GROUNDWATER MANAGEMENT PLAN

_____ ~~April 14~~, 202~~3~~0

LONE STAR GROUNDWATER CONSERVATION DISTRICT MANAGEMENT PLAN

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LONE STAR GROUNDWATER CONSERVATION DISTRICT
GROUNDWATER MANAGEMENT PLAN

1. DISTRICT MISSION

The Lone Star Groundwater Conservation District (the "District") is committed to providing a regulatory program that encourages the best practicable conservation and development practices for the groundwater resources of Montgomery County. The District will serve the public interest as outlined in Section 59, Article XVI, Texas Constitution by developing, promoting, and implementing water conservation, augmentation, and management strategies to both conserve and utilize groundwater resources for the benefit of the citizens, economy, and environment of Montgomery County. The District's mission includes honoring and protecting private property rights by affording an opportunity for a fair share to every owner of each common, subsurface reservoir underlying, in whole or in part, in Montgomery County as authorized under state law. The District will protect both public and private interests through programs designed for the conservation, preservation, protection, recharging, and prevention of waste of groundwater, and by adopting and enforcing rules as authorized by Chapter 36 of the Texas Water Code ("Chapter 36") and consistent with state law. The District will adopt and enforce fair and impartial rules including requiring permits for wells and production, imposing spacing requirements, regulating production, requiring metered production and reporting of non-exempt wells, establishing aquifer management standards using the best available data and science, creating and maintaining aquifer monitoring programs, encouraging conservation, and/or considering potential future adjustments to allowable and permitted production, as warranted and supported by the best available data and science, to achieve aquifer management standards over the long-term. The District also believes the intelligence and independent decision making of each groundwater owner and water user are integral to the long-term success of the District's mission. To assist these stakeholders, the District will work diligently to collect data, perform analyses, and report groundwater conditions and regulatory policy so each stakeholder can make independent and informed decisions that support their interests. The Board of Directors of the District believes it is in this collective manner whereby the future of Montgomery County is best served.

2. TIME PERIOD OF THIS PLAN

This management plan will remain in effect from the date of approval by the Executive Administrator at the Texas Water Development Board ("TWDB") until the Plan is readopted. In accordance with Chapter 36, the District's management plan shall be reviewed annually and readopted with or without revisions at least once every five years.

3. DISTRICT INFORMATION

In 2001, the creation of the District was authorized by the 77th Texas Legislature through House Bill 2362,[1] and was confirmed by the voters of Montgomery County on November 6, 2001. The District does not have the power to tax and receives all of its revenue from water use fees. The District's original management plan was adopted on October 14, 2003, and submitted to the

[1] Chapter 1321, Acts of the 77th Legislature, Regular Session, 2001.

TWDB within two years of the confirmation election, and then amended and re-adopted on October 14, 2008 and November 12, 2013. As such, this update to the District's management plan represents the fourth management plan since creation of the District in 2001.

The District is located in Montgomery County in southeastern Texas. The boundaries of the District are coterminous with the boundaries of Montgomery County, Texas. The District is bordered by Walker County on the north, San Jacinto and Liberty Counties on the east, Harris County on the south, and Waller and Grimes Counties on the west (Figures 1 and 2). Peach Creek forms the boundary with San Jacinto County, and Spring Creek forms most of the boundary with Harris County. The District comprises an area of approximately 1,077 square miles.

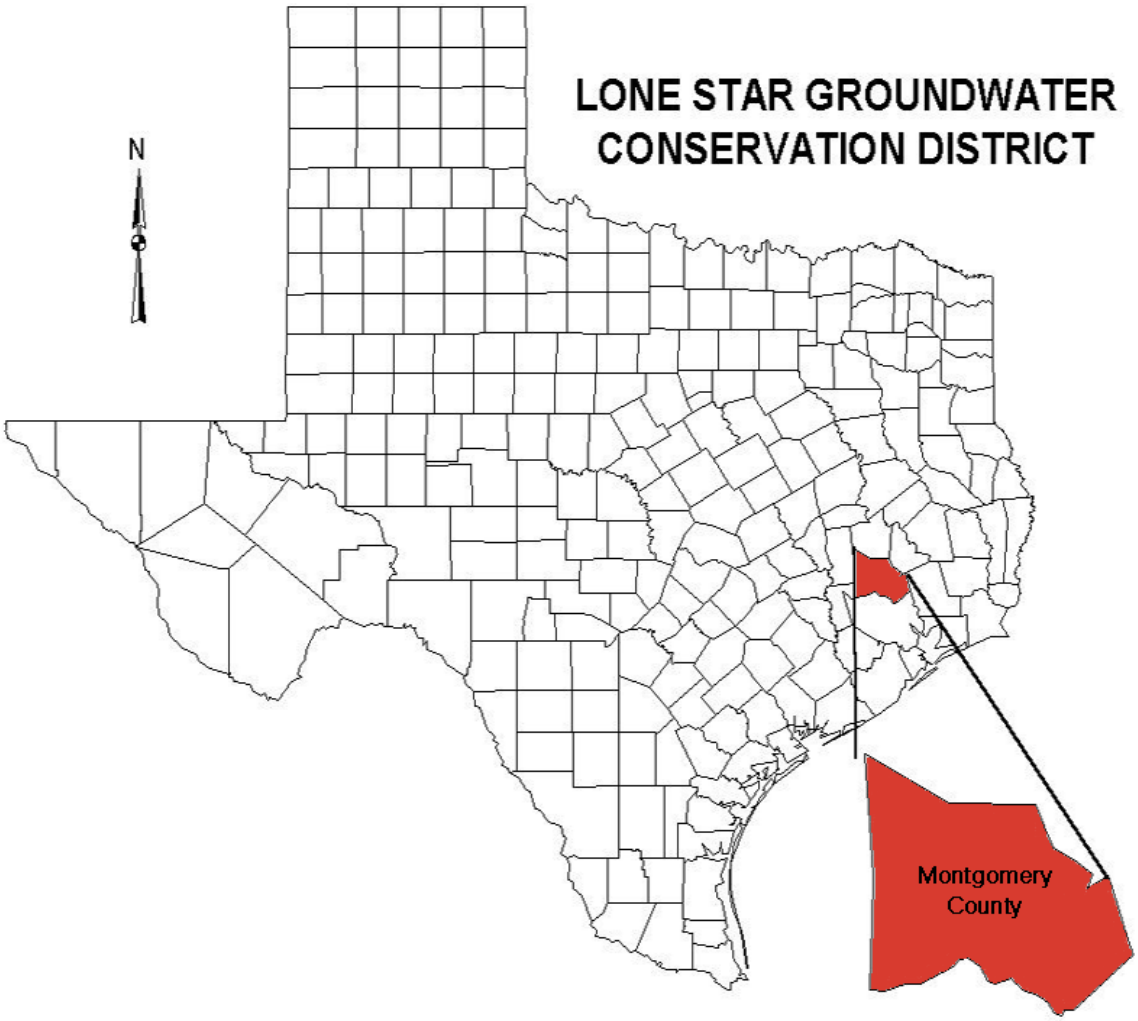

Figure 1 – Location of Lone Star GCD in ~~District State location map.~~Texas.

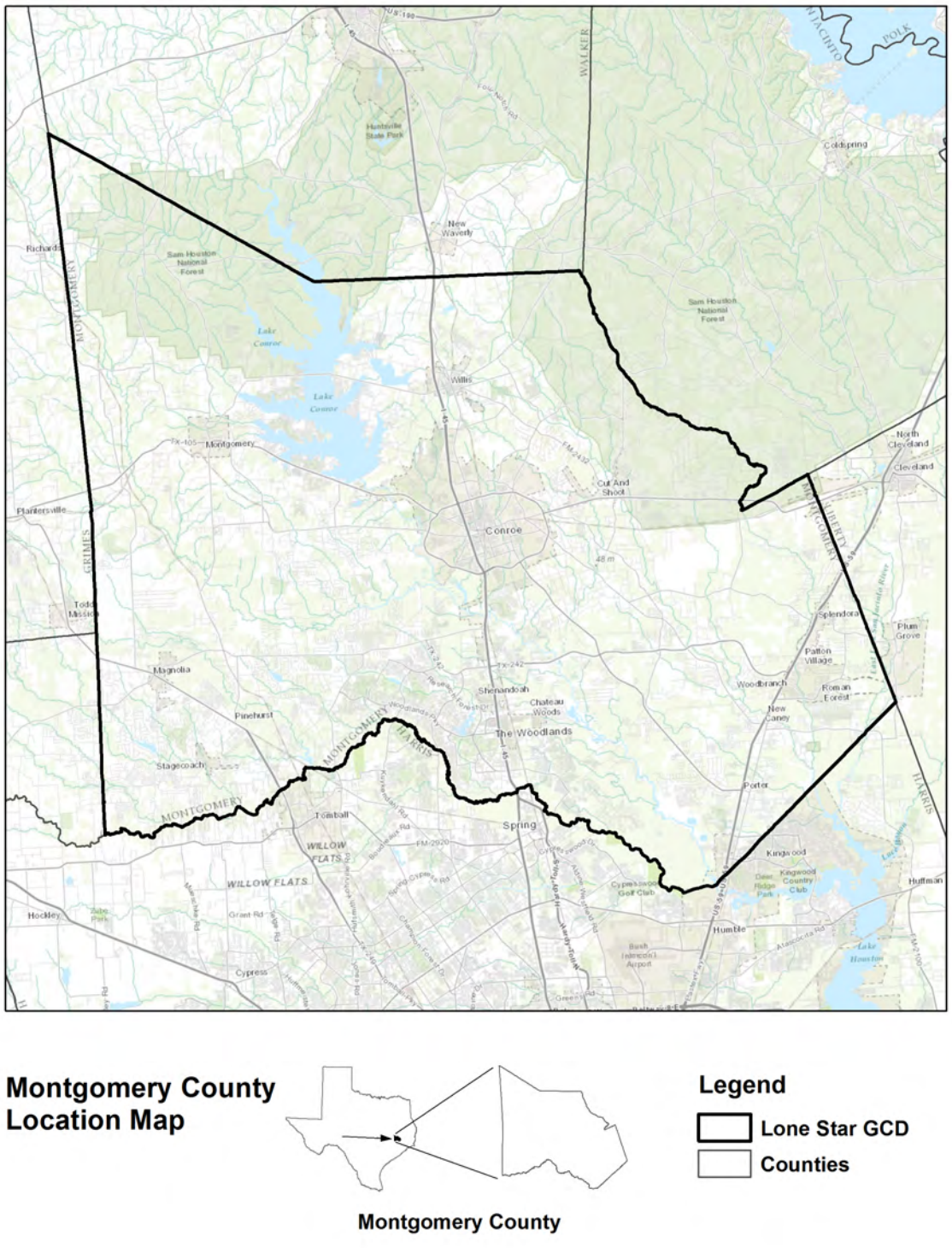

Figure 2 – Detailed location map of the District.

4. ELECTION OF BOARD

Due to the passage of House Bill 1982 by the 85th Texas Legislature (Regular Session) in 2017, the District's Board of Directors changed from a nine-member appointed board to a seven-member elected board. Four of the directors are elected from each of the four county commissioners precincts by the voters of the applicable precinct (Place Nos. 1-4), one director is elected by the voters at large (Place No. 5), one director is elected from the City of Conroe by the voters of the municipality (Place No. 6), and one director is elected from the Woodlands Townships by the voters of that township (Place No. 7). The first election under the new board structure was held on November 6, 2018, and the newly elected Board was sworn into office on November 16, 2018. Permanent directors serve staggered four-year terms. Directors of Place Nos. 1, 5, and 6 shall serve a two-year term ending on December 1, 2020, and the Directors of Place Numbers 2, 3, 4, and 7 shall serve a four-year term ending on December 1, 2022. A director may not serve more than three full terms. The initial two-year terms of the Directors of Place Nos. 1, 5, and 6 do not count toward the three full term limitation.

5. GROUNDWATER RESOURCES OF MONTGOMERY COUNTY

In Montgomery County, the groundwater resources include the Gulf Coast Aquifer System and the Catahoula Sandstone. The Gulf Coast Aquifer System consists of the Chicot Aquifer, the Evangeline Aquifer, the Burkeville confining unit, and the Jasper Aquifer. Although publications such as the Oden and Truini (2013)[2] also include portions of the Catahoula Sandstone as part of the Gulf Coast aquifer system, for regulatory purposes the District considers the Catahoula Sandstone to be a separate hydrogeologic system (the Catahoula confining system) and manages it accordingly.

Table 1 – Geologic and Hydrologic Units of the Gulf Coast Aquifer in Montgomery County (as modified from Baker (1979)[3] and Young and others (2012)[4]).

	Series	Geologic Unit	Hydrologic Unit
Quaternary	Holocene	Alluvium	Chicot Aquifer
	Pleistocene	Beaumont Clay Lissie/Alta Loma	
Tertiary	Pliocene	Willis Sand	

[2] Oden, T. D., and Truini, M., 2013, Estimated rates of groundwater recharge to the Chicot, Evangeline, and Jasper aquifers by using environmental tracers in Montgomery and adjacent counties, Texas, 2008 and 2011: U. S. Geological Survey, Scientific Investigations Report No. 2013-5024, 49 p.

[3] Baker, E. T., Jr., 1979, Stratigraphic and hydrogeologic framework of part of the Coastal Plain of Texas: Texas Department of Water Resources Report 236, 43 p.

[4] Young, S.C, Ewing, T, Hamlin, S., Baker, E., and Lupton, D., 2012. Final Report: Updating the Hydrogeologic Framework for the Northern Portion of the Gulf Coast Aquifer, (prepared for the Texas Water Development Board), 285 p.

	Miocene	Goliad Sand	Evangeline Aquifer
		Fleming Formation (Lagarto)	Burkeville Confining Unit
		Fleming Formation (Oakville)	Jasper Aquifer
	Oligocene	Catahoula Sandstone	Catahoula Aquifer

The water-bearing units of the Gulf Coast aquifer system support the majority of groundwater production use in Montgomery County. These water-bearing units consist of semi-consolidated or unconsolidated sands with interbedded silts and clays. The Burkeville confining unit is a relatively thick clay zone that separates the Evangeline aquifer from the Jasper aquifer.

The geologic structure of the Gulf Coast aquifer system dips from the inland areas into the subsurface towards the coast at an angle greater than the slope of the land surface. The geologic units generally thicken towards the coast in the down-dip direction. The rate of dip, measured in feet per mile, increases with depth below land surface. The base of the Chicot Aquifer dips at approximately 10 feet per mile, while the rate of dip for the Catahoula Sand below the Jasper Aquifer is approximately 90 feet per mile[5]. The increased formation dip with depth is caused by the relative location of the continental shelf during the respective depositional period of each geologic unit.

[5] Popkin, B. P., 1971, Groundwater resources of Montgomery County, Texas: Texas Water Development Board Report 136, 143 p.

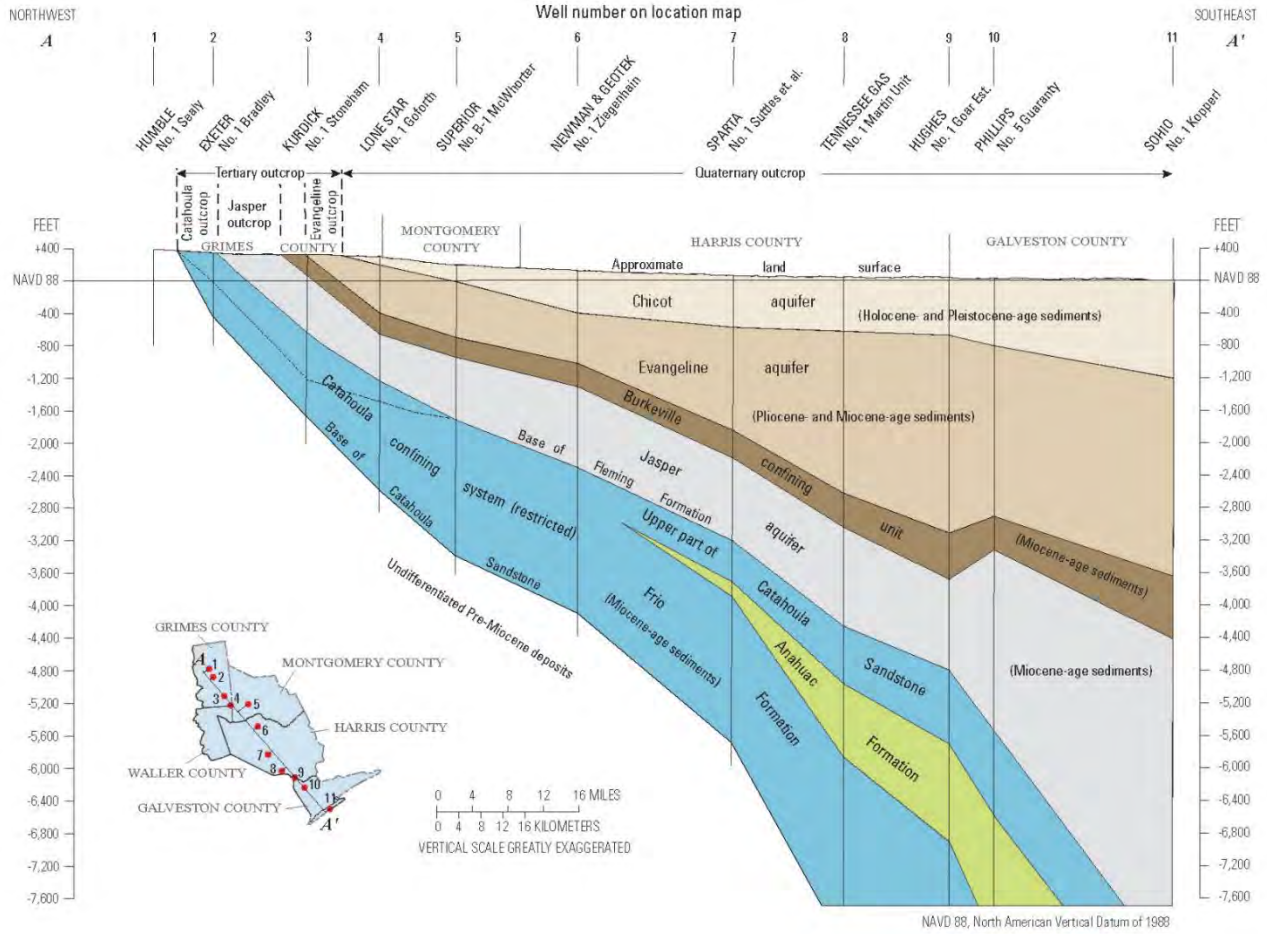

Figure 3 – Geologic cross section of the Gulf Coast Aquifer in the area of Montgomery County (as modified from Baker (1979)[13] and Oden and Truini (2013) [1]).

The topography in the District varies from almost flat near the larger streams and in the southern part of the county to hilly in the northern part. Altitudes range from about 45 feet above mean sea level in the southeastern corner of the county to about 440 feet above mean sea level in the northwestern corner.

The county is in the San Jacinto River drainage basin in which the primary drainage trends from northwest to southeast. The larger streams are the West Fork San Jacinto River, Peach, Spring, Stewart, and Caney Creeks. Secondary drainage, which is roughly west to east, is principally by Lake and Spring Creeks. The primary drainage is controlled by the southeasterly slope of the land surface, while the secondary drainage is controlled, to a large extent, by the occurrence of alternating outcrops of sand and clay.

6. MANAGEMENT AND MONITORING OF GROUNDWATER RESOURCES

The Texas Legislature has established that groundwater conservation districts, such as the District, are the state's preferred method of groundwater management. The Texas Legislature codified its policy decision in Section 36.0015 of the Texas Water Code in 1997, which establishes that groundwater conservation districts will manage groundwater resources through rules developed and implemented in accordance with Chapter 36.

In addition to the statutory authority provided to groundwater conservation districts in Chapter 36, the District has the powers expressly granted to the District by Chapter 1321, Acts of the 77th Legislature, Regular Session, 2001, and Chapter 994, Acts of the 78th Legislature, Regular Session, 2003 (collectively "the District Act"). The District has the rights and responsibilities provided for in Chapter 36, the District Act, and 31 Texas Administrative Code Chapter 356, including the rulemaking authority to implement the policies and procedures needed to manage the groundwater resources of Montgomery County.

As outlined in the District's approved 2013 Management Plan on pp. 6-9, the District previously adopted and implemented a multi-phased regulatory plan known as the District's Regulatory Plan ("DRP"). The DRP was designed to require a comprehensive conversion effort to reduce total annual groundwater production within Montgomery County to a level not to exceed 64,000 acre-feet of groundwater per year for the Gulf Coast Aquifer (see also "Desired Future Conditions" section immediately below for more information on the corresponding DFC associated with the 64,000 acre-feet per year). Under Phase IIA and IIB of the DRP, certain specified large volume groundwater users ("LVGUs") were required to reduce groundwater production by thirty percent (30%) of their Total Qualifying Demand and submit a Groundwater Reduction Plan ("GRP") to meet the conversion obligations. In August 2015, the District, the General Manager and then directors were sued by the City of Conroe, Quadvest, LP, and other investor-owned utilities (collectively, "Plaintiffs") over the validity of the regulations requiring LVGUs to reduce production by thirty-percent. In September 2018, Senior District Judge Lamar McCorkle of the 284th District Court in Montgomery County granted a partial summary judgment holding that Lone Star Groundwater Conservation District's rule requiring a reduction in pumping by Large Volume Groundwater Users effective in 2016 is invalid and outside the District's authority granted by the Legislature.

In January 2019, the District (by a unanimous vote of the newly elected board) entered into a Compromise and Settlement Agreement with the Plaintiffs to end the protracted litigation and accept Judge McCorkle's order declaring the regulations void and unenforceable in a final judgment. On May 17, 2019, the Honorable Judge McCorkle signed the Final Judgment declaring that certain Large Volume Groundwater User rules under the District's Regulatory Plan were adopted "without legal authority and consequently are, and have been, unlawful, void and unenforceable." Effective from the date of the Final Judgment, the LVGU reduction rules are struck from the District's Rules, Regulatory Plan, LVGU Permits, and the District will no longer manage the resources in accordance with those regulations. After notice and hearing, the District will adopt new rule(s) to address the unlawful, void and unenforceable regulations.

The District will evaluate and monitor groundwater conditions and regulate production consistent with this plan and the District Rules including any amended rules. Production will be regulated, as needed, to conserve groundwater, and protect groundwater users, in a manner not to unnecessarily and adversely limit production or impact the economic viability of the public, landowners and private groundwater users. In consideration of the importance of groundwater to the economy and culture of the District, the District will identify and engage in activities and practices that will permit groundwater production and, as appropriate, protect the aquifer and groundwater in accordance with this Management Plan and the District's rules.

The District ~~will adopt~~adopted rules to regulate groundwater withdrawals by means of well spacing and production limits, as authorized in Chapter 36.116, as appropriate to implement this Plan. In issuing new permits or amending existing permits, the District will manage total groundwater production on a long-term basis to achieve an applicable desired future condition.

The District will maintain a monitoring well and subsidence station network that will be used by the District to monitor aquifer conditions over time. The District encourages well owners to volunteer wells to be used as part of the monitoring network. The District will accept wells into, or replace an existing well in, the monitoring network. The selection process will consider the well proximity to other monitoring wells, to permitted and exempt wells, to streams, and to geographic and political boundaries. If no suitable well locations can be found to meet the monitoring objectives in a specific aquifer, the District may evaluate the benefits of converting an oil and gas well to a water well, drilling and installing a new well, or using modeled or estimated water levels for that area until such time as a suitable well can be obtained for monitoring. Well monitoring will be performed under the direction of the general manager, by trained personnel, using a standard operating procedure adopted by the District. The District will coordinate with the neighboring groundwater conservation districts and subsidence districts for the purpose of supplementing its monitoring data and for improving the consistency in the collection, management, and analysis of hydrogeological data in Groundwater Management Area 14 ("GMA 14").

The District will make a regular assessment of water supply, water level and groundwater storage conditions and will report those conditions, as appropriate, in public meetings of the Board or public announcements. The District will undertake investigations, and cooperate with third-party investigations, of the groundwater resources within the District, and the results of the investigations will be made available to the public upon being presented at a meeting of the Board.

7. DESIRED FUTURE CONDITIONS & MODELED AVAILABLE GROUNDWATER

Throughout the joint planning process, the District actively worked with the other member districts and stakeholders within Groundwater Management Area 14 ("GMA 14") to address the issues from the petitions of the District's 2016 DFCs and determine the DFCs for each relevant aquifer located within GMA 14~~each district~~. Pursuant to Texas Water Code Section 36.108(b), during the joint planning process for GMA 14, the district representatives for GMA 14 considered groundwater availability models ("GAMs") and other data, including information from the regional water plans and the Texas State Water Plan, throughout the DFCs development process.

The following DFCs were unanimously adopted by the district representatives in GMA 14 on January 5, 2022. ~~During the second round of joint planning with GMA 14, the District's prior Board of Directors adopted DFCs for the Gulf Coast Aquifer on August 9, 2016.~~

> In each county in Groundwater Management Area 14, no less than 70 percent median available drawdown remaining in 2080 or no more than an average of 1.0 additional foot of subsidence between 2009 and 2080.

~~Shortly after adoption, the District received two separate petitions challenging the reasonableness of the 2016 DFCs. The first petition was filed by the Cities of Conroe and Magnolia on December 2, 2016. The TWDB received a copy of this petition on December 12, 2016. The second petition, filed by Quadvest, L.P., was received by the District on December 6, 2016, and by the TWDB on December 14, 2016. The District contracted with the State Office of Administrative Hearings ("SOAH") to conduct a consolidated contested case hearing requested by the petitioners, and submitted copies of the petitions to the Office. The TWDB prepared a scientific and technical analysis of the desired future conditions and delivered their report to the SOAH Judge Casey Bell on April 10, 2017.~~

~~In October 2017, the District's prior Board of Directors received the results of the three-year Strategic Water Resources Planning Study (the "Planning Study") conducted by LBG-Guyton Associates that it was commissioned to do in October 2014. As a result of the Planning Study, on October 10, 2017, the District's prior Board of Directors unanimously adopted 1) increased pumping levels (from 64,000 acre-feet per year to 100,000 acre-feet per year through 2070) and resulting aquifer conditions included in what is referred to as groundwater availability model "Run D" from the final report for Task 3 of the Planning Study as the District's recommended model scenario; and 2) recommended that the District's General Manager and consultants present the results of the Strategic Water Resources Planning Study, including the District Board's recommendation for Run D, to the district representatives of GMA 14 with a request that Run D be considered in the joint planning process as either an amendment to the DFCs previously adopted in 2016 or as a new proposal.~~

~~On November 6, 2017, the District's prior Board of Directors entered into a settlement agreement and an Agreed Proposal for Decision with the Cities of Conroe and Magnolia, Texas ending the contested case hearing on the reasonableness of the District DFCs. The Agreed Proposal for Decision prepared by Administrative Law Judge Casey A. Bell, included three specific Findings of Fact. The first was a finding consistent with the District's actions approved on October 10, 2017 regarding the Strategic Water Resources Planning Study. The second finding included the sentence: "Based on results of the Strategic Water Resources Planning Study and the District's Board of Directors actions, the District's Board of Directors changed its policy goal to move away from 'sustainability,' which is one of the primary bases for the DFCs that are the subject of the petitions in this proceeding, to a groundwater management policy and goal that allows measured aquifer level declines over time." The third finding of fact states: "Because the District Board of Directors has changed its policy goal for aquifer management as set forth above and has already voted unanimously to pursue changes to the DFCs that are the subject of the DFC appeal, those DFCs are no longer reasonabl~~Per the resolution adopted by the member districts of GMA 14 submitted as part of the explanatory report, the implementation of the DFCs for each district involves taking the single GMA 14-wide DFC statement and quantifying it for use as a

management goal and objective for inclusion in each district's management plan. Further, the Northern Gulf Coast Groundwater Availability Model simulation that serves as the basis for the GMA 14-wide DFC provides the foundation for the DFC ultimately adopted by each district. ~~e.~~"

In accordance with the GMA 14 resolution and utilizing the Northern Gulf Coast Groundwater Availability Model simulation, the District quantified the GMA-14 wide DFC statement for use as a management goal and objective and adopted the DFC of no less than 70 percent median~~l~~ available drawdown remaining in 2080 on September 13, 2022 ~~(Appendix E)~~. For the reasons set forth in the District's Summary Report for Public Comments Received and Position Paper submitted to the Districts in GMA 14 and as part of the explanatory report, the District finds the DFC of no less than 70 percent median available drawdown remaining in 2080 to be~~is~~ reasonable and necessary for the effective and prudent management of the groundwater resources in Montgomery County.

Per GAM Run 21-019 MAG (Appendix D), the modeled available groundwater for the Gulf Coast Aquifers in Montgomery County is ~~are~~ included below.

~~On November 6, 2017, the District signed a Final Order adopting in full Judge Bell's Proposal for Decision and declaring the DFCs no longer reasonable. The District order instructed the General Manager to transmit a copy of the Final Order to all groundwater conservation districts comprising GMA 14 and convey to those districts the Board of Directors' request that GMA 14 promptly convene as required by Texas Water Code 36.1083(p) & (q) to begin the process of adopting new or amended Desired Future Conditions applicable to the District.~~

~~The District then submitted a request on November 20, 2017, to GMA 14 seeking a change in the DFCs for the aquifers to be consistent with the aquifer conditions as modeled in the "Run D" scenario approved by the prior Board of Directors. On December 8, 2017, the voting district representatives of GMA 14, unanimously approved taking up "Run D" for formal consideration as new DFCs for the third five-year joint planning cycle of DFCs, but would not support a more surgical approach to amend only the District's second-cycle DFCs. At least one representative voiced concern that a change in the DFC for Lone Star would, by necessity, require new DFCs to be adopted for their district, as well. This would require a full rework of the necessary explanatory report. The District continued to work with the GMA 14 district representatives in early 2018 to request that they take up the "Run D" request only as an amendment to the second-cycle DFCs on an expedited basis. On March 27, 2018, the GMA 14 district representatives voted down a motion to consider "Run D" only as an amendment to the second-cycle DFCs, but unanimously approved "Run D" for formal consideration both (1) in response to the District's request from the appeal of the second joint planning cycle DFCs, and (2) to develop the third cycle DFCs.~~

~~After the newly elected board took office, it prepared a statement to GMA 14 on the status of the District's DFCs, which included considering defining a common reservoir. At the time of the adoption of this District Management Plan, GMA 14 has begun initial studies of the nine statutory factors the district representatives are statutorily required to consider before adopting new DFCs for the third planning cycle. Under the current schedule, GMA 14 will have proposed DFCs for adoption by May 1, 2021.~~

~~After adoption by the Board on March 12, 2019, the District submitted a new management plan to the TWDB for approval in March 2019. In its March 2019 submittal, the District included the 2016 DFCs and MAG information but stated that the DFCs were found to be no longer reasonable and GMA 14 had taken no action to update the DFCs applicable to the District. In response by letter dated May 16, 2019, TWDB's Executive Administrator notified the District that the submitted plan was not administratively complete.. TWDB acknowledged that the 2016 DFCs were declared "no longer reasonable" and recommended the plan to be revised to address the DFCs as adopted in 2010, which were not challenged.~~

~~The 2010 DFCs are:~~

- ~~From estimated year 2016 conditions, the average draw down of the Chicot Aquifer should not exceed approximately 6 feet after 44 years;~~
- ~~From estimated year 2016 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 25 feet after 44 years;~~
- ~~From estimated year 2016 conditions, the average draw down of the Burkeville confining unit should not exceed approximately 23 feet after 44 years;~~
- ~~From estimated year 2016 conditions, the average draw down of the Jasper aquifer should not exceed approximately 38 feet after 44 years;~~

Groundwater Management Area (GMA) 14
Modeled Available Groundwater for Relevant Aquifers by Groundwater Conservation District (GCD)
2021 Joint Planning

~~TWDB recommended the plan to be revised to address the MAG estimates in GAM Run 10-038 MAG. The modeled available groundwater associated with GAM Run 10-038 MAG for the District is in Table 1 in **Appendix D**.~~

~~The District appealed the Executive Administrator's decision and TWDB upheld the Executive Administrator's decision. In a good faith effort to resolve the dispute, the District and TWDB mediated the dispute. As part of appeal process, the District timely filed an appeal in district court in Travis County, Texas. Through the mediation process, the District incorporated TWDB's recommendation(s) into the plan. Following an order by the district court in Travis County regarding the mediated process, the District revised its management plan in compliance with the statutory requirements and submitted it to TWDB for approval after notice and hearing. Prior to approval of this plan, the District was operating under the effective parts of the plan adopted and approved in 2013.~~

~~The District is actively participating in the joint planning process with the district representatives in GMA 14. The GMA 14 districts shall propose DFCs for round three by May 1, 2021, and the GMA 14 districts shall adopt DFCs by January 5, 2022. When the DFCs are adopted in the third round of joint planning by GMA 14, the District will update its plan as required under Chapter 36.~~

Lone Star GCD								
GCD	Gulf Coast Aquifer System	County	Modeled Available Groundwater (acre-feet per year)					
			2020	2030	2040	2050	2060	2070	2080
Lone Star GCD	Chicot	Montgomery	20,868	22,117	22,136	23,202	22,878	21,030	21,030
Lone Star GCD	Evangeline	Montgomery	41,172	41,160	41,397	40,200	40,269	39,815	39,815
Lone Star GCD	Burkeville confining unit	Montgomery	0	0	0	0	0	0	0
Lone Star GCD	Jasper	Montgomery	34,925	33,676	33,412	33,527	33,769	36,028	36,028
Lone Star GCD Totals									
	Gulf Coast Aquifer System		96,965	96,953	96,945	96,929	96,916	96,873	96,873

8. ACTIONS, PROCEDURES, PERFORMANCE AND AVOIDANCE FOR PLAN IMPLEMENTATION

The District will implement this plan and utilize it as a guide for the ongoing evaluation, and the planning and establishing, of priorities for all District conservation and regulatory activities. All programs, permits and related operations of the District, and any additional planning efforts in which the District may participate will be consistent with this plan.

The District will adopt rules relating to the permitting of wells, the production and transport of groundwater and managing permitted production to achieve DFCs. The rules adopted by the District shall be adopted pursuant to Chapter 36 and provisions of this plan. All rules will be adhered to and enforced. The promulgation and enforcement of the rules will be based on metered production and other technical data recommended by competent professionals and accepted by the Board.

The District shall apply its rules equally to all citizens. Citizens may apply to the District for a variance in enforcement of the rules on grounds of adverse economic effect or unique local conditions. In granting a variance to any rule, the Board shall consider the potential for adverse effect on adjacent landowners and the aquifer(s). The exercise of discretion by the Board shall not be construed as limiting the power of the Board.

The District will endeavor to cooperate with other agencies in the implementation of this plan and the management of groundwater supplies within the District. All activities of the District will be undertaken in a spirit of cooperation and coordination with the appropriate state and regional agencies.

9. METHODOLOGY FOR TRACKING DISTRICT PROGRESS IN ACHIEVING MANAGEMENT GOALS

In order to achieve the goals, management objectives, and performance standards adopted in this management plan, the District continually works to develop, maintain, review, and update rules and procedures for the various programs and activities contained in the management plan. As a means to monitor performance, (a) the General Manager routinely meets with staff to track progress on the various goals, management objectives and performance standards adopted in this management plan, and (b) on an annual basis, the General Manager prepares and submits an annual

report documenting progress made towards implementation of the management plan to the Board of Directors for their review and approval. In addition, the District's staff reviews District Rules to ensure that all provisions necessary to implement the management plan are contained in the rules. The rules are reviewed annually and on an an-needed basis. The District Board of Directors will make revisions to the rules as needed to manage and conserve groundwater resources within the District more effectively and to ensure that the duties prescribed in Chapter 36 and other applicable laws are carried out. A copy of this management plan and the District Rules may be found on the District website at www.lonestargcd.org. The District will encourage cooperation and coordination in the implementation of this plan. All operations and activities of the District will be performed in a manner that best encourages cooperation with the appropriate state, regional, or local water entity.

10. MANAGEMENT GOALS, OBJECTIVES, AND PERFORMANCE STANDARDS

10.1. Efficient Use Of Groundwater

Management Objectives:

1. The District will maintain a monitoring well network to provide coverage across aquifers and measure water levels at least once every calendar year. A written analysis of the water level measurements from the monitoring wells will be made available through a presentation to the Board of Directors at least once every three years.

2. The District will continue to support the activities of the Gulf Coast / Montgomery County Water Efficiency Network, Water Wise Program, and the Home Water Works, and maintain a technical library of information providing guidance on the efficient use of water.

3. The District will provide educational leadership to citizens annually through at least one printed publication, such as a brochure, and/or public speaking at service organizations and public schools as provided for in the District's public education program.

4. Each year, the District will require all new exempt or permitted wells that are constructed within the boundaries of the District to be registered or permitted with the District in accordance with the District Rules.

5. The District will maintain qualified staff and technical consultants necessary to execute and maintain the District's well registration and permitting system. This effort includes the timely processing and technical reviews of permit applications. Each year, the District will regulate the production of groundwater by maintaining a system of permitting the use and production of groundwater within the boundaries of the District in accordance with the District Rules.

Performance Standards:

1. Maintain a monitoring well network and its criteria, and measure monitoring wells at least once every calendar year and perform site inspections as necessary.

2. Program updates, notification of monthly meetings and links to specific topics to improve efficiency will be posted on the District website at: https://www.lonestargcd.org

3. The number of publications and speaking appearances by the District each year under the District's public education program and as it reported in the Annual Report.

4. Each year the District will accept, process, and review applications for the permitted use of groundwater in the District in accordance with the permitting process established by District Rules. The number and type of applications made for the permitted use of groundwater in the District and the number and type of permits issued by the District will be included in the Annual Report submitted by the General Manager to the Board of Directors of the District.

5. The District maintains a qualified staff to assist water users in protecting, preserving, and conserving groundwater resources. The Board of Directors has in the past and continues today to base its decisions on the best data available to treat all water users as equitably as possible. Once data is collected, the District utilizes a wide variety of forums to provide important information to water users throughout the District so that sound decisions regarding the efficient use of groundwater can be made.

10.2. Controlling and Preventing Waste of Groundwater

Management Objectives:

1. The District operates a waste prevention outreach strategy that focuses on enhancing the use of the District's website to provide resources applicable to the prevention of waste of groundwater. The District website provides a routinely updated link containing a *Best Management Practices Guide* (published by the Texas Water Conservation Advisory Council in partnership with the TWDB). The District will work to identify outreach opportunities with regional and local water providers so as to increase public awareness for the prevention of groundwater waste.

2. Each year, the District will apply a water use fee structure to the permitted use of groundwater in the District to encourage the elimination and reduction of waste of groundwater.

Performance Standards:

1. The District provides and will routinely update the link on the District's website to Best Management Practices, which includes helpful tips to control and prevent the waste of groundwater.

2. Each year, with the exception of wells exempt from permitting, the District will apply a water use fee to the permitted use of groundwater in the District pursuant to District Rules. The amount of fees generated by the water use fee structure and the amount of water used for each type of permitted use of groundwater will be included in the Annual Report submitted by the General Manager to the Board of Directors of the District.

10.3. Controlling and Preventing Subsidence

Management Objectives:

1. The District shall, in cooperation with the Harris-Galveston Subsidence District, monitor in real-time and maintain a network of 8 subsidence monitor stations to continually measure subsidence. To date, minor subsidence of less than 1 foot has been measured at monitoring stations located in the southern portion of the District.

2. Each year, the District shall participate in a joint conference with the neighboring groundwater conservation districts or subsidence districts focused on sharing information regarding subsidence and the control and prevention of subsidence through the regulation of groundwater production.

3. Controlling and preventing subsidence will be addressed during the review and processing of permits as authorized in Chapter 36 and District Rules, and in setting desired future conditions for the common reservoirs.

Performance Standards:

1. Each year, a summary of the joint conference on subsidence issues will be included in the Annual Report submitted by the General Manager to the Board of Directors of the District.

2. Results from the subsidence monitor stations will be noted in the summary of the joint conference on subsidence and included in an annual report to the District Board of Directors.

3. The District will continue its subsidence study and provide updates on the results of the study in the Annual Report of the District provided to the Board of Directors.

10.4. Conjunctive Surface Water Management Issues

Management Objectives:

1. Each year, the District's designated representative will participate in the regional planning process by attending at least one of the Region H – Regional Water Planning Group meetings annually.

2. The District will review the State Water Plan in **Appendix B** and coordinate with public water suppliers, other stakeholders and surface water management entities on conjunctive use.

Performance Standards:

1. The participation and attendance of the District's designated representative at each Region H Regional Water Planning Group will be noted in the Annual Report submitted by the General Manager to the Board of Directors of the District.

2. Each year the District will include a summary of the District's review of the State Water Plan and meeting summaries on conjunctive use in the Annual Report to the Board of Directors of the District.

10.5. Natural Resource Issues

Management Objectives:

1. The District will monitor permit applications and permit amendment applications for Class II injection wells filed with the Railroad Commission of Texas and Class I and Class V injection well permit applications and permit amendment applications filed with the Texas Commission on Environmental Quality. District staff will review these notices and brief the Board of Directors as appropriate. A summary of injection well permit activity and any actions taken by the District in response will be included in the Annual Report submitted by the General Manager to the Board of Directors of the District.

Performance Standards:

1. Beginning with the 2014 Annual Report, a summary of injection well permit activity at the Railroad Commission of Texas and the Texas Commission on Environmental Quality along with any actions taken by the District in response will be included in the Annual Report submitted by the General Manager to the Board of Directors of the District.

10.6. Drought Conditions

The aquifers within the District are substantially resistant to depletion of storage during drought conditions. As a result, the District does not have regulatory actions related to a drought management strategy. Additionally, a well-informed public can best respond to developing drought conditions by adopting best management practices appropriate for drought conditions.

Management Objectives:

1. An important objective of the District is to provide ongoing and relevant drought-related meteorological information. Beginning in 2014, the District began making available through the District's website easily accessible drought information with an emphasis on developing droughts and on any current drought conditions. At least one of the following links will be provided: updates to the US Drought Monitor map for the region, the Drought Preparedness Council Situation Report, and the TWDB Drought Page at https://waterdatafortexas.org/drought.

Performance Standards:

1. Current drought conditions information from at least one of the following will continue to be available to the public on the District's website and noted in the Annual Report submitted by the General Manager to the Board of Directors of the District: the US Drought Monitor map for the region, the Drought Preparedness Council Situation Report, or the TWDB Drought Page at https://waterdatafortexas.org/drought.

10.7. Conservation, Recharge Enhancement, Rainwater Harvesting, Precipitation Enhancement, or Brush Control Where Appropriate and Cost Effective

Conservation and rainwater harvesting have been determined to be appropriate goals for the District. As part of this effort, the District sponsors and participates in water conservation programs such as the Gulf Coast/ Montgomery County Water Efficiency Network, Water Wise Program, and the Home Water Works.

A visit to the District's headquarters is all that is required to realize the commitment of the District to rainwater harvesting. The entire comprehensive water conservation demonstration facility was designed as a demonstration to the citizens of Montgomery County of the positive benefits of rainwater harvesting in reducing water consumption from the Gulf Coast Aquifer. The design and subsequent construction of the various rainwater harvesting and water conservation techniques integrated into the District headquarters have not only caught the attention of local residents, but the District was awarded the 2012 Texas Rain Catcher Award from the Texas Water Development Board

for the innovation demonstrated by the design of the new comprehensive water conservation demonstration facility.

After review by the Board of Directors, the General Manager, and the District's technical consultants, it has been determined that recharge enhancement, precipitation enhancement, and brush control are not appropriate groundwater management strategies for the District. Generally, recharge enhancement is difficult because of the shallow depths to water in the water table zones near instream areas, and the lack of long-term trends in the water table.[6] This evaluation is based on costs of operating and maintaining these programs, lack of neighboring programs in which to participate, and probable lack of effectiveness of these programs, due to the climate, hydrogeology, and physiography of the District.

Management Objectives:

1. The District seeks to promote water conservation through an active water conservation awareness program. As part of this program, the District will maintain links to recognized water conservation awareness programs such as the Gulf Coast/Montgomery County Water Efficiency Network, Water Wise Program, and the Home Water Works programs on the District's website.

2. Educational materials specific to rainwater harvesting have been developed to highlight the various water conservation techniques that are incorporated into the design of the new District headquarters. This information will be available at the main entrance to the District headquarters for visitors to take and review for potential use in homes and businesses in Montgomery County.

3. The District added an important tool at its comprehensive water conservation demonstration facility that will collect weather data 24/7 in collaboration with Texas A&M AgriLife Extension experts. The objective of installing this equipment was to generate an Evapotranspiration ("ET") estimate to help residents use their irrigation systems more efficiently by knowing the ideal amount of water needed to sustain a healthy lawn. The District will roll out the information from the program to enable commercial and residential "users" to regulate their irrigation system controllers so that they deliver only the amount of water necessary. Current measurements of ET will be maintained on the District's website.

Performance Standards:

1. Links to at least one of the water conservation awareness programs such as the Gulf Coast/Montgomery County Water Efficiency Network, Water Wise Program, and the Home Water Works programs will be provided on the

[6] Kasmerek, M.C., 2013, Hydrogeology and simulation of groundwater flow and land-surface subsidence in the northern part of the Gulf Coast Aquifer System, Texas, 1891-2009: United States Geological Survey Scientific investigations Report 2012-5154, 55p.

District's website and noted in the Annual Report submitted by the General Manager to the Board of Directors of the District.

2. Information on the District's headquarters and rainwater harvesting capabilities will be made available during business hours for use by visitors to the facilities. A summary of this educational opportunity will be included in the Annual Report submitted by the General Manager to the Board of Directors of the District.

3. Lawn watering guidance based on current measurements of ET will continue to be maintained on the District's website throughout the active growing season each year and noted in the Annual Report submitted by the General Manager to the Board of Directors of the District.

10.8. Desired Future Conditions

Management Objectives:

1. The District is committed to continually work with other members of GMA 14 to adopt, and to achieve, the most appropriate DFCs for each relevant groundwater reservoir identified in the joint planning process. The DFCs adopted by the District will support the District's regulatory mission to afford an opportunity for a fair share to each owner of a common, subsurface reservoir. Because future use and landowner's choices are uncertain, in addition to hydrologic variability and uncertainty, the actual conditions of the reservoirs in the future may change.

2. The District will adopt well spacing and production allocation rules to implement the goals in this plan.

3. At least once every two years, the District will collect and examine monitoring well data for the Chicot, Evangeline and Jasper aquifers from all available sources including USGS monitoring well network and the TWDB groundwater database, and analyze the historical data.

Performance Standards:

1. Draft rules, public meeting, and hearing announcements, and available supporting materials will be included prior to rulemaking activities by the District on the District's website at lonestargcd.org.

2. At least once every two years, the District will include a discussion of the evaluation of the District rules and the determination of whether any amendments to the rules are recommended.

3. A summary of any amendments to District rules that are adopted throughout the calendar year will be included in the Annual Report submitted by the General Manager to the Board of Directors of the District.

4. Based on collected monitoring and reported pumping data demonstrating trends in reservoir conditions, the District will review annually whether: (i) the current plan and rules are working effectively; and (ii) specific amendments need to be made to this plan and/or rules; or (iii) amendments are needed to meet the management goals of the District or (iv) a combination of (ii) and (iii). The collected data may be shared with the GMA 14 districts and used to inform possible amendments to the adopted desired future conditions.

2. ESTIMATED HISTORICAL GROUNDWATER USE IN DISTRICT

During the development of this management plan update, the most current groundwater use information from the TWDB's Water Use Survey ~~, for which results are presented in the TWDB Water Use Database,~~ was ~~utilized~~utsed. Table 2 ~~and Figures 4 and 5~~ shows the ~~present summary information regarding~~ groundwater, surface water, and reuse volumes ~~use~~ used in Montgomery County from ~~2001~~ 2000 through ~~2016~~2020. Note that the TWDB started estimating reuse volumes in 2015. ~~Over this period,~~ As a percent of total water use, groundwater use represents from about 9~~2~~5.9 percent in 200~~0~~, ~~1 to 84.3~~94 percent in 201~~1~~6, and 89 percent in 2020 ~~of total water use in Montgomery County~~. Figure 4 shows the total water use in the District from 1974 through 2020, increases from about ~~The rapidly changing demography of Montgomery County is well illustrated by Figures 4 and 5. Total water use has increased by more than a factor of six from~~ 13,137 acre-feet in 1974 to ~~80,945~~106,771 acre-feet in 201~~0~~, and then decreases to 88,978 acre-feet in 2020, with the ~~vast~~ majority of water supply coming from groundwater. ~~use going to the municipal water use sector.~~ Figure 5 shows the water use by sector, and indicates ~~that the largest water use is for~~ municipal purposes is the largest water use. Figure 6 illustrates the portion of ~~S~~surface water, groundwater, and reuse that is used ~~as increased~~ for municipal purposes, and shows the increase of surface water in 2015. For a more detailed breakdown of historical water use, by year, and by sector, as required by Texas Water Code Section 36.1071(e)(3)(b), please refer to **Appendix B**.

Table 2 – Water use in Montgomery County from ~~2001~~ 2000 – 2020 in acre-feet per year (AFY), (from the TWDB Water Use Survey Database).

Year	Total Groundwater Use	Total Surface Water Use	Total Reuse	Total Water Use
2000	54,624	4,581	-	59,205
2001	51,907	2,170	-	54,077
2002	55,125	3,094	-	58,219
2003	54,571	764	-	55,335
2004	56,540	1,571	-	58,111
2005	65,672	688	-	66,360
2006	67,265	1,012	-	68,277
2007	63,163	2,433	-	65,596
2008	71,274	3,426	-	74,700
2009	76,149	4,791	-	80,940
2010	78,195	4,374	-	82,569
2011	100,798	5,973	-	106,771
2012	88,810	2,766	-	91,576
2013	82,933	4,238	-	87,171
2014	74,920	3,752	-	78,672
2015	74,311	6,882	175	81,368
2016	69,786	12,712	270	82,768
2017	72,083	10,977	297	83,357
2018	73,623	9,389	462	83,474
2019	74,368	9,459	294	84,121
2020	78,751	9,788	439	88,978

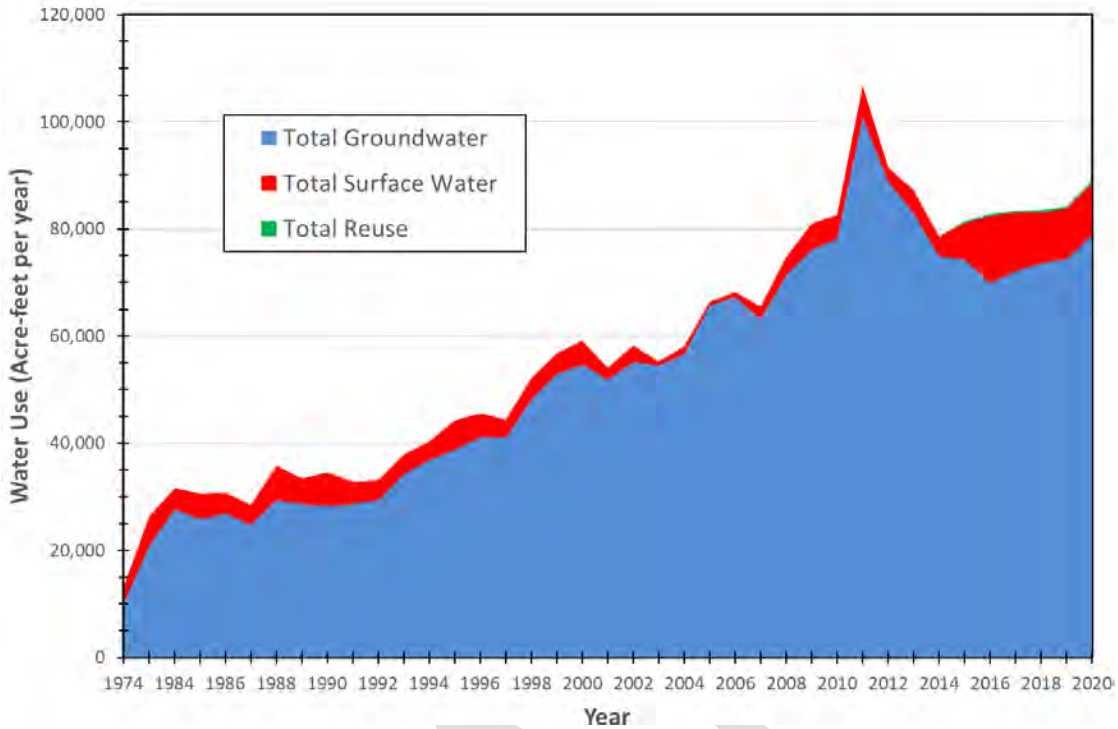

Figure 4 – Water use trends in Montgomery County from 1974 – 2020, in AFY (from the TWDB Water Use Survey Database).

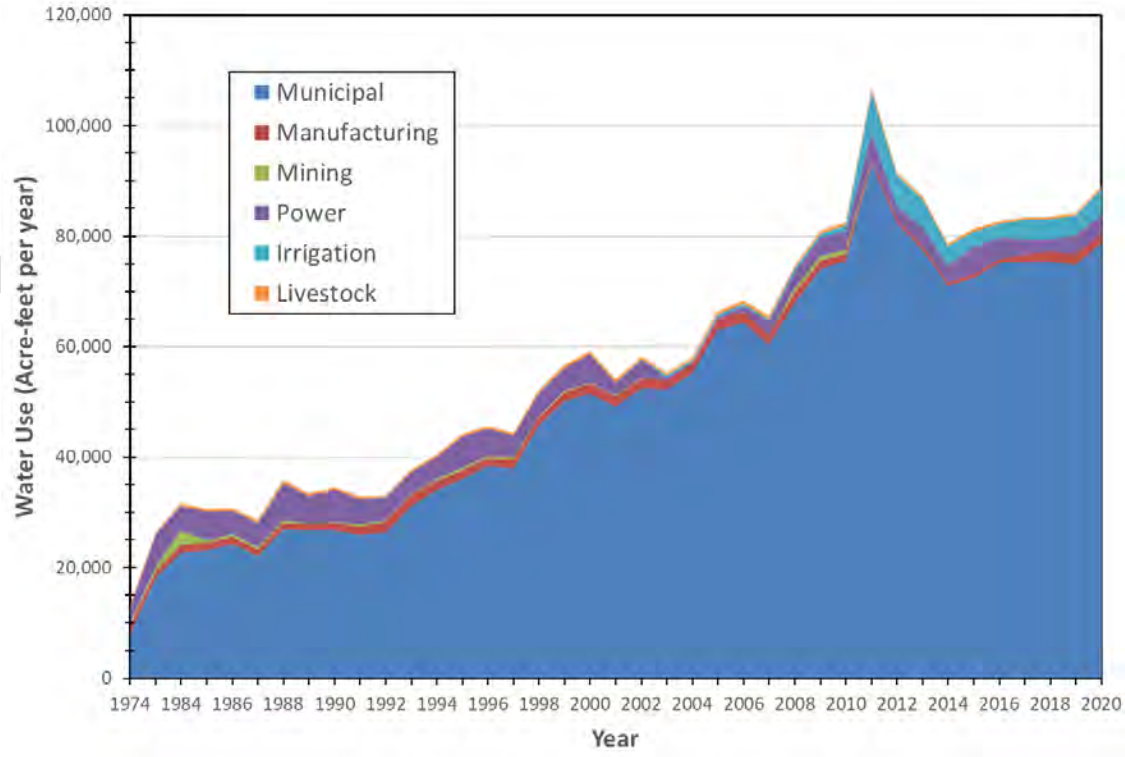

Figure 5 – Water use by sector in Montgomery County from 1974 to 2020, in AFY (from TWDB Water Use Survey Database).

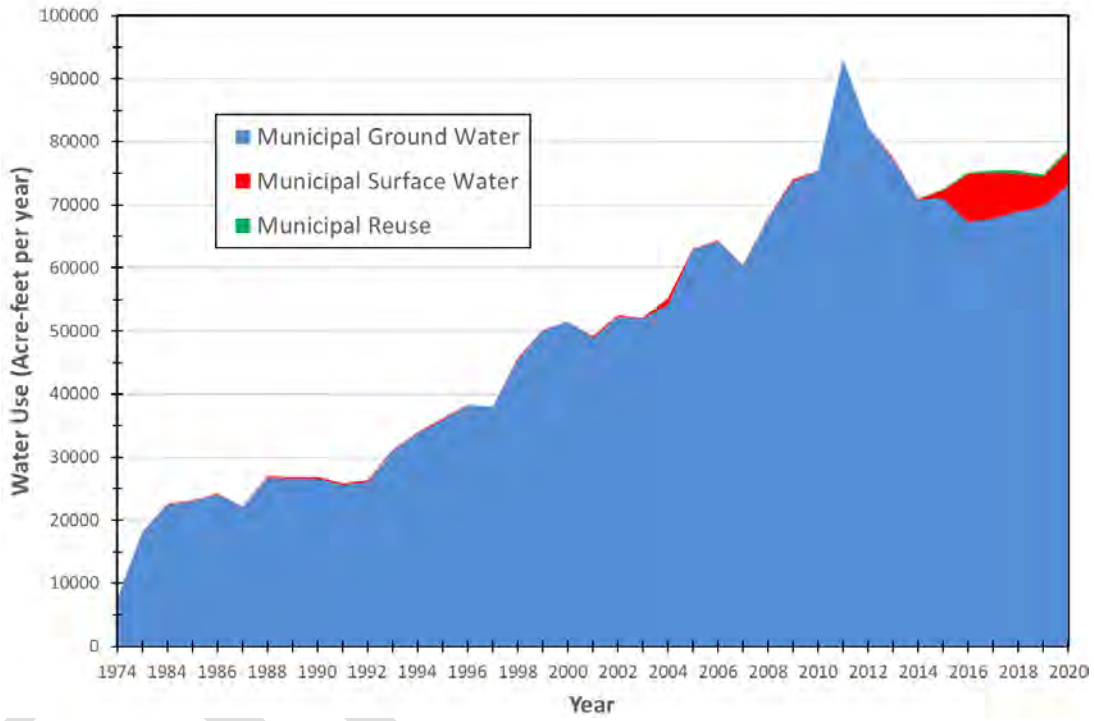

Figure 6 – Municipal water use by type in Montgomery County from 1974 to 2020, in AFY (from TWDB Water Use Survey Database).

3. WATER BUDGETS FOR DISTRICT

Fundamental to the management of groundwater resources is an understanding of the water budgets for the area. The Texas Water Code requires as part of developing and adopting a management plan that provides information pertaining to estimates of recharge, discharge, and cross-formational flow for relevant aquifers are to be presented. This information relative to Montgomery County was provided in GAM Run 17-023[7] (see **Appendix C** for entire report).

Table 3 – Water budget estimates provided by TWDB in GAM Run 17-023.

Management Plan Requirement	Aquifer	Result (acre-feet per year)
Estimated annual amount of recharge from precipitation to the district	Gulf Coast Aquifer	20,923
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	959
Estimated annual volume of flow into the district within each aquifer in the district	Gulf Coast Aquifer	26,732
Estimated annual volume of flow out of the district within each aquifer in the district	Gulf Coast Aquifer	55,095
Estimated net annual volume of flow between each aquifer in the district	From the Catahoula Formation to the Jasper Aquifer	6,896*
	From the Yegua-Jackson subcrop to the Catahoula Formation and younger units	163

*Calculated using the groundwater availability model for the Yegua-Jackson Aquifer.

[7] Wade, S., 2018, GAM Run 17-023: Lone Star Groundwater Conservation District Management Plan: Texas Water Development Board, 10 p.

a. Projected Surface Water Supplies in Montgomery County

The District participates as a member of the Region H Water Planning Group, which is responsible for the development of long-range (50 year) water supply plans for the northern Gulf Coast region. As part of the Texas regional water supply planning process, estimates of water supply, water demands, water supply needs, and water management strategies to meet water supply needs are developed for a wide variety of water user groups. To ensure that groundwater conservation districts consider the comprehensive nature of the water supply landscape during development of their management plans, consideration of the planning estimates listed above are included herein.

The estimates of projected surface water supplies are taken from the 2017 State Water Plan. Summary information on projected surface water supplies is included in **Appendix B**[8]. The primary surface water supply in Montgomery County is Lake Conroe. A majority of surface water supplies are for municipal use.

b. Projected Water Demands in Montgomery County

As part of the Texas regional and state water planning process, estimates of water demands during drought conditions are developed on a decadal basis for the 50-year planning horizon. A summary of water demand projections for Montgomery County is included in Table 4 and provided in detail in **Appendix B**. The demographic outlook for Montgomery County is one of growth and opportunity. Population projections for Montgomery County show an increase in the population from 627,917 in 2020 to 1,946,063 in 2070, equating to a 209 percent increase in population.[9] This increase in population, along with the associated increases in industrial and other water demands, increases water demands from 110,422 acre-feet per year in 2020 to 291,791 acre-feet per year in 2070, or an approximate 164 percent increase.

Table 4 – Projected total water demands for Montgomery County included in the 2017 State Water Plan.

Projected Total Demand for Water						
Year	2020	2030	2040	2050	2060	2070
Montgomery County	110,422	135,318	163,626	197,839	240,722	291,791

c. Projected Water Supply Needs in Montgomery County

During the Texas regional water planning process, after projections of water supply and water demands have been quantified, the need for additional water supplies is determined on a water user group basis and a wholesale water supply basis. The difference in projections between demands

[8] Allen, S., 2018, Estimated historical use and 2017 State Water Plan datasets: Lone Star Groundwater Conservation District: Texas Water Development Board, 5 p.

[9] Draft populations for Montgomery County from 2010 – 2070 obtained from the Texas Water Development Board Water Planning website at http://www.twdb.texas.gov/waterplanning/data/projections/2017/popproj.asp

and supplies is illustrated in Figure ~~6~~ 7 below. Estimates of water supply needs in Montgomery County are summarized in Table 5 below and provided in detail in **Appendix B**. Estimates of projected needs are from the 2017 State Water Plan.

Table 5 – Water supply needs in the 2017 State Water Plan for Montgomery County.

	Projected Water Supply Needs					
Year	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Montgomery County	17,582	39,817	65,282	96,275	137,957	188,418

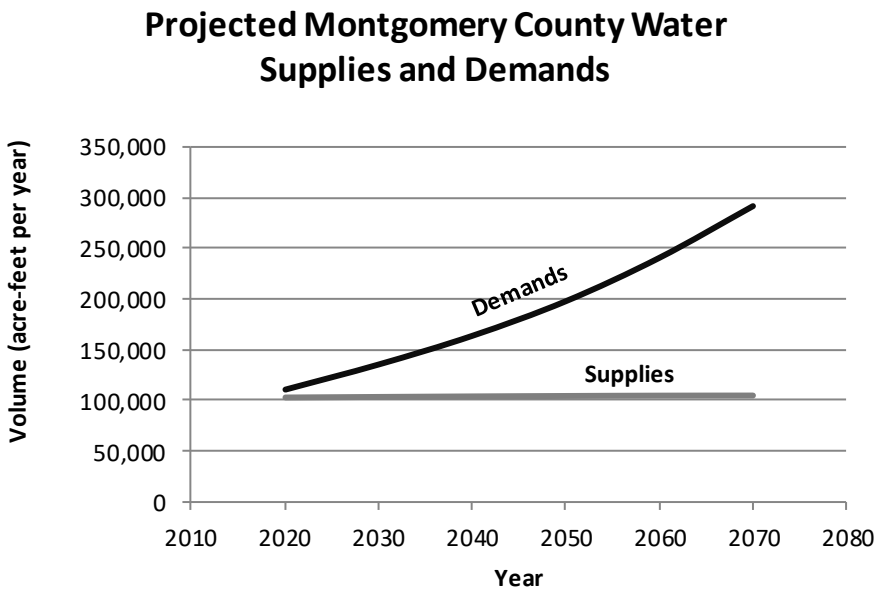

Figure 7 – Comparison of water supply demands and supplies in Montgomery County reported in the 2017 State Water Plan.

d. Water Management Strategies Recommended to Meet Water Supply Needs in Montgomery County

To meet the needs of water user groups in the Montgomery County, the 2017 State Water Plan includes a variety of water management strategies that, when implemented, will meet the projected water supply needs. For a complete list of water management strategies see **Appendix B**. Important water management strategies included in the 2017 State Water Plan for Montgomery County include water conservation, wastewater reclamation, the Lake Livingston/Wallisville Reservoir project, and brackish groundwater development.

Appendix A - Groundwater Conservation District Management Plan Checklist from the Texas Water Development Board

Texas Water Development Board

Groundwater Conservation District Management Plan Checklist, effective December 6, 2012

District name: ☐ Official review ☐ Prereview

Reviewing staff: **Date plan received:** **Date plan reviewed:**

A management plan shall contain, unless explained as not applicable, the following elements, 31 TAC §356.52(a):

	Citation of rule	Citation of statute	Present in plan and administratively complete	Source of data	Evidence that best available data was used	Notes
Is a paper hard copy of the plan available?	31 TAC §356.53(a)(1)					
Is an electronic copy of the plan available?	31 TAC §356.53(a)(2)					
1. Is an estimate of the modeled available groundwater in the District based on the desired future condition established under Section 36.108 included?	31 TAC §356.52(a)(5)(A)	TWC §36.1071(e)(3)(A)				p.
2. Is an estimate of the amount of groundwater being used within the District on an annual basis for at least the most recent five years included?	31 TAC §356.52(a)(5)(B); §356.10(2)	TWC §36.1071(e)(3)(B)				p.
For sections 3-5 below, each district must use the groundwater availability modeling information provided by the TWDB in conjunction with available site-specific information provided by the district when developing the required estimates, 31 TAC §356.52(c):						
3. Is an estimate of the annual amount of recharge, from precipitation, if any, to the groundwater resources within the District included?	31 TAC §356.52(a)(5)(C)	TWC §36.1071(e)(3)(C)				p.
4. For each aquifer in the district, is an estimate of the annual volume of water that discharges from the aquifer to springs and any surface water bodies, including lakes, streams and rivers, included?	31 TAC §356.52(a)(5)(D)	TWC §36.1071(e)(3)(D)				p.
5. Is an estimate of the annual volume of flow	31 TAC §356.52(a)(5)(E)	TWC §36.1071(e)(3)(E)				
a) into the District within each aquifer,						p.
b) out of the District within each aquifer,						p.
c) and between aquifers in the District,						p.
if a groundwater availability model is available, included?						
6. Is an estimate of the projected surface water supply within the District according to the most recently adopted state water plan included?	31 TAC §356.52(a)(5)(F)	TWC §36.1071(e)(3)(F)				p.
7. Is an estimate of the projected total demand for water within the District according to the most recently adopted state water plan included?	31 TAC §356.52(a)(5)(G)	TWC §36.1071(e)(3)(G)				p.
8. Did the District consider and include the water supply needs from the adopted state water plan?		TWC §36.1071(e)(4)				p.
9. Did the District consider and include the water management strategies from the adopted state water plan?		TWC §36.1071(e)(4)				p.
10. Did the district include details of how it will manage groundwater supplies in the district	31 TAC §356.52(a)(4)					p.
11. Are the actions, procedures, performance, and avoidance necessary to effectuate the management plan, including specifications and proposed rules, all specified in as much detail as possible, included in the plan?		TWC §36.1071(e)(2)				p.
12. Was evidence that the plan was adopted, after notice and hearing, included? Evidence includes the posted agenda, meeting minutes, and copies of the notice printed in the newspaper(s) and/or copies of certified receipts from the county courthouse(s).	31 TAC §356.53(a)(3)	TWC §36.1071(a)				p.
13. Was evidence that, following notice and hearing, the District coordinated in the development of its management plan with regional surface water management entities?	31 TAC §356.51	TWC §36.1071(a)				p.
14. Has any available site-specific information been provided by the district to the executive administrator for review and comment before being used in the management plan when developing the estimates required in subsections 31 TAC §356.52(a)(5)(C), (D), and (E) ?	31 TAC §356.52(c)	TWC §36.1071(h)				p.

Mark an affirmative response with YES
Mark a negative response with NO
Mark a non-applicable checklist item with N/A

Management goals required to be addressed unless declared not applicable	Management goal (time-based and quantifiable) 31 TAC §356.51	Methodology for tracking progress 31TAC §356.52(a)(4)	Management objective(s) (specific and time-based statements of future outcomes) 31 TAC §356.52 (a)(2)	Performance standard(s) (measures used to evaluate the effectiveness of district activities) 31 TAC §356.52 (a)(3)	Notes
Providing the most efficient use of groundwater 31 TAC 356.52(a)(1)(A); TWC §36.1071(a)(1)	15)	16)	17)	18)	p.
Controlling and preventing waste of groundwater 31 TAC 356.52(a)(1)(B); TWC §36.1071(a)(2)	19)	20)	21)	22)	p.
Controlling and preventing subsidence 31 TAC 356.52(a)(1)(C); TWC §36.1071(a)(3)	23)	24)	25)	26)	p.
Addressing conjunctive surface water management issues 31 TAC 356.52(a)(1)(D); TWC §36.1071(a)(4)	27)	28)	29)	30)	p.
Addressing natural resource issues that impact the use and availability of groundwater and which are impacted by the use of groundwater 31 TAC 356.52(a)(1)(E); TWC §36.1071(a)(5)	31)	32)	33)	34)	p.
Addressing drought conditions 31 TAC 356.52(a)(1)(F); TWC §36.1071(a)(6)	35)	36)	37)	38)	p.
Addressing	39)	40)	41)	42)	
a) conservation	39a)	40a)	41a)	42a)	p.
b) recharge enhancement	39b)	40b)	41b)	42b)	p.
c) rainwater harvesting	39c)	40c)	41c)	42c)	p.
d) precipitation enhancement, and	39d)	40d)	41d)	42d)	p.
e) brush control	39e)	40e)	41e)	42e)	p.
where appropriate and cost effective 31 TAC 356.52(a)(1)(G); TWC §36.1071(a)(7)					
Addressing the desired future conditions established under TWC §36.108; 31 TAC 356.52(a)(1)(H); TWC §36.1071(a)(8)	43)	44)	45)	46)	p.
Does the plan identify the performance standards and management objectives for effecting the plan? 31 TAC §356.52(a)(2)&(3); TWC §36.1071(e)(1)			47)	48)	
Mark required elements that are present in the plan with YES Mark any required elements that are missing from the plan with NO Mark plan elements that have been indicated as not applicable to the district with N/A					

Appendix B - Estimated Historical Water Use and 2017 State Water Plan Datasets for Lone Star Groundwater Conservation District - Provided by the Texas Water Development Board

Estimated Historical Water Use And 2017 State Water Plan Datasets:

Lone Star Groundwater Conservation District

by Stephen Allen
Texas Water Development Board
Groundwater Division
Groundwater Technical Assistance Section
stephen.allen@twdb.texas.gov
(512) 463-7317
August 13, 2018

GROUNDWATER MANAGEMENT PLAN DATA:

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

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

The five reports included in this part are:

1. Estimated Historical 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 8/13/2018. Although it does not happen frequently, either of these datasets are subject to change pending the availability of more accurate WUS data or an amendment to the 2017 SWP. District personnel must review these datasets and correct any discrepancies in order to ensure approval of their groundwater management plan.

The WUS dataset can be verified at this web address:

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

The 2017 SWP dataset can be verified by contacting Sabrina Anderson (sabrina.anderson@twdb.texas.gov or 512-936-0886).

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.

MONTGOMERY COUNTY

All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2016	GW	65,750	633	0	385	1,048	471	68,287
	SW	7,667	0	0	3,597	1,369	25	12,658
2015	GW	70,530	695	0	480	1,612	468	73,785
	SW	1,233	46	0	4,362	1,167	25	6,833
2014	GW	70,786	502	0	632	2,518	477	74,915
	SW	239	51	0	2,344	1,045	25	3,704
2013	GW	76,952	648	0	620	3,949	429	82,598
	SW	300	56	0	2,674	1,151	23	4,204
2012	GW	81,593	685	4	653	4,675	427	88,037
	SW	0	52	0	1,686	967	22	2,727
2011	GW	93,157	669	388	597	5,753	614	101,178
	SW	0	55	415	4,000	1,847	32	6,349
2010	GW	75,478	1,248	392	3	467	603	78,191
	SW	0	51	419	3,255	583	32	4,340
2009	GW	73,630	1,502	387	2	129	499	76,149
	SW	395	43	413	3,343	571	26	4,791
2008	GW	67,806	1,779	383	620	187	499	71,274
	SW	155	51	408	2,235	551	26	3,426
2007	GW	60,270	1,443	3	657	244	546	63,163
	SW	155	341	0	1,752	156	29	2,433
2006	GW	64,244	1,857	3	727	0	434	67,265
	SW	155	66	0	232	536	23	1,012
2005	GW	62,874	1,862	4	369	65	498	65,672
	SW	155	69	0	3	435	26	688
2004	GW	54,151	1,704	5	418	50	212	56,540
	SW	1,061	53	0	2	138	317	1,571
2003	GW	51,995	1,826	4	484	50	212	54,571
	SW	134	0	0	1	311	318	764
2002	GW	52,234	1,726	91	810	66	198	55,125
	SW	277	0	11	2,509	0	297	3,094
2001	GW	48,879	1,794	161	810	66	197	51,907
	SW	288	0	0	1,586	0	296	2,170

Projected Surface Water Supplies
TWDB 2017 State Water Plan Data

MONTGOMERY COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070
H	CONROE	SAN JACINTO	CONROE LAKE/RESERVOIR	8,624	8,624	8,624	8,624	8,624	8,624
H	COUNTY-OTHER, MONTGOMERY	SAN JACINTO	CONROE LAKE/RESERVOIR	1,129	1,129	1,129	1,129	1,129	1,129
H	IRRIGATION, MONTGOMERY	SAN JACINTO	CONROE LAKE/RESERVOIR	1,145	1,145	1,145	1,145	1,145	1,145
H	IRRIGATION, MONTGOMERY	SAN JACINTO	SAN JACINTO RUN-OF-RIVER	25	25	25	25	25	25
H	MONTGOMERY COUNTY WCID #1	SAN JACINTO	CONROE LAKE/RESERVOIR	195	195	195	195	195	195
H	OAK RIDGE NORTH	SAN JACINTO	CONROE LAKE/RESERVOIR	375	375	375	375	375	375
H	RAYFORD ROAD MUD	SAN JACINTO	CONROE LAKE/RESERVOIR	642	642	642	642	642	642
H	SOUTHERN MONTGOMERY COUNTY MUD	SAN JACINTO	CONROE LAKE/RESERVOIR	668	668	668	668	668	668
H	STEAM ELECTRIC POWER, MONTGOMERY	SAN JACINTO	CONROE LAKE/RESERVOIR	7,841	7,841	7,841	7,841	7,841	7,841
H	THE WOODLANDS	SAN JACINTO	CONROE LAKE/RESERVOIR	15,250	15,250	15,250	15,250	15,250	15,250
H	THE WOODLANDS	SAN JACINTO	SAN JACINTO RUN-OF-RIVER	116	116	116	116	116	116
	Sum of Projected Surface Water Supplies (acre-feet)			**36,010**	**36,010**	**36,010**	**36,010**	**36,010**	**36,010**

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.

MONTGOMERY COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
H	BENDERS LANDING WATER SYSTEM	SAN JACINTO	2,188	3,456	4,762	6,070	7,373	7,372
H	CLEVELAND	SAN JACINTO	6	8	10	14	18	23
H	CONROE	SAN JACINTO	13,336	15,705	17,863	19,899	22,144	24,564
H	COUNTY-OTHER, MONTGOMERY	SAN JACINTO	35,816	50,901	68,894	91,167	119,227	153,649
H	CUT AND SHOOT	SAN JACINTO	116	120	134	158	190	235
H	DOBBIN-PLANTERSVILLE WSC	SAN JACINTO	642	840	1,117	1,485	1,972	2,614
H	EAST PLANTATION UD	SAN JACINTO	212	213	244	278	320	331
H	HOUSTON	SAN JACINTO	981	1,375	1,810	2,233	2,654	2,776
H	INDIGO LAKE WATER SYSTEM	SAN JACINTO	1,133	1,548	2,212	3,156	4,491	6,671
H	IRRIGATION, MONTGOMERY	SAN JACINTO	737	737	737	737	737	737
H	KINGS MANOR MUD	SAN JACINTO	224	225	231	236	242	246
H	LAKE WINDCREST WATER SYSTEM	SAN JACINTO	916	1,026	1,298	1,681	2,219	2,972
H	LIVESTOCK, MONTGOMERY	SAN JACINTO	521	521	521	521	521	521
H	MAGNOLIA	SAN JACINTO	694	823	997	1,256	1,637	2,230
H	MANUFACTURING, MONTGOMERY	SAN JACINTO	2,135	2,388	2,640	2,863	3,107	3,372
H	MINING, MONTGOMERY	SAN JACINTO	1,453	1,363	1,077	921	806	728
H	MONTGOMERY	SAN JACINTO	631	1,164	1,442	1,722	2,008	2,459
H	MONTGOMERY COUNTY MUD #15	SAN JACINTO	497	525	598	699	850	1,065
H	MONTGOMERY COUNTY MUD #18	SAN JACINTO	1,285	1,644	1,861	2,080	2,302	2,842
H	MONTGOMERY COUNTY MUD #19	SAN JACINTO	261	253	247	245	247	249
H	MONTGOMERY COUNTY MUD #8	SAN JACINTO	445	462	506	554	607	728
H	MONTGOMERY COUNTY MUD #83	SAN JACINTO	281	289	298	307	316	323
H	MONTGOMERY COUNTY MUD #89	SAN JACINTO	335	337	341	366	402	415
H	MONTGOMERY COUNTY MUD #9	SAN JACINTO	507	520	584	651	720	862
H	MONTGOMERY COUNTY MUD #94	SAN JACINTO	592	595	657	720	783	782

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.

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
H	MONTGOMERY COUNTY UD #2	SAN JACINTO	172	168	172	183	197	217
H	MONTGOMERY COUNTY UD #3	SAN JACINTO	267	303	305	347	438	557
H	MONTGOMERY COUNTY UD #4	SAN JACINTO	509	642	637	724	923	1,184
H	MONTGOMERY COUNTY WCID #1	SAN JACINTO	255	262	274	299	328	361
H	NEW CANEY MUD	SAN JACINTO	742	774	818	889	992	1,120
H	OAK RIDGE NORTH	SAN JACINTO	559	569	595	609	616	618
H	PANORAMA VILLAGE	SAN JACINTO	585	586	617	663	730	819
H	PATTON VILLAGE	SAN JACINTO	151	159	177	199	227	263
H	POINT AQUARIUS MUD	SAN JACINTO	339	336	355	383	424	478
H	PORTER SUD	SAN JACINTO	1,693	2,116	2,543	2,963	3,383	3,731
H	RAYFORD ROAD MUD	SAN JACINTO	994	1,015	1,080	1,159	1,249	1,282
H	RIVER PLANTATION MUD	SAN JACINTO	511	534	651	767	895	944
H	ROMAN FOREST	SAN JACINTO	320	317	348	391	449	524
H	SHENANDOAH	SAN JACINTO	1,292	1,667	1,820	1,923	2,046	2,203
H	SOUTHERN MONTGOMERY COUNTY MUD	SAN JACINTO	861	865	865	870	880	894
H	SPLENDORA	SAN JACINTO	180	190	222	265	322	394
H	SPRING CREEK UD	SAN JACINTO	645	689	715	773	851	877
H	STAGECOACH	SAN JACINTO	37	44	71	110	172	279
H	STANLEY LAKE MUD	SAN JACINTO	569	630	807	1,047	1,365	1,765
H	STEAM ELECTRIC POWER, MONTGOMERY	SAN JACINTO	8,537	9,981	11,741	13,886	16,502	19,611
H	THE WOODLANDS	SAN JACINTO	23,987	25,132	26,326	27,820	30,098	32,896
H	WESTWOOD NORTH WSC	SAN JACINTO	351	369	410	451	492	551
H	WILLIS	SAN JACINTO	817	826	874	951	1,068	1,232
H	WOODBRANCH	SAN JACINTO	105	106	122	148	182	225
	Sum of Projected Water Demands (acre-feet)		**110,422**	**135,318**	**163,626**	**197,839**	**240,722**	**291,791**

Projected Water Supply Needs
TWDB 2017 State Water Plan Data

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

MONTGOMERY COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
H	BENDERS LANDING WATER SYSTEM	SAN JACINTO	-516	-1,784	-3,090	-4,398	-5,701	-5,700
H	CLEVELAND	SAN JACINTO	18	16	14	10	6	1
H	CONROE	SAN JACINTO	-604	-2,973	-5,131	-7,167	-9,412	-11,832
H	COUNTY-OTHER, MONTGOMERY	SAN JACINTO	-11,751	-26,836	-44,829	-67,102	-95,162	-129,584
H	CUT AND SHOOT	SAN JACINTO	64	60	46	22	-10	-55
H	DOBBIN-PLANTERSVILLE WSC	SAN JACINTO	-216	-414	-691	-1,059	-1,546	-2,188
H	EAST PLANTATION UD	SAN JACINTO	-31	-32	-63	-97	-139	-150
H	HOUSTON	SAN JACINTO	117	0	0	0	0	0
H	INDIGO LAKE WATER SYSTEM	SAN JACINTO	-267	-682	-1,346	-2,290	-3,625	-5,805
H	IRRIGATION, MONTGOMERY	SAN JACINTO	912	912	912	912	912	912
H	KINGS MANOR MUD	SAN JACINTO	0	0	0	0	0	0
H	LAKE WINDCREST WATER SYSTEM	SAN JACINTO	-216	-326	-598	-981	-1,519	-2,272
H	LIVESTOCK, MONTGOMERY	SAN JACINTO	-123	-123	-123	-123	-123	-123
H	MAGNOLIA	SAN JACINTO	-65	-194	-368	-627	-1,008	-1,601
H	MANUFACTURING, MONTGOMERY	SAN JACINTO	-727	-980	-1,232	-1,455	-1,699	-1,964
H	MINING, MONTGOMERY	SAN JACINTO	-343	-253	33	189	304	382
H	MONTGOMERY	SAN JACINTO	-149	-682	-960	-1,240	-1,526	-1,977
H	MONTGOMERY COUNTY MUD #15	SAN JACINTO	-117	-145	-218	-319	-470	-685
H	MONTGOMERY COUNTY MUD #18	SAN JACINTO	541	385	168	-51	-273	-813
H	MONTGOMERY COUNTY MUD #19	SAN JACINTO	98	106	112	114	112	110
H	MONTGOMERY COUNTY MUD #8	SAN JACINTO	440	423	379	331	278	157
H	MONTGOMERY COUNTY MUD #83	SAN JACINTO	48	40	31	22	13	6
H	MONTGOMERY COUNTY MUD #89	SAN JACINTO	252	250	246	221	185	172
H	MONTGOMERY COUNTY MUD #9	SAN JACINTO	329	316	252	185	116	-26
H	MONTGOMERY COUNTY MUD #94	SAN JACINTO	-140	-143	-205	-268	-331	-330
H	MONTGOMERY COUNTY UD #2	SAN JACINTO	92	96	92	81	67	47

Projected Water Supply Needs
TWDB 2017 State Water Plan Data

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

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
H	MONTGOMERY COUNTY UD #3	SAN JACINTO	245	227	266	244	151	-72
H	MONTGOMERY COUNTY UD #4	SAN JACINTO	246	212	293	247	50	-107
H	MONTGOMERY COUNTY WCID #1	SAN JACINTO	-3	-10	-22	-47	-76	-109
H	NEW CANEY MUD	SAN JACINTO	-113	-145	-189	-260	-363	-491
H	OAK RIDGE NORTH	SAN JACINTO	-22	-32	-58	-72	-79	-81
H	PANORAMA VILLAGE	SAN JACINTO	-24	-25	-56	-102	-169	-258
H	PATTON VILLAGE	SAN JACINTO	-36	-44	-62	-84	-112	-148
H	POINT AQUARIUS MUD	SAN JACINTO	-46	-43	-62	-90	-131	-185
H	PORTER SUD	SAN JACINTO	-1,074	-1,497	-1,924	-2,344	-2,764	-3,112
H	RAYFORD ROAD MUD	SAN JACINTO	-48	-69	-134	-213	-303	-336
H	RIVER PLANTATION MUD	SAN JACINTO	177	154	37	-79	-207	-256
H	ROMAN FOREST	SAN JACINTO	-76	-73	-104	-147	-205	-280
H	SHENANDOAH	SAN JACINTO	-404	-779	-932	-1,035	-1,158	-1,315
H	SOUTHERN MONTGOMERY COUNTY MUD	SAN JACINTO	-9	-13	-13	-18	-28	-42
H	SPLENDORA	SAN JACINTO	311	301	269	226	169	97
H	SPRING CREEK UD	SAN JACINTO	-152	-196	-222	-280	-358	-384
H	STAGECOACH	SAN JACINTO	-13	-20	-47	-86	-148	-255
H	STANLEY LAKE MUD	SAN JACINTO	248	294	224	36	-282	-682
H	STEAM ELECTRIC POWER, MONTGOMERY	SAN JACINTO	5,649	4,205	2,445	300	-2,316	-5,425
H	THE WOODLANDS	SAN JACINTO	166	-979	-2,173	-3,667	-5,945	-8,743
H	WESTWOOD NORTH WSC	SAN JACINTO	-83	-101	-142	-183	-224	-283
H	WILLIS	SAN JACINTO	-193	-202	-250	-327	-444	-608
H	WOODBRANCH	SAN JACINTO	-21	-22	-38	-64	-98	-141
	Sum of Projected Water Supply Needs (acre-feet)		**-17,582**	**-39,817**	**-65,282**	**-96,275**	**-137,954**	**-188,418**

Projected Water Management Strategies
TWDB 2017 State Water Plan Data

MONTGOMERY COUNTY

WUG, Basin (RWPG)

All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
BENDERS LANDING WATER SYSTEM, SAN JACINTO (H)							
MUNICIPAL CONSERVATION, BENDERS LANDING WATER SYSTEM	DEMAND REDUCTION [MONTGOMERY]	18	71	133	250	304	295
NEW / EXPANDED CONTRACT WITH SJRA	LIVINGSTON-WALLISVILLE LAKE/RESERVOIR SYSTEM [RESERVOIR]	0	0	0	0	4,717	4,729
SJRA GRP - GROUNDWATER OFFSET	GULF COAST AQUIFER [MONTGOMERY]	97	1,196	2,440	3,631	0	0
		115	**1,267**	**2,573**	**3,881**	**5,021**	**5,024**
CLEVELAND, SAN JACINTO (H)							
MUNICIPAL CONSERVATION, CLEVELAND	DEMAND REDUCTION [MONTGOMERY]	0	0	0	1	1	1
WATER LOSS REDUCTION, CLEVELAND	DEMAND REDUCTION [MONTGOMERY]	0	0	1	1	2	3
		0	**0**	**1**	**2**	**3**	**4**
CONROE, SAN JACINTO (H)							
CONROE BRACKISH GROUNDWATER DESALINATION	GULF COAST AQUIFER [MONTGOMERY]	5,600	5,600	5,600	5,600	5,600	5,600
MUNICIPAL CONSERVATION, CONROE	DEMAND REDUCTION [MONTGOMERY]	113	321	499	821	912	981
SJRA GRP - PARTICIPANT SURFACE WATER	CONROE LAKE/RESERVOIR [RESERVOIR]	2,045	3,940	5,666	7,295	9,091	10,828
		7,758	**9,861**	**11,765**	**13,716**	**15,603**	**17,409**
COUNTY-OTHER, MONTGOMERY, SAN JACINTO (H)							
BRACKISH GROUNDWATER SUPPLIES	GULF COAST AQUIFER [MONTGOMERY]	0	0	0	0	3,622	10,000
MUNICIPAL CONSERVATION, COUNTY-OTHER - MONTGOMERY COUNTY	DEMAND REDUCTION [MONTGOMERY]	305	1,040	1,921	3,759	4,913	6,137
NEW / EXPANDED CONTRACT WITH SJRA	CONROE LAKE/RESERVOIR [RESERVOIR]	631	1,606	16,235	11,771	5,344	199
NEW / EXPANDED CONTRACT WITH SJRA	LIVINGSTON-WALLISVILLE LAKE/RESERVOIR SYSTEM [RESERVOIR]	0	0	0	23,542	43,304	37,613
NEW / EXPANDED CONTRACT WITH SJRA - REGIONAL RETURN FLOWS	INDIRECT REUSE [HARRIS]	0	0	0	0	0	31,422
SJRA CATAHOULA AQUIFER SUPPLIES	GULF COAST AQUIFER [MONTGOMERY]	3,920	3,920	3,920	3,920	3,920	3,920

Projected Water Management Strategies
TWDB 2017 State Water Plan Data

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

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
SJRA GRP - GROUNDWATER OFFSET	GULF COAST AQUIFER [MONTGOMERY]	5,311	7,799	4,921	1,554	2,005	0
SJRA GRP - PARTICIPANT SURFACE WATER	CONROE LAKE/RESERVOIR [RESERVOIR]	4,728	7,231	9,711	10,915	12,102	12,840
WASTEWATER RECLAMATION FOR MUNICIPAL IRRIGATION	DIRECT REUSE [MONTGOMERY]	0	2,684	5,827	9,680	14,492	20,387
		14,895	**24,280**	**42,535**	**65,141**	**89,702**	**122,518**
CUT AND SHOOT, SAN JACINTO (H)							
MUNICIPAL CONSERVATION, CUT AND SHOOT	DEMAND REDUCTION [MONTGOMERY]	1	2	4	7	8	9
WATER LOSS REDUCTION, CUT AND SHOOT	DEMAND REDUCTION [MONTGOMERY]	1	3	3	4	4	5
		2	**5**	**7**	**11**	**12**	**14**
DOBBIN-PLANTERSVILLE WSC, SAN JACINTO (H)							
BRACKISH GROUNDWATER SUPPLIES	GULF COAST AQUIFER [MONTGOMERY]	153	327	570	890	1,337	1,930
MUNICIPAL CONSERVATION, DOBBIN-PLANTERSVILLE WSC	DEMAND REDUCTION [MONTGOMERY]	5	17	31	61	81	104
WATER LOSS REDUCTION, DOBBIN-PLANTERSVILLE WSC	DEMAND REDUCTION [MONTGOMERY]	9	21	41	59	79	105
		167	**365**	**642**	**1,010**	**1,497**	**2,139**
EAST PLANTATION UD, SAN JACINTO (H)							
MUNICIPAL CONSERVATION, EAST PLANTATION UD	DEMAND REDUCTION [MONTGOMERY]	2	4	7	11	13	13
NEW / EXPANDED CONTRACT WITH SJRA	LIVINGSTON-WALLISVILLE LAKE/RESERVOIR SYSTEM [RESERVOIR]	0	0	0	0	5	16
RIVER PLANTATION AND EAST PLANTATION JOINT GRP	DIRECT REUSE [MONTGOMERY]	0	65	65	65	65	65
		2	**69**	**72**	**76**	**83**	**94**
HOUSTON, SAN JACINTO (H)							
MUNICIPAL CONSERVATION, HOUSTON	DEMAND REDUCTION [MONTGOMERY]	8	28	51	92	109	111
WATER LOSS REDUCTION, HOUSTON	DEMAND REDUCTION [MONTGOMERY]	14	38	71	111	134	140
		22	**66**	**122**	**203**	**243**	**251**
INDIGO LAKE WATER SYSTEM , SAN JACINTO (H)							
MUNICIPAL CONSERVATION, INDIGO LAKE WATER SYSTEM	DEMAND REDUCTION [MONTGOMERY]	10	32	62	130	185	267

Projected Water Management Strategies
TWDB 2017 State Water Plan Data

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

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
NEW / EXPANDED CONTRACT WITH SJRA	LIVINGSTON-WALLISVILLE LAKE/RESERVOIR SYSTEM [RESERVOIR]	0	0	0	0	0	2,464
SJRA GRP - GROUNDWATER OFFSET	GULF COAST AQUIFER [MONTGOMERY]	0	344	936	1,767	2,993	2,540
WATER LOSS REDUCTION, INDIGO LAKE WATER SYSTEM	DEMAND REDUCTION [MONTGOMERY]	15	39	81	126	180	267
		25	**415**	**1,079**	**2,023**	**3,358**	**5,538**
KINGS MANOR MUD, SAN JACINTO (H)							
MUNICIPAL CONSERVATION, KINGS MANOR MUD	DEMAND REDUCTION [MONTGOMERY]	2	5	6	10	10	10
		2	**5**	**6**	**10**	**10**	**10**
LAKE WINDCREST WATER SYSTEM , SAN JACINTO (H)							
MUNICIPAL CONSERVATION, LAKE WINDCREST WATER SYSTEM	DEMAND REDUCTION [MONTGOMERY]	8	21	36	69	91	119
SJRA GRP - PARTICIPANT SURFACE WATER	CONROE LAKE/RESERVOIR [RESERVOIR]	733	821	1,038	1,345	1,775	2,378
WATER LOSS REDUCTION, LAKE WINDCREST WATER SYSTEM	DEMAND REDUCTION [MONTGOMERY]	12	26	47	67	89	119
		753	**868**	**1,121**	**1,481**	**1,955**	**2,616**
MAGNOLIA, SAN JACINTO (H)							
MUNICIPAL CONSERVATION, MAGNOLIA	DEMAND REDUCTION [MONTGOMERY]	6	17	28	52	67	89
SJRA GRP - GROUNDWATER OFFSET	GULF COAST AQUIFER [MONTGOMERY]	0	0	110	331	681	1,229
WATER LOSS REDUCTION, MAGNOLIA	DEMAND REDUCTION [MONTGOMERY]	9	21	36	50	66	89
		15	**38**	**174**	**433**	**814**	**1,407**
MANUFACTURING, MONTGOMERY, SAN JACINTO (H)							
INDUSTRIAL CONSERVATION, MONTGOMERY COUNTY	DEMAND REDUCTION [MONTGOMERY]	26	58	96	139	187	242
NEW / EXPANDED CONTRACT WITH SJRA	LIVINGSTON-WALLISVILLE LAKE/RESERVOIR SYSTEM [RESERVOIR]	0	0	0	0	0	1,287
SJRA GRP - PARTICIPANT SURFACE WATER	CONROE LAKE/RESERVOIR [RESERVOIR]	266	487	701	881	1,077	0
		292	**545**	**797**	**1,020**	**1,264**	**1,529**

Projected Water Management Strategies
TWDB 2017 State Water Plan Data

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

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
MONTGOMERY, SAN JACINTO (H)							
MUNICIPAL CONSERVATION, MONTGOMERY	DEMAND REDUCTION [MONTGOMERY]	5	24	40	71	83	98
NEW / EXPANDED CONTRACT WITH SJRA	CONROE LAKE/RESERVOIR [RESERVOIR]	0	509	771	0	0	0
NEW / EXPANDED CONTRACT WITH SJRA	LIVINGSTON-WALLISVILLE LAKE/RESERVOIR SYSTEM [RESERVOIR]	0	0	0	1,020	1,294	1,730
		5	**533**	**811**	**1,091**	**1,377**	**1,828**
MONTGOMERY COUNTY MUD #15, SAN JACINTO (H)							
MUNICIPAL CONSERVATION, MONTGOMERY COUNTY MUD #15	DEMAND REDUCTION [MONTGOMERY]	4	11	17	29	35	43
SJRA GRP - GROUNDWATER OFFSET	GULF COAST AQUIFER [MONTGOMERY]	0	17	84	173	318	525
		4	**28**	**101**	**202**	**353**	**568**
MONTGOMERY COUNTY MUD #18, SAN JACINTO (H)							
MUNICIPAL CONSERVATION, MONTGOMERY COUNTY MUD #18	DEMAND REDUCTION [MONTGOMERY]	11	34	52	86	95	114
NEW / EXPANDED CONTRACT WITH SJRA	LIVINGSTON-WALLISVILLE LAKE/RESERVOIR SYSTEM [RESERVOIR]	0	0	0	0	0	403
		11	**34**	**52**	**86**	**95**	**517**
MONTGOMERY COUNTY MUD #19, SAN JACINTO (H)							
MUNICIPAL CONSERVATION, MONTGOMERY COUNTY MUD #19	DEMAND REDUCTION [MONTGOMERY]	2	5	7	10	10	10
SJRA GRP - PARTICIPANT SURFACE WATER	CONROE LAKE/RESERVOIR [RESERVOIR]	209	202	198	196	198	199
WATER LOSS REDUCTION, MONTGOMERY COUNTY MUD #19	DEMAND REDUCTION [MONTGOMERY]	3	6	9	10	10	10
		214	**213**	**214**	**216**	**218**	**219**
MONTGOMERY COUNTY MUD #8, SAN JACINTO (H)							
MONTGOMERY COUNTY MUDS #8 AND #9 REUSE	INDIRECT REUSE [MONTGOMERY]	163	163	163	163	163	163
MONTGOMERY COUNTY MUDS #8 AND #9 REUSE	INDIRECT REUSE [WALKER]	677	677	677	677	677	677
MUNICIPAL CONSERVATION, MONTGOMERY COUNTY MUD #8	DEMAND REDUCTION [MONTGOMERY]	4	9	14	23	25	29
		844	**849**	**854**	**863**	**865**	**869**

Projected Water Management Strategies
TWDB 2017 State Water Plan Data

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

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
MONTGOMERY COUNTY MUD #83, SAN JACINTO (H)							
MUNICIPAL CONSERVATION, MONTGOMERY COUNTY MUD #83	DEMAND REDUCTION [MONTGOMERY]	2	6	8	13	13	13
		2	**6**	**8**	**13**	**13**	**13**
MONTGOMERY COUNTY MUD #89, SAN JACINTO (H)							
MUNICIPAL CONSERVATION, MONTGOMERY COUNTY MUD #89	DEMAND REDUCTION [MONTGOMERY]	3	7	10	15	17	17
SJRA GRP - PARTICIPANT SURFACE WATER	CONROE LAKE/RESERVOIR [RESERVOIR]	268	270	273	293	322	332
WATER LOSS REDUCTION, MONTGOMERY COUNTY MUD #89	DEMAND REDUCTION [MONTGOMERY]	4	9	12	15	16	17
		275	**286**	**295**	**323**	**355**	**366**
MONTGOMERY COUNTY MUD #9, SAN JACINTO (H)							
MONTGOMERY COUNTY MUDS #8 AND #9 REUSE	INDIRECT REUSE [MONTGOMERY]	163	163	163	163	163	163
MONTGOMERY COUNTY MUDS #8 AND #9 REUSE	INDIRECT REUSE [WALKER]	677	677	677	677	677	677
MUNICIPAL CONSERVATION, MONTGOMERY COUNTY MUD #9	DEMAND REDUCTION [MONTGOMERY]	4	11	16	27	30	34
		844	**851**	**856**	**867**	**870**	**874**
MONTGOMERY COUNTY MUD #94, SAN JACINTO (H)							
MUNICIPAL CONSERVATION, MONTGOMERY COUNTY MUD #94	DEMAND REDUCTION [MONTGOMERY]	5	12	18	30	32	31
SJRA GRP - GROUNDWATER OFFSET	GULF COAST AQUIFER [MONTGOMERY]	0	0	47	98	159	159
		5	**12**	**65**	**128**	**191**	**190**
MONTGOMERY COUNTY UD #2, SAN JACINTO (H)							
MUNICIPAL CONSERVATION, MONTGOMERY COUNTY UD #2	DEMAND REDUCTION [MONTGOMERY]	1	3	5	8	8	9
		1	**3**	**5**	**8**	**8**	**9**
MONTGOMERY COUNTY UD #3, SAN JACINTO (H)							
MUNICIPAL CONSERVATION, MONTGOMERY COUNTY UD #3	DEMAND REDUCTION [MONTGOMERY]	2	6	9	14	18	22
		2	**6**	**9**	**14**	**18**	**22**
MONTGOMERY COUNTY UD #4, SAN JACINTO (H)							
MUNICIPAL CONSERVATION, MONTGOMERY COUNTY UD #4	DEMAND REDUCTION [MONTGOMERY]	4	13	18	30	38	47
		4	**13**	**18**	**30**	**38**	**47**

Projected Water Management Strategies
TWDB 2017 State Water Plan Data

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

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
MONTGOMERY COUNTY WCID #1, SAN JACINTO (H)							
MUNICIPAL CONSERVATION, MONTGOMERY COUNTY WCID #1	DEMAND REDUCTION [MONTGOMERY]	2	5	8	12	14	14
SJRA GRP - PARTICIPANT SURFACE WATER	CONROE LAKE/RESERVOIR [RESERVOIR]	9	15	24	44	67	94
WATER LOSS REDUCTION, MONTGOMERY COUNTY WCID #1	DEMAND REDUCTION [MONTGOMERY]	3	7	10	12	13	14
		14	**27**	**42**	**68**	**94**	**122**
NEW CANEY MUD, SAN JACINTO (H)							
MUNICIPAL CONSERVATION, NEW CANEY MUD	DEMAND REDUCTION [MONTGOMERY]	6	16	23	37	41	45
SJRA GRP - GROUNDWATER OFFSET	GULF COAST AQUIFER [MONTGOMERY]	0	0	0	29	128	252
		6	**16**	**23**	**66**	**169**	**297**
OAK RIDGE NORTH, SAN JACINTO (H)							
MUNICIPAL CONSERVATION, OAK RIDGE NORTH	DEMAND REDUCTION [MONTGOMERY]	5	12	17	25	25	25
SJRA GRP - PARTICIPANT SURFACE WATER	CONROE LAKE/RESERVOIR [RESERVOIR]	73	81	102	113	119	120
		78	**93**	**119**	**138**	**144**	**145**
PANORAMA VILLAGE, SAN JACINTO (H)							
MUNICIPAL CONSERVATION, PANORAMA VILLAGE	DEMAND REDUCTION [MONTGOMERY]	5	12	17	27	30	33
NEW / EXPANDED CONTRACT WITH SJRA	CONROE LAKE/RESERVOIR [RESERVOIR]	19	13	39	0	0	0
NEW / EXPANDED CONTRACT WITH SJRA	LIVINGSTON-WALLISVILLE LAKE/RESERVOIR SYSTEM [RESERVOIR]	0	0	0	75	139	225
		24	**25**	**56**	**102**	**169**	**258**
PATTON VILLAGE, SAN JACINTO (H)							
MUNICIPAL CONSERVATION, PATTON VILLAGE	DEMAND REDUCTION [MONTGOMERY]	1	3	5	8	9	11
SJRA GRP - GROUNDWATER OFFSET	GULF COAST AQUIFER [MONTGOMERY]	0	1	15	32	58	90
WATER LOSS REDUCTION, PATTON VILLAGE	DEMAND REDUCTION [MONTGOMERY]	2	4	6	8	9	11
		3	**8**	**26**	**48**	**76**	**112**

Projected Water Management Strategies
TWDB 2017 State Water Plan Data

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

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
POINT AQUARIUS MUD, SAN JACINTO (H)							
MUNICIPAL CONSERVATION, POINT AQUARIUS MUD	DEMAND REDUCTION [MONTGOMERY]	3	7	10	16	17	19
SJRA GRP - GROUNDWATER OFFSET	GULF COAST AQUIFER [MONTGOMERY]	0	0	0	0	6	56
WATER LOSS REDUCTION, POINT AQUARIUS MUD	DEMAND REDUCTION [MONTGOMERY]	5	9	13	15	17	19
		8	**16**	**23**	**31**	**40**	**94**
PORTER SUD, SAN JACINTO (H)							
MUNICIPAL CONSERVATION, PORTER SUD	DEMAND REDUCTION [MONTGOMERY]	14	43	71	122	139	149
PORTER SUD JOINT GRP	INDIRECT REUSE [MONTGOMERY]	2,240	2,240	2,240	2,240	2,299	2,623
WATER LOSS REDUCTION, PORTER SUD	DEMAND REDUCTION [MONTGOMERY]	23	54	93	119	135	149
		2,277	**2,337**	**2,404**	**2,481**	**2,573**	**2,921**
RAYFORD ROAD MUD, SAN JACINTO (H)							
MUNICIPAL CONSERVATION, RAYFORD ROAD MUD	DEMAND REDUCTION [MONTGOMERY]	8	21	30	48	51	51
SJRA GRP - PARTICIPANT SURFACE WATER	CONROE LAKE/RESERVOIR [RESERVOIR]	153	170	222	285	357	384
		161	**191**	**252**	**333**	**408**	**435**
RIVER PLANTATION MUD, SAN JACINTO (H)							
MUNICIPAL CONSERVATION, RIVER PLANTATION MUD	DEMAND REDUCTION [MONTGOMERY]	4	11	18	32	37	38
NEW / EXPANDED CONTRACT WITH SJRA	LIVINGSTON-WALLISVILLE LAKE/RESERVOIR SYSTEM [RESERVOIR]	0	0	0	0	0	37
RIVER PLANTATION AND EAST PLANTATION JOINT GRP	DIRECT REUSE [MONTGOMERY]	0	27	27	27	27	27
WATER LOSS REDUCTION, RIVER PLANTATION MUD	DEMAND REDUCTION [MONTGOMERY]	6	8	9	11	13	14
		10	**46**	**54**	**70**	**77**	**116**
ROMAN FOREST, SAN JACINTO (H)							
MUNICIPAL CONSERVATION, ROMAN FOREST	DEMAND REDUCTION [MONTGOMERY]	3	6	10	16	18	21
SJRA GRP - GROUNDWATER OFFSET	GULF COAST AQUIFER [MONTGOMERY]	0	0	5	39	93	162
WATER LOSS REDUCTION, ROMAN FOREST	DEMAND REDUCTION [MONTGOMERY]	4	8	13	16	18	21
		7	**14**	**28**	**71**	**129**	**204**

Projected Water Management Strategies
TWDB 2017 State Water Plan Data

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

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
SHENANDOAH, SAN JACINTO (H)							
MUNICIPAL CONSERVATION, SHENANDOAH	DEMAND REDUCTION [MONTGOMERY]	11	34	51	79	84	88
NEW / EXPANDED CONTRACT WITH SJRA	CONROE LAKE/RESERVOIR [RESERVOIR]	101	427	68	0	0	0
NEW / EXPANDED CONTRACT WITH SJRA	LIVINGSTON-WALLISVILLE LAKE/RESERVOIR SYSTEM [RESERVOIR]	0	0	0	132	245	392
PANORAMA AND SHENANDOAH JOINT GRP	GULF COAST AQUIFER [MONTGOMERY]	0	0	472	472	472	472
WATER LOSS REDUCTION, SHENANDOAH	DEMAND REDUCTION [MONTGOMERY]	17	43	66	77	82	88
		129	**504**	**657**	**760**	**883**	**1,040**
SOUTHERN MONTGOMERY COUNTY MUD, SAN JACINTO (H)							
MUNICIPAL CONSERVATION, SOUTHERN MONTGOMERY COUNTY MUD	DEMAND REDUCTION [MONTGOMERY]	7	18	24	36	36	36
SJRA GRP - PARTICIPANT SURFACE WATER	CONROE LAKE/RESERVOIR [RESERVOIR]	21	24	24	28	36	47
		28	**42**	**48**	**64**	**72**	**83**
SPLENDORA, SAN JACINTO (H)							
MUNICIPAL CONSERVATION, SPLENDORA	DEMAND REDUCTION [MONTGOMERY]	2	4	6	11	13	16
WATER LOSS REDUCTION, SPLENDORA	DEMAND REDUCTION [MONTGOMERY]	2	4	4	5	6	7
		4	**8**	**10**	**16**	**19**	**23**
SPRING CREEK UD, SAN JACINTO (H)							
MUNICIPAL CONSERVATION, SPRING CREEK UD	DEMAND REDUCTION [MONTGOMERY]	5	14	20	32	35	35
SJRA GRP - PARTICIPANT SURFACE WATER	CONROE LAKE/RESERVOIR [RESERVOIR]	516	551	572	618	681	702
		521	**565**	**592**	**650**	**716**	**737**
STAGECOACH, SAN JACINTO (H)							
MUNICIPAL CONSERVATION, STAGECOACH	DEMAND REDUCTION [MONTGOMERY]	0	1	2	5	7	11
NEW / EXPANDED CONTRACT WITH SJRA	CONROE LAKE/RESERVOIR [RESERVOIR]	6	11	35	0	0	0

Projected Water Management Strategies
TWDB 2017 State Water Plan Data

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

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
NEW / EXPANDED CONTRACT WITH SJRA	LIVINGSTON-WALLISVILLE LAKE/RESERVOIR SYSTEM [RESERVOIR]	0	0	0	70	127	226
WATER LOSS REDUCTION, STAGECOACH	DEMAND REDUCTION [MONTGOMERY]	0	1	3	4	7	11
		6	**13**	**40**	**79**	**141**	**248**
STANLEY LAKE MUD, SAN JACINTO (H)							
MUNICIPAL CONSERVATION, STANLEY LAKE MUD	DEMAND REDUCTION [MONTGOMERY]	5	13	23	43	56	71
NEW / EXPANDED CONTRACT WITH SJRA	LIVINGSTON-WALLISVILLE LAKE/RESERVOIR SYSTEM [RESERVOIR]	0	0	0	0	110	495
		5	**13**	**23**	**43**	**166**	**566**
STEAM ELECTRIC POWER, MONTGOMERY, SAN JACINTO (H)							
SJRA CATAHOULA AQUIFER SUPPLIES	GULF COAST AQUIFER [MONTGOMERY]	3,920	3,920	3,920	3,920	3,920	3,920
		3,920	**3,920**	**3,920**	**3,920**	**3,920**	**3,920**
THE WOODLANDS, SAN JACINTO (H)							
MUNICIPAL CONSERVATION, THE WOODLANDS	DEMAND REDUCTION [MONTGOMERY]	203	514	735	1,148	1,239	1,314
SJRA GRP - PARTICIPANT SURFACE WATER	CONROE LAKE/RESERVOIR [RESERVOIR]	3,940	4,856	5,811	7,006	8,828	11,067
		4,143	**5,370**	**6,546**	**8,154**	**10,067**	**12,381**
WESTWOOD NORTH WSC, SAN JACINTO (H)							
MUNICIPAL CONSERVATION, WESTWOOD NORTH WSC	DEMAND REDUCTION [MONTGOMERY]	3	8	11	19	20	22
SJRA GRP - PARTICIPANT SURFACE WATER	CONROE LAKE/RESERVOIR [RESERVOIR]	281	295	328	361	394	441
		284	**303**	**339**	**380**	**414**	**463**
WILLIS, SAN JACINTO (H)							
MUNICIPAL CONSERVATION, WILLIS	DEMAND REDUCTION [MONTGOMERY]	7	17	24	39	44	49
SJRA GRP - GROUNDWATER OFFSET	GULF COAST AQUIFER [MONTGOMERY]	0	0	33	95	207	366
		7	**17**	**57**	**134**	**251**	**415**

Projected Water Management Strategies
TWDB 2017 State Water Plan Data

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

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
WOODBRANCH, SAN JACINTO (H)							
MUNICIPAL CONSERVATION, WOODBRANCH	DEMAND REDUCTION [MONTGOMERY]	1	2	3	6	7	9
SJRA GRP - GROUNDWATER OFFSET	GULF COAST AQUIFER [MONTGOMERY]	0	0	5	26	58	97
WATER LOSS REDUCTION, WOODBRANCH	DEMAND REDUCTION [MONTGOMERY]	1	3	4	6	7	9
		2	**5**	**12**	**38**	**72**	**115**
Sum of Projected Water Management Strategies (acre-feet)		**37,896**	**54,151**	**79,453**	**110,494**	**144,566**	**188,770**

Appendix C - GAM Run 17-023: Lone Star Groundwater Conservation District Management Plan

GAM Run 17-023: Lone Star Groundwater Conservation District Management Plan

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January 31, 2018

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1/31/2018

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GAM RUN 17-023: LONE STAR GROUNDWATER CONSERVATION DISTRICT MANAGEMENT PLAN

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January 31, 2018

EXECUTIVE SUMMARY:

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

The TWDB provides data and information to the Lone Star Groundwater Conservation District in two parts. Part 1 is the Estimated Historical Water Use/State Water Plan dataset report, which will be provided to you separately by the TWDB Groundwater Technical Assistance Section. Please direct questions about the water data report to Mr. Stephen Allen at (512) 463-7317 or stephen.allen@twdb.texas.gov. Part 2 is the required groundwater availability modeling information and this information includes:

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

The groundwater management plan for the Lone Star Groundwater Conservation District should be adopted by the district on or before September 18, 2018, and submitted to the Executive Administrator of the TWDB on or before October 18, 2018. The current management plan for the Lone Star Groundwater Conservation District expires on December 17, 2018.

We used two groundwater availability models to estimate the management plan information for the Gulf Coast Aquifer System within the Lone Star Groundwater Conservation District. Information for interaction with the Gulf Coast Aquifer System and deeper units is from version 1.01 of the groundwater availability model for the Yegua-Jackson Aquifer (Deeds and others, 2010). Information for the Gulf Coast Aquifer System is from version 3.01 of the groundwater availability model for the northern portion of Gulf Coast Aquifer System (Kasmarek, 2013).

This report discusses the methods, assumptions, and results from the model runs described above. This report replaces the results of GAM Run 13-007 (Kohlrenken, 2013). GAM Run 17-023 meets current standards set after the release of GAM Run 13-007 and includes results from the recently released groundwater availability model for the northern portion of the Gulf Coast Aquifer System (Kasmarek, 2013). 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 Lone Star 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 groundwater availability models for the Yegua-Jackson Aquifer and the northern portion of the Gulf Coast Aquifer System were used to estimate information for the Lone Star Groundwater Conservation District management plan. Water budgets were extracted for the historical model periods (1980 through 1997 for interaction with deeper units and 1980 through 2009 for the Gulf Coast Aquifer System) using ZONEBUDGET Version 3.01 (Harbaugh, 2009). The average annual water budget values for recharge, surface-water outflow, inflow to the district, and outflow from the district for the aquifers within the district are summarized in this report.

PARAMETERS AND ASSUMPTIONS:

Gulf Coast Aquifer System

- We used version 3.01 of the groundwater availability model for the northern portion of the Gulf Coast Aquifer System for this analysis. See Kasmarek (2013) 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).
- Water budgets for the district were determined for the Gulf Coast Aquifer System (Layers 1 through 4 collectively).
- The model was run with MODFLOW-2000 (Harbaugh and others, 2000).
- Because this model assumes a no-flow boundary condition at the base we used version 1.01 of the groundwater availability model for the Yegua-Jackson Aquifer to investigate groundwater flows between the Catahoula Formation and the Yegua-Jackson subcrop (non-aquifer) and between the Catahoula Formation and the base of the Gulf Coast Aquifer System. See Deeds and others (2010) for assumptions and limitations of the groundwater availability model for the Yegua-Jackson Aquifer.

RESULTS:

A groundwater budget summarizes the amount of water entering and leaving the aquifer according to the groundwater availability model. Selected groundwater budget components listed below were extracted from the groundwater availability models for the Yegua-Jackson Aquifer and the northern portion of the Gulf Coast Aquifer System within Lone Star Groundwater Conservation District and averaged over the historical calibration periods, as shown in Table 1.

1. Precipitation recharge—the areally distributed recharge sourced from precipitation falling on the outcrop areas of the aquifers (where the aquifer is exposed at land surface) within the district.
2. Surface-water outflow—the total water discharging from the aquifer (outflow) to surface-water features such as streams, reservoirs, and springs.

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

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

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

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

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Gulf Coast Aquifer System	20,923
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	959
Estimated annual volume of flow into the district within each aquifer in the district	Gulf Coast Aquifer System	26,732
Estimated annual volume of flow out of the district within each aquifer in the district	Gulf Coast Aquifer System	55,095
Estimated net annual volume of flow between each aquifer in the district	From the Catahoula Formation to the Jasper Aquifer	6,896[1]
	From the Yegua-Jackson subcrop to the Catahoula Formation and younger units	163

[1] Part of this flow represents internal flow within the Gulf Coast Aquifer System and part represents cross-formational flow because in the shallow subcrop the Catahoula Formation is part of the Gulf Coast Aquifer System.

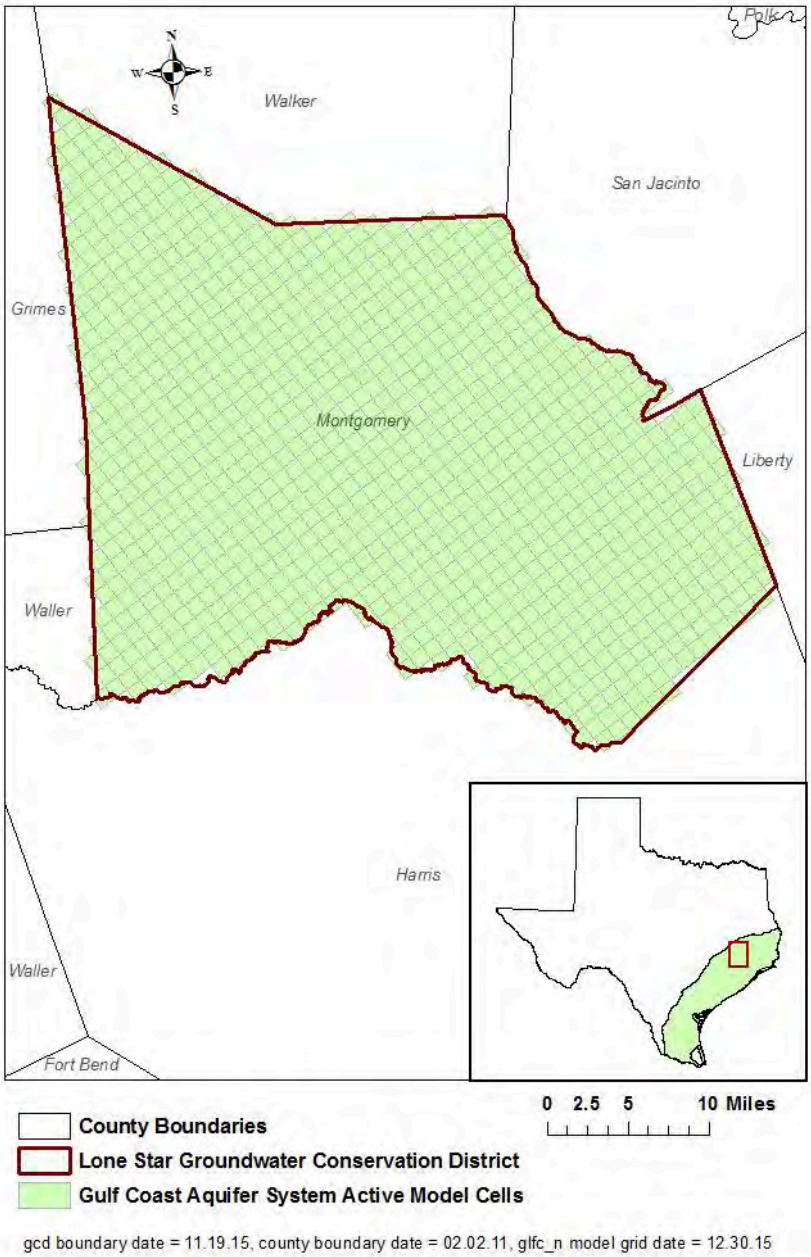

FIGURE 1: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE GULF COAST AQUIFER SYSTEM FROM WHICH THE INFORMATION IN TABLE 1 WAS EXTRACTED (THE AQUIFER SYSTEM EXTENT WITHIN THE DISTRICT BOUNDARY).

LIMITATIONS:

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

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

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

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

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

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Appendix D Modeled Available Groundwater GAM Run ~~10-038~~21-019 MAG for Groundwater Management Area 14

GAM Run 10-038 MAG

By Mohammad Masud Hassan, P.E.

Edited and finalized by Shirley Wade to reflect statutory changes effective September 1, 2011

Texas Water Development Board
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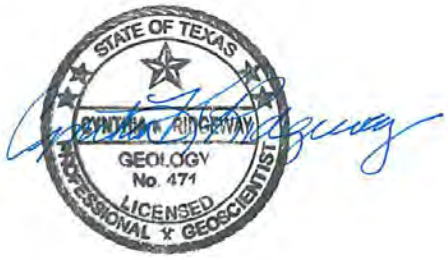

Cynthia K. Ridgeway, the Manager of the Groundwater Availability Modeling Section and Interim Director of the Groundwater Resources Division, is responsible for oversight of work performed by employees under her direct supervision. The seal appearing on this document was authorized by Cynthia K. Ridgeway, P.G. 471 on November 18, 2011.

GAM Run 21-019 MAG:
Modeled Available Groundwater for the Gulf Coast Aquifer System in Groundwater Management Area 14

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EXECUTIVE SUMMARY:

The modeled available groundwater for the Gulf Coast Aquifer as a result of the desired future conditions adopted by the members of Groundwater Management Area 14 declines from approximately 978,000 acre-feet per year to 844,000 acre-feet per year between 2010 and 2060. This is shown divided by county, regional water planning area, and river basin in Table 2 for use in the regional water planning process. Modeled available groundwater is summarized by county, regional water planning area, river basin, and groundwater conservation district for each unit of the Gulf Coast Aquifer in tables 3 through 18. The estimates were extracted from Groundwater Availability Modeling Run 10-023, Scenario 3, which meets the desired future conditions adopted by Groundwater Management Area 14.

REQUESTOR:

Mr. Lloyd Behm of the Bluebonnet Groundwater Conservation District on behalf of Groundwater Management Area 14

DESCRIPTION OF REQUEST:

In a letter dated August 25, 2010, Mr. Lloyd Behm provided the Texas Water Development Board (TWDB) with the desired future conditions of the Gulf Coast Aquifer adopted by the members of Groundwater Management Area 14. As shown in Resolution No. 2010-01, the desired future conditions for the Gulf Coast Aquifer within Groundwater Management Area 14 were stated as average water-level declines (drawdowns) over a specified time period. The average drawdowns (in feet) specified as desired future conditions for Groundwater Management Area 14 are shown in Table 1.

Table 1: Desired future conditions (average drawdown in feet) for the Gulf Coast Aquifer in Groundwater Management Area 14. Negative values indicate a water level rise.

County	Austin	Brazoria	Brazos	Chambers	Grimes	Hardin	Jasper	Jefferson	Liberty
Duration (years)	52	52	52	52	52	52	52	52	52
	Base year 2008								
Chicot Aquifer	17	45	-	43	0	17	10	25	32
Evangeline Aquifer	10	40	-	36	5	27	23	26	37
Burkeville Confining Unit	11	-	-	-	10	23	24	-	28
Jasper Aquifer	20	-	7	-	28	37	21	-	64

Table 1: Continued.

County	Montgomery		Newtown	Orange	Polk	San Jacinto	Tyler	Walker	Waller	Washington
Duration (years)	8	44	52	52	52	52	52	52	52	52
	Base year 2008	Base year 2016	Base year 2008							
Chicot Aquifer	3	6	9	14	4	5	3	-	7	-
Evangeline Aquifer	13	25	20	19	4	7	16	10	8	1
Burkeville Confining Unit	10	23	22	-	20	18	19	5	9	17
Jasper Aquifer	61	-38	18	-	41	72	33	33	25	20

In response to receiving the adopted desired future conditions, the Texas Water Development Board has estimated the modeled available groundwater in Groundwater Management Area 14. Since the desired future conditions were divided by unit within the Gulf Coast Aquifer (Chicot Aquifer, Evangeline Aquifer, Burkeville Confining Unit, and Jasper Aquifer), modeled available groundwater is presented separately for each unit.

METHODS:

The Texas Water Development Board previously completed several predictive groundwater availability model simulations of the Gulf Coast Aquifer to assist the members of Groundwater Management Area 14 in developing desired future conditions. The location of Groundwater Management Area 14, the Gulf Coast Aquifer, and the groundwater availability model cells that represent the aquifer are shown in Figure 1. As described in Resolution No. 2010-01, the management area considered Scenario 3 of GAM Run 10-023 when developing desired future conditions for the Gulf Coast Aquifer (Oliver, 2010). Since each of the above desired future conditions is met in Scenario 3 of GAM Run 10-023, the estimated pumping for Groundwater Management Area 14 presented here was taken directly from that simulation. The pumping was then divided by county, regional water planning area, river basin, and groundwater conservation district (Figure 2).

PARAMETERS AND ASSUMPTIONS:

The parameters and assumptions for the model run using the groundwater availability model for the northern portion of the Gulf Coast Aquifer are described below:

- The results presented in this report are based on Scenario 3 in GAM Run 10-023 (Oliver, 2010). See GAM Run 10-023 for a full description of the methods, assumptions, and results for the groundwater availability model run.
- We used version 2.01 of the groundwater availability model for the northern portion of the Gulf Coast Aquifer. See Kasmarek and Robinson (2004) and Kasmarek and others (2005) for assumptions and limitations of the model.
- The model includes four layers representing the Chicot Aquifer (Layer 1), the Evangeline Aquifer (Layer 2), the Burkeville Confining Unit (Layer 3), and the

Management Area 14 on January 5, 2022. The desired future conditions, as described in Resolution 2021-10-5 (GMA 14 and Oliver, 2022; Appendix G) are:

- "In each county in GMA 14, no less than 70 percent median available drawdown remaining in 2080 or no more than an average of 1.0 additional foot of subsidence between 2009 and 2080."

The Carrizo-Wilcox, Queen City, Sparta, Yegua-Jackson, and Brazos River Alluvium aquifers were declared not relevant for purposes of joint planning by Groundwater Management Area 14 in Resolution 2021-10-5 (GMA 14 and Oliver, 2022; Appendix G).

On March 4, 2022, Mr. John Martin, technical coordinator of Groundwater Management Area 14, submitted the desired future conditions packet for Groundwater Management Area 14. TWDB staff reviewed the model files associated with the desired future conditions and received clarification on assumptions from the Groundwater Management Area 14 technical coordinator on March 23, 2022. In Resolution 2021-10-5, the desired future condition is defined for "each county in GMA 14"; however, Groundwater Management Area 14 clarified that it is their intent per pages 15 and 38 of the explanatory report that the subsidence district counties are not to be included in the county-specific desired future condition definition. For this reason, the TWDB did not consider subsidence district counties during the desired future conditions evaluation. An additional clarification from Groundwater Management Area 14 was a request that the modeled available groundwater values and modeled pumping values be provided by model aquifer layer in addition to the total values for the entire Gulf Coast Aquifer System. These additional splits are included in the current report in Appendix A.

Harris, Galveston, and Fort Bend counties (Subsidence Districts)

Harris-Galveston Subsidence District and Fort Bend Subsidence District are not subject to the provisions of Section 36.108 of the Texas Water Code and, therefore, have not specified desired future conditions. Because desired future conditions were not adopted for the counties in the subsidence districts, the TWDB does not provide "modeled available groundwater" values for those counties. However, the districts in Groundwater Management Area 14 incorporated the groundwater pumpage projections made by the subsidence districts in their regulatory plans so that all known regional groundwater pumping was factored into the joint planning process. Therefore, the subsidence district "groundwater pumpage projections" are still provided in this report (Table 2 and Table 3) even though these values are not official "modeled available groundwater" values.

METHODS:

The TWDB ran the groundwater availability model (version 3.01; Kasmarek, 2013) for the northern part of the Gulf Coast Aquifer System (Figure 1) using the predictive model files

Jasper Aquifer, which includes the more transmissive portions of the Catahoula Formation (Layer 4).

- Cells were assigned to individual counties, river basins, regional water planning areas, and groundwater conservation districts as shown in the August 12, 2010 version of the file that associates the model grid with political and natural boundaries for the Gulf Coast Aquifer.

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. This is distinct from "managed available groundwater," shown in the draft version of this report dated December 29, 2010, which was a permitting value and accounted for the estimated use of the aquifer exempt from permitting. This change was made to reflect changes in statute by the 82nd Texas Legislature, effective September 1, 2011.

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. The estimated amount of pumping exempt from permitting, which the Texas Water Development Board is now required to develop after soliciting input from applicable groundwater conservation districts, will be provided in a separate report.

RESULTS:

The modeled available groundwater for the Gulf Coast Aquifer in Groundwater Management Area 14 as a result of the desired future conditions declines from approximately 978,000 acre-feet per year in 2010 to 844,000 acre-feet per year in 2060. This has been divided by county, regional water planning area, and river basin for each decade between 2010 and 2060 for use in the regional water planning process (Table 2).

The modeled available groundwater for the four units of the Gulf Coast Aquifer is also summarized by county (tables 3 through 6), regional water planning area (tables 7 through 10), river basin (tables 11 through 14), and groundwater conservation district (tables 15 through 18). In tables 15 through 18, the modeled available groundwater both excluding and including areas outside of a groundwater conservation district is shown.

LIMITATIONS:

The groundwater model used in developing estimates of modeled available groundwater is the best available scientific tool that can be used to estimate the pumping that will achieve the desired future conditions. Although the groundwater model used in this analysis is the best available scientific tool for this purpose, it, like all models, has limitations. 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 develop estimates of modeled available groundwater is the need to make assumptions about the location in the aquifer where future pumping will occur. As actual pumping changes in the future, it will be necessary to evaluate the amount of that pumping as well as its location in the context of the assumptions associated with this analysis. Evaluating the amount and location of future pumping is as important as evaluating the changes in groundwater levels, spring flows, and other metrics that describe the condition of the groundwater resources in the area that relate to the adopted desired future condition(s).

Given these limitations, users of this information are cautioned that the modeled available groundwater numbers should not be considered a definitive, permanent description of the amount of groundwater that can be pumped to meet the adopted desired future condition. 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 future groundwater pumping as well as whether or not they are achieving their desired future conditions. Because of the limitations of the model and the assumptions in this analysis, it is important that the groundwater conservation districts work with the TWDB to refine the modeled available groundwater numbers given the reality of how the aquifer responds to the actual amount and location of pumping now and in the future.

REFERENCES:

Oliver, W., 2010, GAM Run 10-023: Texas Water Development Board, GAM Run 10-023 Report, 32 p.

Kasmarek, M.C., and Robinson, J.L., 2004, Hydrogeology and simulation of groundwater flow and land-surface subsidence in the northern part of the Gulf Coast aquifer system, Texas: U.S. Geological Survey Scientific Investigations Report 2004-5102, 111 p.

Kasmarek, M.C., Reece, B.D., and Houston, N.A., 2005, Evaluation of groundwater flow and land-surface subsidence caused by hypothetical withdrawals in the northern part of the northern part of the Gulf Coast aquifer system, Texas: U.S. Geological Survey Scientific Investigations Report 2005-5024, 70 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.

Texas Water Development Board, 2007, Water for Texas – 2007-Volumes I-III; Texas Water Development Board Document No. GP-8-1, 392 p.

Table 2: Modeled available groundwater for the Gulf Coast Aquifer in Groundwater Management Area 14. Results are in acre-feet per year and are divided by county, regional water planning area, and river basin.

County	Regional Water Planning Area	River Basin	Year					
			2010	2020	2030	2040	2050	2060
Austin	H	Brazos	6,585	6,585	6,585	6,585	6,585	6,585
		Brazos-Colorado	15,608	15,608	15,608	15,608	15,608	15,608
		Colorado	121	121	121	121	121	121
Brazoria	H	Brazos	6,658	6,658	6,658	6,658	6,658	6,658
		Brazos-Colorado	11,648	11,648	11,648	11,648	11,648	11,648
		San Jacinto-Brazos	32,090	32,090	32,090	32,090	32,090	32,090
Brazos	G	Brazos	1,189	1,189	1,189	1,189	1,189	1,189
Chambers	H	Neches-Trinity	9,527	9,527	9,527	9,527	9,527	9,527
		San Jacinto-Brazos	0	0	0	0	0	0
		Trinity	10,112	10,112	10,112	10,112	10,112	10,112
		Trinity-San Jacinto	2,068	2,068	2,068	2,068	2,068	2,068
Fort Bend	H	Brazos	60,217	52,923	43,673	43,189	42,862	42,953
		Brazos-Colorado	20,633	22,023	18,095	17,715	17,043	17,077
		San Jacinto	9,723	9,524	9,043	8,809	8,642	8,650
		San Jacinto-Brazos	23,356	24,235	21,266	22,457	23,765	23,810
Galveston	H	Neches-Trinity	0	0	0	0	0	0
		San Jacinto-Brazos	4,774	5,257	5,867	5,841	5,814	5,815
		Trinity-San Jacinto	0	0	0	0	0	0
Grimes	G	Brazos	10,889	10,889	10,889	10,889	10,889	10,889
		San Jacinto	2,197	2,197	2,197	2,197	2,197	2,197
		Trinity	764	764	223			
Hardin	I	Neches	34,821	34,821	34,821	34,821	34,821	34,821
		Trinity	138	138	138	138	138	138
Harris	H	San Jacinto	293,855	249,851	197,553	197,326	196,992	197,270
		San Jacinto-Brazos	4,801	7,202	6,798	7,563	8,428	8,440
		Trinity-San Jacinto	6,894	5,893	5,026	5,141	5,259	5,266
Jasper	I	Neches	37,659	37,620	37,541	37,541	37,541	37,541
		Sabine	29,953	29,953	29,953	29,953	29,953	29,953
Jefferson	I	Neches	804	804	804	804	804	804
		Neches-Trinity	1,641	1,641	1,641	1,641	1,641	1,641
Liberty	H	Neches	5,074	5,074	5,074	5,074	5,074	5,074
		Neches-Trinity	364	364	364	364	364	364
		San Jacinto	5,852	5,852	5,852	5,852	5,852	5,852
		Trinity	22,887	22,887	22,887	22,887	22,887	22,887
		Trinity-San Jacinto	8,856	8,856	8,856	8,856	8,856	8,856

Table 2: Continued.

County	Regional Water Planning Area	River Basin	Year					
			2010	2020	2030	2040	2050	2060
Montgomery	H	San Jacinto	73,264	61,629	61,629	61,629	61,629	61,629
Newton	I	Neches	176	176	176	176	176	176
		Sabine	34,001	34,001	33,963	33,963	33,963	33,963
Orange	I	Neches	3,925	3,925	3,925	3,925	3,925	3,925
		Neches-Trinity	256	256	256	256	256	256
		Sabine	15,832	15,832	15,832	15,832	15,832	15,832
Polk	H	Trinity	21,830	21,830	21,830	21,783	21,783	21,783
		Neches	14,912	11,886	11,886	11,886	11,276	11,224
San Jacinto	H	San Jacinto	10,368	10,368	10,368	10,368	10,368	10,368
		Trinity	10,611	8,811	8,811	8,811	8,811	8,811
Tyler	I	Neches	38,199	38,199	38,156	38,156	38,156	38,156
Walker	H	San Jacinto	9,139	9,116	9,116	9,116	9,116	9,116
		Trinity	8,873	8,873	8,873	8,797	8,797	8,797
Waller	H	Brazos	14,933	14,933	14,933	14,933	14,933	14,933
		San Jacinto	26,694	26,694	26,694	26,694	26,694	26,694
Washington	G	Brazos	12,972	12,972	12,972	12,604	12,604	12,604
		Colorado	73	73	73	73	73	73
Total			**977,816**	**913,948**	**843,660**	**843,666**	**843,820**	**844,244**

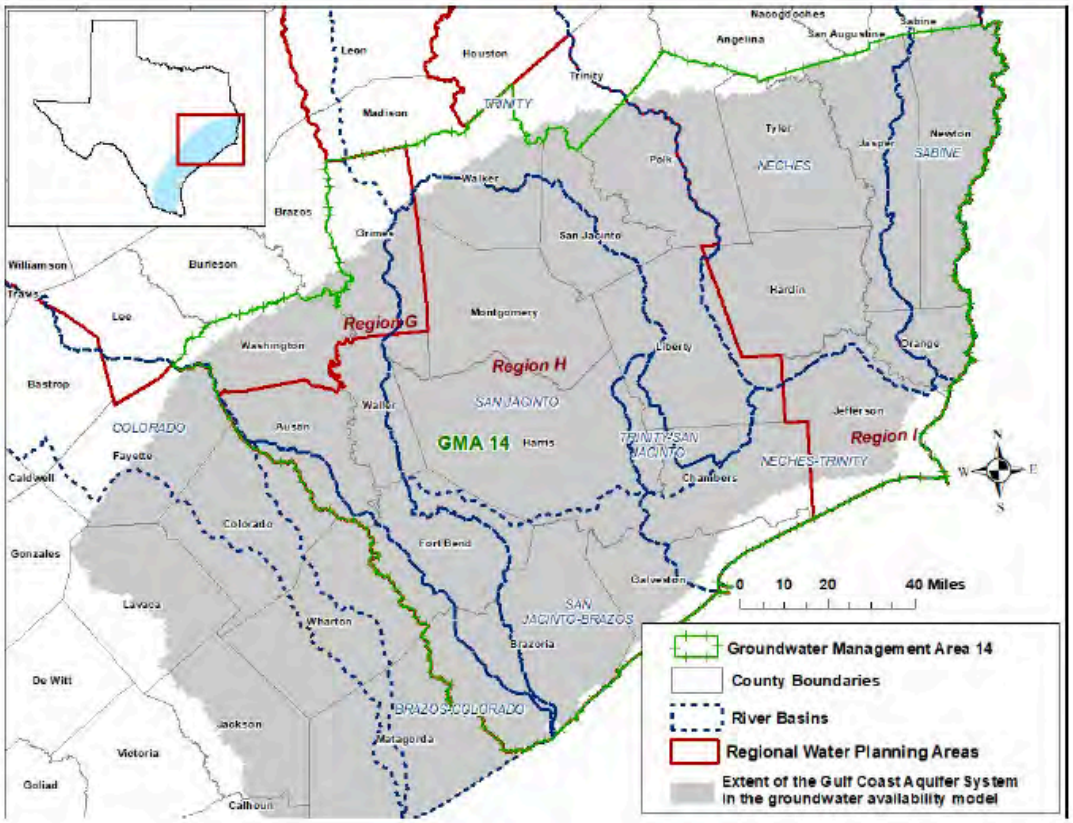


FIGURE 2. LOCATION OF REGIONAL WATER PLANNING AREAS AND RIVER BASINS IN GROUNDWATER MANAGEMENT AREA 14.

Table 4: Modeled available groundwater for the Evangeline Aquifer portion of the Gulf Coast Aquifer summarized by county in Groundwater Management Area 14 for each decade between 2010 and 2060. Results are in acre-feet per year.

County	Year					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Austin	20,013	20,013	20,013	20,013	20,013	20,013
Brazoria	2,271	2,271	2,271	2,271	2,271	2,271
Chambers	379	379	379	379	379	379
Fort Bend	30,923	32,789	30,420	31,166	32,251	32,313
Galveston	471	560	634	647	662	662
Grimes	3,002	3,002	3,002	3,002	3,002	3,002
Hardin	33,696	33,696	33,696	33,696	33,696	33,696
Harris	234,977	193,759	152,256	151,126	149,225	149,435
Jasper	40,755	40,755	40,755	40,755	40,755	40,755
Jefferson	100	100	100	100	100	100
Liberty	27,669	27,669	27,669	27,669	27,669	27,669
Montgomery	39,381	38,293	38,293	38,293	38,293	38,293
Newton	21,288	21,288	21,288	21,288	21,288	21,288
Orange	1,204	1,204	1,204	1,204	1,204	1,204
Polk	8,311	8,311	8,311	8,311	8,311	8,311
San Jacinto	8,178	8,178	8,178	8,178	8,178	8,178
Tyler	20,592	20,592	20,592	20,592	20,592	20,592
Walker	2,001	2,001	2,001	2,001	2,001	2,001
Waller	41,027	41,027	41,027	41,027	41,027	41,027
Washington	3,239	3,239	3,239	3,239	3,239	3,239
Total	**539,477**	**499,126**	**455,328**	**454,957**	**454,156**	**454,428**

TABLE 3. MODELED AVAILABLE GROUNDWATER AND PROJECTED GROUNDWATER PUMPAGE VALUES (*IN ITALICS*) BY DECADE FOR THE GULF COAST AQUIFER SYSTEM IN GROUNDWATER MANAGEMENT AREA 14. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN.

County	RWPA	River Basin	Aquifer	2030	2040	2050	2060	2070	2080
Austin	H	Brazos-Colorado	Gulf Coast	20,652	20,652	20,652	20,652	20,652	20,652
Austin	H	Brazos	Gulf Coast	25,243	25,243	25,243	25,243	25,243	25,243
Austin	H	Colorado	Gulf Coast	665	665	665	665	665	665
Brazoria	H	Brazos-Colorado	Gulf Coast	10,049	9,846	9,582	9,324	9,072	9,072
Brazoria	H	Brazos	Gulf Coast	3,641	3,578	3,510	3,454	3,407	3,407
Brazoria	H	San Jacinto-Brazos	Gulf Coast	41,240	41,483	41,803	42,110	42,408	42,408
Chambers	H	Neches-Trinity	Gulf Coast	9,968	9,968	9,968	9,968	9,968	9,968
Chambers	H	Trinity-San Jacinto	Gulf Coast	2,142	2,152	2,161	2,163	2,164	2,164
Chambers	H	Trinity	Gulf Coast	10,222	10,222	10,222	10,222	10,222	10,222
Fort Bend	*H*	*Brazos-Colorado*	*Gulf Coast*	*7,891*	*9,586*	*12,056*	*15,660*	*20,927*	*20,927*
Fort Bend	*H*	*Brazos*	*Gulf Coast*	*37,845*	*46,525*	*55,134*	*64,011*	*73,732*	*73,732*
Fort Bend	*H*	*San Jacinto-Brazos*	*Gulf Coast*	*40,844*	*45,913*	*50,471*	*54,218*	*57,258*	*57,258*
Fort Bend	*H*	*San Jacinto*	*Gulf Coast*	*17,362*	*17,532*	*17,497*	*17,445*	*17,430*	*17,430*
Galveston	*H*	*Neches-Trinity*	*Gulf Coast*	*0*[1]	*0*	*0*	*0*	*0*	*0*
Galveston	*H*	*San Jacinto-Brazos*	*Gulf Coast*	*6,788*	*7,435*	*8,060*	*8,646*	*9,181*	*9,181*
Grimes	G	Brazos	Gulf Coast	31,117	31,117	31,117	31,117	31,117	31,117
Grimes	G	San Jacinto	Gulf Coast	19,087	19,087	19,087	19,087	19,087	19,087
Grimes	G	Trinity	Gulf Coast	1,283	1,283	1,283	1,283	1,283	1,283
Hardin	I	Neches	Gulf Coast	37,571	37,571	37,571	37,571	37,571	37,571
Hardin	I	Trinity	Gulf Coast	150	150	150	150	150	150
Harris	*H*	*San Jacinto-Brazos*	*Gulf Coast*	*6,956*	*7,617*	*8,282*	*8,819*	*9,463*	*9,463*
Harris	*H*	*San Jacinto*	*Gulf Coast*	*280,676*	*187,992*	*199,990*	*208,033*	*216,067*	*216,067*

[1] A zero value in the table indicates the groundwater availability model pumping scenario did not include any pumping in that part of the aquifer.

Table 4: Modeled available groundwater for the Evangeline Aquifer portion of the Gulf Coast Aquifer summarized by county in Groundwater Management Area 14 for each decade between 2010 and 2060. Results are in acre-feet per year.

County	Year					
	2010	2020	2030	2040	2050	2060
Austin	20,013	20,013	20,013	20,013	20,013	20,013
Brazoria	2,271	2,271	2,271	2,271	2,271	2,271
Chambers	379	379	379	379	379	379
Fort Bend	30,923	32,789	30,420	31,166	32,251	32,313
Galveston	471	560	634	647	662	662
Grimes	3,002	3,002	3,002	3,002	3,002	3,002
Hardin	33,696	33,696	33,696	33,696	33,696	33,696
Harris	234,977	193,759	152,256	151,126	149,225	149,435
Jasper	40,755	40,755	40,755	40,755	40,755	40,755
Jefferson	100	100	100	100	100	100
Liberty	27,669	27,669	27,669	27,669	27,669	27,669

TABLE 3 (CONTINUED). MODELED AVAILABLE GROUNDWATER AND PROJECTED GROUNDWATER PUMPAGE VALUES (*IN ITALICS*) BY DECADE FOR THE GULF COAST AQUIFER SYSTEM IN GROUNDWATER MANAGEMENT AREA 14. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN.

County	RWPA	River Basin	Aquifer	2030	2040	2050	2060	2070	2080
Harris	*H*	*Trinity-San Jacinto*	*Gulf Coast*	*2,952*	*2,909*	*3,097*	*3,198*	*3,297*	*3,297*
Jasper	I	Neches	Gulf Coast	40,821	40,821	40,821	40,821	40,821	40,821
Jasper	I	Sabine	Gulf Coast	32,544	32,544	32,544	32,544	32,544	32,544
Jefferson	I	Neches-Trinity	Gulf Coast	13,571	13,571	13,571	13,571	13,571	13,571
Jefferson	I	Neches	Gulf Coast	1,853	1,853	1,853	1,853	1,853	1,853
Liberty	H	Neches-Trinity	Gulf Coast	2,053	2,053	2,053	2,053	2,053	2,053
Liberty	H	Neches	Gulf Coast	8,732	8,732	8,732	8,732	8,732	8,732
Liberty	H	San Jacinto	Gulf Coast	11,299	11,299	11,299	11,299	11,299	11,299
Liberty	H	Trinity-San Jacinto	Gulf Coast	10,544	10,543	10,543	10,544	10,544	10,544
Liberty	H	Trinity	Gulf Coast	39,032	39,031	39,032	39,032	39,032	39,032
Montgomery	H	San Jacinto	Gulf Coast	96,954	96,945	96,930	96,916	96,873	96,873
Newton	I	Neches	Gulf Coast	199	199	199	199	199	199
Newton	I	Sabine	Gulf Coast	37,309	37,309	37,309	37,309	37,309	37,309
Orange	I	Neches-Trinity	Gulf Coast	280	280	280	280	280	280
Orange	I	Neches	Gulf Coast	6,266	6,266	6,266	6,266	6,266	6,266
Orange	I	Sabine	Gulf Coast	18,659	18,659	18,659	18,659	18,659	18,659
Polk	I	Neches	Gulf Coast	16,765	16,765	16,765	16,765	16,765	16,765
Polk	H	Trinity	Gulf Coast	23,981	23,981	23,981	23,981	23,981	23,981
San Jacinto	H	San Jacinto	Gulf Coast	18,443	18,452	18,467	18,482	18,524	18,524
San Jacinto	H	Trinity	Gulf Coast	16,604	16,604	16,604	16,604	16,604	16,604
Tyler	I	Neches	Gulf Coast	34,390	34,390	34,390	34,390	34,390	34,390
Walker	H	San Jacinto	Gulf Coast	26,622	26,622	26,622	26,622	26,622	26,622
Walker	H	Trinity	Gulf Coast	15,881	15,881	15,881	15,881	15,881	15,881

Table 5: Modeled available groundwater for the Burkeville Confining Unit portion of the Gulf Coast Aquifer summarized by county in Groundwater Management Area 14 for each decade between 2010 and 2060. Results are in acre-feet per year.

County	Year					
	2010	2020	2030	2040	2050	2060
Austin	0	0	0	0	0	0
Fort Bend	0	0	0	0	0	0
Grimes	0	0	0	0	0	0
Hardin	0	0	0	0	0	0
Harris	335	329	256	249	254	254
Jasper	1	1	1	1	1	1
Liberty	0	0	0	0	0	0
Montgomery	0	0	0	0	0	0
Newton	0	0	0	0	0	0
Polk	744	744	744	744	744	744
San Jacinto	2,699	899	899	899	899	899
Tyler	1	1	1	1	1	1
Walker	0	0	0	0	0	0
Waller	0	0	0	0	0	0
Washington	368	368	368	0	0	0
Total	**4,148**	**2,342**	**2,269**	**1,894**	**1,899**	**1,899**

TABLE 3 (CONTINUED). MODELED AVAILABLE GROUNDWATER AND PROJECTED GROUNDWATER PUMPAGE VALUES (*IN ITALICS*) BY DECADE FOR THE GULF COAST AQUIFER SYSTEM IN GROUNDWATER MANAGEMENT AREA 14. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN.

County	RWPA	River Basin	Aquifer	2030	2040	2050	2060	2070	2080
Waller	H	Brazos	Gulf Coast	23,397	23,397	23,397	23,397	23,397	23,397
Waller	H	San Jacinto	Gulf Coast	32,136	32,136	32,136	32,136	32,136	32,136
Washington	G	Brazos	Gulf Coast	40,164	40,164	40,164	40,164	40,164	40,164
Washington	G	Colorado	Gulf Coast	233	233	233	233	233	233
GMA 14 Total			Gulf Coast Aquifer System	1,183,076	1,107,256	1,136,332	1,161,772	1,189,096	1,189,096

Table 13: Modeled available groundwater for the Burkeville Confining Unit portion of the Gulf Coast Aquifer, summarized by river basin in Groundwater Management Area 14 for each decade between 2010 and 2060. Results are in acre-feet per year.

River Basin	Year					
	2010	2020	2030	2040	2050	2060
Brazos	368	368	368	0	0	0
Brazos-Colorado	0	0	0	0	0	0
Colorado	0	0	0	0	0	0
Neches	119	119	119	119	119	119
Sabine	1	1	1	1	1	1
San Jacinto	335	329	256	249	254	254
San Jacinto-Brazos	0	0	0	0	0	0
Trinity	3,325	1,525	1,525	1,525	1,525	1,525
Trinity-San Jacinto	0	0	0	0	0	0
Total	**4,148**	**2,342**	**2,269**	**1,894**	**1,899**	**1,899**

Table 14: Modeled available groundwater for the Jasper Aquifer portion of the Gulf Coast Aquifer, summarized by river basin in Groundwater Management Area 14 for each decade between 2010 and 2060. Results are in acre-feet per year.

River Basin	Year					
	2010	2020	2030	2040	2050	2060
Brazos	20,312	20,312	20,312	20,312	20,312	20,312
Brazos-Colorado	76	76	76	76	76	76
Colorado	171	171	171	171	171	171
Neches	41,505	38,440	38,318	38,318	37,708	37,656
Sabine	15,717	15,717	15,679	15,679	15,679	15,679
San Jacinto	46,417	35,607	35,603	35,602	35,603	35,603
San Jacinto-Brazos	0	0	0	0	0	0
Trinity	31,601	31,601	31,060	30,714	30,714	30,714
Trinity-San Jacinto	0	0	0	0	0	0
Total	**155,799**	**141,924**	**141,219**	**140,872**	**140,263**	**140,211**

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.

Table 15: Modeled available groundwater for the Chicot Aquifer portion of the Gulf Coast Aquifer, summarized by groundwater conservation district (GCD) in Groundwater Management Area 14 for each decade between 2010 and 2060. Results are in acre-feet per year.

Groundwater Conservation District	Year					
	2010	2020	2030	2040	2050	2060
Bluebonnet GCD	1,600	1,600	1,600	1,600	1,600	1,600
Brazoria County GCD	48,125	48,125	48,125	48,125	48,125	48,125
Brazos Valley GCD	0	0	0	0	0	0
Lone Star GCD	1,482	1,722	1,722	1,722	1,722	1,722
Lower Trinity GCD	0	0	0	0	0	0
Southeast Texas GCD	12,599	12,599	12,599	12,599	12,599	12,599
Total (groundwater conservation districts)	**63,806**	**64,046**	**64,046**	**64,046**	**64,046**	**64,046**
Fort Bend Subsidence District	83,006	75,916	61,657	61,004	60,061	60,177
Harris-Galveston Coastal Subsidence District	74,522	73,536	62,083	63,835	66,337	66,425
No District	57,058	57,058	57,058	57,058	57,058	57,058
Total (all areas)	**278,392**	**270,556**	**244,844**	**245,943**	**247,502**	**247,706**

Table 16: Modeled available groundwater forthe Evangeline Aquifer portion of the Gulf Coast Aquifer, summarized by groundwater conservation district (GCD) in Groundwater Management Area 14 for each decade between 2010 and 2060. Results are in acre-feet per year.

Groundwater Conservation District	Year					
	2010	2020	2030	2040	2050	2060
Bluebonnet GCD	66,043	66,043	66,043	66,043	66,043	66,043
Brazoria County GCD	2,271	2,271	2,271	2,271	2,271	2,271
Brazos Valley GCD	0	0	0	0	0	0
Lone Star GCD	39,381	38,293	38,293	38,293	38,293	38,293
Lower Trinity GCD	16,489	16,489	16,489	16,489	16,489	16,489
Southeast Texas GCD	116,331	116,331	116,331	116,331	116,331	116,331
Total (groundwater conservation districts)	**240,515**	**239,427**	**239,427**	**239,427**	**239,427**	**239,427**
Fort Bend Subsidence District	30,923	32,789	30,420	31,166	32,251	32,313
Harris-Galveston Coastal Subsidence District	235,448	194,319	152,890	151,773	149,887	150,097
No District	32,591	32,591	32,591	32,591	32,591	32,591
Total (all areas)	**539,477**	**499,126**	**455,328**	**454,957**	**454,156**	**454,428**

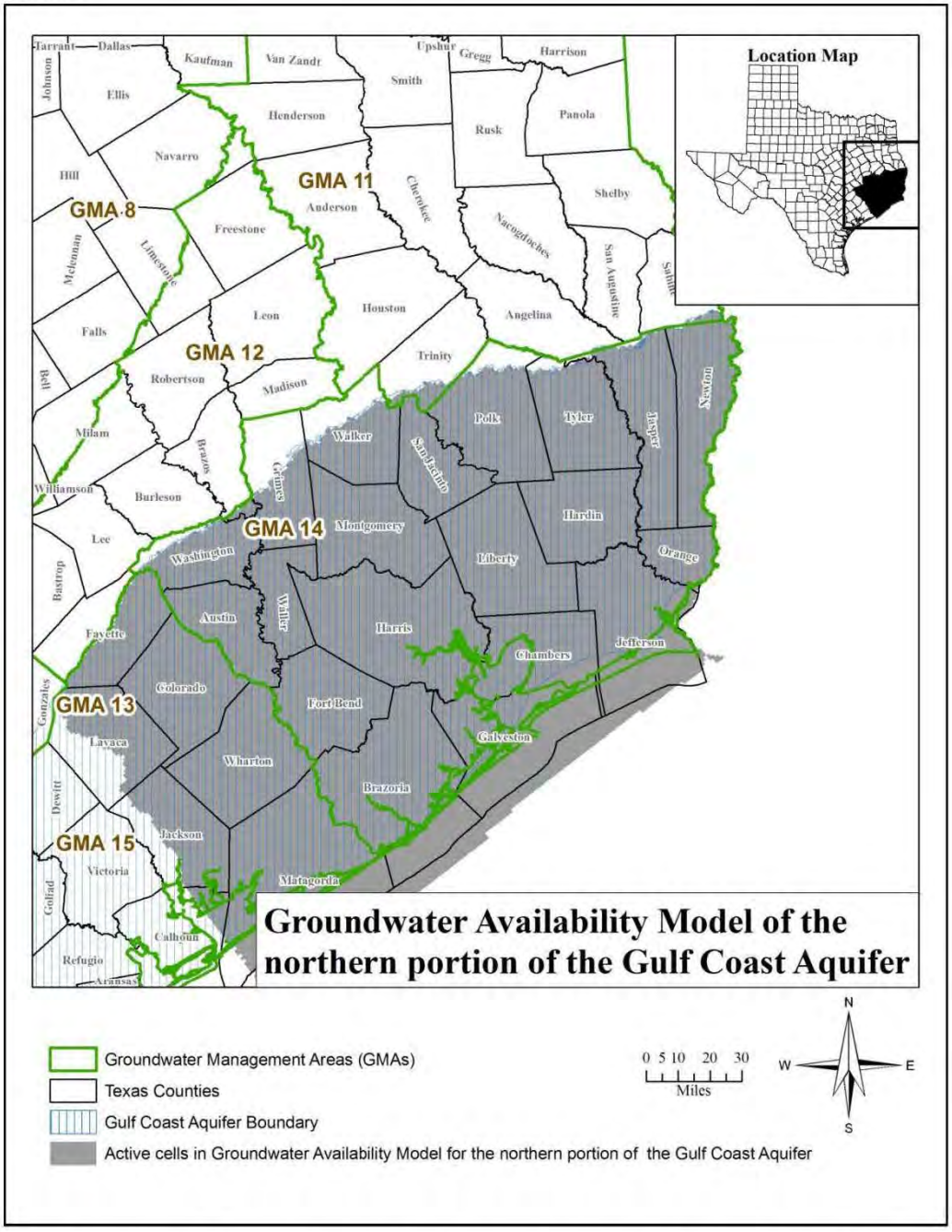


Figure 1: Map showing the areas covered by the groundwater availability model for the northern portion of the Gulf Coast Aquifer.

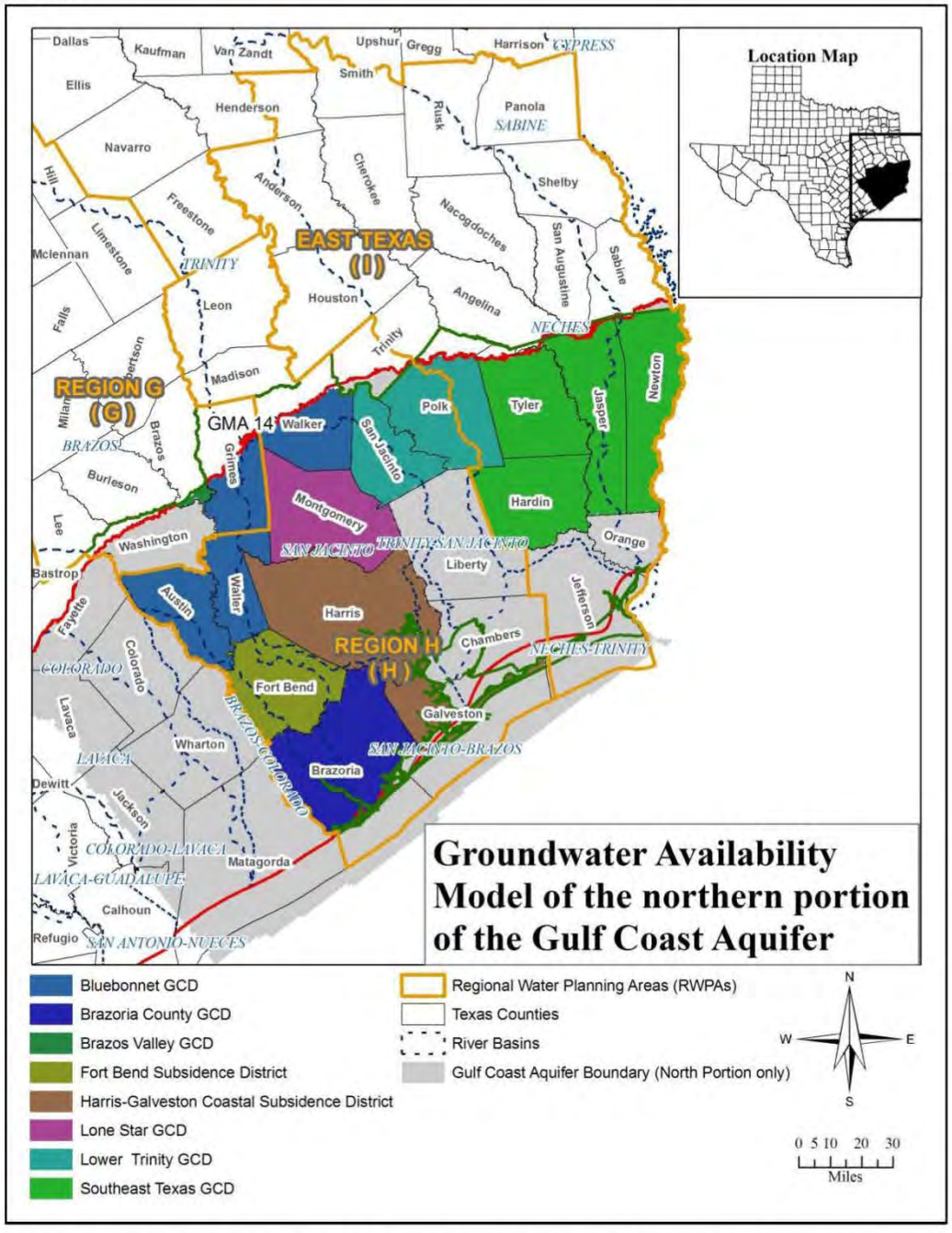


Figure 2: Map showing regional water planning areas (RWPAs), groundwater conservation districts (GCDs), subsidence districts, counties, and river basins in Groundwater Management Area 14.

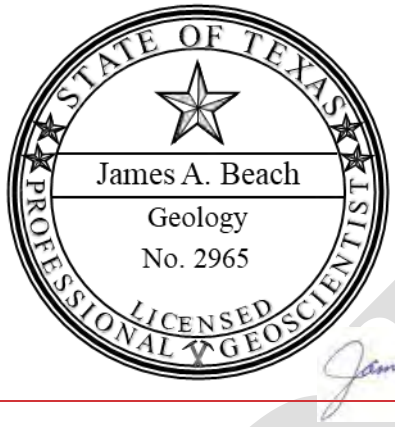
Appendix E – Certified copy of the Lone Star Groundwater Conservation District Resolution Adopting This Management Plan

Appendix F – Evidence of Management Plan Adoption after Notice and Hearing

Appendix G – Evidence of Coordination with Surface Water Management Entities

Appendix H – Professional Geoscientist Seal

Advanced Groundwater Solutions, LLC (AGS) assisted in the preparation of the Management Plan for the Lone Star Groundwater Conservation District.



The seal appearing on this document was authorized by James A. Beach, P.G. 2965 on April 7, 2023
Advanced Groundwater Solutions, LLC (TBPG Firm Registration No. 50639)