Calhoun County Groundwater Conservation District

Management Plan

Calhoun County Groundwater Conservation District Board of Directors Management Plan Original Adoption:	**May 31, 2017**
Texas Water Development Board Administrative Management Plan Original Approval:	

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DISTRICT MISSION

The mission of the Calhoun County Groundwater Conservation District (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 Calhoun County for the benefit of Calhoun County's landowners, citizens, economy, and environment.

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 protection of the groundwater resources within Calhoun County.

PURPOSE OF THE 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 the amount 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 DISTRICT'S jurisdiction and the amount of modeled available groundwater from such aquifers is required by statute to be included in the DISTRICT's management plan and will guide the DISTRICT's regulatory and management policies. 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 1290, 82nd Legislature and continued by Senate Bill 1835, 83rd Legislature, and codified as Chapter 8860, Special District and Local Laws Code. The citizens of Calhoun County through a confirmation election held on November 4, 2014 ratified the DISTRICT. The boundaries of the District are conterminous with those of Calhoun County, Texas. The DISTRICT was formed to protect, conserve, and prevent waste of the groundwater resources beneath the area of Calhoun 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 Management Plan, and the District Rules.

Directors

The Calhoun County Groundwater Conservation District Board of Directors consists of five members. These five directors are elected by the voters of Calhoun County and serve a four-year term. The DISTRICT observes the same four precincts as the Calhoun County Commissioners' with one at-large position. Director terms 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 management plan, provide for the permitting of certain water wells, and implement programs to achieve statutory requirements. The DISTRICT has rule-making authority to implement its policies and procedures to manage the groundwater resources of Calhoun County.

Location and Extent

The boundaries of the DISTRICT are the same as Calhoun County. This area encompasses approximately 1,032 square miles. The District is bounded by Refugio County, Victoria County, Jackson County, and Matagorda County.

GROUNDWATER RESOURCES OF CALHOUN COUNTY

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

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

<table>
<tr><th colspan="2">Stratigraphic Unit</th><th>Hydrogeologic Unit</th></tr>
<tr><td colspan="2">Alluvium</td><td rowspan="5">Chicot Aquifer</td></tr>
<tr><td colspan="2">Beaumont Clay</td></tr>
<tr><td>Montgomery Formation</td><td rowspan="2">Lissie Formation</td></tr>
<tr><td>Bentley Formation</td></tr>
<tr><td colspan="2">Willis Sand</td></tr>
<tr><td colspan="2">Goliad Sand</td><td rowspan="2">Evangeline Aquifer</td></tr>
<tr><td colspan="2" rowspan="2">Fleming Formation</td></tr>
<tr><td>Burkeville Confining Unit</td></tr>
<tr><td colspan="2">Oakville Sandstone</td><td rowspan="2">Jasper Aquifer</td></tr>
<tr><td colspan="2">Catahoula Sandstone (Tuff)</td></tr>
</table>

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 Aquifer is utilized the most within Calhoun County. The Chicot Aquifer outcrops across the entire county. The thickness of the Chicot aquifer ranges between approximately 500 feet to 1,200 feet in Calhoun County. The thickness of the Evangeline aquifer ranges between approximately 1,100 feet to 1,600 feet in Calhoun County. The Chicot and Evangeline aquifer 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 Calhoun 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 the 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 Calhoun 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 DISTRICT's management plan is intended to serve as a tool to focus the thoughts and actions of those given the responsibility for the execution of the DISTRICT's activities as well as to provide information to the staff of the DISTRICT, landowners, and others responsible for the execution of, or compliance with, the DISTRICT's policies and rules. The DISTRICT will carry out its programs and responsibilities in implementing this management plan in a prudent and cost effective manner. The DISTRICT, with public input, will adopt and enforce rules necessary to implement this management plan.

CRITERIA FOR PLAN APPROVAL

Planning Horizon

The time period for this plan is 10 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 management plan with or without amendments as required by §36.1072(e) of the Texas Water Code.

This 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 Calhoun County region for coordination purposes are included in Appendix E.

Calhoun County Groundwater Conservation District Board of Director Resolution Adopting Management Plan

A copy of the DISTRICT's resolution 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 required by the 79th Legislature with the passage of House Bill 1763 into law.

The DISTRICT is located in Groundwater Management Area 15. The groundwater conservation districts of Groundwater Management Area 15 completed the second-round of joint planning process to determine the desired future condition of the aquifers within the groundwater management area.

District representatives of Groundwater Management Area 15 adopted, by resolution, the desired future condition for Gulf Coast Aquifer within Groundwater Management Area 15 on April 29, 2016. The administrator of Groundwater Management Area 15 submitted the adopted desired future conditions and explanatory report for Groundwater Management Area 15 on June 23, 2016 to Texas Water Development Board. The Texas Water Development Board designated the Groundwater Management Area 15 Explanatory Report administratively complete on October 20, 2016. The Texas Water Development Board provided the Modeled Available Groundwater estimates for Groundwater Management Area 15 to district representatives on March 22, 2017.

The desired future condition for the entire area is stated as follows:
"Drawdown of the Gulf Coast Aquifer System shall not exceed an average of 13 feet in December 2069 from estimated year 2000 conditions."

The desired future condition for Calhoun County is stated as follows:

"Drawdown of the Gulf Coast Aquifer System shall not exceed an average of 5 feet in December 2069 from estimated year 2000 conditions."

The Texas Water Development Board reported the modeled available groundwater for Groundwater Management Area 15 based on the desired future condition in GAM Run 16-025 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 1 of the GAM Run 16-025 MAG report is as follows:

Year					
2020	2030	2040	2050	2060	2069
7,565 AFY	7,565 AFY	7,565 AFY	7,565 AFY	7,565 AFY	7,565 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)

Please refer to Appendix A.

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)

Please refer to Appendix B.

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)

Please refer to Appendix B.

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)

Please refer to Appendix B.

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)

Please refer to Appendix A.

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)

Please refer to Appendix A.

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

Please refer to Appendix A.

DETAILS ON THE DISTRICT MANAGEMENT OF GROUNDWATER

The Texas Legislature established that groundwater conservation districts are the preferred method of groundwater management in TWC §36.0015. The DISTRICT will manage the use of groundwater within Calhoun 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 Calhoun County as practicably as possible as established in the plan. In consideration of the economic and cultural activities occurring within Calhoun 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 Calhoun 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 DISTRICT's enabling legislation.

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 Section 36.001 of the Texas Water Code.

An observation well network will be established and maintained by the DISTRICT in order to monitor changing water levels and water quality of groundwater supplies within Calhoun County. When a monitoring well network has been established, the DISTRICT will make a regular assessment of water supply and groundwater storage conditions, water quality conditions and will report those conditions to the Calhoun County Groundwater Conservation District Board of Directors and to the public. The DISTRICT may undertake, as necessary, investigations of the groundwater resources within Calhoun County and will make the results of investigations available to the public. The DISTRICT will co-operate with investigations of the groundwater resources of Calhoun 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 Calhoun County; or

2. Each geographic area overlying an aquifer or subdivision of an aquifer located in whole or in part within Calhoun County.

For the purpose of managing the use of groundwater within Calhoun County, the DISTRICT may define sustainable use as the use of an amount of groundwater in Calhoun 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 Calhoun 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 Calhoun 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 Calhoun 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 DISTRICT's management plan; and
3. Are reasonably necessary to protect historic use.

The DISTRICT may adopt rules to regulate groundwater withdrawals by means of spacing and/or 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 DISTRICT enabling Legislation, 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 Calhoun 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 DISTRICT's enabling legislation. The exercise of said discretion by the Calhoun County

Groundwater Conservation District Board of Directors shall not be construed as limiting the power of the Calhoun County Groundwater Conservation District Board of Directors.

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

Rules adopted by the DISTRICT for the permitting of wells and the use of groundwater 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 DISTRICT's rules are available at the following website addresses:
www.calhouncountygcd.org

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 Calhoun County Groundwater Conservation District Board of Directors regarding the DISTRICT's performance in achieving management goals and objectives for the fiscal year. The report will be presented within 120 days following the completion of the DISTRICT's fiscal year. The DISTRICT will maintain the report on file for public inspection at the District's offices upon adoption at a meeting of the Calhoun County Groundwater Conservation 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 water well registration program for tracking well information for wells within Calhoun County.

Performance Standard: Each year, the DISTRICT will summarize within the annual report the changes related to water well registration including the number of non-grandfathered and grandfathered wells registered.

Objective: Develop and maintain a water well permitting program for processing and tracking all permits authorizing groundwater production.

Performance Standard: Each year, the DISTRICT will summarize within the annual report the changes related to water well permitting including the number of new applications and the disposition of the applications.

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

Objective: Develop and maintain a water well inspection program for non-exempt wells.

Performance Standard: Each year, the DISTRICT will summarize within the annual report the findings of the inspection activities including information regarding the number of wells that require improvement to control or prevent waste of groundwater.

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 has occurred in Calhoun 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 subsidence develop.

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 at least one South Central Texas Regional Water Planning Group (Region L) meeting per year.

Performance Standard: Each year, the DISTRICT will summarize within the annual report the representatives of the DISTRICT, dates, and the number of meetings of the South Central Texas Regional Water Planning Group attended.

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 water quality monitoring program.

Performance Standard: Each year, the DISTRICT will summarize within the annual report the monitoring activities including the number of wells monitored and the year-to-year change of water quality.

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

Objective: Collect and review drought condition information related to Calhoun County and the surrounding region of Texas.

Performance Standard: Each year, the District will summarize within the annual report the drought condition information collected and reviewed.

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 Calhoun County.

Performance Standard: Each year, the DISTRICT will summarize within the annual report the activities directly related to conservation, rainwater harvesting or brush control including participation in scientific investigations and studies, educational materials developed and delivered to local schools, cooperative educational contributions and grants, public speaking events and presentations, community event participation, and educational publications.

Recharge enhancement and precipitation enhancement are deemed to be

not appropriate or cost-effective programs for the DISTRICT at this time because there are no existing recharge enhancement or precipitation enhancement programs operating in nearby counties in which the DISTRICT could participate and share costs. The costs of operating a single-county recharge enhancement or precipitation enhancement program are prohibitive and would require the DISTRICT to increase taxes. Therefore, these goals are not 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 water level monitoring program.

Performance Standard: Each year, the DISTRICT will summarize within the annual report the water level monitoring activities including the number of wells monitored and the year-to-year change of water level.

Objective: Analyze water level monitoring information to evaluate water level trends and determine the degree to which the DISTRICT is complying with the desired future conditions of Gulf Coast Aquifer in Calhoun County.

Performance Standard: Each year, the DISTRICT will summarize within the annual report the water level trends and the conclusions regarding the DISTRICT's compliance with the desired future condition of the Gulf Coast Aquifer in Calhoun County.

List of Appendices

Appendix A. Estimated Historical Water Use and State Water Plan Datasets provided by Texas Water Development Board

Appendix B. Groundwater Availability Model Run 15-010 provided by Texas Water Development Board

Appendix C. Groundwater Availability Model Run 16-025 MAG

Appendix D. Public Notices Regarding Hearings Related to Plan Adoption

Appendix E. Letters Coordinating with Regional Surface Water Management Entities

Appendix F. Calhoun County Groundwater Conservation District Board of Director Resolution Adopting Management Plan

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

Appendix H. Calhoun County Groundwater Conservation District Contact Information

Appendix A. Estimated Historical Water Use and State Water Plan Datasets provided by Texas Water Development Board

Estimated Historical Water Use And 2017 State Water Plan Datasets:

Calhoun County Groundwater Conservation District

by Stephen Allen
Texas Water Development Board
Groundwater Division
Groundwater Technical Assistance Section
stephen.allen@twdb.texas.gov
(512) 463-7317
May 11, 2017

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 5/11/2017. 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) or Rima Petrossian (rima.petrossian@twdb.texas.gov or 512-936-2420).

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

Groundwater and surface water historical use estimates are currently unavailable for calendar year 2016. TWDB staff anticipates the calculation and posting of these estimates at a later date.

CALHOUN COUNTY

All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2015	GW	568	1,440	0	0	355	188	2,551
	SW	2,474	41,394	0	0	3,000	81	46,949
2014	GW	799	1,170	0	0	643	187	2,799
	SW	2,099	42,987	0	0	15,500	79	60,665
2013	GW	901	1,406	0	0	23	190	2,520
	SW	2,092	41,459	0	0	15,225	80	58,856
2012	GW	917	1,576	0	0	0	200	2,693
	SW	2,137	42,502	0	0	20,000	85	64,724
2011	GW	1,074	1,488	16	0	345	220	3,143
	SW	2,550	42,933	10	0	17,000	94	62,587
2010	GW	979	909	23	0	0	219	2,130
	SW	2,319	38,482	14	0	10,459	96	51,370
2009	GW	356	997	12	0	0	252	1,617
	SW	2,505	37,131	8	0	14,900	108	54,652
2008	GW	248	1,111	2	0	0	240	1,601
	SW	2,451	37,389	1	0	14,015	103	53,959
2007	GW	305	1	1,280	0	1,270	229	3,085
	SW	2,350	36,261	910	0	11,000	98	50,619
2006	GW	322	1	1,110	0	0	229	1,662
	SW	2,118	35,802	246	0	15,812	98	54,076
2005	GW	310	2	1,290	0	0	253	1,855
	SW	2,073	39,994	885	0	19,805	109	62,866
2004	GW	326	2	1,249	27	0	195	1,799
	SW	2,028	37,212	1,165	0	15,509	169	56,083
2003	GW	332	2	1,303	8	0	204	1,849
	SW	2,045	39,804	980	0	14,030	176	57,035
2002	GW	335	3	1,160	101	0	176	1,775
	SW	2,097	40,583	837	0	6,375	153	50,045
2001	GW	343	2	1,299	75	0	175	1,894
	SW	1,996	37,125	658	0	14,655	152	54,586
2000	GW	395	3	1,322	62	0	206	1,988
	SW	2,328	40,235	818	0	8,077	138	51,596

Projected Surface Water Supplies
TWDB 2017 State Water Plan Data

CALHOUN COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070
L	CALHOUN COUNTY WS	LAVACA-GUADALUPE	GUADALUPE RUN-OF-RIVER	1,500	1,500	1,500	1,500	1,500	1,500
L	LIVESTOCK, CALHOUN	COLORADO-LAVACA	COLORADO-LAVACA LIVESTOCK LOCAL SUPPLY	64	64	64	64	64	64
L	LIVESTOCK, CALHOUN	LAVACA-GUADALUPE	LAVACA-GUADALUPE LIVESTOCK LOCAL SUPPLY	92	92	92	92	92	92
L	LIVESTOCK, CALHOUN	SAN ANTONIO-NUECES	SAN ANTONIO-NUECES LIVESTOCK LOCAL SUPPLY	16	16	16	16	16	16
L	MANUFACTURING, CALHOUN	COLORADO-LAVACA	GUADALUPE RUN-OF-RIVER	18,865	18,865	18,865	18,865	18,865	18,865
L	MANUFACTURING, CALHOUN	COLORADO-LAVACA	TEXANA LAKE/RESERVOIR	16,857	16,857	16,857	16,857	16,858	16,857
L	MANUFACTURING, CALHOUN	LAVACA-GUADALUPE	CANYON LAKE/RESERVOIR	100	100	100	100	100	100
L	MANUFACTURING, CALHOUN	LAVACA-GUADALUPE	GUADALUPE RUN-OF-RIVER	15,435	15,435	15,435	15,435	15,435	15,435
L	MANUFACTURING, CALHOUN	LAVACA-GUADALUPE	TEXANA LAKE/RESERVOIR	13,793	13,793	13,793	13,793	13,792	13,793
L	POINT COMFORT	COLORADO-LAVACA	TEXANA LAKE/RESERVOIR	178	178	178	178	178	178
L	PORT LAVACA	LAVACA-GUADALUPE	GUADALUPE RUN-OF-RIVER	4,480	4,480	4,480	4,480	4,480	4,480
L	PORT O'CONNOR MUD	LAVACA-GUADALUPE	GUADALUPE RUN-OF-RIVER	1,120	1,120	1,120	1,120	1,120	1,120
	Sum of Projected Surface Water Supplies (acre-feet)			**72,500**	**72,500**	**72,500**	**72,500**	**72,500**	**72,500**

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.

CALHOUN COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
L	CALHOUN COUNTY WS	LAVACA-GUADALUPE	356	376	398	425	457	490
L	COUNTY-OTHER, CALHOUN	COLORADO-LAVACA	94	101	110	120	129	138
L	COUNTY-OTHER, CALHOUN	LAVACA-GUADALUPE	141	152	167	180	195	210
L	COUNTY-OTHER, CALHOUN	SAN ANTONIO-NUECES	9	9	11	12	13	13
L	IRRIGATION, CALHOUN	COLORADO-LAVACA	712	630	575	536	499	461
L	IRRIGATION, CALHOUN	LAVACA-GUADALUPE	12,748	11,294	10,309	9,603	8,945	8,257
L	IRRIGATION, CALHOUN	SAN ANTONIO-NUECES	12	11	10	9	9	8
L	LIVESTOCK, CALHOUN	COLORADO-LAVACA	66	66	66	66	66	66
L	LIVESTOCK, CALHOUN	GUADALUPE	2	2	2	2	2	2
L	LIVESTOCK, CALHOUN	LAVACA-GUADALUPE	260	260	260	260	260	260
L	LIVESTOCK, CALHOUN	SAN ANTONIO-NUECES	16	16	16	16	16	16
L	MANUFACTURING, CALHOUN	COLORADO-LAVACA	30,171	32,579	34,966	37,073	39,731	42,030
L	MANUFACTURING, CALHOUN	LAVACA-GUADALUPE	24,686	26,656	28,609	30,333	32,507	34,389
L	MINING, CALHOUN	COLORADO-LAVACA	26	27	20	15	9	6
L	MINING, CALHOUN	LAVACA-GUADALUPE	26	28	21	15	10	6
L	POINT COMFORT	COLORADO-LAVACA	87	92	99	107	115	124
L	PORT LAVACA	LAVACA-GUADALUPE	1,927	2,080	2,237	2,408	2,598	2,786
L	PORT O'CONNOR MUD	LAVACA-GUADALUPE	110	116	123	132	142	152
L	SEADRIFT	LAVACA-GUADALUPE	256	278	300	324	349	374
	Sum of Projected Water Demands (acre-feet)		**71,705**	**74,773**	**78,299**	**81,636**	**86,052**	**89,788**

Projected Water Supply Needs
TWDB 2017 State Water Plan Data

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

CALHOUN COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
L	CALHOUN COUNTY WS	LAVACA-GUADALUPE	1,144	1,124	1,102	1,075	1,043	1,010
L	COUNTY-OTHER, CALHOUN	COLORADO-LAVACA	76	69	59	50	41	31
L	COUNTY-OTHER, CALHOUN	LAVACA-GUADALUPE	90	80	65	51	36	23
L	COUNTY-OTHER, CALHOUN	SAN ANTONIO-NUECES	15	14	13	12	11	10
L	IRRIGATION, CALHOUN	COLORADO-LAVACA	-564	-482	-427	-388	-351	-313
L	IRRIGATION, CALHOUN	LAVACA-GUADALUPE	-11,697	-10,243	-9,258	-8,552	-7,894	-7,206
L	IRRIGATION, CALHOUN	SAN ANTONIO-NUECES	-12	-11	-10	-9	-9	-8
L	LIVESTOCK, CALHOUN	COLORADO-LAVACA	0	0	0	0	0	0
L	LIVESTOCK, CALHOUN	GUADALUPE	0	0	0	0	0	0
L	LIVESTOCK, CALHOUN	LAVACA-GUADALUPE	0	0	0	0	0	0
L	LIVESTOCK, CALHOUN	SAN ANTONIO-NUECES	0	0	0	0	0	0
L	MANUFACTURING, CALHOUN	COLORADO-LAVACA	5,746	3,338	951	-1,156	-3,813	-6,113
L	MANUFACTURING, CALHOUN	LAVACA-GUADALUPE	4,642	2,672	719	-1,005	-3,180	-5,061
L	MINING, CALHOUN	COLORADO-LAVACA	2	0	8	13	19	22
L	MINING, CALHOUN	LAVACA-GUADALUPE	1	0	6	12	17	21
L	POINT COMFORT	COLORADO-LAVACA	91	86	79	71	63	54
L	PORT LAVACA	LAVACA-GUADALUPE	2,553	2,400	2,243	2,072	1,882	1,694
L	PORT O'CONNOR MUD	LAVACA-GUADALUPE	1,210	1,204	1,197	1,188	1,178	1,168
L	SEADRIFT	LAVACA-GUADALUPE	472	450	428	404	379	354
	Sum of Projected Water Supply Needs (acre-feet)		**-12,273**	**-10,736**	**-9,695**	**-11,110**	**-15,247**	**-18,701**

Projected Water Management Strategies
TWDB 2017 State Water Plan Data

CALHOUN COUNTY

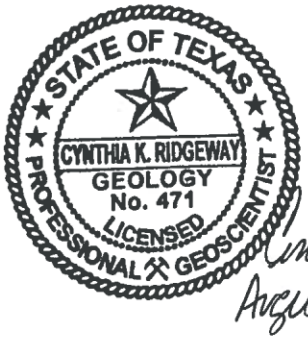
WUG, Basin (RWPG) All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
IRRIGATION, CALHOUN, COLORADO-LAVACA (L)							
IRRIGATION WATER CONSERVATION	DEMAND REDUCTION [CALHOUN]	0	0	0	0	0	0
		0	**0**	**0**	**0**	**0**	**0**
IRRIGATION, CALHOUN, LAVACA-GUADALUPE (L)							
IRRIGATION WATER CONSERVATION	DEMAND REDUCTION [CALHOUN]	0	0	0	0	0	0
		0	**0**	**0**	**0**	**0**	**0**
IRRIGATION, CALHOUN, SAN ANTONIO-NUECES (L)							
IRRIGATION WATER CONSERVATION	DEMAND REDUCTION [CALHOUN]	0	0	0	0	0	0
		0	**0**	**0**	**0**	**0**	**0**
MANUFACTURING, CALHOUN, COLORADO-LAVACA (L)							
GBRA NEW APPROPRIATION (LOWER BASIN)	GUADALUPE RUN-OF-RIVER [CALHOUN]	0	0	0	1,156	3,813	6,113
		0	**0**	**0**	**1,156**	**3,813**	**6,113**
MANUFACTURING, CALHOUN, LAVACA-GUADALUPE (L)							
GBRA NEW APPROPRIATION (LOWER BASIN)	GUADALUPE RUN-OF-RIVER [CALHOUN]	0	0	0	1,005	3,180	5,061
		0	**0**	**0**	**1,005**	**3,180**	**5,061**
SEADRIFT, LAVACA-GUADALUPE (L)							
MUNICIPAL WATER CONSERVATION (RURAL)	DEMAND REDUCTION [CALHOUN]	6	14	16	22	31	41
		6	**14**	**16**	**22**	**31**	**41**
Sum of Projected Water Management Strategies (acre-feet)		**6**	**14**	**16**	**2,183**	**7,024**	**11,215**

Appendix B. Groundwater Availability Model Run 15-010 provided by Texas Water Development Board

GAM Run 15-010: Calhoun County Groundwater Conservation District Management Plan

by Richard C. Bagans and Shirley Wade, Ph.D., P.G.
Texas Water Development Board
Groundwater Resources Division
Groundwater Availability Modeling Section
(512) 936-0883
August 12, 2015



Cindy K Ridgeway
August 12, 2015

Shirley C. Wade
8/12/15

Cynthia K. Ridgeway is the Manager of the Groundwater Availability Modeling Section and is responsible for oversight of work performed by Richard C. Bagans under her direct supervision. The seal appearing on this document was authorized by Cynthia K. Ridgeway, P.G. 471 on August 12, 2015.

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GAM RUN 15-010: CALHOUN COUNTY GROUNDWATER CONSERVATION DISTRICT MANAGEMENT PLAN

by Richard C. Bagans and Shirley Wade, Ph.D., P.G.
Texas Water Development Board
Groundwater Resources Division
Groundwater Availability Modeling Section
(512) 936-0883
August 12, 2015

EXECUTIVE SUMMARY:

Texas State Water Code, Section 36.1071, Subsection (h) (Texas Water Code, 2011), 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 the Calhoun County Groundwater Conservation District—fulfills the requirements noted above. Part 1 of the two-part package is the Estimated Historical Water Use/State Water Plan data report. The District 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 Calhoun County Groundwater Conservation District should be adopted by the district on or before August 4, 2017 and submitted to the Executive Administrator of the TWDB on or before September 5, 2017. The management plan for the Calhoun County Groundwater Conservation District is due by on November 4, 2017.

This report discusses the methods, assumptions, and results from model runs using the groundwater availability model of the central portion of the Gulf Coast Aquifer System (Chowdhury and others, 2004). Table 1 summarizes the groundwater availability model data required by statute, and Figure 1 shows the area of the model from which the values in the table were extracted. If after review of the figure, the Calhoun County Groundwater Conservation District determines that the district boundaries used in the assessment do not reflect current conditions, please notify the TWDB at your earliest convenience.

METHODS:

In accordance with the provisions of the Texas State Water Code, Section 36.1071, Subsection (h), the central portion of the Gulf Coast Aquifer System (Chowdhury and others, 2004) was run for this analysis. Calhoun County Groundwater Conservation District water budgets were extracted for the historical model period used for calibration of the model 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 portion of the aquifer system located within the district are summarized in this report.

PARAMETERS AND ASSUMPTIONS:

Gulf Coast Aquifer System

- Version 1.01 of the groundwater availability model for the central part of the Gulf Coast Aquifer System was used for this analysis. See Chowdhury and others (2004) and Waterstone and others (2003) for assumptions and limitations of the groundwater availability model.

- This groundwater availability model includes four layers which generally represent the Chicot Aquifer (Layer 1), the Evangeline Aquifer (Layer 2), the Burkeville Confining Unit (Layer 3), and the Jasper Aquifer including parts of the Catahoula Formation near where it outcrops (Layer 4).

- The model for the central portion of the Gulf Coast Aquifer System assumes that wells screened in the Evangeline Aquifer do not penetrate the full thickness of the aquifer near the Gulf of Mexico. This means the areas where wells are drilled into the Evangeline Aquifer are represented using data from the shallow portions of the aquifer, such as the outcrop or just below the Chicot Aquifer closer to the Gulf of Mexico. Lower portions of the aquifer near the Gulf of Mexico are not accessible with existing wells so deeper wells will be needed to understand the aquifer properties over the entire thickness of the aquifer.

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

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 run in the district, as shown in Tables 1 through 6.

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

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

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

- Flow between aquifers—The net vertical flow between the aquifer and adjacent aquifers or confining units. This flow is controlled by the relative water levels in each aquifer or confining unit and aquifer properties of each aquifer or confining unit that define the amount of leakage that occurs.

The information needed for the District's management plan is summarized in 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.

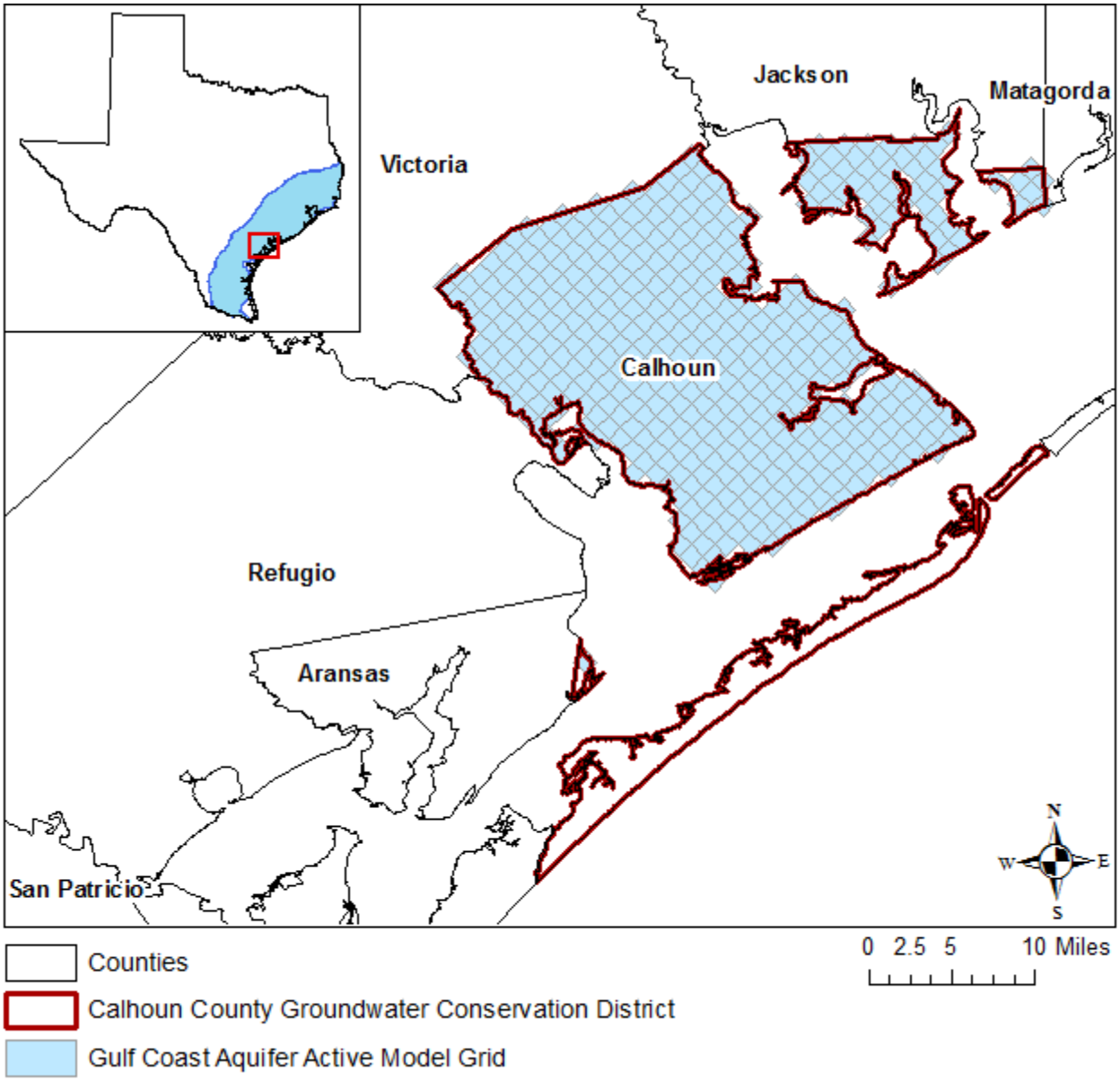

FIGURE 1: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE CENTRAL PORTION OF THE GULF COAST AQUIFER SYSTEM FROM WHICH THE INFORMATION IN TABLE 1 WAS EXTRACTED [THE CENTRAL PORTION OF THE GULF COAST AQUIFER SYSTEM EXTENT MODELED WITHIN THE DISTRICT BOUNDARY].

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

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Gulf Coast Aquifer System	2,573
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Gulf Coast Aquifer System	7,236
Estimated annual volume of flow into the district within each aquifer in the district	Gulf Coast Aquifer System	11,921
Estimated annual volume of flow out of the district within each aquifer in the district	Gulf Coast Aquifer System	8,967
Estimated net annual volume of flow between each aquifer in the district	Not applicable*	Not applicable*

* The groundwater availability model for the central portion of the Gulf Coast Aquifer System assumes no-flow conditions at the base of the aquifer system.

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

It is important for groundwater conservation districts to monitor groundwater pumping and overall conditions of the aquifer. Because of the limitations of the groundwater model and the assumptions in this analysis, it is important that the groundwater conservation districts work with the TWDB to refine this analysis in the future given the reality of how the aquifer responds to the actual amount and location of pumping now and in the future. Historic precipitation patterns also need

to be placed in context as future climatic conditions, such as dry and wet year precipitation patterns, may differ and affect groundwater flow conditions.

REFERENCES:

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

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.

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

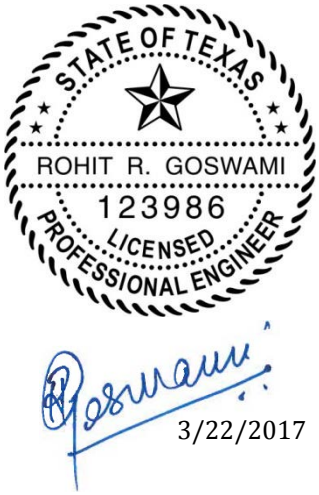
Texas Water Code, 2011, http://www.statutes.legis.state.tx.us/docs/WA/pdf/WA.36.pdf

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. Groundwater Availability Model Run 16-025 MAG

GAM RUN 16-025 MAG:
MODELED AVAILABLE GROUNDWATER FOR THE GULF COAST AQUIFER SYSTEM IN GROUNDWATER MANAGEMENT AREA 15

Rohit Raj Goswami, Ph.D., P.E.
Texas Water Development Board
Groundwater Division
Groundwater Availability Modeling Section
(512) 463-0495
March 22, 2017



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GAM RUN 16-025 MAG: MODELED AVAILABLE GROUNDWATER FOR THE GULF COAST AQUIFER SYSTEM IN GROUNDWATER MANAGEMENT AREA 15

Rohit Raj Goswami, Ph.D., P.E.
Texas Water Development Board
Groundwater Division
Groundwater Availability Modeling Section
(512) 463-0495
March 22, 2017

EXECUTIVE SUMMARY:

The modeled available groundwater for Groundwater Management Area 15 for the Gulf Coast Aquifer System is summarized by decade for the groundwater conservation districts (Table 1) and for use in the regional water planning process (Table 2). The modeled available groundwater estimates range from approximately 515,000 acre-feet per year in 2020 to approximately 518,000 acre-feet per year in 2069(Table 1). The estimates were extracted from results of a model run using the groundwater availability model for the central part of the Gulf Coast Aquifer System (version 1.01). The model run files, which meet the desired future conditions adopted by district representatives of Groundwater Management Area 15, were submitted to the Texas Water Development Board (TWDB) on June 28, 2016, as part of the Desired Future Conditions Explanatory Report for Groundwater Management Area 15. The explanatory report and other materials submitted to the Texas Water Development Board (TWDB) were determined to be administratively complete on October 20, 2016.

REQUESTOR:

Mr. Tim Andruss, chair of Groundwater Management Area 15.

DESCRIPTION OF REQUEST:

In a letter dated June 23, 2016, Mr. Tim Andruss provided the TWDB with the desired future conditions of the Gulf Coast Aquifer System adopted by the groundwater conservation districts in Groundwater Management Area 15. The Gulf Coast Aquifer System includes the Chicot Aquifer, Evangeline Aquifer, Burkeville Confining Unit and the Jasper Aquifer (including parts of the Catahoula Formation). TWDB staff worked with INTERA Incorporated, the consultant for Groundwater Management Area 15, in reviewing

model files associated with the desired future conditions. We received clarification from INTERA Incorporated, on behalf of Groundwater Management Area 15, on September 18, 2016, concerning assumptions on variances of average drawdown values per county to model results, which was ±3.5 feet for nearly all areas within the Groundwater Management Area 15. The exception is Goliad County which has a variance in drawdown of ±5 feet. The desired future conditions for the Gulf Coast Aquifer System, as described in Resolution No. 2016-01 and adopted April 29, 2016, by the groundwater conservation districts within Groundwater Management Area 15, are described below:

Groundwater Management Area 15 [all counties]

Drawdown of the Gulf Coast Aquifer System shall not exceed an average of 13 feet in December 2069 from estimated year 2000 conditions.

Aransas County

Drawdown of the Gulf Coast Aquifer System shall not exceed an average of 0 feet in December 2069 from estimated year 2000 conditions.

Bee County

Drawdown of the Gulf Coast Aquifer System shall not exceed an average of 7 feet in December 2069 from estimated year 2000 conditions.

Calhoun County

Drawdown of the Gulf Coast Aquifer System shall not exceed an average of 5 feet in December 2069 from estimated year 2000 conditions.

Colorado County

Drawdown shall not exceed an average of 17 feet in Chicot and Evangeline Aquifers and 23 feet in in the Jasper Aquifer in December 2069 from estimated year 2000 conditions.

DeWitt County

Drawdown of the Gulf Coast Aquifer System shall not exceed an average of 17 feet in December 2069 from estimated year 2000 conditions.

Fayette County

Drawdown of the Gulf Coast Aquifer System shall not exceed an average of 16 feet in December 2069 from estimated year 2000 conditions.

Goliad County

Drawdown of the Gulf Coast Aquifer System shall not exceed an average of 10 feet in December 2069 from estimated year 2000 conditions.

Jackson County

Drawdown of the Gulf Coast Aquifer System shall not exceed an average of 15 feet in December 2069 from estimated year 2000 conditions.

Karnes County

Drawdown of the Gulf Coast Aquifer System shall not exceed an average of 22 feet in December 2069 from estimated year 2000 conditions.

Lavaca County

Drawdown of the Gulf Coast Aquifer System shall not exceed an average of 18 feet in December 2069 from estimated year 2000 conditions.

Matagorda County

Drawdown shall not exceed an average of 11 feet in Chicot and Evangeline Aquifers in December 2069 from estimated year 2000 conditions.

Refugio County

Drawdown of the Gulf Coast Aquifer System shall not exceed an average of 5 feet in December 2069 from estimated year 2000 conditions.

Victoria County

Drawdown of the Gulf Coast Aquifer System shall not exceed an average of 5 feet in December 2069 from estimated year 2000 conditions.

Wharton County

Drawdown shall not exceed an average of 15 feet in Chicot and Evangeline Aquifers in December 2069 from estimated year 2000 conditions.

Based on the adopted desired future conditions, TWDB has estimated the modeled available groundwater for the Gulf Coast Aquifer System in Groundwater Management Area 15.

METHODS:

The groundwater availability model for the central part of the Gulf Coast Aquifer System (Figure 1) was run using the model files submitted with the explanatory report (GMA 15 and others, 2016). Model-calculated water levels were extracted for the year 2000 and the end of the year 2069, and drawdown was calculated as the difference between water levels at the beginning of 2000 and water levels at the end of 2069. Drawdown averages were calculated for each county by aquifer and for the entire Groundwater Management Area 15 by aquifer. As specified in the explanatory report (GMA 15 and others, 2016), drawdown for cells which became dry during the simulation (water level dropped below the base of the cell) were excluded from the averaging. The calculated drawdown averages were compared with the desired future conditions to verify that the pumping scenario achieved the desired future conditions within one foot.

The modeled available groundwater values were determined by extracting pumping rates by decade from the model results using ZONEBUDGET Version 3.01 (Harbaugh, 2009). Annual pumping rates are presented by county and groundwater conservation district, subtotaled by groundwater conservation district, and then summed by Groundwater Management Area 15 (Figure 2 and Table 1). Annual pumping rates are also presented by county, river basin, and regional water planning area within Groundwater Management Area 15 (Figure 2 and Table 2).

Modeled Available Groundwater and Permitting

As defined in Chapter 36 of the Texas Water Code, “modeled available groundwater” is the estimated average amount of water that may be produced annually to achieve a desired future condition. Groundwater conservation districts 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 groundwater availability are described below:

- Version 1.01 of the groundwater availability model for the central portion of the Gulf Coast Aquifer System was used for this analysis. See Chowdhury and others (2004) and Waterstone and others (2003) for assumptions and limitations of the model.

- The model has four layers which represent 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).

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

- Drawdown averages and modeled available groundwater values are based on the extent of the model area rather than official aquifer boundaries (Figures 1 and 2).

- Drawdown for cells with water levels below the base elevation of the cell ("dry" cells) were excluded from the averaging per emails exchanged with INTERA, Inc. dated October 21, 2015.

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

- A model drawdown tolerance of up to 5 feet was assumed for Goliad County and up to 3.5 feet for the rest of Groundwater Management Area 15 when comparing desired future conditions (average drawdown values per county) to model drawdown results.

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

RESULTS:

The modeled available groundwater for the Gulf Coast Aquifer System that achieves the desired future conditions adopted by Groundwater Management Area 15 increases from approximately 515,000 acre-feet per year in 2020 to approximately 518,000 acre-feet per year in 2069 (Table 1). The modeled available groundwater is summarized by groundwater conservation district and county (Table 1). The modeled available groundwater has also been summarized by county, river basin, and regional water planning area for use in the regional water planning process (Table 2). Small differences of values between table summaries are due to rounding.

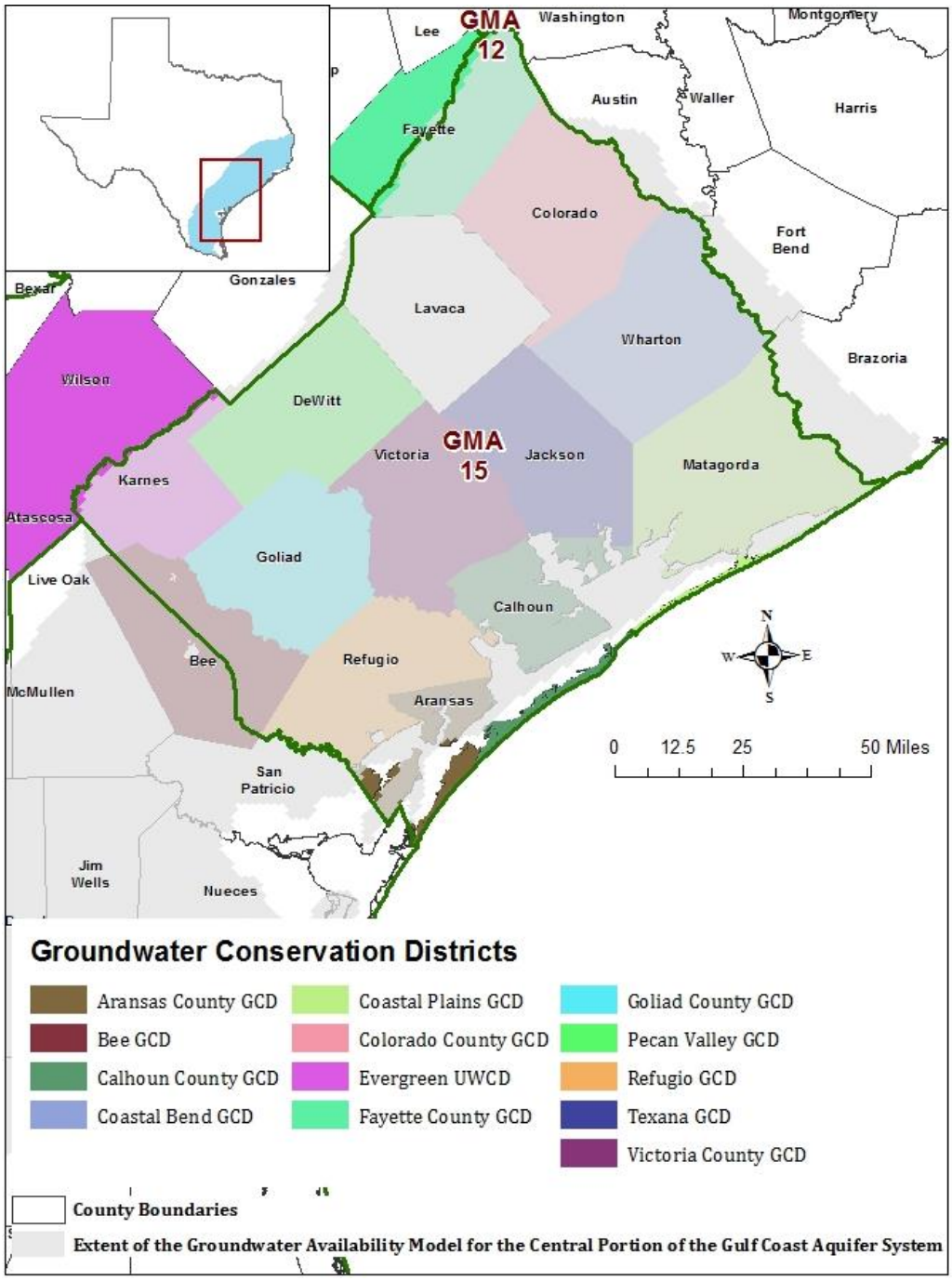

FIGURE 1. MAP SHOWING GROUNDWATER CONSERVATION DISTRICTS (GCDS) AND COUNTIES IN GROUNDWATER MANAGEMENT AREA 15 OVERLAIN ON THE EXTENT OF THE GROUNDWATER AVAILABILITY MODEL FOR THE CENTRAL PORTION OF THE GULF COAST AQUIFER SYSTEM.

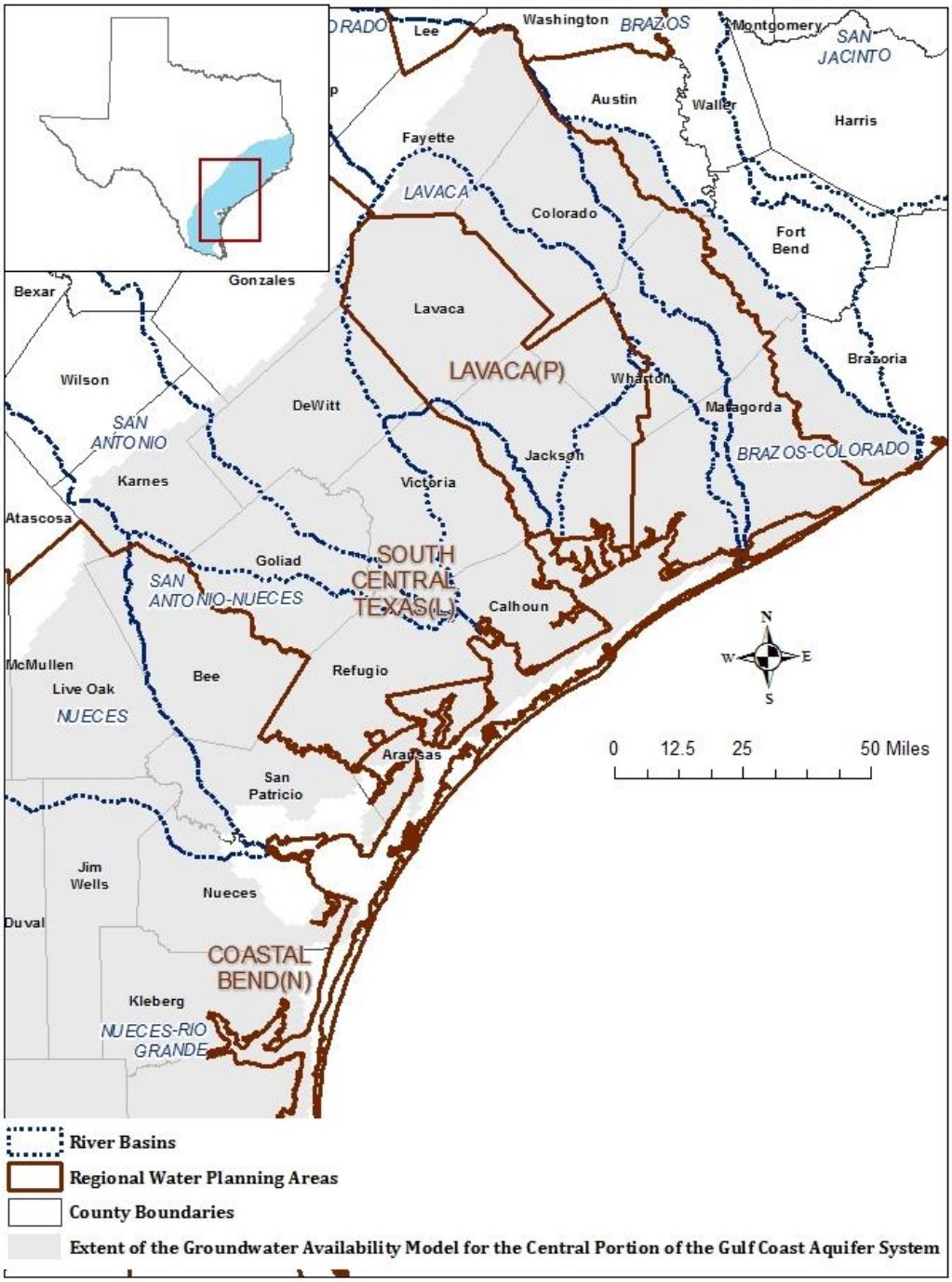

FIGURE 2. MAP SHOWING REGIONAL WATER PLANNING AREAS, GROUNDWATER CONSERVATION DISTRICTS (GCDS), COUNTIES, AND RIVER BASINS IN GROUNDWATER MANAGEMENT AREA 15 OVERLAIN ON THE EXTENT OF THE GROUNDWATER AVAILABILITY MODEL FOR THE CENTRAL PORTION OF THE GULF COAST AQUIFER SYSTEM.

TABLE 1. 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 2010 AND 2069. VALUES ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District	County	Aquifer	2010	2020	2030	2040	2050	2060	2069
Aransas County GCD Total	**Aransas**	**Gulf Coast Aquifer System**	**1,542**	**1,542**	**1,542**	**1,542**	**1,542**	**1,542**	**1,542**
Bee County GCD Total	**Bee**	**Gulf Coast Aquifer System**	**9,456**	**9,456**	**9,431**	**9,431**	**9,379**	**9,379**	**9,361**
Calhoun County GCD Total	**Calhoun**	**Gulf Coast Aquifer System**	**2,569**	**7,565**	**7,565**	**7,565**	**7,565**	**7,565**	**7,565**
Coastal Bend GCD Total	**Wharton**	**Gulf Coast Aquifer System (Chicot and Evangeline)**	**181,168**	**181,168**	**181,168**	**181,168**	**181,168**	**181,168**	**181,168**
Coastal Plains GCD Total	**Matagorda**	**Gulf Coast Aquifer System (Chicot and Evangeline)**	**38,828**	**38,828**	**38,828**	**38,828**	**38,828**	**38,828**	**38,828**
Colorado County GCD	Colorado	Gulf Coast Aquifer System (Chicot and Evangeline)	79,780	74,964	74,964	72,765	72,765	71,618	71,618
Colorado County GCD	Colorado	Gulf Coast Aquifer System (Jasper)	918	918	918	918	918	918	918
Colorado County GCD Total	**Colorado**	**Gulf Coast Aquifer System**	**80,698**	**75,882**	**75,882**	**73,683**	**73,683**	**72,536**	**72,536**
Evergreen UWCD Total	**Karnes**	**Gulf Coast Aquifer System**	**10,196**	**10,196**	**10,196**	**3,015**	**2,917**	**2,751**	**2,751**
Fayette County GCD Total	**Fayette**	**Gulf Coast Aquifer System**	**1,977**	**1,853**	**1,853**	**1,853**	**1,853**	**1,853**	**1,703**
Goliad County GCD Total	**Goliad**	**Gulf Coast Aquifer System**	**11,420**	**11,539**	**11,539**	**11,539**	**11,539**	**11,552**	**11,539**

Groundwater Conservation District	County	Aquifer	2010	2020	2030	2040	2050	2060	2069
Pecan Valley GCD Total	**DeWitt**	**Gulf Coast Aquifer System**	**15,471**	**15,476**	**15,476**	**14,485**	**14,485**	**14,485**	**14,485**
Refugio GCD Total	**Refugio**	**Gulf Coast Aquifer System**	**5,847**	**5,847**	**5,847**	**5,847**	**5,847**	**5,847**	**5,847**
Texana GCD Total	**Jackson**	**Gulf Coast Aquifer System**	**76,787**	**90,482**	**90,482**	**90,482**	**90,482**	**90,482**	**90,482**
Victoria County GCD Total	**Victoria**	**Gulf Coast Aquifer System**	**35,640**	**44,974**	**49,970**	**54,966**	**54,966**	**59,963**	**59,963**
Total (GCDs)		**Gulf Coast Aquifer System**	**471,599**	**494,808**	**499,779**	**494,404**	**494,254**	**497,951**	**497,770**
No District-County	Bee	Gulf Coast Aquifer System	10	10	10	10	10	10	10
No District-County	Lavaca	Gulf Coast Aquifer System	20,253	20,253	20,253	20,253	20,253	20,253	20,239
No district-County Total		**Gulf Coast Aquifer System**	**20,263**	**20,263**	**20,263**	**20,263**	**20,263**	**20,263**	**20,249**
Total for GMA 15		**Gulf Coast Aquifer System**	**491,862**	**515,071**	**520,042**	**514,667**	**514,517**	**518,214**	**518,019**

TABLE 2 MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE GULF COAST AQUIFER SYSTEM IN GROUNDWATER MANAGEMENT AREA 15. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), RIVER BASIN, AND AQUIFER.

County	RWPA	River Basin	Aquifer	2020	2030	2040	2050	2060
Aransas	N	San Antonio- Nueces	Gulf Coast Aquifer System	1,542	1,542	1,542	1,542	1,542
Bee	N	San Antonio- Nueces	Gulf Coast Aquifer System	9,439	9,414	9,414	9,362	9,362
Bee	N	Nueces	Gulf Coast Aquifer System	27	27	27	27	27
Calhoun	L	Colorado- Lavaca	Gulf Coast Aquifer System	5,210	5,210	5,210	5,210	5,210
Calhoun	L	Guadalupe	Gulf Coast Aquifer System	18	18	18	18	18
Calhoun	L	Lavaca-Guadalupe	Gulf Coast Aquifer System	2,330	2,330	2,330	2,330	2,330
Calhoun	L	San Antonio- Nueces	Gulf Coast Aquifer System	7	7	7	7	7
Colorado	K	Brazos-Colorado	Gulf Coast Aquifer System (Chicot and Evangeline)	15,342	15,342	15,342	15,342	15,342
Colorado	K	Brazos-Colorado	Gulf Coast Aquifer System (Jasper Aquifer)	49	49	49	49	49
Colorado	K	Colorado	Gulf Coast Aquifer System (Chicot and Evangeline)	20,506	20,506	20,066	20,066	20,066
Colorado	K	Colorado	Gulf Coast Aquifer System (Jasper Aquifer)	273	273	273	273	273
Colorado	K	Lavaca	Gulf Coast Aquifer System (Chicot and Evangeline)	39,116	39,116	37,357	37,357	36,210
Colorado	K	Lavaca	Gulf Coast Aquifer System (Jasper Aquifer)	596	596	596	596	596
Dewitt	L	Guadalupe	Gulf Coast Aquifer System	11,358	11,358	10,470	10,470	10,470
Dewitt	L	Lavaca-Guadalupe	Gulf Coast Aquifer System	417	417	417	417	417
Dewitt	L	Lavaca	Gulf Coast Aquifer System	2,935	2,935	2,935	2,874	2,874
Dewitt	L	San Antonio	Gulf Coast Aquifer System	766	766	724	724	724

County	RWPA	River Basin	Aquifer	2020	2030	2040	2050	2060
Fayette	K	Brazos	Gulf Coast Aquifer System	2	2	2	2	2
Fayette	K	Colorado	Gulf Coast Aquifer System	989	989	989	989	989
Fayette	K	Lavaca	Gulf Coast Aquifer System	862	862	862	862	862
Goliad	L	Guadalupe	Gulf Coast Aquifer System	4,377	4,377	4,377	4,377	4,380
Goliad	L	San Antonio- Nueces	Gulf Coast Aquifer System	1,190	1,190	1,190	1,190	1,195
Goliad	L	San Antonio	Gulf Coast Aquifer System	5,972	5,972	5,972	5,972	5,977
Jackson	P	Colorado-Lavaca	Gulf Coast Aquifer System	28,025	28,025	28,025	28,025	28,025
Jackson	P	Lavaca-Guadalupe	Gulf Coast Aquifer System	12,875	12,875	12,875	12,875	12,875
Jackson	P	Lavaca	Gulf Coast Aquifer System	49,582	49,582	49,582	49,582	49,582
Karnes	L	Guadalupe	Gulf Coast Aquifer System	11	11	11	11	11
Karnes	L	Nueces	Gulf Coast Aquifer System	1,057	1,057	78	78	78
Karnes	L	San Antonio	Gulf Coast Aquifer System	9,082	9,082	2,880	2,782	2,616
Karnes	L	San Antonio-Nueces	Gulf Coast Aquifer System	46	46	46	46	46
Lavaca	P	Guadalupe	Gulf Coast Aquifer System	41	41	41	41	41
Lavaca	P	Lavaca-Guadalupe	Gulf Coast Aquifer System	401	401	401	401	401
Lavaca	P	Lavaca	Gulf Coast Aquifer System	19,811	19,811	19,811	19,811	19,811
Matagorda	K	Brazos-Colorado	Gulf Coast Aquifer System (Chicot and Evangeline)	15,282	15,282	15,282	15,282	15,282
Matagorda	K	Colorado-Lavaca	Gulf Coast Aquifer System (Chicot and Evangeline)	20,329	20,329	20,329	20,329	20,329
Matagorda	K	Colorado	Gulf Coast Aquifer System (Chicot and Evangeline)	3,217	3,217	3,217	3,217	3,217
Refugio	L	San Antonio- Nueces	Jasper Aquifer	5,526	5,526	5,526	5,526	5,526
Refugio	L	San Antonio	Gulf Coast Aquifer System	321	321	321	321	321
Victoria	L	Guadalupe	Gulf Coast Aquifer System	17,600	22,596	27,592	27,592	27,592
Victoria	L	Lavaca-Guadalupe	Gulf Coast Aquifer System	25,451	25,451	25,451	25,451	30,448
Victoria	L	Lavaca	Gulf Coast Aquifer System	234	234	234	234	234
Victoria	L	San Antonio	Gulf Coast Aquifer System	1,689	1,689	1,689	1,689	1,689

County	RWPA	River Basin	Aquifer	2020	2030	2040	2050	2060
Wharton	K	Brazos-Colorado	Gulf Coast Aquifer System (Chicot and Evangeline)	50,527	50,527	50,527	50,527	50,527
Wharton	K	Colorado-Lavaca	Gulf Coast Aquifer System (Chicot and Evangeline)	16,196	16,196	16,196	16,196	16,196
Wharton	P	Colorado-Lavaca	Gulf Coast Aquifer System (Chicot and Evangeline)	14,091	14,091	14,091	14,091	14,091
Wharton	K	Colorado	Gulf Coast Aquifer System (Chicot and Evangeline)	35,910	35,910	35,910	35,910	35,910
Wharton	P	Colorado	Gulf Coast Aquifer System (Chicot and Evangeline)	873	873	873	873	873
Wharton	K	Lavaca	Gulf Coast Aquifer System (Chicot and Evangeline)	579	579	579	579	579
Wharton	P	Lavaca	Gulf Coast Aquifer System (Chicot and Evangeline)	62,992	62,992	62,992	62,992	62,992
GMA 15 Total			**Gulf Coast Aquifer System**	**515,071**	**520,042**	**514,667**	**514,517**	**518,214**

LIMITATIONS:

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

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

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

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

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

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