

**Appendix H. Refugio Groundwater Conservation District Contact Information**



# Groundwater Conservation District Registration Form

Legal Name of District

Mailing Address  City  TX Zip Code (9 Digits)

Physical Address  City  TX Zip Code (9 Digits)

Phone Number  Website

District E-mail

**BOARD MEMBERS**

TITLE	FULL NAME (First Middle Last)	ADDRESS	BUSINESS PHONE	HOME PHONE	E or A	TERM BEGINS (mm/dd/yyyy)	TERM ENDS (mm/dd/yyyy)
President	Carroll Borden	621 FM 1360, Woodboro, TX 78393		361-543-0991	E	11/2020	11/2024
Vice President	Scott Carter	PO Box 856, Woodsboro, TX 78393		361-318-4039	E	11/20/20	11/2024
Secretary	Fredric Biery	PO Box 57, Austwell, TX 77950		361-484-3091	E	11/2020	11/2024
Treasurer	John Snyder	105 W. Depot, Refugio, TX 78377		361-652-5451	E	11/2022	11/2026

All information provided herein is subject to the Public Information Act and will be made available on the [TCEQ Website](#)





# Groundwater Conservation District Registration Form

## CONSULTANTS and REPRESENTATIVES

POSITION	FULL NAME	FIRM / ORGANIZATION	ADDRESS	BUSINESS PHONE	FAX
General Manager	Tim Andruss	Refugio Groundwater Conservation District	604 Commerce St., Refugio, TX 78377	361-526-1483	
Attorney	James Allison	Allison, Bass & Magee., LLP	402 W. 12th St., Austin, TX 78701	512-482-0701	

I certify that the information contained herein is correct and complete to the best of my knowledge.

Signature *Caitlynn Davenport*  
 Printed Name/Title Caitlynn Davenport / Administrative Coordinator

Date Signed 2/20/23

Individuals are entitled to request and review personal information the TCEQ gathers on its forms. For assistance with this form or to request your personal information and correct any errors, contact us at (512) 239-2789

## STATUTORY AND RULE REQUIREMENTS

Texas Water Code statutory requirements can be found at [TWC Chapter 36](#).  
Texas Administrative Code Section 293.20 rule requirements can be found at [TAC 293.20](#).

To submit your completed form: Press the SUBMIT button (if using electronic signature); E-mail to [GPAT@tceq.texas.gov](mailto:GPAT@tceq.texas.gov); Fax to (512) 239-2214; or, Mail to:

Texas Commission on Environmental Quality  
Groundwater Planning & Assessment  
MC-147, PO Box 13087  
Austin, Texas 78711-3087

SUBMIT