Brazos Valley Groundwater Conservation District

Groundwater Management Plan

ADOPTED

APPROVED BY THE TEXAS WATER DEVELOPMENT BOARD ON

____________________.

OBJECTIVES AMENDED BY ACTION OF THE BOARD ON

____________________.

BRAZOS VALLEY GROUNDWATER CONSERVATION DISTRICT

GROUNDWATER MANAGEMENT PLAN

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1. MISSION STATEMENT:

The Brazos Valley Groundwater Conservation District (BVGCD) was authorized to be created by the Texas Legislature to protect and conserve the groundwater resources of Robertson and Brazos counties through local management in concert with Groundwater Management Area 12 (GMA 12). The District directs its efforts toward preventing waste of water, collecting data, promoting water conservation, protecting existing water rights, and preventing irreparable harm to the aquifers. The District's rules and management plan are based on the best available science, the laws and rules in effect, and the area's beneficial needs.

2. TIME PERIOD FOR THIS PLAN:

This plan becomes effective upon adoption by the BVGCD Board of Directors and subsequent approval by the Texas Water Development Board (TWDB). The Management Plan is based on a ten-year planning period; however, the plan may be revised at any time to ensure that it is consistent with the applicable Regional Water plans, the State Water Plan, and additional science that may be developed. The District's Board of Directors shall re-adopt the management plan, with or without revisions, at least every five years.

3. STATEMENT OF GUIDING PRINCIPLES:

A vast majority of the residents of Brazos and Robertson counties rely solely on the local groundwater supplies to meet their drinking water needs and the majority of their industrial, agricultural, and livestock needs. Therefore, the local groundwater resources are vital to the Brazos Valley's growth, health, economy, and environment. The District believes this valuable resource can be managed in a reasonable manner through conservation, education, and regulation. The overall management goal will be to ensure a sustainable supply of water from local groundwater resources while recognizing the need to balance protection of rights of private landowners with the responsibility of managing the area's groundwater resources for future generations. A basic understanding of local aquifers and their hydrogeological properties, as well as quantification of available water supplies, is the foundation for development of prudent management strategies. The Carrizo-Wilcox Aquifer, as well as the minor aquifers in the area, must be conserved and preserved for future generations to the extent allowed by law and made possible through implementation of scientific data and information collected by the District. This Management Plan is intended as a tool for the District to provide continuity and consistency in decision making and to develop an understanding of local aquifer conditions for implementation of proper groundwater management policies.

The District has a responsibility to continually monitor aquifer conditions. As conditions warrant, this document may be modified to best serve the District in meeting its goals. At a minimum, the District Board will review and re-adopt this plan every five years.

4. DISTRICT INFORMATION

A. Creation

The BVGCD was originally created as a temporary District by the 76th Legislature in 1999 through Senate Bill 1911. The District then operated with all of the powers granted to groundwater conservation districts by Chapter 36 of the Texas Water Code (TWC), except the authority to adopt a management plan or levy an ad-valorem tax. The District was ratified by House Bill 1784 in the 77th Legislative Session in 2001 and was subsequently confirmed by the voters of both Brazos and Robertson counties in a general election held on November 5, 2002. The District was then granted full authorities afforded groundwater conservation districts by Chapter 36 of the TWC, limited only by provisions of the District's enabling legislation. The District's enabling act has been codified in Chapter 8835 of the Special Districts and Local Laws Code.

The District was created to implement proper management techniques at the local level to address groundwater needs that are vital to Brazos and Robertson counties. The District directs its efforts toward preventing waste of groundwater, collecting data, and providing education about water conservation, protecting existing water rights, and preventing irreparable harm to the aquifers. This plan provides a template for the District to follow, aiding in the development of an understanding of local aquifer conditions for implementation of proper groundwater management policies.

B. Location and Extent

The District encompasses Brazos and Robertson counties in Central Texas. The boundaries of the District are coterminous with the counties' boundaries. The District is bordered by Falls and Limestone counties to the North; Grimes and Washington counties to the South; Madison, Leon and Grimes counties to the East; and Milam and Burleson counties to the West. The District comprises an area of approximately 1,456 square miles or 932,000 acres.

C. Background

The District's Board of Directors consists of eight (8) members appointed by their respective County Commissioners Courts. Four (4) members represent Robertson County and four (4) members represent Brazos County. The directors are appointed to represent the following interests:

Robertson County

1. One must represent municipal interests in the county.
2. One must be a bona fide agricultural producer who derives a substantial portion of his or her income from agriculture in the county.
3. One must be an employee or director of a rural water supply corporation in the county.
4. One must represent active industrial interests in the county.

Brazos County

1. One must be an employee or director of a rural water supply corporation in the county.
2. One must be a bona fide agricultural producer who derives a substantial portion of his or her income from agriculture in the county.
3. The governing body of the City of Bryan, with the approval of the Brazos County Commissioners Court, shall appoint one Director.
4. The governing body of the City of College Station, with the approval of the Brazos County Commissioners Court, shall appoint one Director.

D. Authority/Regulatory Framework

In the preparation of its management plan, the District followed all procedures and satisfied all requirements of Chapter 36 of the TWC and Chapter 356 of the TWDB rules contained in Title 30 of the Texas Administrative Code (TAC). The District exercises the powers it was granted and authorized to use by and through the special and general laws that govern it, including Chapter 1307, Acts of the 77th Legislature, Regular Session, 2001, and Chapter 36 of the TWC.

E. Groundwater Resources of the Brazos Valley Groundwater Conservation District

The five significant aquifers within the District's boundaries are the Carrizo-Wilcox, Queen City, Sparta, Yegua-Jackson, and Brazos River Alluvium aquifers. The Simsboro Sand is the most prolific water-yielding unit and is part of the Carrizo-Wilcox Aquifer. The Brazos River Alluvium, located near the Brazos River, is the next most prolific aquifer. The Queen City, Sparta, and Yegua-Jackson aquifers provide small to large pumping rates of useable groundwater to wells, as noted in Groundwater Resources of Brazos and Burleson Counties, Texas, Report 185 (Follett, 1974). A large pumping rate is defined as 200 gallons per minute or more. The vertical sequence of geologic units in descending order is listed in *Figure 1*. The Carrizo-Wilcox (Simsboro Sand) and Sparta aquifers provide water for large capacity public water supply and agricultural wells. Water from the Yegua-Jackson Aquifer is used for domestic, livestock, irrigation, industrial, and some minor retail public water supply use. Brazos River Alluvium wells are used mostly for agricultural irrigation purposes. The outcrop of the Gulf Coast aquifer occurs in the very southern part of the District providing a small amount of water for domestic and livestock wells.

The primary freshwater aquifers consist of sandy fluvial and deltaic sediments, while marine silts and clays act as aquitards separating the water-yielding zones. The Wilcox Group, from the shallowest to the deepest, consists of the Calvert Bluff, Simsboro Sand, and Hooper aquifers. No freshwater aquifers are located below the Midway, which is a thick impermeable clay located at the base of the Hooper Aquifer. The Calvert Bluff Aquifer is comprised of clay, sandy clay, shale, silt, and sand. The Simsboro Sand is generally composed of sand, while the Hooper Aquifer is made up of sand, silt, clay, and shale. The Simsboro Sand is older than the Calvert Bluff, Carrizo, Queen City, Sparta, and Yegua-Jackson aquifers. The Carrizo Sand and Queen City Sand are separated by the Reklaw, which is a clay rich zone. The Cook Mountain Formation is composed of mostly clay separating the Sparta Sand and Yegua-Jackson aquifers. The Catahoula Sandstone or Catahoula Aquifer of the Gulf Coast Aquifer is composed of clay and sand in cross-bedded lenses. The Brazos River Alluvium can be found in a two to six mile wide zone of floodplain alluvial deposits along the Brazos River on the western boundary of the District. Sand, small gravel and clay compose the relatively thin Brazos River Alluvium. *Figure 2* illustrates a geologic cross section through Brazos and Robertson Counties and depicts the position, depth, thickness, and dip of the aquifers and confining units.

System	Series	Geologic Unit	Hydrogeologic Unit
Quaternary	Holocene	Flood-plain alluvium	Brazos River alluvium
	Pleistocene	Terrace deposits	
Tertiary	Miocene	Catahoula Sandstone	Gulf Coast aquifer
	Eocene	Jackson Group Whitsett Formation Manning Formation Wellborn Formation Caddell Formation	Yegua-Jackson aquifer
		Yegua Formation	
		Cook Mountain Formation	
		Sparta Sand	Sparta aquifer
		Weches Formation	
		Queen City Sand	Queen City aquifer
		Reklaw Formation	
		Carrizo Sand	Carrizo-Wilcox aquifer
		Wilcox Group Calvert Bluff Simsboro Hooper	

Figure 1: Geologic Units

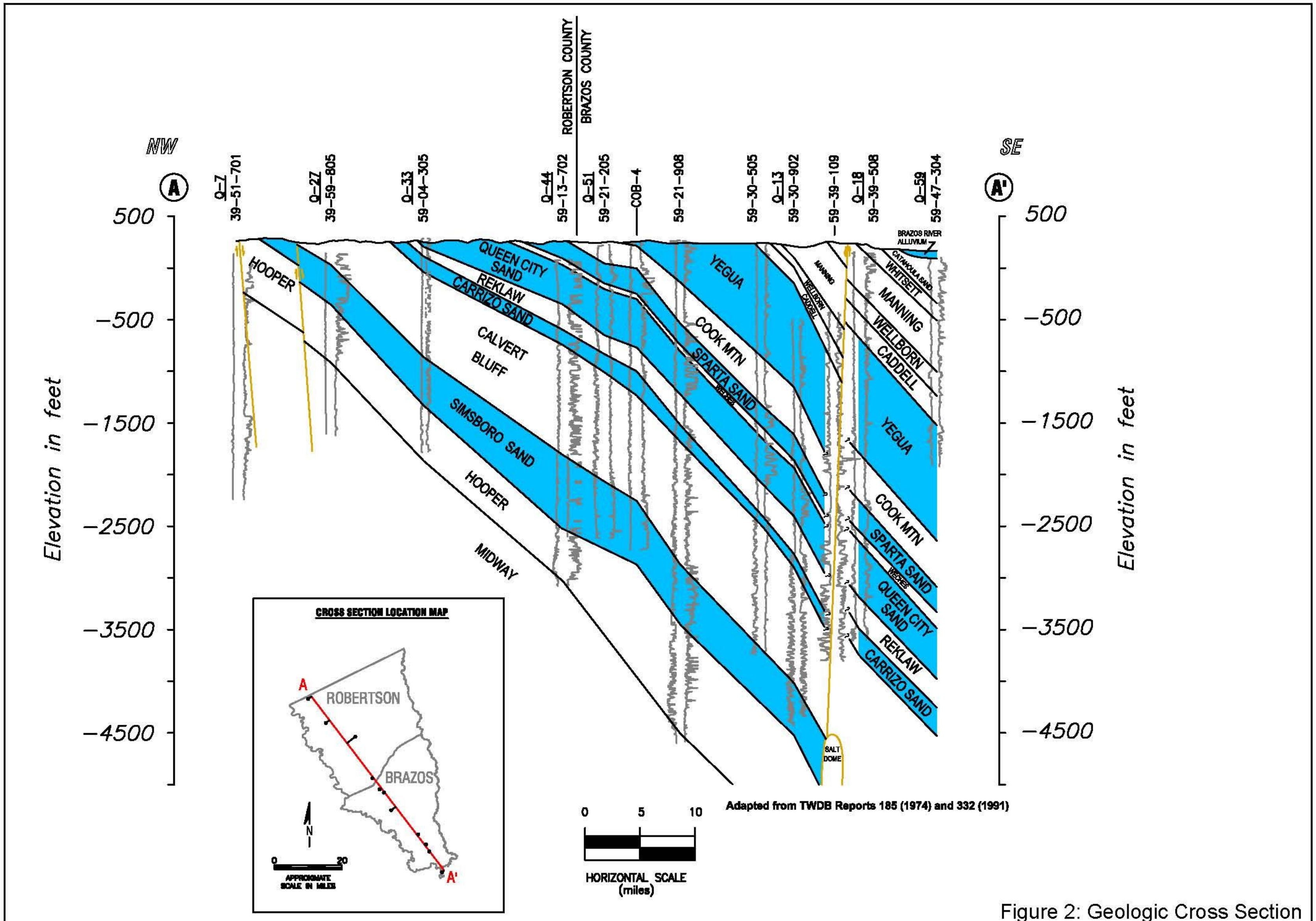
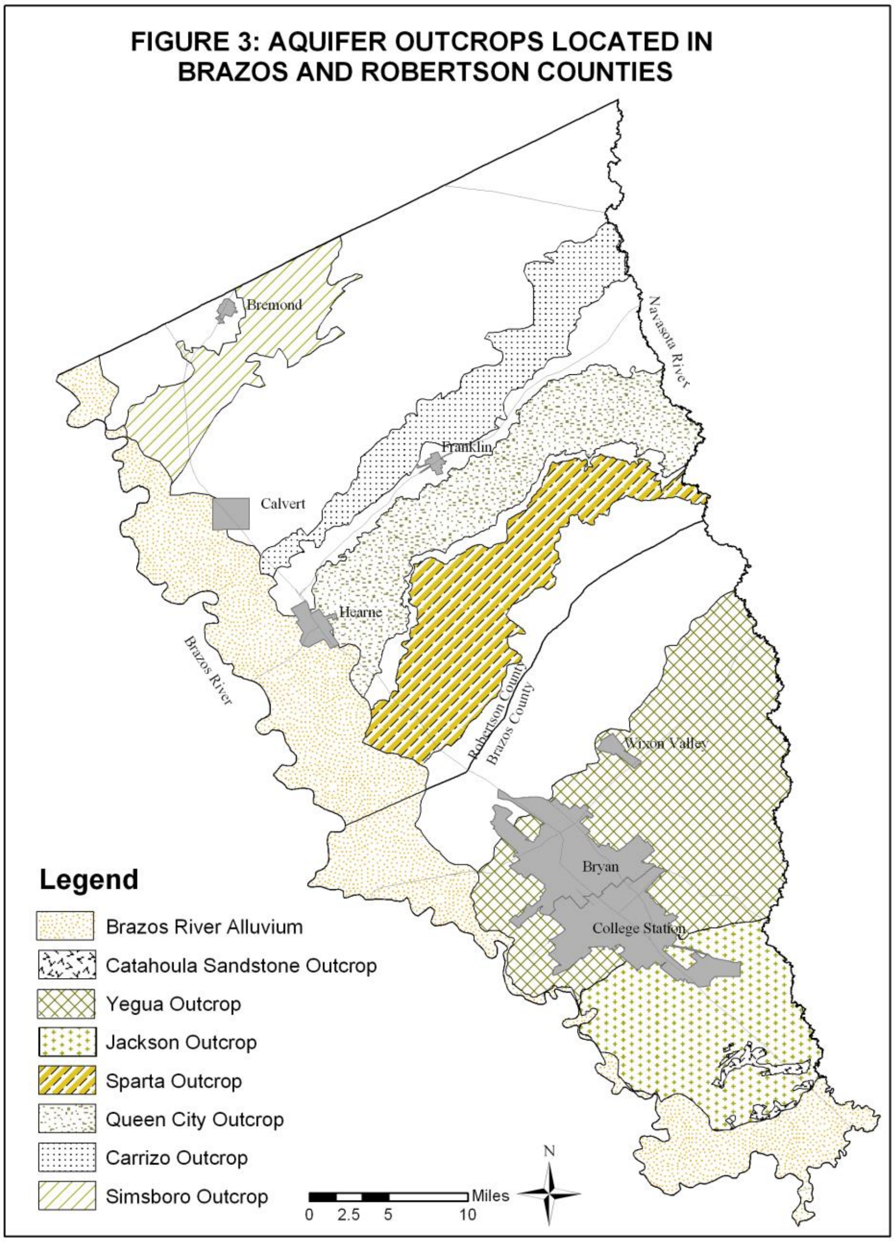


Figure 2: Geologic Cross Section

The Carrizo-Wilcox, Queen City, Sparta, and Yegua-Jackson aquifers outcrop within the Districts' boundaries in northeast to southwest trending belts paralleling the Gulf coastline. An aquifer outcrop map is included for Brazos and Robertson counties in *Figure 3*. The aquifer outcrops extend outside of the two counties shown on the map.



Younger aquifers outcrop closest to the coast. Older aquifers outcrop progressively further inland with increased age of the aquifer. The Catahoula Sandstone, which is the basal sand of the Gulf Coast Aquifer, occurs in a very limited area in the southern tip of Brazos County.

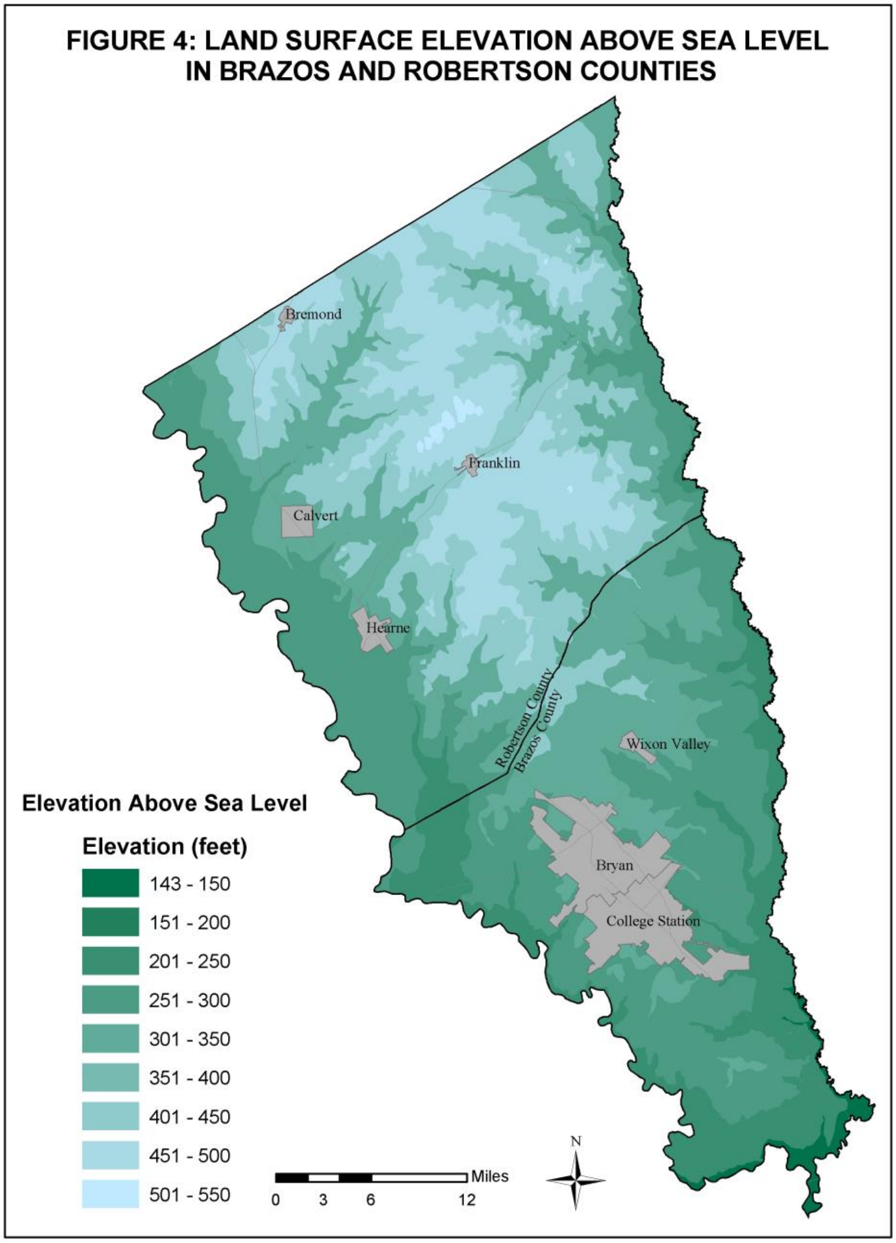
The general trend of the aquifers, with the exception of the Brazos River Alluvium, is to dip underground southeastward towards the Gulf Coast from their surface exposure. The aquifers dip at a maximum rate of about 110 feet per mile. Each aquifer underlies younger aquifers that have a similar dip toward the coast. A salt dome occurs in the southern part of Brazos County. The top of the salt dome has an elevation of about 4,600 feet relative to sea level. The thickness and position of the Simsboro Sand is influenced by the salt dome, but the dome occurs significantly down dip of the area where the Simsboro Sand contains potable quality groundwater.

Topography and Drainage

Natural topography in Brazos and Robertson counties range from gently hilly terrain in the center of the counties to relatively flat terrain along the Brazos and Navasota river corridors. The western border of the counties is the Brazos River and the eastern is the Navasota River. The land surface elevation above sea level for Brazos and Robertson counties is shown on *Figure 4*. Altitudes in the District range from about 140 feet to 550 feet above mean sea level, with higher elevations in the center of the counties.

Numerous creeks drain runoff into the Brazos River, west of the surface water drainage divide and into the Navasota River east of the divide. At the southernmost tip of Brazos County, the Navasota River merges with the Brazos River. Drainages include Carters Creek, Cedar Creek, Duck Creek, Mud Creek, Peach Creek, Pin Oak Creek, Spring Creek, Thompson Creek, Walnut Creek, Wickson Creek, and the Little Brazos River. The Little Brazos River drains Walnut Creek, Mud Creek, Pin Oak Creek, and Spring Creek into the Brazos River.

Carters Creek has a stream gradient of about 10 feet per mile towards the Navasota River from its origin in central Brazos County. Cedar Creek drains from central Robertson County through Brazos County to the Navasota River and has a stream gradient of about 9 feet per mile. Duck Creek has a stream gradient of about 7 feet per mile and drains northeast Robertson County into the Navasota River. Mud Creek drains central Robertson County into the Little Brazos River and has a stream gradient of about 10 feet per mile. Peach Creek has a stream gradient of about 12 feet per mile and drains southern Brazos County into the Navasota River. Pin Oak Creek drains southern Robertson County into the Little Brazos River and has a stream gradient of about 22 feet per mile. Spring Creek has a stream gradient of about 17 feet per mile and drains southern Robertson County into the Little Brazos River. Thompson Creek drains northwest Brazos County into the Brazos River and has a stream gradient of about 11 feet per mile. Walnut Creek has a stream gradient of about 7 feet per mile and drains northwestern Robertson County into the Little Brazos River. Wickson Creek drains central Brazos County into the Navasota River and has a stream gradient of about 8 feet per mile.



F. <u>Surface Water Supplies of Brazos and Robertson Counties</u>

Brazos and Robertson counties are within the Region G Regional Water Planning Group commonly designated as Brazos G. Each regional water group supplies their specific assessments to TWDB for incorporation into the State water plan.

Projected surface water supplies are the maximum amount of surface water available from existing sources for use during drought of record conditions that is physically and legally available for use. These are the existing surface water supply volumes that, without implementing any recommended water management strategies, could be used during a drought by water user groups located within the specified geographic area.

Surface water sources include any water resources where water is obtained directly from a surface water body. This would include rivers, streams, creeks, lakes, ponds, and tanks. In the State of Texas, all waters contained in a watercourse (rivers, natural streams and lakes, and storm water, flood water, and rainwater of every river, natural stream, canyon, ravine, depression, and watershed) are waters of the State and thus belong to the State. The State grants individuals, municipalities, water suppliers and industries the right to divert and use this water through water rights permits. Water rights are considered property rights and can be bought, sold, or transferred with state approval. These permits are issued based on the concept of prior appropriation, or "first-in-time, first-in-right." Because of the interruptible nature of these permits, water is not always available to all permit holders when low streamflow occurs. Water rights issued by the State generally fall into two major categories: run-of-river rights and stored water rights.

In addition to the water rights permits issued by the State, individual landowners may use State waters without a specific permit for certain types of uses. The most common of these uses is domestic and livestock use. These types of water sources are generally referred to as "Local Supply Sources". Many individuals with land along a river or stream that still have an old riparian right can also divert a reasonable amount of water for domestic and livestock uses without a permit.

5. REQUIRED ESTIMATES: 31 TAC 356.5(a)(5)(A)-(G)

A. Modeled Available Groundwater

Section 36.001 of the TWC defines modeled available groundwater (MAG) as "the amount of water that the Executive Administrator [of the TWDB] determines may be produced on an average annual basis to achieve a desired future condition established under §36.108." Desired future condition (DFC) is defined in §36.001 of the TWC as "a quantitative description, adopted in accordance with §36.108 of the Texas Water Code, of the desired condition of the groundwater resources in a management area at one or more specified future times." The District participates in the joint planning process in GMA 12, as defined per TWC §36.108, and established DFCs for aquifers within the District.

DFCs Adopted by GMA 12.

The District's current DFCs for the area covered by GMA 12 are the average drawdowns listed in *Table 1*. The average drawdowns are for a 70-year period beginning January, 2000 and ending December, 2069. For each of the aquifers, the DFC average drawdowns are for the area covered by each aquifer in Brazos and Robertson counties as defined by the stratigraphy used in the TWDB Groundwater Availability Models for the Central Queen City and Sparta aquifers and the Brazos River Alluvium Aquifer.

Table 1. Adopted Aquifer DFCs based on the Average Threshold that occurs between January, 2000 and December, 2069. Yegua-Jackson (2010-2069), Brazos River Alluvium (2013-2070)	**Artesian Head (ft)**
Sparta	12
Queen City	12
Carrizo	61
Upper Wilcox (Calvert Bluff Formation)	125
Middle Wilcox (Simsboro Formation)	295
Lower Wilcox (Hooper Formation)	207
Yegua-Jackson	Yegua – 70 Jackson – 114
Brazos Alluvium Aquifer	BVGCD Brazos and Robertson Counties Percent saturation above well depth shall average at least 30 percent for wells located north of State Highway 21 and 40 percent for wells located south of State Highway 21. If the percent saturation criteria are reached for three consecutive years then the DFC would be reached.

A. Resolution to Adopt Desired Future Conditions, October 5, 2017, letter from Gary Westbrook, General Manager, Post Oak Savannah GCD to Jeff Walker, Executive Administrator, Texas Water Development Board (Sparta, Queen City, Carrizo, Upper Wilcox, Middle Wilcox, Lower Wilcox, Yegua,, Jackson, and Brazos River Alluvium). .

The TWDB's **MAG Estimates** based on GMA 12 adopted DFCs GAM Run 17-030 MAG:

Carrizo

Modeled Available Groundwater for the Carrizo Aquifer summarized by county in GMA 12 for each decade between 2010 and 2069. Results are in ac-ft/yr.

County	2010	2020	2030	2040	2050	2060	2069
Brazos	1,196	3,717	3,724	3,737	3,761	3,763	3,763
Robertson	887	1,707	1,698	1,713	1,730	1,731	1,731

Calvert Bluff

Modeled Available Groundwater for the Calvert Bluff Aquifer summarized by county in GMA 12 for each decade between 2010 and 2069. Results are in ac-ft/yr.

County	2010	2020	2030	2040	2050	2060	2069
Brazos	0	0	0	0	0	0	0
Robertson	776	1,764	1,757	1,758	1,757	1,757	1,757

Simsboro

Modeled Available Groundwater for the Simsboro Aquifer summarized by county in GMA 12 for each decade between 2010 and 2069. Results are in ac-ft/yr.

County	2010	2020	2030	2040	2050	2060	2069
Brazos	35,086	41,115	44,120	45,681	50,208	53,404	53,404
Robertson	37,236	41,673	42,061	42,468	42,794	42,794	42,794

Hooper

Modeled Available Groundwater for the Hooper Aquifer summarized by county in GMA 12 for each decade between 2010 and 2069. Results are in ac-ft/yr.

County	2010	2020	2030	2040	2050	2060	2069
Brazos	0	0	0	0	0	0	0
Robertson	836	1,446	1,884	1,942	2,000	2,000	2,000

Queen City

Modeled Available Groundwater for the Queen City Aquifer summarized by county in GMA 12 for each decade between 2010 and 2069. Results are in ac-ft/yr.

County	2010	2020	2030	2040	2050	2060	2069
Brazos	541	836	883	887	891	891	891
Robertson	0	368	309	309	309	309	309

Sparta

Modeled Available Groundwater for the Sparta Aquifer summarized by county in GMA 12 for each decade between 2010 and 2069. Results are in ac-ft/yr.

County	2010	2020	2030	2040	2050	2060	2069
Brazos	3,745	5,404	6,505	7,507	8,509	8,509	8,509
Robertson	16	510	510	510	510	510	510

Yegua-Jackson

Modeled Available Groundwater for the Yegua-Jackson Aquifer summarized by county in GMA 12 for each decade between 2010 and 2069. Results are in ac-ft/yr.

County	2010	2020	2030	2040	2050	2060	2069
Brazos	6,863	6,856	6,854	6,854	6,854	6,854	6,854
Robertson	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Brazos River Alluvium

Modeled Available Groundwater for the Brazos River Alluvium Aquifer summarized by county in GMA 12 for each decade between 2013 and 2070. Results are in ac-ft/yr.

County	2013	2020	2030	2040	2050	2060	2070
Brazos	122,785	81,581	80,311	80,081	79,976	79,913	79,872
Robertson	66,608	61,161	57,959	57,633	57,544	57,503	57,480

B. Historical Water Use Data

Data from the TWDB Historical Water Use Survey, included in *Appendix B1*, provides annual historical water use projections from 2010 to 2016, the most recent years of record availability. The table includes groundwater and surface water accounting for municipal, manufacturing, steam electric, irrigation, mining, and livestock usage. Data presented in *Table 2* reflects groundwater use within the District from metered wells required to report water production to the District.

The data is for the 2011-2017 period and delineated by aquifer. Exempt well use (domestic, livestock, wells used for oil and gas rig supply) are not included. Brazos River Alluvium wells have no requirement to be metered and are not a part of *Table 2*.

Table 2. Metered Groundwater Use by Aquifer (ac-ft/yr)

Aquifer	2011	2012	2013	2014	2015	2016	2017
Hooper	621	956	794	1,065	1,084	909	756
Simsboro	69,378	53,327	64,107	62,946	56,638	54,237	53,326
Calvert Bluff	153	72	82	184	160	132	272
Carrizo	1,563	849	806	852	666	762	630
Queen City	582	69	64	497	190	100	237
Sparta	4,337	3,177	3,402	5,358	4,122	4,153	4,241
Yegua-Jackson	1,659	1,419	1,438	2,533	1,664	1,565	1,510
Totals	78,293	59,869	70,693	73,435	64,524	61,858	60,972

C. Annual Recharge from Precipitation

Scope: This is the recharge to aquifers from precipitation falling on outcrop areas of the aquifers within the District. Additional recharge to aquifers occurs in areas outside the District.

Methodology: Using data from the TWDB GAM Run 18-021, the annual estimated recharge is given in acre-feet per year (ac-ft/yr) in *Table 3*.

D. Annual Volume of Water Discharging to Surface Water

Scope: This includes groundwater discharging from each aquifer within the District to springs and surface water bodies including lakes, streams, and rivers.

Methodology: Using data from the TWDB GAM Run 18-021, *Table 3* summarizes the flow from each aquifer to surface water springs, lakes, streams, and rivers.

Table 3. GAM Recharge & Discharge Estimates

Management Plan Requirements	Aquifer or Confining Unit	Results ac-ft/yr
Estimated annual amount of recharge from precipitation to the District	Gulf Coast Aquifer System	40
	Yegua-Jackson Aquifer	26,512
	Sparta Aquifer	8,568
	Queen City Aquifer	10,391
	Carrizo-Wilcox Aquifer	47,122
	Brazos River Alluvium Aquifer	23,333
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	255
	Yegua-Jackson Aquifer	39,287
	Sparta Aquifer	12,874
	Queen City Aquifer	11,123
	Carrizo-Wilcox Aquifer	54,520
	Brazos River Alluvium Aquifer	33,859

Source: TWDB GAM Run 18-021

GAM Run 18-021 Recharge & Discharge Estimates

E. Annual Flow Into/Out and Between Aquifers

Scope: Flow into and out of the District is described as lateral flow within the aquifers between the District and adjacent counties. Flow between aquifers describes the vertical flow, or leakage, between aquifers. Flow into the District from each aquifer is provided in the *Table 4*.
Methodology: Using data from the TWDB GAM Run 18-021, annual flow into/out and between aquifers was calculated. Groundwater flow results are provided in *Table 4*.

Table 4. GAM Flow Estimates

Management Plan Requirements	Aquifer or Confining Unit	Results ac-ft/yr
Estimated annual volume of flow into the District within each aquifer in the District	Gulf Coast Aquifer System	332
	Yegua-Jackson Aquifer	12,069
	Sparta Aquifer	1,415
	Queen City Aquifer	3,046
	Carrizo-Wilcox Aquifer	32,600
	Brazos River Alluvium Aquifer	24,447
Estimated annual volume of flow out of the District within each aquifer in the District	Gulf Coast Aquifer System	48
	Yegua-Jackson Aquifer	9,923
	Sparta Aquifer	347
	Queen City Aquifer	1,211
	Carrizo-Wilcox Aquifer	10,109
	Brazos River Alluvium Aquifer	20,432

Estimated net annual volume of flow between each aquifer in the District	Flow into the Catahoula unit from the Jasper Aquifer[1]	46
	Flow from the Gulf Coast Aquifer System into the Brazos River Alluvium[2]	2,154
	Flow into the Yegua-Jackson Aquifer from the Catahoula and younger units	17
	Flow from the confined portion of the Yegua and Jackson groups into the Yegua-Jackson Aquifer	134
	Flow from the Yegua-Jackson Aquifer into the Brazos River Alluvium Aquifer[3]	2,399
	Flow from the Queen City Aquifer into the Sparta Aquifer	205
	Flow into the Sparta Aquifer from the underlying Weches Confining Unit	2,542
	Flow from the Sparta Aquifer into downdip Sparta units	8
	Flow from the Sparta Aquifer into overlying units	149
	Flow from the Sparta Aquifer into the Brazos River Alluvium Aquifer[4]	3,870
	Flow into the Queen City Aquifer from the Carrizo-Wilcox Aquifer	95
	Flow into the Queen City Aquifer from the underlying Recklaw Confining Unit	1,896
	Flow into the Queen City Aquifer from downdip Queen City units	30
	Flow from the Queen City Aquifer into the overlying Weches Confining Unit	2,818
	Flow from the Queen City Aquifer into the Sparta Aquifer	205
	Flow from the Queen City Aquifer into the Brazos River Alluvium Aquifer[5]	6,288
	Flow into the Carrizo-Wilcox Aquifer from downdip Carrizo-Wilcox units	2,537
	Flow from the Carrizo-Wilcox Aquifer into the overlying Reklaw Confining Unit	1,951
	Flow into the Queen City Aquifer from the	95

[1] Based on the general head boundary flux from the groundwater availability model for the Yegua-Jackson Aquifer. A part of the flow between the Catahoula confining system and the Jasper Aquifer represents flow between the Gulf Coast Aquifer System and the deeper units and part represents flow into the Gulf Coast Aquifer System.

[2] Flow based on water budget from the groundwater availability model for the Brazos River Alluvium.

[3] Flow based on water budget from the groundwater availability model for the Brazos River Alluvium.

[4] Flow based on water budget from the groundwater availability model for the Brazos River Alluvium.

[5] Flow based on water budget from the groundwater availability model for the Brazos River Alluvium.

	Carrizo-Wilcox Aquifer	
	Flow from the Carrizo-Wilcox Aquifer into the Brazos River Alluvium Aquifer[6]	2,290

Source: TWDB GAM Run 18-021

GAM Run 18-021 Flow Estimates

F. Projected Surface Water Supply

Surface water is currently allocated by the Texas Commission on Environmental Quality (TCEQ) for the use and benefit of all people of the State. Anyone seeking a new water right must submit an application to the TCEQ. The TCEQ then determines whether or not the permit will be issued and permit conditions. The water right grants a certain quantity of water to be diverted and/or stored, a priority date, and other conditions, which may include a maximum diversion rate and in stream flow restrictions to protect existing water rights and environmental flows.

The Brazos River Authority (BRA) is the largest surface water right holder within the District, holding most of the rights to the water within the Brazos River Basin, including the water in Lake Limestone in northeast Robertson County. There are several water rights within the District consisting primarily of irrigation rights along the rivers, steam electric, and water for public supply rights for surface water. The BRA contracts raw water to various entities for long and short-term supplies for municipal, industrial, and agricultural irrigation uses.

Wellborn Special Utility District (Wellborn) is currently the only retail water supply within the District utilizing surface water in addition to groundwater, holding a permit for 4,000 ac-ft/yr.

Projected surface water supplies are described in the 2017 State Water Plan and are referenced in a table provided by the TWDB in *Appendix B2*.

G. Projected Water Demands

The Brazos G Regional Water Planning Group (BGRWPG) and local water use data indicate that total water demands for the District will be 243,783 acre-feet, by the year 2070. This number includes use from all available groundwater and surface water sources within the District.

Current and projected water demands by user group within each county in the District through the year 2070 are described in *Appendix B3*. These estimates are in the current 2017 State Water Plan. Projected water demands were significantly adjusted in the 2017 State Water Plan regarding agricultural and public water supply needs and addressed the District's concerns relative to projected growth and current usage by these user groups. The District will continue to work to collect accurate data about current production as well as projected demands. This information will be provided to the TWDB for inclusion in future Regional and State water plans. As indicated in the regional water plan, these projections take into account population growth, rainfall, and conservation measures to be taken by each user group.

[6] Flow based on water budget from the groundwater availability model for the Brazos River Alluvium. The historical period used for averaging was 1980 through 2012.

H. Projected Water Supply Needs

The projected need for additional water supplies stated in the 2017 State Water Plan clearly indicates three primary areas of need; Agricultural irrigation, domestic/municipal use and potentially steam electric production. Each of these sectors faces their own hurdles and will meet their demand needs in different manners.

Agricultural irrigation will continue a pattern of conservation through best management practices. The industry is likely to use several methods to meet their needs including improved irrigation methods, dryland farming, crop selection and utilizing untapped groundwater water resources and potentially some surface water.

Municipalities and rural water supplier face decades of projected population increases. The water supply needs associated with the growth will likely be met using conservation methods including lowered gallons per day use per customer, aquifer storage and recovery, indirect and direct potable reuse projects, and further development of groundwater, with the available supply currently being assessed, and surface water resources.

Steam electric production in northern Robertson County could continue to grow, if it is cost competitive with other sources of electricity, due to the population growth throughout Texas and the favorable locations of the existing power plants with lignite deposits in close proximity or coal from out of state mines. Groundwater and surface water are readily available and likely sources of water to remedy any long term needs.

The District has considered the future needs projects in the 2017 State Water Plan and believes that further development of groundwater and surface water resources along with conservation practices will meet the projected needs. Monitoring of large scale production projects in GMA 12 will be an ongoing process.

Projected water supply needs, based on projections in the 2017 State Water Plan, are included in *Appendix B4*. Negative values (listed in red) indicate a projected water supply need, and additional water will be required to meet the demand. An updated groundwater availability model (GAM) was developed by the TWDB in 2018 for the Sparta, Queen City and Carrizo-Wilcox aquifers and Brazos River Alluvium for the area encompassing the District and all of GMA 12. The GAM will be used to reassess and most likely result in an increase in the estimates of the availability of groundwater. The anticipated increase in the groundwater supply can be used to help address water supply needs.

I. Projected Water Management Strategies to Meet Future Supply Needs

Demand and supply data developed as part of the Region G planning process in 2017, District records, and GMA 12 planning efforts indicate that groundwater and surface water supplies should be adequate to meet the recommended strategies. There will be a need for infrastructure improvements to provide water at higher rates as water demands increase. However, if current conditions and projected needs from the State Water Plan are low, these shortages will be satisfied by further development of groundwater and surface water resources. While there seems to be sufficient water resources today to meet the 50-year planning horizon, large scale water development projects, both within the District and in neighboring districts, could alter available water supplies. Hydrogeological studies indicate that as groundwater production approaches the estimates of water demands being developed as part of the GMA 12 process, some older production wells in the Simsboro Sand may need to be replaced due to declining water levels and limited available drawdown. As part of its long-range management strategy, the District will review changes in aquifer utilization and well water level changes to help estimate appropriate future well construction and possible need for a change in the water management strategy. Some water management strategies, as given in the 2017 State Water Plan, are included in *Appendix B5*.

J. <u>Natural or Artificial Recharge of Groundwater Resources</u>

1. Estimate of Average Recharge to the Groundwater Resources within the District.

Aquifers within the District receive recharge from infiltration of precipitation and water from streams that cross aquifer outcrops. Estimated locations of aquifer outcrops within the District are shown on *Figure 3*. Recharge to aquifers within the District can occur outside District boundaries as an aquifer outcrop extends to the north into an adjoining county or to the east and west of the District.

Estimates of recharge for the Carrizo-Wilcox Aquifer have been in the range of 3 to 5 inches per year based on groundwater flow modeling work. TWDB GAM Run 18-021 provides estimates of recharge for the aquifer systems. Based on areas of the aquifer outcrops within Robertson County, the resulting estimate of recharge to the Carrizo-Wilcox Aquifer is about 47,122 ac-ft/yr. Additional recharge occurs outside the District that contributes to the total recharge to the aquifer system.

The Queen City Aquifer is composed of fine-grained sands with interbedded clay. The outcrop area also can contain alternating areas of sands and other areas of lower permeability silt or clay. The TWDB GAM Run 18-021, estimates the recharge to the Queen City Aquifer within the District is about 10,391 ac-ft/yr. The Queen City Aquifer outcrop occurs over about 105 square miles in Robertson County.

The Sparta Aquifer is composed of quartz sand with a small amount of interbedded clay within the aquifer thickness. Recharge to the aquifer via infiltrated precipitation and stream flow is estimated at about 8,568 ac-ft/yr in the TWDB GAM Run 18-021. The estimated outcrop of the aquifer encompasses about 100 square miles within the District.

The Yegua-Jackson Aquifer is composed of sandstone, clay, and lignite beds in some areas. The outcrop area is extensive in Brazos County as shown on Figure 3. Estimated recharge to the Yegua-Jackson aquifer is about 26,512 ac-ft/yr, based on the TWDB GAM Run 18-021. The aquifer or overlying fluviatile terrace deposits outcrop over about 350 square miles in Brazos County.

The outcrop for the Catahoula sandstone of the Gulf Coast Aquifer System occurs in the very southern part of the District. In part of the outcrop area, either the Navasota River or Brazos River Alluvium has covered or washed away the surface sediments of the Catahoula sandstone. Most likely, some recharge to the buried sediments of the Gulf Coast Aquifer System occurs via leakage from the Navasota River or Brazos River Alluvium. It is estimated, based on the TWDB GAM Run 18-021 that recharge to the Gulf Coast Aquifer System is about 40 ac-ft/yr.

The Brazos River Alluvium, located in the area of the Brazos River floodplain encompasses about 140 square miles within Brazos and Robertson counties. Recharge to the Brazos River Alluvium is estimated to occur via infiltration of precipitation and stream flow. Recharge to the Brazos River Alluvium is about 23,333 ac-ft/yr based on the TWDB GAM Run 18-021.

GAM Run 18-021 Natural or Artificial Recharge of Groundwater Resources

2. How Natural or Artificial Recharge of Groundwater Within The District Might Be Increased.

Recharge enhancement may increase the amount of groundwater available from the aquifers within the District. Increasing recharge can be difficult in geologic environments that occur within the District because a large percentage of the potential recharge is rejected due to shallow water levels in the sediments of the aquifer outcrops or to the low permeability of sediments in some of the aquifer outcrops. Recharge might be enhanced by the construction of rainfall runoff retention structures on ephemeral streams. Further study of the surface geology and soil characteristics in the District may result in the identification of areas with porous soils that could provide sites for enhanced recharge or test sites for recharge investigations.

The District encourages and supports the use of Aquifer Storage and Recovery projects as a means of water conservation. This most likely would occur in the form of reuse of effluent produced by municipalities or industry.

6. MANAGEMENT OF GROUNDWATER SUPPLIES – 31 TAC 356.5(A)(6)

Groundwater conservation districts have statutorily been designated as Texas' preferred method of groundwater management through the rules developed, adopted, and promulgated by individual groundwater districts, as authorized by Chapter 36 of the TWC and the individual district's enabling act (TWC §36.0015). The BVGCD may manage groundwater supplies, in part, by regulating the spacing and production of wells, to minimize drawdown of the water table or reduction of artesian pressure, to control subsidence, to prevent interference between wells, to prevent degradation of water quality, or to prevent waste (TWC §36.116). The method of groundwater production regulation must be based on hydrogeological conditions of aquifers in the District. However, the District may preserve historic use (TWC §36.116(b)).

The BVGCD, as authorized by law, has adopted the following groundwater management strategy:

A. Availability Goal

The water availability goals of the District are expressed through the Desired Future Conditions adopted by the GMA 12 pursuant to §36.108 of the TWC.

B. Historic Use

The District shall preserve historic or existing groundwater use in the District before the effective date of the District's rules, to the maximum extent practicable.

C. <u>Pumping Rate Limit</u>

The District will regulate groundwater withdrawal through permitting efforts and by setting a maximum pumping rate limit of 3,300 gpm/well. New wells producing water from all District aquifers, excluding the Brazos River Alluvium, will be required to have land legally assigned to the well in an amount to be determined in relationship to the average annual production rate of the well.

D. <u>Beneficial Use</u>

The District will regulate groundwater withdrawal by setting production limits on wells based on evidence of beneficial use; and the District will continue to study various management methods including regulating groundwater production based on surface acreage which may become appropriate for effective management of groundwater withdrawal.

E. <u>Well Spacing</u>

The District will require well spacing on new water wells as follows:

1. A new well may not be drilled within 50 feet from the property line of any adjoining landowners;
2. Spacing of new wells completed in the Simsboro formation shall be spaced one foot per average annual gallons per minute from existing wells; and
3. Spacing of new wells completed in other formations (other than the Brazos River Alluvium) shall be spaced two feet per average annual gallons per minute from existing wells.

The District will incorporate these management strategies into its rules and will permit wells accordingly.

7. <u>METHODOLOGY TO TRACK DISTRICT PROGRESS IN ACHIEVING MANAGEMENT GOALS 31 TAC 356.5 (a)(6)</u>

An annual report will be developed by the General Manager and District staff and provided to the District's Board of Directors. The Annual Report will cover activities of the District including information on the District's performance regarding achieving the District's management goals and objectives. The Annual Report will be delivered to the District Board within 60 days following the completion of the District's fiscal year, beginning with the fiscal year that starts on January 1, 2018. A copy of the Annual Report will be kept on file and available for public inspection at the District's offices upon adoption.

8. <u>ACTIONS, PROCEDURES, PERFORMANCE, AND AVOIDANCE FOR DISTRICT IMPLEMENTATION OF MANAGEMENT PLAN 31 TAC 356.5 (a)(4)</u>

The District will act on goals and directives established in this District Management Plan. The District will use the objectives and provisions of the Management Plan as a guideline in its policy implementation and decision-making. In both its daily operations and long-term planning efforts, the District will continuously strive to comply with the initiatives and standards created by the Management Plan.

The District will amend rules in accordance with Chapter 36 of the TWC and rules will be followed and enforced. The District may amend the District rules as necessary to comply with changes to Chapter 36 of the TWC and to insure the best management of the groundwater within the District. Development and enforcement of the rules of the District will be based on the best scientific and technical evidence available to the District.

The District will encourage public cooperation and coordination in implementation of the District Management Plan. All operations and activities of the District will be performed in a manner that best encourages cooperation with appropriate state, regional, and local water entities, as well as landowners and the general public. Meetings of the District's Board of Directors will be noticed and conducted in accordance with the Texas Open Meetings Act. The District will also make available for public inspection all official documents, reports, records, and minutes of the District pursuant with the Texas Public Information Act.

For information concerning rules of the District, visit the District's website (https://brazosvalleygcd.org) or use the following hyperlink (Brazos Valley GCD Rules & Regulations).

9. MANAGEMENT GOALS AND OBJECTIVES 31 TAC 356.5(A)(1)

Unless indicated otherwise, performance on goals will be measured annually. The Management Plan will be subject to review at least every five years and modification will be made as deemed appropriate. Information describing programs, policies, and actions taken by the District to meet goals and objectives established by the District will be included in the Annual Report prepared by the General Manager and presented to the District's Board of Directors. Following District Board approval, the report will be made available to the County Commissioners Courts and general public.

A. Management Goals:

1. Implement Strategies Providing For the Most Efficient Use of Groundwater:

1a. **Objective** – Require all existing and new non-exempt wells constructed within the boundaries of the District to be permitted by the District and operated in accordance with District Rules. In addition, the District will encourage all exempt wells constructed within the District boundaries to be registered with the District.

- **Performance Standard** – The number of exempt and permitted wells registered within the District will be reported annually in the District's Annual Report submitted to the District Board of Directors.

1b. **Objective –** Regulate the production of groundwater by permitting wells within the District boundaries based on beneficial use and in accordance with District Rules. Each year the District will accept and process applications for permitted use of groundwater in the District, in accordance with the permitting process established by District rules. The District will regulate production of groundwater from permitted wells by verification of pumpage using meters.

- **Performance Standard –** Number and type of applications made for permitted use of groundwater in the District, number and type of permits issued by the District, and amount of groundwater permitted will be included in the Annual Report given to the District Board of Directors.

- **Performance Standard –** Actual annual pumpage from each metered well within the District will be reported annually and compared to the amount permitted for that well. This information will be included in the District's Annual Report submitted to the District Board of Directors.

1c. **Objective –** Conduct ongoing monitoring of aquifers underlying the District and current groundwater production within the District, and then assess the available groundwater that can be produced from each aquifer within the District after sufficient data are collected and evaluated. Using this data and information developed for GMA 12, the District will re-evaluate availability goals as necessary and will permit wells in accordance with appropriate production goals.

- **Performance Standard –** The District will conduct appropriate studies to identify issues and criteria needed to address groundwater management needs within the District's boundaries. Groundwater availability goals will take into consideration GMA 12 planning and research of hydrogeological and geologic characteristics of the aquifers, which may include, but not necessarily be limited to, amount of water use, water quality, and water level declines.

- **Performance Standard –** A progress report on the work of the District regarding groundwater availability will be written annually, as substantial additional data are developed. The progress report will be included in the Annual Report to the District Board of Directors.

2. **Implement Strategies to Control and Prevent Waste of Groundwater:**

2a. **Objective –** Apply a water use fee to the permitted use of groundwater in the District to encourage conservation-oriented use of groundwater resources to eliminate or reduce waste.

- **Performance Standard –** Each year the District will apply a water use fee to the non-exempt permitted use of groundwater produced within the District pursuant to District rules. The amount of fees generated and amount of water produced for each type of permitted use will be a part of the Annual Report presented to the District Board of Directors.

2b. **Objective –** Evaluate District rules annually to determine whether any amendments are necessary to decrease the amount of waste within the District.

- **Performance Standard –** The District will include a discussion of the annual evaluation of District rules, and determination of whether any amendments to the rules are necessary to prevent waste of groundwater. The evaluation will be included in the Annual Report provided to the District Board of Directors.

2c. **Objective** – Provide information to the general public and schools within the District on wise use of water to eliminate and reduce wasteful practices.

- **Performance Standard** – The District will include a page on the District's web-site devoted to wise use of water and providing tips to help eliminate and reduce wasteful use of groundwater. The District will provide information to local school districts including providing Texas Education Agency approved water curriculum and in-school presentations to encourage wise use of water and understanding of the significance of aquifers to District residents.

3. **<u>Implement Strategies to Address Conjunctive Surface Water Management Issues:</u>**

3a. **Objective** – Encourage the use of surface water supplies where available, to meet the needs of specific user groups within the District.

- **Performance Standard** – The District will participate in the Region G Regional Water Planning process by attending at least one BGRWPG meeting annually and will encourage the development of surface water supplies where appropriate. This activity will be noted in the Annual Report presented to the District Board of Directors.

4. **<u>Implement Strategies to Address Natural Resource Issues which Impact the Use and Availability of groundwater, and which are Impacted by the Use of Groundwater</u>**

4a. **Objective** – Determine if there are any natural spring flows within the District that may be impacted by increased groundwater pumping.

- **Performance Standard –** Annually monitor water levels in at least two (2) wells near natural spring flows, if found, for potential impact from groundwater production. Prepare an annual assessment statement and include in the Annual Report to the District Board of Directors.

5. **<u>Implement Strategies to Address Drought Conditions:</u>**

5a. **Objective** – A District staff member will download at least one Palmer Drought Severity Index (PDSI) map monthly. The Palmer Drought Severity Index map will be used to monitor drought conditions and will be used by the Board to determine trigger conditions provided by the District Drought Contingency Plan.

- **Performance Standard** –District staff will make an assessment of drought conditions in the District and will brief the District Board at each regularly scheduled board meeting.

5b. **Objective** – Require 100 percent of entities that are mandated by the State of Texas to have drought contingency plans, to submit those plans to the District or follow the District's plan when applying for a permit from the District for water production.

- **Performance Standard** – Review 100 percent of the drought contingency plans submitted as a result of permitting, whenever permit applications for water production are received. The number of drought contingency plans required to be submitted by permitted entities to the District as part of the well permitting process and the number of drought contingency plans actually submitted to the District will be described in the Annual Report to the District Board.

5c. **Objective** – The District drought contingency plan will be reviewed for effectiveness and needed updates at least once every three years.

- **Performance Standard –** A report summarizing findings of the review of the District drought contingency plan will be included in the Annual Report to the District Board of Directors. Additional drought information sources are available at: https://waterdatafortexas.org/drought **.**

6. **Implement Strategies to Promote Water Conservation:**

6a. **Objective -** Require 100 percent of water applicants requesting a permit for water production within the District to submit a water conservation plan, unless one is already on file with the District at the time of the permit application, or agree to comply with the District Water Conservation Plan.

- **Performance Standard** – Review 100 percent of the water conservation plans submitted as a result of permit requirements to ensure compliance with permit conditions. Number of water conservation plans required to be submitted by water permittees to the District that year as part of the well permitting process and number of water conservation plans actually submitted to the District will be reported in the Annual Report to the District Board of Directors. If the water permittee chooses to agree to follow the District Water Conservation Plan in lieu of submitting a water conservation plan, then that number will be indicated in the Annual Report to the District Board.

6b. **Objective** – Develop a system for measurement and evaluation of groundwater supplies.

- **Performance Standard** – Water level monitoring wells will be identified for Brazos River Alluvium, Yegua-Jackson, Sparta, Queen City, Carrizo, Calvert Bluff, Simsboro, and Hooper aquifers. At least two (2) wells per aquifer will be monitored on an annual basis to track changes in static water levels.

6c. **Objective** – Assist in funding and obtaining grant funds for the implementation of water conservation methods. Work with the appropriate state and federal agencies to facilitate bringing grant funds to various groups within the District boundaries to develop and implement water conservation methods. Work with local entities to help develop plans for obtaining grant funding from the District. The District will meet with at least one state or federal agency annually to discuss bringing water conservation methods grant funds into the District.

- **Performance Standard** – Number of meetings held annually with at least one state or federal agency and the number of grants for water conservation methods applied for and obtained will be included in the Annual Report to the District Board of Directors.

- **Performance Standard** – The District will address potential District grant funding for water conservation projects upon request by and/or submission to the District. Following proposal submission, applications will be reviewed for possible District Board approval. The number of water conservation projects submitted and the number of projects approved for grant funding by the District will be reported in the Annual Report to the District Board.

7. <u>Implement Strategies to Protect Water Quality:</u>

7a. **Objective** - Develop baseline water quality data and a system for continued evaluation of groundwater quality.

- **Performance Standard** – Develop general understanding of water quality within aquifers in the District based on TCEQ, TWDB, and other data. Coordinate with TCEQ on water quality issues.

7b. **Objective –** Require all water permittees that are required by the TCEQ to have well vulnerability studies prior to constructing a well, to provide evidence of the study to the District prior to construction of a well within the District.

- **Performance Standard** – Review all vulnerability studies submitted as a result of permit requirements to help ensure water quality protection.

7c. **Objective** – Provide information to the general public and schools within the District on the importance of protecting water quality.

- **Performance Standard** – The District will include a page on the District's web-site devoted to water quality issues and will provide information to permittees on wellhead protection. The District will provide in-school presentations addressing aquifer contamination and aquifer protection.

8. <u>Implement Strategies to Assess Adopted Desired Future Conditions</u>

8a. **Objective** - At least once every three years, the District will evaluate well water level monitoring data and determine whether the change in water levels is in general conformance with the DFCs adopted by the District. The District will estimate total annual groundwater production for each aquifer based on the water use reports, estimated exempted use, and other relevant information, and compare these production estimates to the MAGs.

- **Performance Standard** – At least once every three years, the General Manager will report to the District Board the water level data obtained from the monitoring wells in each aquifer, the average artesian head change for each aquifer calculated from the water levels of the monitoring wells in each aquifer, a comparison of the average artesian head change for each aquifer with the DFCs for each aquifer, and the District progress in conforming with the DFCs.

- **Performance Standard** – At least once every year, the General Manager will report to the District Board the total permitted groundwater production and the estimated total annual groundwater production for each aquifer and compare these amounts to the MAGs.

B. <u>Management Goals Determined Not to be Applicable to the Brazos Valley Groundwater Conservation District</u>

1. Controlling and Preventing Subsidence:

The Carrizo, Simsboro and Brazos River alluvium are aquifers in the District that have and will continue to provide moderate to large amounts of water to wells. The formations that compose the aquifers are principally sand or some gravel for the Brazos River alluvium, with only minor amounts of clay in the Carrizo or Simsboro aquifers and surficial clays for the Brazos River alluvium. With the minor amounts of clay or surficial clays in the formations that compose the aquifers, there is not a significant risk of subsidence occurring due to groundwater pumping. The report "Controlling and Preventing Subsidence" prepared by the Texas Water Development Board was reviewed while considering the potential for significant subsidence occurring due to groundwater pumping.

2. Rainwater Harvesting:

With average annual precipitation in the District about 39 inches, a goal of rainwater harvesting is not applicable at this time.

3. Recharge Enhancement:

With an average annual precipitation of about 39 inches and outcrop areas of the Carrizo-Wilcox limited to the northern part of Robertson County, this goal in not applicable at this time. The exception would be the utilization of Aquifer Storage and Recovery projects.

4. Precipitation Enhancement:

With the high amount of annual rainfall in the District, precipitation enhancement does not appear to be needed. This goal is therefore not applicable at this time.

5. Brush Control:

A significant amount of the District's area is heavily forested with other areas in improved pasture or cultivated land. Brush control, as a goal, in not applicable at this time.

APPENDIX A

DEFINITIONS, ACRONYMS and ABBREVIATIONS

Definitions

Desired Future Condition – “a quantitative description, adopted in accordance with §36.108 of the Texas Water Code, of the desired future condition of the groundwater resources in a management area at one or more specified future times” as defined in §36.001 of the Texas Water Code.

Modeled Available Groundwater – “the amount of water that the Executive Administrator (of the TWDB) determines may be produced on an annual average basis to achieve a desired future condition established under §36.108”.

Data Definitions*

Projected Water Demands*

From the 2017 State Water Plan Glossary: “**WATER DEMAND – “**Quantity of water projected to meet the overall necessities of a water user group in a specific future year.” (See 2017 State Water Plan Chapter 5 for more detail.)
Additional explanation: These are water demand volumes as projected for specific Water User Groups in the 2016 Regional Water Plans. This is NOT groundwater pumpage or demand based on any existing water source. This demand is how much water each Water User Group is projected to require in each decade over the planning horizon.

Projected Surface Water Supplies*

From the 2017 State Water Plan Glossary: “**EXISTING *[surface]* WATER SUPPLY -** Maximum amount of *[surface]* water available from existing sources for use during drought of record conditions that is physically and legally available for use.” (See 2017 State Water Plan Chapter 6 for more detail.)
Additional explanation: These are the existing surface water supply volumes that, without implementing any recommended WMSs, could be used during a drought (in each planning decade) by Water User Groups located within the specified geographic area.

Projected Water Supply Needs*

From the 2017 State Water Plan Glossary: “**NEEDS -**Projected water demands in excess of existing water supplies for a water user group or a wholesale water provider.” (See 2017 State Water Plan Chapter 7 for more detail.)
Additional explanation: These are the volumes of water that result from comparing each Water User Group’s projected existing water supplies to its projected water demands. If the volume listed is a negative number, then the Water User Group shows a projected need during a drought if they do not implement any water management strategies. If the volume listed is a positive number, then the Water User Group shows a projected surplus. Note that if a Water User Group shows a need in any decade, then they are considered to have a potential need during the planning horizon, even if they show a surplus elsewhere.

Projected Water Management Strategies*

From the 2017 State Water Plan Glossary: “**RECOMMENDED WATER MANAGEMENT STRATEGY -** Specific project or action to increase water supply or maximize existing supply to meet a specific need.” (See 2017 State Water Plan Chapter 8 for more detail.)
Additional explanation: These are the specific water management strategies (with associated water volumes) that were recommended in the 2016 Regional Water Plans.
**Terminology used by TWDB staff in providing data for ‘Estimated Historical Water Use And 2017 State Water Plan Datasets’ reports issued by TWDB.*

Acronyms

BGRWPG – Brazos G Regional Water Planning Group

BRA – Brazos River Authority

BVGCD – Brazos Valley Groundwater Conservation District

DFC(s) – Desired Future Condition(s)

MAG – Modeled Available Groundwater

GAM – Groundwater Availability Model

GCD – Groundwater Conservation District

GMA 12 – Groundwater Management Area 12

TAC – Texas Administrative Code

TWC – Texas Water Code

TWDB – Texas Water Development Board

Abbreviations

ac-ft/yr – acre feet per year

gpm – gallons per minute

APPENDIX B1

Estimated Historical Water Use

Estimated Historical Water Use And 2017 State Water Plan Datasets:

Brazos Valley Groundwater Conservation District

by Stephen Allen
Texas Water Development Board
Groundwater Division
Groundwater Technical
Assistance Section
stephen.allen@twdb.texas.gov
(512) 463-7317
January 23, 2019

GROUNDWATER MANAGEMENT PLAN DATA:

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

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

The five reports included in this part are:

1. Estimated Historical Water Use (checklist item 2)

   from the TWDB Historical Water Use Survey (WUS)

2. Projected Surface Water Supplies (checklist item 6)
3. Projected Water Demands (checklist item 7)
4. Projected Water Supply Needs (checklist item 8)
5. Projected Water Management Strategies (checklist item 9)

   from the 2017 Texas State Water Plan (SWP)

Part 2 of the 2-part package is the groundwater availability model (GAM) report for the District (checklist items 3 through 5). The District should have received, or will receive, this report from the Groundwater Availability Modeling Section. Questions about the GAM can be directed to Dr. Shirley Wade, shirley.wade@twdb.texas.gov, (512) 936-0883.

DISCLAIMER:

The data presented in this report represents the most up-to-date WUS and 2017 SWP data available as of 1/23/2019. Although it does not happen frequently, either of these datasets are subject to change pending the availability of more accurate WUS data or an amendment to the 2017 SWP. District personnel must review these datasets and correct any discrepancies in order to ensure approval of their groundwater management plan.

The WUS dataset can be verified at this web address:

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

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

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

Estimated Historical Water Use

TWDB Historical Water Use Survey (WUS) Data

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

BRAZOS COUNTY

All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2016	GW	35,512	1,368	253	80	31,585	432	69,230
	SW	474	0	28	422	1,327	801	3,052
2015	GW	35,131	1,310	1,096	78	17,310	426	55,351
	SW	739	0	122	387	984	791	3,023
2014	GW	34,446	1,158	1,640	91	31,734	414	69,483
	SW	397	0	182	301	2,244	769	3,893
2013	GW	34,521	1,299	611	75	45,229	407	82,142
	SW	794	0	67	159	1,751	756	3,527
2012	GW	33,826	1,422	52	114	34,442	386	70,242
	SW	943	0	4	307	2,873	716	4,843
2011	GW	38,521	1,770	134	114	38,700	486	79,725
	SW	974	0	349	307	3,702	902	6,234
2010	GW	32,667	1,666	82	123	31,834	482	66,854
	SW	0	0	211	112	3,707	896	4,926
2009	GW	33,324	1,947	75	101	28,181	414	64,042
	SW	0	0	192	104	1,434	770	2,500
2008	GW	32,573	2,066	67	126	24,019	368	59,219
	SW	0	0	173	214	1,615	683	2,685
2007	GW	28,689	2,184	1	149	25,638	502	57,163
	SW	0	0	0	472	260	932	1,664
2006	GW	31,592	2,100	1	249	25,168	550	59,660
	SW	0	0	0	426	1,043	1,022	2,491
2005	GW	42,095	2,118	1	347	28,498	480	73,539
	SW	0	0	0	441	981	891	2,313
2004	GW	27,041	2,144	1	381	18,854	494	48,915
	SW	0	0	0	0	626	740	1,366
2003	GW	25,624	2,084	1	145	9,706	497	38,057
	SW	0	0	0	434	1,361	745	2,540
2002	GW	37,539	2,001	1	52	5,555	404	45,552
	SW	13	0	0	75	1,138	606	1,832
2001	GW	28,813	94	10	248	5,394	413	34,972
	SW	47	0	0	260	1,105	619	2,031

ROBERTSON COUNTY

All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2016	GW	2,199	35	3,324	5,185	63,188	830	74,761
	SW	0	0	51	28,392	628	1,937	31,008
2015	GW	2,434	40	3,056	5,672	44,752	807	56,761
	SW	0	0	28	22,567	1,405	1,882	25,882
2014	GW	2,741	45	156	5,317	63,183	787	72,229
	SW	0	0	65	31,713	2,765	1,836	36,379
2013	GW	2,394	43	135	4,752	85,426	788	93,538
	SW	0	0	56	30,193	3,000	1,840	35,089
2012	GW	2,387	39	213	3,952	62,023	812	69,426
	SW	0	0	77	29,327	2,051	1,895	33,350
2011	GW	2,632	44	415	5,206	93,264	1,107	102,668
	SW	0	0	6	40,660	4,586	2,583	47,835
2010	GW	2,375	51	15,185	342	76,833	1,077	95,863
	SW	0	0	114	22,059	2,780	2,514	27,467
2009	GW	2,709	88	14,821	190	62,036	484	80,328
	SW	0	0	113	6,219	7,750	1,130	15,212
2008	GW	2,847	3,882	15,691	14	62,627	508	85,569
	SW	0	85	113	154	0	1,185	1,537
2007	GW	2,663	4,619	7,734	2	56,934	396	72,348
	SW	0	136	0	0	1,691	925	2,752
2006	GW	2,948	4,613	7,676	1	58,391	487	74,116
	SW	0	136	0	0	1,163	1,137	2,436
2005	GW	3,007	3,660	7,676	0	60,246	542	75,131
	SW	0	107	0	0	9,353	1,265	10,725
2004	GW	2,702	4,151	7,475	0	40,411	750	55,489
	SW	0	305	0	0	9,266	1,126	10,697
2003	GW	2,809	4,769	7,584	0	18,425	721	34,308
	SW	0	0	0	0	9,332	1,083	10,415
2002	GW	2,910	4,802	7,554	1	23,624	613	39,504
	SW	0	0	0	0	3,222	921	4,143
2001	GW	2,845	4,692	8,291	0	20,541	590	36,959
	SW	0	174	0	0	2,801	885	3,860

APPENDIX B2

Projected Surface Water Supplies

Projected Surface Water Supplies
TWDB 2017 State Water Plan Data

BRAZOS COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070
G	IRRIGATION, BRAZOS	BRAZOS	BRAZOS RIVER AUTHORITY MAIN STEM LAKE/RESERVOIR SYSTEM	350	349	347	346	345	344
G	LIVESTOCK, BRAZOS	BRAZOS	BRAZOS LIVESTOCK LOCAL SUPPLY	1,322	1,322	1,322	1,322	1,322	1,322
G	STEAM ELECTRIC POWER, BRAZOS	BRAZOS	DANSBY POWER PLANT/BRYAN UTILITIES LAKE/RESERVOIR	85	85	85	85	85	85
G	WELLBORN SUD	BRAZOS	BRAZOS RIVER AUTHORITY MAIN STEM LAKE/RESERVOIR SYSTEM	938	938	938	938	938	938
	Sum of Projected Surface Water Supplies (acre-feet)			**2,695**	**2,694**	**2,692**	**2,691**	**2,690**	**2,689**

ROBERTSON COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070
G	IRRIGATION, ROBERTSON	BRAZOS	BRAZOS RUN-OF-RIVER	535	535	535	535	535	535
G	LIVESTOCK, ROBERTSON	BRAZOS	BRAZOS LIVESTOCK LOCAL SUPPLY	1,612	1,612	1,612	1,612	1,612	1,612
G	STEAM ELECTRIC POWER, ROBERTSON	BRAZOS	BRAZOS RIVER AUTHORITY MAIN STEM LAKE/RESERVOIR SYSTEM	25,000	24,819	24,638	24,457	24,275	24,094
G	STEAM ELECTRIC POWER, ROBERTSON	BRAZOS	TWIN OAK LAKE/RESERVOIR	2,885	2,867	2,749	2,831	2,813	2,795
G	WELLBORN SUD	BRAZOS	BRAZOS RIVER AUTHORITY MAIN STEM LAKE/RESERVOIR SYSTEM	182	182	182	182	182	182
	Sum of Projected Surface Water Supplies (acre-feet)			**30,214**	**30,015**	**29,716**	**29,617**	**29,417**	**29,218**

<u>APPENDIX B3</u>

Projected Water Demands

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.

BRAZOS COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
G	BRYAN	BRAZOS	15,696	16,243	20,342	23,492	26,926	30,652
G	COLLEGE STATION	BRAZOS	19,178	24,320	25,726	29,619	33,927	38,728
G	COUNTY-OTHER, BRAZOS	BRAZOS	904	590	551	629	752	947
G	IRRIGATION, BRAZOS	BRAZOS	26,050	24,791	23,594	22,459	21,374	20,438
G	LIVESTOCK, BRAZOS	BRAZOS	1,322	1,322	1,322	1,322	1,322	1,322
G	MANUFACTURING, BRAZOS	BRAZOS	2,456	2,779	3,109	3,405	3,694	4,008
G	MINING, BRAZOS	BRAZOS	1,088	1,610	1,433	1,144	923	814
G	STEAM ELECTRIC POWER, BRAZOS	BRAZOS	503	406	460	312	405	384
G	TEXAS A & M UNIVERSITY	BRAZOS	6,322	6,350	6,309	6,292	6,289	6,288
G	WELLBORN SUD	BRAZOS	1,837	2,070	2,318	2,634	2,982	3,368
G	WICKSON CREEK SUD	BRAZOS	991	1,155	1,332	1,558	1,809	2,088
		Sum of Projected Water Demands (acre-feet)	**76,347**	**81,636**	**86,496**	**92,866**	**100,403**	**109,037**

ROBERTSON COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
G	BREMOND	BRAZOS	189	201	213	229	244	260
G	CALVERT	BRAZOS	190	183	180	180	179	179
G	COUNTY-OTHER, ROBERTSON	BRAZOS	439	512	589	665	734	796
G	FRANKLIN	BRAZOS	256	272	288	307	328	348
G	HEARNE	BRAZOS	757	734	715	713	711	711
G	IRRIGATION, ROBERTSON	BRAZOS	63,420	61,607	59,841	58,127	56,460	55,124
G	LIVESTOCK, ROBERTSON	BRAZOS	1,612	1,612	1,612	1,612	1,612	1,612
G	MANUFACTURING, ROBERTSON	BRAZOS	133	154	176	197	214	232
G	MINING, ROBERTSON	BRAZOS	9,913	11,753	13,768	16,222	19,217	22,940
G	ROBERTSON COUNTY WSC	BRAZOS	246	256	267	282	300	319
G	STEAM ELECTRIC POWER, ROBERTSON	BRAZOS	17,461	30,380	35,512	46,984	49,133	51,381
G	TRI-COUNTY SUD	BRAZOS	115	121	128	136	145	154
G	WELLBORN SUD	BRAZOS	356	401	450	511	578	653
G	WICKSON CREEK SUD	BRAZOS	28	30	31	33	35	37
		Sum of Projected Water Demands (acre-feet)	**95,115**	**108,216**	**113,770**	**126,198**	**129,890**	**134,746**

APPENDIX B4

Projected Water Supply Needs

Projected Water Supply Needs
TWDB 2017 State Water Plan Data

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

BRAZOS COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
G	BRYAN	BRAZOS	-3,335	-1,269	-5,533	-11,875	-18,790	-26,578
G	COLLEGE STATION	BRAZOS	-4,973	-8,024	-7,372	-7,673	-8,085	-8,401
G	COUNTY-OTHER, BRAZOS	BRAZOS	39	379	424	346	223	28
G	IRRIGATION, BRAZOS	BRAZOS	-10,934	-9,669	-8,474	-7,340	-6,256	-5,321
G	LIVESTOCK, BRAZOS	BRAZOS	0	0	0	0	0	0
G	MANUFACTURING, BRAZOS	BRAZOS	-1,800	-886	-1,219	-1,513	-1,802	-2,116
G	MINING, BRAZOS	BRAZOS	-1,088	-1,610	-1,433	-1,144	-923	-814
G	STEAM ELECTRIC POWER, BRAZOS	BRAZOS	-271	-151	-197	-49	-142	-121
G	TEXAS A & M UNIVERSITY	BRAZOS	5,253	6,760	7,323	7,340	7,343	7,344
G	WELLBORN SUD	BRAZOS	377	90	-300	-846	-1,448	-2,114
G	WICKSON CREEK SUD	BRAZOS	1,535	1,378	1,154	892	604	301
		Sum of Projected Water Supply Needs (acre-feet)	**-22,401**	**-21,609**	**-24,528**	**-30,440**	**-37,446**	**-45,465**

ROBERTSON COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
G	BREMOND	BRAZOS	202	190	178	162	147	131
G	CALVERT	BRAZOS	339	346	349	349	350	350
G	COUNTY-OTHER, ROBERTSON	BRAZOS	318	245	168	92	23	-39
G	FRANKLIN	BRAZOS	372	356	340	321	300	280
G	HEARNE	BRAZOS	2,085	2,108	2,127	2,129	2,131	2,131
G	IRRIGATION, ROBERTSON	BRAZOS	-52,989	-51,076	-49,210	-47,448	-45,781	-44,445
G	LIVESTOCK, ROBERTSON	BRAZOS	0	0	0	0	0	0
G	MANUFACTURING, ROBERTSON	BRAZOS	118	97	75	54	37	19
G	MINING, ROBERTSON	BRAZOS	292	-1,548	-3,563	-6,017	-9,012	-12,735
G	ROBERTSON COUNTY WSC	BRAZOS	265	255	244	229	211	192
G	STEAM ELECTRIC POWER, ROBERTSON	BRAZOS	16,438	3,320	-2,111	-13,682	-16,031	-18,478
G	TRI-COUNTY SUD	BRAZOS	-15	-18	-19	-19	-26	-31
G	WELLBORN SUD	BRAZOS	73	17	-58	-164	-280	-410
G	WICKSON CREEK SUD	BRAZOS	44	36	27	19	11	5
		Sum of Projected Water Supply Needs (acre-feet)	**-53,004**	**-52,642**	**-54,961**	**-67,330**	**-71,130**	**-76,138**

APPENDIX B5

Projected Water Management Strategies

Projected Water Management Strategies
TWDB 2017 State Water Plan Data

BRAZOS COUNTY

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

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
BRYAN, BRAZOS (G)							
CARRIZO AQUIFER DEVELOPMENT	CARRIZO-WILCOX AQUIFER [BRAZOS]	0	0	0	5,100	5,100	5,100
MUNICIPAL WATER CONSERVATION (URBAN) - BRYAN	DEMAND REDUCTION [BRAZOS]	493	1,573	1,616	1,697	1,899	2,143
REUSE- BRYAN (OPTION 2)	DIRECT REUSE [BRAZOS]	2,419	2,419	2,419	2,419	2,419	2,419
REUSE- MIRAMONT	DIRECT REUSE [BRAZOS]	600	600	600	600	600	600
SIMSBORO - BRAZOS COUNTY ASR	SIMSBORO AQUIFER ASR [BRAZOS]	2,841	2,841	3,917	5,581	12,294	19,839
		6,353	**7,433**	**8,552**	**15,397**	**22,312**	**30,101**
COLLEGE STATION, BRAZOS (G)							
MUNICIPAL WATER CONSERVATION (URBAN) - COLLEGE STATION	DEMAND REDUCTION [BRAZOS]	679	2,585	3,465	3,823	4,332	4,926
YEGUA-JACKSON AQUIFER DEVELOPMENT	YEGUA-JACKSON AQUIFER [BRAZOS]	4,452	5,565	5,565	5,565	5,565	5,565
		5,131	**8,150**	**9,030**	**9,388**	**9,897**	**10,491**
IRRIGATION, BRAZOS, BRAZOS (G)							
BRA SYSTEM OPERATION MAIN STEM	BRAZOS RIVER AUTHORITY MAIN STEM LAKE/RESERVOIR SYSTEM [RESERVOIR]	10,200	8,500	6,900	5,800	4,800	3,900
IRRIGATION WATER CONSERVATION	DEMAND REDUCTION [BRAZOS]	782	1,240	1,652	1,572	1,496	1,431
		10,982	**9,740**	**8,552**	**7,372**	**6,296**	**5,331**
MANUFACTURING, BRAZOS, BRAZOS (G)							
GULF COAST AQUIFER DEVELOPMENT	GULF COAST AQUIFER [BRAZOS]	530	530	530	530	530	530
INDUSTRIAL WATER CONSERVATION	DEMAND REDUCTION [BRAZOS]	74	139	218	238	259	281
TEXAS A&M REDUCTION TO BRAZOS MANUFACTURING	CARRIZO-WILCOX AQUIFER [BRAZOS]	1,200	300	500	800	1,100	1,400
		1,804	**969**	**1,248**	**1,568**	**1,889**	**2,211**
MINING, BRAZOS, BRAZOS (G)							
INDUSTRIAL WATER CONSERVATION	DEMAND REDUCTION [BRAZOS]	33	81	100	80	65	57
		33	**81**	**100**	**80**	**65**	**57**
STEAM ELECTRIC POWER, BRAZOS, BRAZOS(G)	DEMAND REDUCTION [BRAZOS]						
		15	20	32	22	28	27

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
REUSE- BRYAN (OPTION 1)	DIRECT REUSE [BRAZOS]	256	131	165	27	114	94
		271	**151**	**197**	**49**	**142**	**121**
TEXAS A & M UNIVERSITY, BRAZOS (G)							
MUNICIPAL WATER CONSERVATION (SUBURBAN) - TEXAS A & M UNIVERSITY	DEMAND REDUCTION [BRAZOS]	416	942	1,418	1,869	2,289	2,670
		416	**942**	**1,418**	**1,869**	**2,289**	**2,670**
WELLBORN SUD, BRAZOS (G)							
BRA SYSTEM OPERATION MAIN STEM	BRAZOS RIVER AUTHORITY MAIN STEM LAKE/RESERVOIR SYSTEM [RESERVOIR]	0	0	1,876	1,876	1,876	1,876
MUNICIPAL WATER CONSERVATION (URBAN) - WELLBORN SUD	DEMAND REDUCTION [BRAZOS]	65	234	425	472	530	597
		65	**234**	**2,301**	**2,348**	**2,406**	**2,473**
Sum of Projected Water Management Strategies (acre-feet)		**25,055**	**27,700**	**31,398**	**38,071**	**45,296**	**53,455**

ROBERTSON COUNTY

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

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
BREMOND, BRAZOS (G)							
MUNICIPAL WATER CONSERVATION (SUBURBAN) - BREMOND	DEMAND REDUCTION [ROBERTSON]	6	20	22	23	23	25
		6	**20**	**22**	**23**	**23**	**25**
CALVERT, BRAZOS (G)							
MUNICIPAL WATER CONSERVATION (SUBURBAN) - CALVERT	DEMAND REDUCTION [ROBERTSON]	3	0	0	0	0	0
		3	**0**	**0**	**0**	**0**	**0**
COUNTY-OTHER, ROBERTSON, BRAZOS (G)							
CARRIZO AQUIFER DEVELOPMENT	CARRIZO-WILCOX AQUIFER [ROBERTSON]	0	0	0	0	0	81
		0	**0**	**0**	**0**	**0**	**81**
HEARNE, BRAZOS (G)							
MUNICIPAL WATER CONSERVATION (SUBURBAN) - HEARNE	DEMAND REDUCTION [ROBERTSON]	22	35	16	14	12	12
		22	**35**	**16**	**14**	**12**	**12**

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
IRRIGATION, ROBERTSON, BRAZOS (G)							
CARRIZO AQUIFER DEVELOPMENT	CARRIZO-WILCOX AQUIFER [ROBERTSON]	15,764	16,143	16,222	15,172	8,912	1,179
IRRIGATION WATER CONSERVATION	DEMAND REDUCTION [ROBERTSON]	1,903	3,080	4,189	4,069	3,952	3,859
		17,667	**19,223**	**20,411**	**19,241**	**12,864**	**5,038**
MINING, ROBERTSON, BRAZOS (G)							
INDUSTRIAL WATER CONSERVATION	DEMAND REDUCTION [ROBERTSON]	0	588	964	1,136	1,345	1,606
		0	**588**	**964**	**1,136**	**1,345**	**1,606**
STEAM ELECTRIC POWER, ROBERTSON, BRAZOS (G)							
BRA SYSTEM OPERATION MAIN STEM	BRAZOS RIVER AUTHORITY MAIN STEM LAKE/RESERVOIR SYSTEM [RESERVOIR]	0	0	0	2,000	4,000	6,000
INDUSTRIAL WATER CONSERVATION	DEMAND REDUCTION [ROBERTSON]	0	0	2,486	3,289	3,439	3,597
PURCHASE FROM WALNUT CREEK MINE-REUSE	DIRECT REUSE [ROBERTSON]	0	0	0	9,000	9,000	9,000
		0	**0**	**2,486**	**14,289**	**16,439**	**18,597**
TRI-COUNTY SUD, BRAZOS (G)							
CARRIZO AQUIFER DEVELOPMENT	CARRIZO-WILCOX AQUIFER [LIMESTONE]	37	39	41	43	45	46
		37	**39**	**41**	**43**	**45**	**46**
WELLBORN SUD, BRAZOS (G)							
BRA SYSTEM OPERATION MAIN STEM	BRAZOS RIVER AUTHORITY MAIN STEM LAKE/RESERVOIR SYSTEM [RESERVOIR]	0	0	364	364	364	364
MUNICIPAL WATER CONSERVATION (URBAN) - WELLBORN SUD	DEMAND REDUCTION [ROBERTSON]	13	45	83	91	103	116
		13	**45**	**447**	**455**	**467**	**480**
Sum of Projected Water Management Strategies (acre-feet)		**17,748**	**19,950**	**24,387**	**35,201**	**31,195**	**25,885**

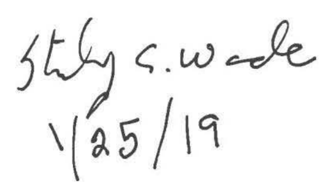
APPENDIX C

GAM Run 18-021

GAM Run 18-021: Brazos Valley Groundwater Conservation District Groundwater Management Plan

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

January 25, 2019



GAM RUN 18-021: BRAZOS VALLEY GROUNDWATER CONSERVATION DISTRICT GROUNDWATER MANAGEMENT PLAN

Shirley C. Wade, Ph.D., P.G.
Texas Water Development Board
Groundwater Division
Groundwater Availability Modeling Department
512-936-0883
January 25, 2019

EXECUTIVE SUMMARY:

Texas State Water Code, Section 36.1071, Subsection (h) (Texas Water Code, 2011), states that, in developing its groundwater management plan, a groundwater conservation district shall use groundwater availability modeling information provided by the Executive Administrator of the Texas Water Development Board (TWDB) in conjunction with any available site-specific information provided by the district for review and comment to the Executive Administrator.

The TWDB provides data and information to the Brazos Valley 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 Department. 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 Brazos Valley Groundwater Conservation District should be adopted by the district on or before December 13, 2019 and submitted to the Executive Administrator of the TWDB on or before January 12, 2020. The current management plan for the Brazos Valley Groundwater Conservation District expires on March 12, 2020.

We used four groundwater availability models to estimate the management plan information for the aquifers within the Brazos Valley Groundwater Conservation District. Information for the Carrizo-Wilcox, Queen City, and Sparta aquifers is from version 3.01 of the groundwater availability model for the central part of the Carrizo-Wilcox, Queen City, and Sparta aquifers (Young and others, 2018). Information for the Yegua-Jackson Aquifer 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 the Gulf Coast Aquifer System (Kasmarek, 2013). Information for the Brazos River Alluvium Aquifer is from version 1.01 of the groundwater availability model for the Brazos River Alluvium Aquifer (Ewing and Jigmond, 2016).

This report replaces the results of GAM Run 18-019 (Wade, 2018). GAM Run 18-021 includes results from the newly released and updated groundwater availability model for the Carrizo-Wilcox, Queen City, and Sparta aquifers (Young and others, 2018). Tables 1 through 6 summarize the groundwater availability model data required by statute and Figures 1 through 6 show the area of the models from which the values in the tables were extracted. If, after review of the figures, the Brazos Valley 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 four groundwater availability models mentioned above were used to estimate information for the Brazos Valley Groundwater Conservation District management plan. Water budgets were extracted for the historical model periods for the Carrizo-Wilcox, Queen City, and Sparta aquifers (1980 through 2010), Yegua-Jackson Aquifer (1980 through 1997), Gulf Coast Aquifer System (1980 through 2009) and Brazos River Alluvium Aquifer (1980 through 2012) using ZONEBUDGET Version 3.01 (Harbaugh, 2009) or ZONEBUDGET-USG (Panday and others, 2013) as applicable. 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:

Carrizo-Wilcox, Queen City, and Sparta aquifers

- We used version 3.01 of the groundwater availability model for the central part of the Carrizo-Wilcox, Queen City, and Sparta aquifers. See Young and others (2018) for assumptions and limitations of the groundwater availability model for the central part of the Carrizo-Wilcox, Queen City, and Sparta aquifers.
- This groundwater availability model includes ten layers, which represent the Colorado or Brazos River Alluvium (Layer 1), the outcrop and shallow flow zone of all of the underlying aquifers (Layer 2), the Sparta Aquifer (Layer 3), the Weches Formation confining unit (Layer 4), the Queen City Aquifer (Layer 5), the Reklaw Formation confining unit (Layer 6), the Carrizo Formation (Layer 7), the Calvert Bluff Formation (Layer 8), the Simsboro Formation (Layer 9), and the Hooper Formation (Layer 10).
- Individual water budgets for the district were determined for the Sparta Aquifer (Layers 2 and 3), the Queen City Aquifer (Layers 2 and 5), and the Carrizo-Wilcox Aquifer (Layers 2 and 7 through 10, collectively).
- The model was run with MODFLOW-USG (unstructured grid; Panday and others, 2013).

Yegua-Jackson Aquifer

- We used version 1.01 of the groundwater availability model for the Yegua-Jackson Aquifer. See Deeds and others (2010) for assumptions and limitations of the groundwater availability model.
- This groundwater availability model includes five layers, which represent the outcrop of the Yegua-Jackson Aquifer and younger overlying units—the Catahoula Formation (Layer 1), the upper portion of the Jackson Group (Layer 2), the lower portion of the Jackson Group (Layer 3), the upper portion of the Yegua Group (Layer 4), and the lower portion of the Yegua Group (Layer 5).
- An overall water budget for the district was determined for the Yegua-Jackson Aquifer (Layer 1 through Layer 5, collectively, for the portions of the model that represent the Yegua-Jackson Aquifer).
- The model was run with MODFLOW-2000 (Harbaugh and others, 2000).

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 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.

Brazos River Alluvium Aquifer

- We used version 1.01 of the groundwater availability model for the Brazos River Alluvium Aquifer released on December 16, 2016. See Ewing and Jigmond (2016) for assumptions and limitations of the model.
- The groundwater availability model for the Brazos River Alluvium Aquifer contains three layers. Layers 1 and 2 represent the Brazos River Alluvium Aquifer and Layer 3 represents the surficial portions of the Carrizo-Wilcox, Queen City, Sparta, Yegua-Jackson, and Gulf Coast aquifers as well as various geologic units of the Cretaceous System.
- In the Brazos Valley Groundwater Conservation District flow between underlying aquifers and the Brazos River Alluvium Aquifer is represented by flow between model layers 2 and 3.
- Perennial rivers and streams were simulated using the MODFLOW Streamflow-Routing package and ephemeral streams were simulated using the MODFLOW River package. Springs were simulated using the MODFLOW Drain package.

- The model was run with MODFLOW-USG (unstructured grid; Panday and others, 2013).

RESULTS:

A groundwater budget summarizes the amount of water entering and leaving the aquifers according to the groundwater availability model. Selected groundwater budget components listed below were extracted from the groundwater availability model results for the Carrizo-Wilcox, Queen City, Sparta, Yegua-Jackson, and Brazos River Alluvium aquifers and the Gulf Coast Aquifer System, located within Brazos Valley Groundwater Conservation District and averaged over the historical calibration periods, as shown in Tables 1 through 6.

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 Tables 1 through 6. 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 CARRIZO-WILCOX AQUIFER FOR BRAZOS VALLEY GROUNDWATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT.

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Carrizo-Wilcox Aquifer	47,122
Estimated annual volume of water that discharges from the aquifer to springs and any surface-water body including lakes, streams, and rivers	Carrizo-Wilcox Aquifer	54,520
Estimated annual volume of flow into the district within each aquifer in the district	Carrizo-Wilcox Aquifer	32,600
Estimated annual volume of flow out of the district within each aquifer in the district	Carrizo-Wilcox Aquifer	10,109
Estimated net annual volume of flow between each aquifer in the district	Flow into the Carrizo-Wilcox Aquifer from downdip Carrizo-Wilcox units	2,537
	Flow from the Carrizo-Wilcox Aquifer into the overlying Reklaw Confining Unit	1,951
	Flow into the Queen City Aquifer from the Carrizo-Wilcox Aquifer	95
	Flow from the Carrizo-Wilcox Aquifer into the Brazos River Alluvium Aquifer[1]	2,290

[1] Flow based on water budget from the groundwater availability model for the Brazos River Alluvium. The historical period used for averaging was 1980 through 2012.

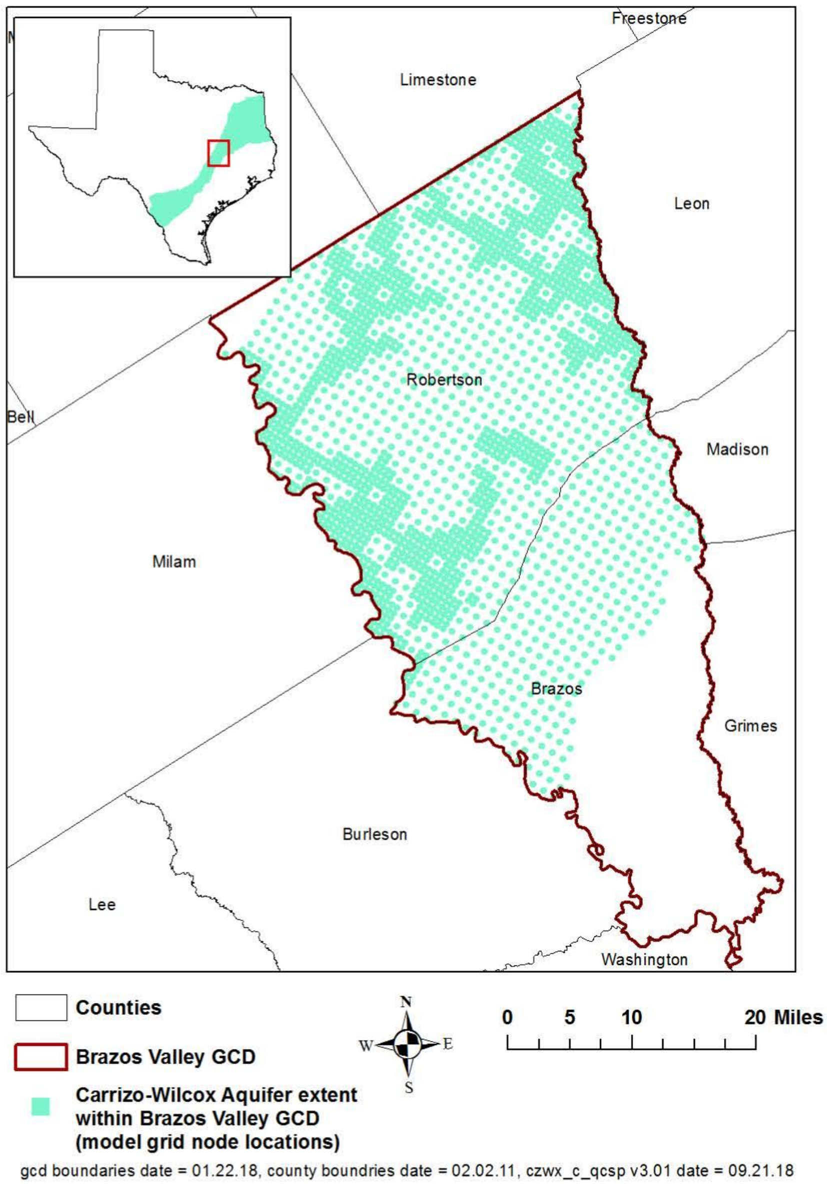


FIGURE 1. AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE CARRIZO-WILCOX AQUIFER FROM WHICH THE INFORMATION IN TABLE 1 WAS EXTRACTED (THE AQUIFER SYSTEM EXTENT WITHIN THE DISTRICT BOUNDARY).

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

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Queen City Aquifer	10,391
Estimated annual volume of water that discharges from the aquifer to springs and any surface-water body including lakes, streams, and rivers	Queen City Aquifer	11,123
Estimated annual volume of flow into the district within each aquifer in the district	Queen City Aquifer	3,046
Estimated annual volume of flow out of the district within each aquifer in the district	Queen City Aquifer	1,211
Estimated net annual volume of flow between each aquifer in the district	Flow into the Queen City Aquifer from the Carrizo-Wilcox Aquifer	95
	Flow into the Queen City Aquifer from the underlying Reklaw Confining Unit	1,896
	Flow into the Queen City Aquifer from downdip Queen City units	30
	Flow from the Queen City Aquifer into the overlying Weches Confining Unit	2,818
	Flow from the Queen City Aquifer into the Sparta Aquifer	205
	Flow from the Queen City Aquifer into the Brazos River Alluvium Aquifer[2]	6,288

[2] Flow based on water budget from the groundwater availability model for the Brazos River Alluvium. The historical period used for averaging was 1980 through 2012.

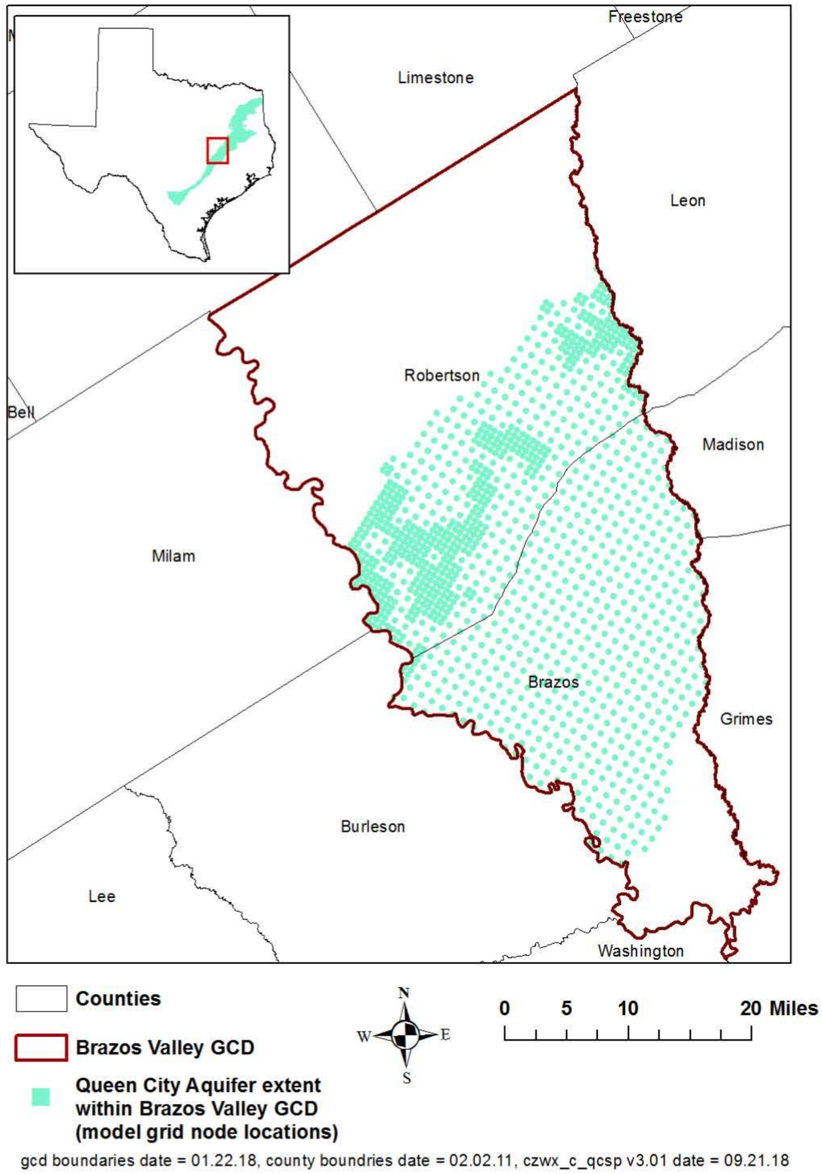


FIGURE 2. AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE QUEEN CITY AQUIFER FROM WHICH THE INFORMATION IN TABLE 2 WAS EXTRACTED (THE AQUIFER SYSTEM EXTENT WITHIN THE DISTRICT BOUNDARY).

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

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Sparta Aquifer	8,568
Estimated annual volume of water that discharges from the aquifer to springs and any surface-water body including lakes, streams, and rivers	Sparta Aquifer	12,874
Estimated annual volume of flow into the district within each aquifer in the district	Sparta Aquifer	1,415
Estimated annual volume of flow out of the district within each aquifer in the district	Sparta Aquifer	347
Estimated net annual volume of flow between each aquifer in the district	Flow from the Queen City Aquifer into the Sparta Aquifer	205
	Flow into the Sparta Aquifer from the underlying Weches Confining Unit	2,542
	Flow from the Sparta Aquifer into downdip Sparta units	8
	Flow from the Sparta Aquifer into overlying units	149
	Flow from the Sparta Aquifer into the Brazos River Alluvium Aquifer[3]	3,870

[3] Flow based on water budget from the groundwater availability model for the Brazos River Alluvium. The historical period used for averaging was 1980 through 2012.

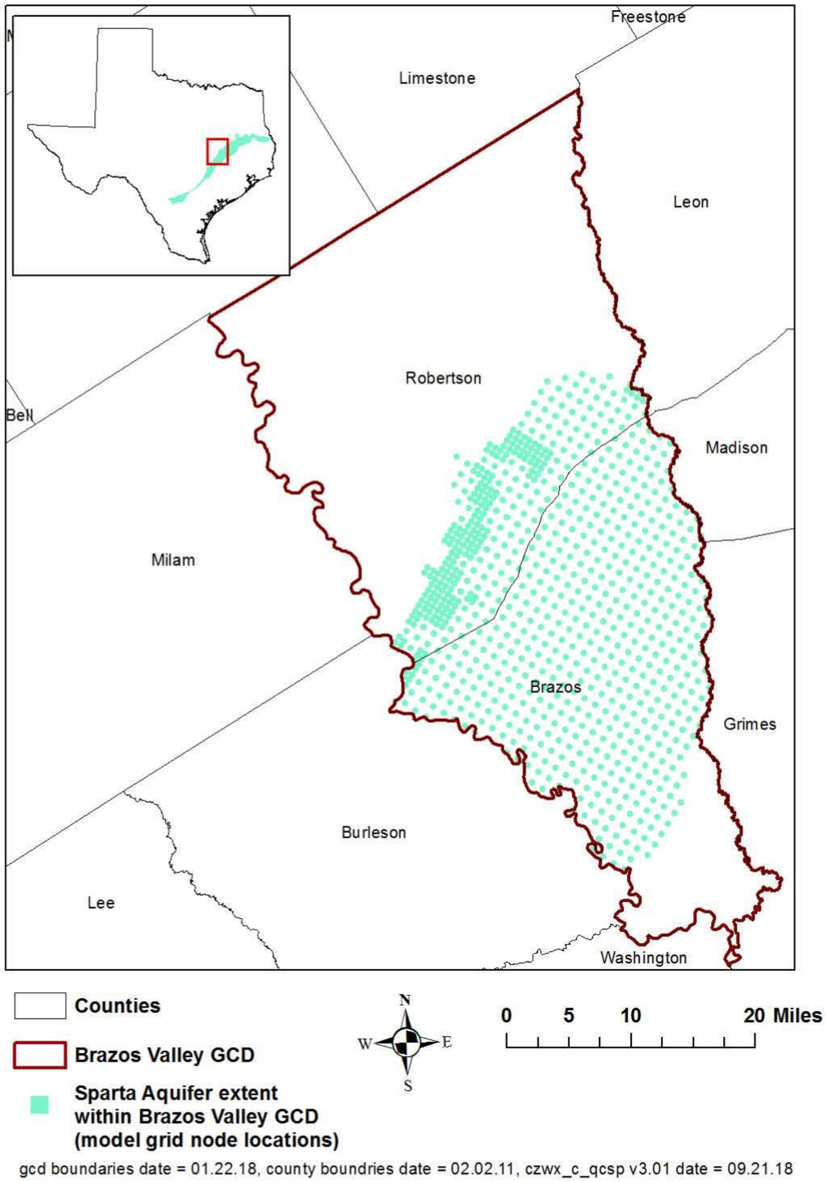


FIGURE 3. AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE SPARTA AQUIFER FROM WHICH THE INFORMATION IN TABLE 3 WAS EXTRACTED (THE AQUIFER SYSTEM EXTENT WITHIN THE DISTRICT BOUNDARY).

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

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Yegua-Jackson Aquifer	26,512
Estimated annual volume of water that discharges from the aquifer to springs and any surface-water body including lakes, streams, and rivers	Yegua-Jackson Aquifer	39,287
Estimated annual volume of flow into the district within each aquifer in the district	Yegua-Jackson Aquifer	12,069
Estimated annual volume of flow out of the district within each aquifer in the district	Yegua-Jackson Aquifer	9,923
Estimated net annual volume of flow between each aquifer in the district	Flow into the Yegua-Jackson Aquifer from the Catahoula and younger units	17
	Flow from the confined portion of the Yegua and Jackson groups into the Yegua-Jackson Aquifer	134
	Flow from the Yegua-Jackson Aquifer into the Brazos River Alluvium Aquifer[4]	2,399

[4] Flow based on water budget from the groundwater availability model for the Brazos River Alluvium. The historical period used for averaging was 1980 through 2012.

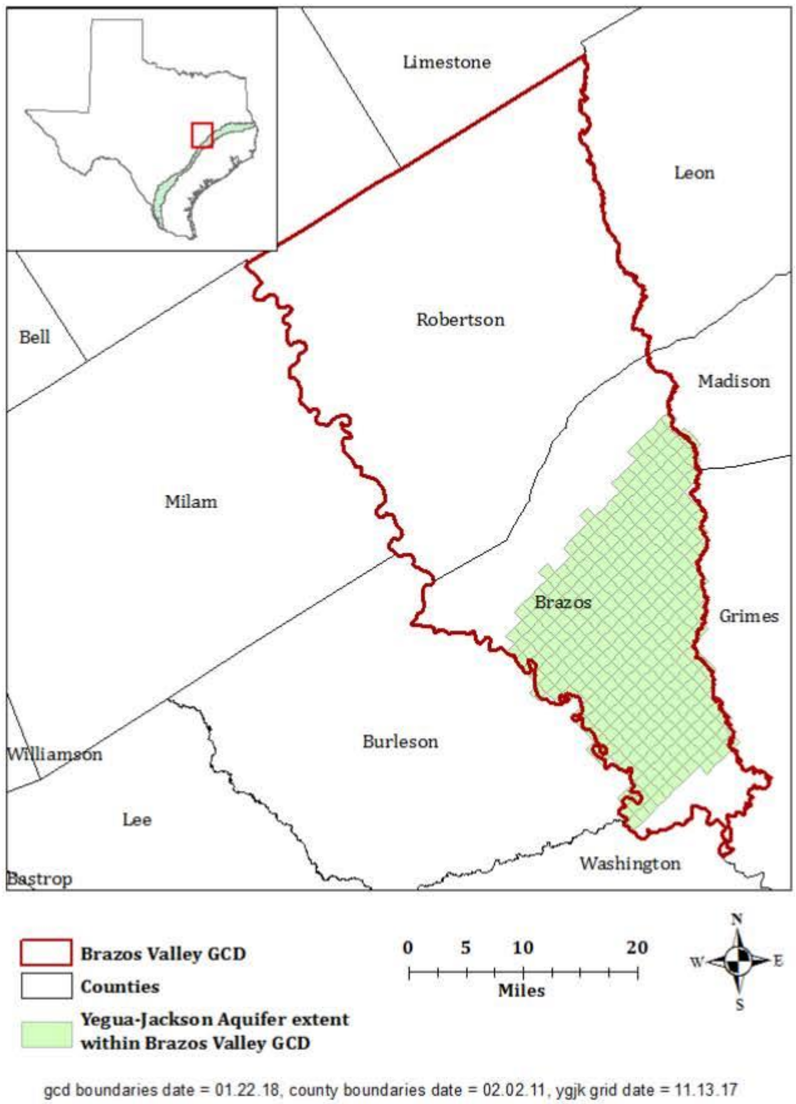


FIGURE 4. AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE YEGUA-JACKSON AQUIFER FROM WHICH THE INFORMATION IN TABLE 4 WAS EXTRACTED (THE AQUIFER SYSTEM EXTENT WITHIN THE DISTRICT BOUNDARY).

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

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Gulf Coast Aquifer System	40
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	255
Estimated annual volume of flow into the district within each aquifer in the district	Gulf Coast Aquifer System	332
Estimated annual volume of flow out of the district within each aquifer in the district	Gulf Coast Aquifer System	48
Estimated net annual volume of flow between each aquifer in the district	Flow into the Catahoula unit from the Jasper Aquifer[5]	46
	Flow from the Gulf Coast Aquifer System into the Brazos River Alluvium[6]	2,154

[5] Based on the general head boundary flux from the groundwater availability model for the Yegua-Jackson Aquifer. A part of the flow between the Catahoula confining system and the Jasper Aquifer represents flow between the Gulf Coast Aquifer System and deeper units and part represents flow within the Gulf Coast Aquifer System.

[6] Flow based on water budget from the groundwater availability model for the Brazos River Alluvium. The historical period used for averaging was 1980 through 2012.

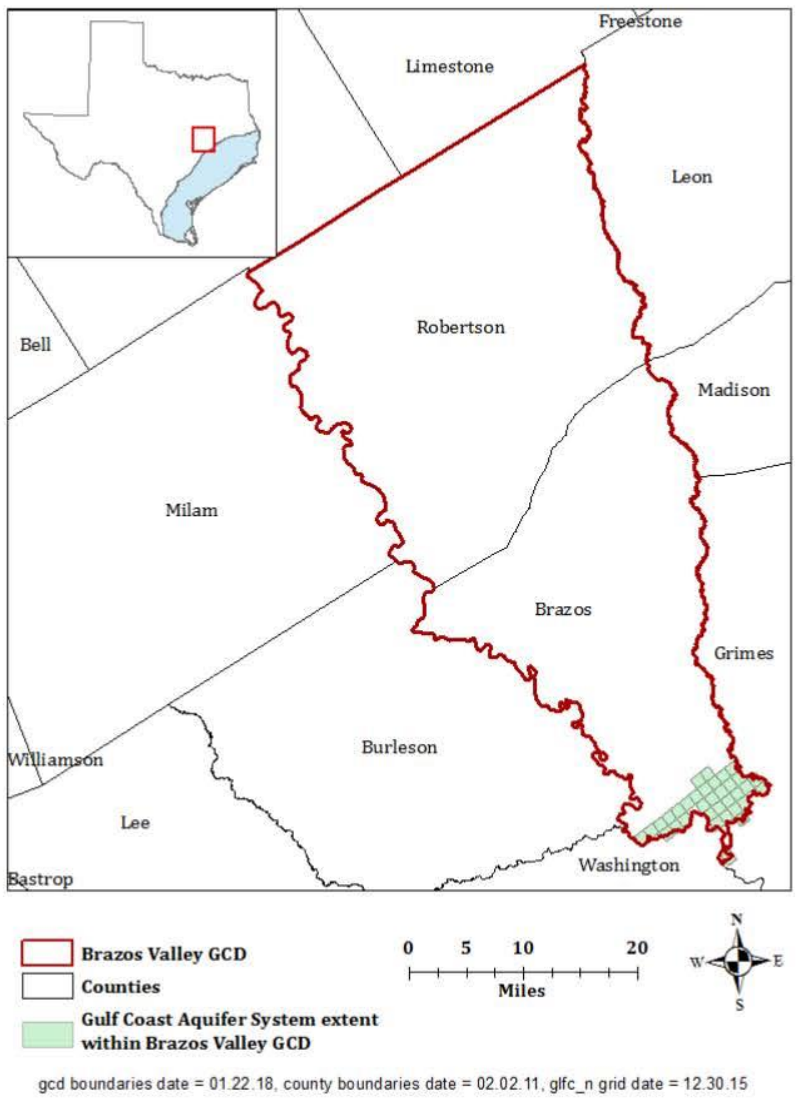


FIGURE 5. AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE GULF COAST AQUIFER SYSTEM FROM WHICH THE INFORMATION IN TABLE 5 WAS EXTRACTED (THE AQUIFER SYSTEM EXTENT WITHIN THE DISTRICT BOUNDARY).

TABLE 6. SUMMARIZED INFORMATION FOR THE BRAZOS RIVER ALLUVIUM AQUIFER FOR BRAZOS VALLEY GROUNDWATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT.

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Brazos River Alluvium Aquifer	23,333
Estimated annual volume of water that discharges from the aquifer to springs and any surface-water body including lakes, streams, and rivers	Brazos River Alluvium Aquifer	33,859
Estimated annual volume of flow into the district within each aquifer in the district	Brazos River Alluvium Aquifer	24,447
Estimated annual volume of flow out of the district within each aquifer in the district	Brazos River Alluvium Aquifer	20,432
Estimated net annual volume of flow between each aquifer in the district	Flow from the Carrizo-Wilcox Aquifer into the Brazos River Alluvium Aquifer	2,290
	Flow from the Queen City Aquifer into the Brazos River Alluvium Aquifer	6,288
	Flow from the Sparta Aquifer into the Brazos River Alluvium Aquifer	3,870
	Flow from the Yegua-Jackson Aquifer into the Brazos River Alluvium Aquifer	2,399
	Flow from the Gulf Coast Aquifer System into the Brazos River Alluvium	2,154

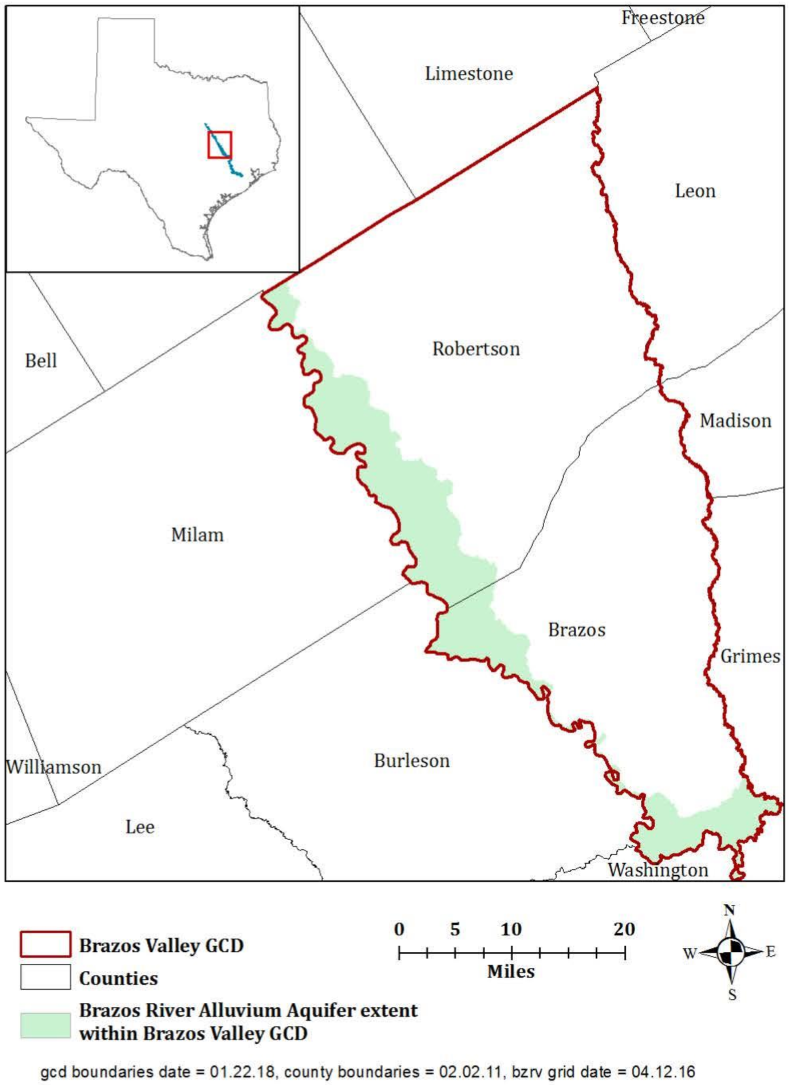


FIGURE 6. AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE BRAZOS RIVER ALLUVIUM AQUIFER FROM WHICH THE INFORMATION IN TABLE 6 WAS EXTRACTED (THE AQUIFER SYSTEM EXTENT WITHIN THE DISTRICT BOUNDARY).

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 historical groundwater flow conditions includes the assumptions about the location in the aquifer where historical pumping was placed. Understanding the amount and location of historical 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 historical 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. Historical 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

GAM Run 17-030 MAG

GAM RUN 17-030 MAG:
MODELED AVAILABLE GROUNDWATER FOR THE CARRIZO-WILCOX, QUEEN CITY, SPARTA, YEGUA-JACKSON, AND BRAZOS RIVER ALLUVIUM AQUIFERS IN GROUNDWATER MANAGEMENT AREA 12

Shirley C. Wade, Ph.D., P.G. and Natalie Ballew, GIT
Texas Water Development Board
Groundwater Division
Groundwater Availability Modeling Department
(512) 936-0883
December 15, 2017

Cynthia K. Ridgeway is the Manager of the Groundwater Availability Modeling Section and is responsible for oversight of work performed by Natalie Ballew under her direct supervision.

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GAM RUN 17-030 MAG: MODELED AVAILABLE GROUNDWATER FOR THE CARRIZO-WILCOX, QUEEN CITY, SPARTA, YEGUA-JACKSON, AND BRAZOS RIVER ALLUVIUM AQUIFERS IN GROUNDWATER MANAGEMENT AREA 12

Shirley C. Wade, Ph.D., P.G. and Natalie Ballew, GIT
Texas Water Development Board
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(512) 936-0883
December 15, 2017

EXECUTIVE SUMMARY:

This report presents modeled available groundwater for Groundwater Management Area 12 for the Carrizo-Wilcox, Queen City, Sparta, Yegua-Jackson, and Brazos River Alluvium aquifers by decade for the groundwater conservation districts (Tables 4 through 11 respectively) and for use in the regional water planning process (Tables 12 through 19 respectively). The total modeled available groundwater estimates for the Carrizo-Wilcox Aquifer range from approximately 135,000 acre-feet per year in 2010 to approximately 260,000 acre-feet per year in 2069 (Tables 4 through 7). The modeled available groundwater estimates for the Queen City Aquifer range from approximately 3,000 acre-feet per year in 2010 to approximately 7,000 acre-feet per year in 2069 (Table 8). The modeled available groundwater estimates for the Sparta Aquifer range from approximately 8,000 acre-feet per year in 2010 to approximately 24,000 acre-feet per year in 2069 (Table 9). The estimates were extracted from results of a model run using the groundwater availability model for the central part of the Carrizo-Wilcox, Queen City, and Sparta aquifers (version 2.02). District representatives in Groundwater Management Area 12 prepared and approved the model run files that meet the desired future condition adopted for the Carrizo-Wilcox, Queen City, and Sparta Aquifers. The files were submitted to the Executive Administrator of the Texas Water Development Board (TWDB) on October 6, 2017, as part of the resubmittal of the Desired Future Conditions Explanatory Report for Groundwater Management Area 12.

The modeled available groundwater estimates for the Yegua-Jackson Aquifer range from approximately 31,000 acre-feet per year in 2010 to 27,000 acre-feet per year in 2069 (Table 10). The estimates were extracted from results of a model run using the groundwater availability model for the Yegua-Jackson Aquifer (version 1.01). District representatives prepared and approved the model run files that meet the desired future conditions adopted for the Yegua-Jackson Aquifer. The files were submitted to the Executive Administrator of the TWDB on July 5, 2017, as part of Groundwater Management Area 12's original submittal of the Explanatory Report.

The modeled available groundwater estimates for the Brazos River Alluvium Aquifer range from approximately 269,000 acre-feet per year in 2013 to approximately 214,000 acre-feet per year in 2070 (Table 11). The estimates were extracted from results of a model run using the groundwater availability model for the Brazos River Alluvium Aquifer (version 1.01). The model run was developed to meet the desired future conditions adopted by district representatives of Groundwater Management Area 12 for the Brazos River Alluvium Aquifer.

The Executive Administrator of the TWDB determined that the explanatory reports and other supporting files and materials for Groundwater Management Area 12 were administratively complete on October 31, 2017.

REQUESTOR:

Mr. Gary Westbrook, coordinator of Groundwater Management Area 12.

DESCRIPTION OF REQUEST:

In a letter dated October 5, 2017, Gary Westbrook, on behalf of Groundwater Management Area 12, provided the TWDB with the desired future conditions of the Carrizo-Wilcox (Hooper, Simsboro, Calvert Bluff, and Carrizo), Queen City, Sparta, Yegua-Jackson, and Brazos River Alluvium aquifers adopted by the groundwater conservation districts in Groundwater Management Area 12. The desired future conditions for the Carrizo-Wilcox, Queen City, and Sparta aquifers are expressed as average drawdowns in feet from January 2000 through December 2069 (Table 1).

TABLE 1 ADOPTED DESIRED FUTURE CONDITIONS FOR THE CARRIZO-WILCOX, QUEEN CITY, AND SPARTA AQUIFERS IN GROUNDWATER MANAGEMENT AREA 12. VALUES ARE AVERAGE AQUIFER DRAWDOWN IN FEET FROM JANUARY 2000 THROUGH DECEMBER 2069 (DANIEL B. STEPHENS AND ASSOCIATES AND OTHERS, 2017).

Groundwater Conservation District (GCD) or County	Sparta	Queen City	Carrizo	Calvert Bluff	Simsboro	Hooper
Brazos Valley GCD	12	12	61	125	295	207
Fayette County GCD	47*	64*	110*	NR	NR	NR
Lost Pines GCD	5	15	62	100	240	165
Mid-East Texas GCD	5	2	80	90	138	125
Post Oak Savannah GCD	28	30	67	149	318	205
Falls County	NP	NP	NP	NP	-2	27
Limestone County	NP	NP	NP	11	50	50
Navarro County	NP	NP	NP	-1	3	3
Williamson County	NP	NP	NP	-11	47	69
GMA12	16	16	75	114	228	168

*Fayette County GCD desired future conditions are for all of Fayette County.
NR = Not relevant; NP = Not present

The desired future condition for Fayette County Groundwater Conservation District is for all of Fayette County including both Groundwater Management Areas 12 and 15. The Calvert Bluff, Simsboro, and Hooper aquifers occur in Fayette County but are not used so they were declared non-relevant (NR in Table 1). The Sparta, Queen City, and Carrizo aquifers do not occur (NP in Table 1) in Falls, Limestone, Navarro, and Williamson counties. The Calvert Bluff Aquifer does not occur in Falls County.

Groundwater availability models are regional in scale and are developed with data from many sources with differing levels of confidence (refer to the Limitations section at the end of this report). Therefore, groundwater availability models — like all numerical models — generate predictions that contain some uncertainty. Considering this situation, Groundwater Management Area 12 considers the desired future conditions to be compatible and physically possible if the difference between the modeled drawdown results and the desired future condition drawdown targets are within a 10 percent or a 5-foot variance, whichever is greater, for the Carrizo-Wilcox, Queen City, and Sparta aquifers with the exception of the Simsboro aquifer, which was held within a 5 percent or a 5-foot variance, whichever is greater (Daniel B. Stephens and Associates and others, 2017).

The desired future conditions for the Yegua-Jackson Aquifer are average drawdowns in feet from January 2010 through December 2069 (Table 2). The desired future condition for Fayette County Groundwater Conservation District is for all of Fayette County including both Groundwater Management Areas 12 and 15.

TABLE 2 ADOPTED DESIRED FUTURE CONDITIONS FOR THE YEGUA-JACKSON AQUIFER IN GROUNDWATER MANAGEMENT AREA 12. VALUES ARE AVERAGE AQUIFER DRAWDOWN IN FEET FROM JANUARY 2010 THROUGH DECEMBER 2069 (DANIEL B. STEPHENS AND ASSOCIATES AND OTHERS, 2017).

Groundwater Conservation District (GCD)	Yegua	Jackson	Yegua-Jackson
Brazos Valley GCD	70	114	NA
Fayette County GCD	NA	NA	77*
Lost Pines GCD	NR	NR	NR
Mid-East Texas GCD	NA	NA	7
Post Oak Savannah GCD	NA	NA	100
GMA-12	NA	NA	65

*Fayette County GCD desired future conditions are for all of Fayette County.
NR = Not relevant; NA = Not applicable

Brazos Valley Groundwater Conservation District manages the Yegua and Jackson aquifers separately and adopted two separate desired future conditions. The other groundwater conservation districts manage the Yegua-Jackson Aquifer as a single-unit and adopted single desired future conditions for their districts. Lost Pines Groundwater Conservation District has declared the Yegua-Jackson Aquifer not relevant in their district. As with the Carrizo-Wilcox aquifers, Groundwater Management Area 12 considers the desired future conditions to be compatible and physically possible if the difference between the modeled drawdown results and the desired future condition drawdown targets are within a 10 percent or a 5-foot variance, whichever is greater, for the Yegua-Jackson Aquifer (Daniel B. Stephens and Associates and others, 2017).

In Groundwater Management Area 12 the desired future conditions for the Brazos River Alluvium consist of percent saturation values or decrease in saturated thickness for the Brazos Valley and Post Oak Savannah Groundwater Conservation Districts, respectively (Table 3).

TABLE 3 ADOPTED DESIRED FUTURE CONDITIONS FOR THE BRAZOS RIVER ALLUVIUM AQUIFER FOR GROUNDWATER MANAGEMENT AREA 12. (DANIEL B. STEPHENS AND ASSOCIATES AND OTHERS, 2017).

Groundwater Conservation District	County	Desired Future Condition
Brazos Valley	Brazos and Robertson	North of State Highway 21: Percent saturation shall average at least 30 percent of total well depth. South of State Highway 21: Percent Saturation shall average at least 40 percent of total well depth.
Post Oak Savannah	Burleson	A decrease in 6 feet in the average saturated thickness over the period from 2010 to 2070.
Post Oak Savannah	Milam	A decrease in 5 feet in average saturated thickness over the period from 2010 to 2070.

TWDB staff reviewed the model files associated with the desired future conditions, requested clarification on certain technical elements of the files, and received clarification on procedures and assumptions from Groundwater Management Area 12 in Appendix V of the re-submittal of the Explanatory Report on October 6, 2017, and via email on November 3, 2017. Questions for the Carrizo-Wilcox, Queen City, Sparta, and Yegua-Jackson aquifers included whether drawdown averages and modeled available groundwater values were based on official aquifer extent or model extent, whether desired future conditions for Fayette County were for all of the county or for only the Groundwater Management Area 12 part, whether to include dry cells (dry cells are explained in the Methods section) in drawdown averaging, and which stress periods to use for drawdown calculations. In addition, the original model file submission for the Carrizo-Wilcox, Queen City, and Sparta aquifers (July 6, 2017) did not match the desired future conditions for the Lost Pines Groundwater Conservation District. The revised model files for the Carrizo-Wilcox, Queen City, and Sparta aquifers submitted on October 6, 2017, did match the desired future conditions for all of the groundwater conservation districts (Table 1) within the specified variance. All clarifications are included in the Parameters and Assumptions Section of this report.

Groundwater Management Area 12 did not submit model files for the Brazos River Alluvium Aquifer, so the TWDB developed a predictive scenario using the calibrated historical groundwater availability model of the Brazos River Alluvium Aquifer. The TWDB received clarification from Groundwater Management Area 12 on September 18, 2017, that the assumptions used for the predictive scenario were acceptable. Groundwater Management Area 12 provided additional clarification to the TWDB on November 3, 2017, that the small portion of the Brazos River Alluvium located in Falls County was considered not relevant for Groundwater Management Area 12.

METHODS:

We ran the groundwater availability model for the central part of the Carrizo-Wilcox, Queen City, and Sparta aquifers (Figures 1 through 4) using the model files prepared and approved by districts in Groundwater Management Area 12 and submitted with the explanatory report (Daniel B. Stephens and Associates and others, 2017). Model-estimated water levels were extracted and drawdowns were calculated for the year 2069 (stress period 95). Average drawdown was calculated for each groundwater conservation district for each individual aquifer. The calculated drawdown average was compared with the desired future conditions (Table 1) to verify that the pumping scenario achieved the desired future conditions within 10 percent or 5-foot variance (5 percent or 5-foot variance for the Simsboro Aquifer).

As noted in the clarifications, cells that became dry during the simulation were excluded from the drawdown averaging. Dry cells occur during a model run when the simulated water level in a cell falls below the bottom of the cell, and when this occurs the cell is deactivated. If high pumpage is the primary factor for a cell going dry, the models are implying that the pumping may create drawdowns that may locally partially dewater the aquifer. This typically is simulated in the shallow or thin portions of the unconfined area of the aquifers. In the groundwater availability models used for Groundwater Management Area 12, when a model deactivates a cell, that cell is inactive for the rest of the simulation. It is important to identify why a cell went dry and address the causes. In reality, the aquifer will probably not go dry because pumping will become uneconomical before the aquifer is fully dewatered in any particular area.

The groundwater availability model for the Yegua-Jackson Aquifer (Figures 5 and 6) was run using the model files submitted on July 26, 2017, and drawdowns were calculated for the year 2069. Average drawdowns were calculated for Brazos Valley, Fayette County, Mid-East Texas and Post Oak Savannah Groundwater Conservation Districts. For Brazos Valley Groundwater Conservation District separate drawdown averages were calculated for the Yegua and Jackson Aquifers. For the other districts average drawdown was calculated for all layers combined. Based on clarifications, the reference period (or starting point) for drawdown calculation was stress period 39 (January 2010). As specified in the clarifications, cells that became dry during the simulation were excluded from the averaging. The calculated drawdown averages were compared with the desired future to verify that the pumping scenario achieved the desired future conditions (Table 2) within 10 percent or 5-foot variance.

We developed a predictive model scenario for the Brazos River Alluvium Aquifer based on the calibrated historical groundwater availability model. We extended the model period from 2012 to 2070 by adding 58 annual stress periods and we used average recharge and average streamflow for 2013 to 2070. The pumping distribution for 2013 through 2070 is based on the average annual pumping for 2012 and the pumping amounts were adjusted uniformly within each groundwater conservation district to achieve the desired future conditions (Table 3).

We calculated the average percent saturation of the aquifer for the two areas within Brazos Valley Groundwater Conservation District by determining the ratio of the saturated thickness to the total alluvium thickness for each model cell in 2070 and averaging the ratios for all cells within the groundwater district areas (north of Highway 21 and south of Highway 21). The total alluvium thickness was used as an estimate for total well depth. The decrease in average saturated thickness in Post Oak Savannah Groundwater Conservation District was calculated by subtracting the average saturated thickness in 2070 from the average saturated thickness in 2010. The desired future conditions were achieved within one foot or one percentage point with the exception that it was not possible to decrease percent saturation in the Brazos Valley Groundwater Conservation District south of Highway 21 below 45 percent, because the model would not converge with additional pumping.

The modeled available groundwater values for aquifers in Groundwater Management Area 12 were determined by extracting pumping rates by decade from the model results using ZONEBUDGET Version 3.01 (Harbaugh, 2009). Tables 4 through 11 present the modeled available groundwater values (annual pumping rates to achieve the desired future conditions) for each aquifer by county and groundwater conservation district. Tables 12 through 19 present the modeled available groundwater (annual pumping rates to achieve the desired future conditions) for each aquifer by county, river basin, and regional water planning area.

Modeled Available Groundwater and Permitting

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

PARAMETERS AND ASSUMPTIONS:

This section describes the parameters and assumptions for the modeled available groundwater estimates:

Carrizo-Wilcox, Queen City, and Sparta aquifers

- We used Version 2.02 of the groundwater availability model for the central part of the Carrizo-Wilcox, Queen City, and Sparta aquifers. See Dutton and others (2003) and Kelley and others (2004) for assumptions and limitations of the groundwater availability model for the central part of the Carrizo-Wilcox, Queen City, and Sparta aquifers.
- This groundwater availability model includes eight layers, which generally represent the Sparta Aquifer (Layer 1), the Weches Confining Unit (Layer 2), the Queen City Aquifer (Layer 3), the Reklaw Confining Unit (Layer 4), the Carrizo (Layer 5), the Calvert Bluff (Layer 6), the Simsboro (Layer 7), and the Hooper (Layer 8).
- The model was run with MODFLOW-96 (Harbaugh and McDonald, 1996).
- Drawdowns were based on water levels in December 2069 (stress period 95) and water levels in January 2000 (stress period 25).
- Drawdown averages and modeled available groundwater values were based on the extent of the model area within Groundwater Management Area 12 rather than the official aquifer boundaries.
- The drawdown average for Fayette County Groundwater Conservation District was based on all of Fayette County including areas in Groundwater Management Areas 12 and 15.
- Drawdowns for cells where water levels dropped below the base elevation of the cell causing the cell to become inactive (dry cells) were excluded from the averaging.
- Modeled available groundwater values are extracted from the model output files and do not include pumping in dry cells or inactive cells.

- A tolerance of 10 percent (5 percent for the Simsboro) or 5 feet was assumed when comparing desired future conditions (Table 1, average drawdown values per county) to model drawdown results.
- Estimates of modeled available groundwater from the model simulation were rounded to whole numbers.

Yegua-Jackson Aquifer

- We used version 1.01 of the groundwater availability model for the Yegua-Jackson Aquifer. See Deeds and others (2010) for assumptions and limitations of the groundwater availability model.
- This groundwater availability model includes five layers which represent the outcrop of the Yegua-Jackson Aquifer and younger overlying units—the Catahoula Formation (Layer 1), the upper portion of the Jackson Group (Layer 2), the lower portion of the Jackson Group (Layer 3), the upper portion of the Yegua Group (Layer 4), and the lower portion of the Yegua Group (Layer 5).
- The model was run with MODFLOW-2000 (Harbaugh and others, 2000).
- The end of the calibration period was extended from 1997 to 2009 (Oliver, 2010).
- Drawdowns were based on water levels in December 2069 (stress period 99) and water levels from December 2009/January 2000 (stress period 39).
- Drawdown averages and modeled available groundwater values were based on the extent of the model area within Groundwater Management Area 12 rather than the official aquifer boundaries.
- The drawdown average for Fayette County Groundwater Conservation District was based on all of Fayette County including areas in Groundwater Management Area 12 and Groundwater Management Area 15.
- Drawdown for cells where water levels dropped below the base elevation of the cell causing the cell to become inactive (dry cells) were excluded from the averaging.
- Modeled available groundwater values are extracted from the model output files and do not include pumping in dry cells or inactive cells.
- A tolerance of 10 percent or 5 feet was assumed when comparing desired future conditions (Table 2, average drawdown values per county) to model drawdown results.

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

Brazos River Alluvium Aquifer

- We used version 1.01 of the groundwater availability model for the Brazos River Alluvium Aquifer released on December 16, 2016. See Ewing and Jigmond (2016) for assumptions and limitations of the model.
- The groundwater availability model for the Brazos River Alluvium Aquifer contains three layers. Layers 1 and 2 represent the Brazos River Alluvium Aquifer and Layer 3 represents the surficial portions of the Carrizo-Wilcox, Queen City, Sparta, Yegua-Jackson, and Gulf Coast aquifers as well as various geologic units of the Cretaceous System.
- The model was run with MODFLOW-USG (unstructured grid; Panday and others, 2013).
- Perennial rivers and streams were simulated using the MODFLOW Streamflow-Routing package and ephemeral streams were simulated using the MODFLOW River package. Springs were simulated using the MODFLOW Drain package.
- Average streamflow and recharge conditions were assumed for the predictive modeling period of 2013 through 2070.
- The pumping distribution during the predictive model years (2013 through 2070) is based on the average pumping distribution from the last year of the historical model (2012).
- Dry cells do not occur in the groundwater availability model for the Brazos River Alluvium Aquifer; however, pumping is reduced by the model code (MODFLOW USG) to prevent model cells from going dry during the simulation. All reported modeled available groundwater values are extracted from the budget output files rather than from the well file input package and reflect what was actually pumping in the model.
- A tolerance of one foot or 5 percent (whichever was greater) was assumed when comparing desired future conditions to average saturated thickness decline or percent saturation values.
- Estimates of modeled available groundwater from the model simulation were rounded to whole numbers.

RESULTS:

The modeled available groundwater estimates for the Carrizo-Wilcox Aquifer range from approximately 135,000 acre-feet per year in 2010 to approximately 260,000 acre-feet per year in 2069 (Tables 4 through 7). The modeled available groundwater estimates for the Queen City Aquifer range from approximately 3,000 acre-feet per year in 2010 to approximately 7,000 acre-feet per year in 2069 (Table 8). The modeled available groundwater estimates for the Sparta Aquifer range from approximately 8,000 acre-feet per year in 2010 to approximately 24,000 acre-feet per year in 2069 (Table 9). The modeled available groundwater is summarized by groundwater conservation district and county for the Hooper, Simsboro, Calvert Bluff, Carrizo, Queen City, and Sparta aquifers (Tables 4, 5, 6, 7, 8, and 9 respectively). The modeled available groundwater has also been summarized by county, river basin, and regional water planning area for use in the regional water planning process for the Hooper, Simsboro, Calvert Bluff, Carrizo, Queen City, and Sparta aquifers (Tables 12, 13, 14, 15, 16, and 17 respectively). Small differences in values between table summaries are due to rounding.

The modeled available groundwater estimates for the Yegua-Jackson Aquifer range from approximately 31,000 acre-feet per year in 2010 to 27,000 acre-feet per year in 2069 (Table 10). The modeled available groundwater for the Yegua-Jackson Aquifer is summarized by groundwater conservation district and county (Table 10) and by county, river basin, and regional water planning area for use in the regional water planning process (Table 18). Small differences in values between table summaries are due to rounding.

The modeled available groundwater estimates for the Brazos River Alluvium Aquifer range from approximately 269,000 acre-feet per year in 2013 to 214,000 acre-feet per year in 2070 (Table 11). The modeled available groundwater for the Brazos River Alluvium Aquifer is summarized by groundwater conservation district and county (Table 11) and by county, river basin, and regional water planning area for use in the regional water planning process (Table 19). Small differences in values between table summaries are due to rounding.

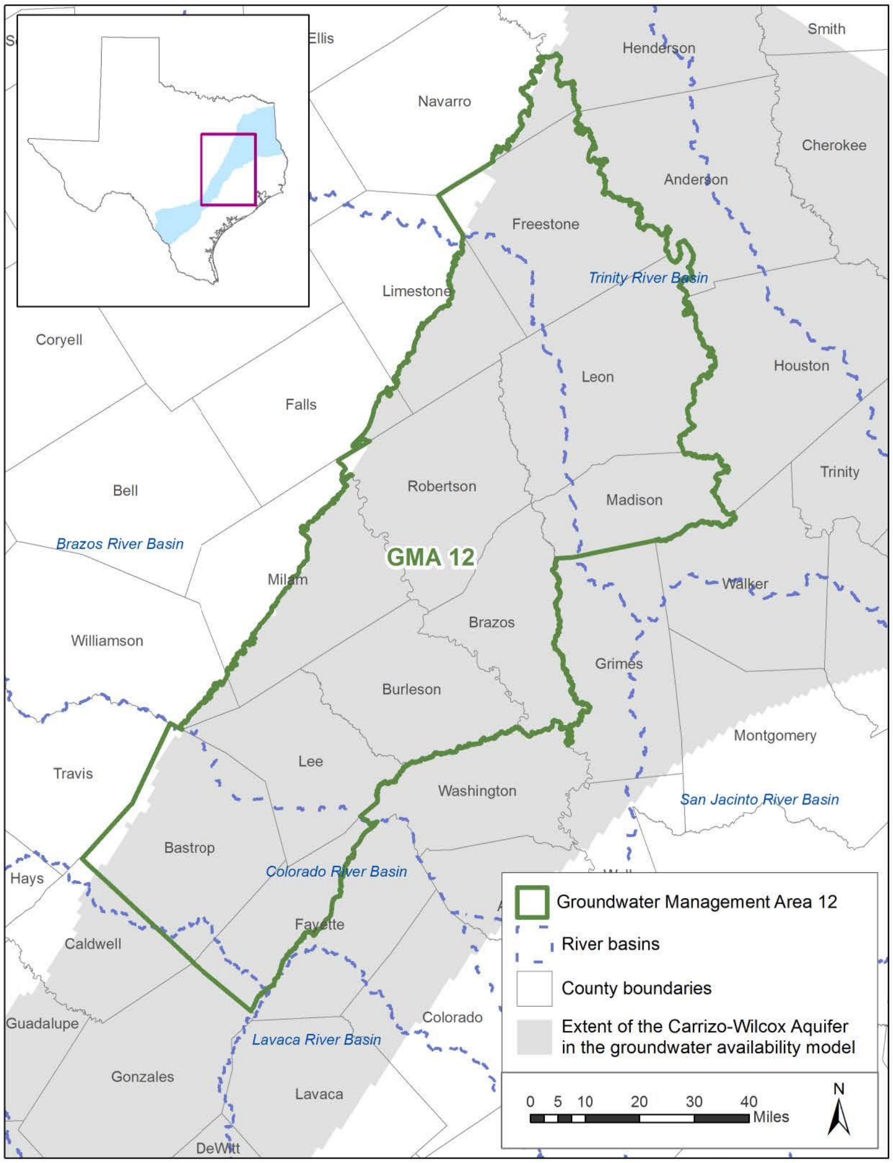

FIGURE 1. **GROUNDWATER MANAGEMENT AREA 12 BOUNDARY, RIVER BASINS, AND COUNTIES OVERLAIN ON THE EXTENT OF THE CARRIZO-WILCOX AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL FOR THE CENTRAL PORTION OF THE CARRIZO-WILCOX, QUEEN CITY, AND SPARTA AQUIFERS.**

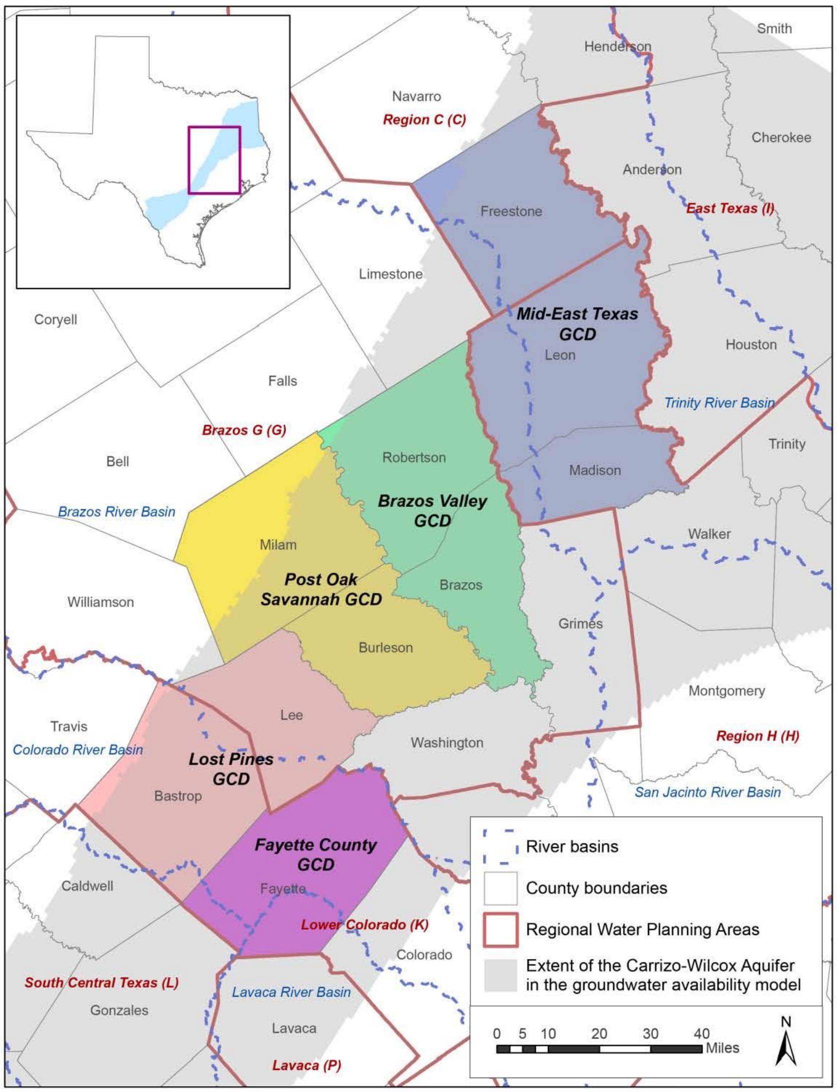

FIGURE 2. REGIONAL WATER PLANNING AREAS , RIVER BASINS, GROUNDWATER CONSERVATION DISTRICTS(GCDS), AND COUNTIES OVERLAIN ON THE EXTENT OF THE CARRIZO-WILCOX AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL FOR THE CENTRAL PORTION OF THE CARRIZO-WILCOX, QUEEN CITY, AND SPARTA AQUIFERS.

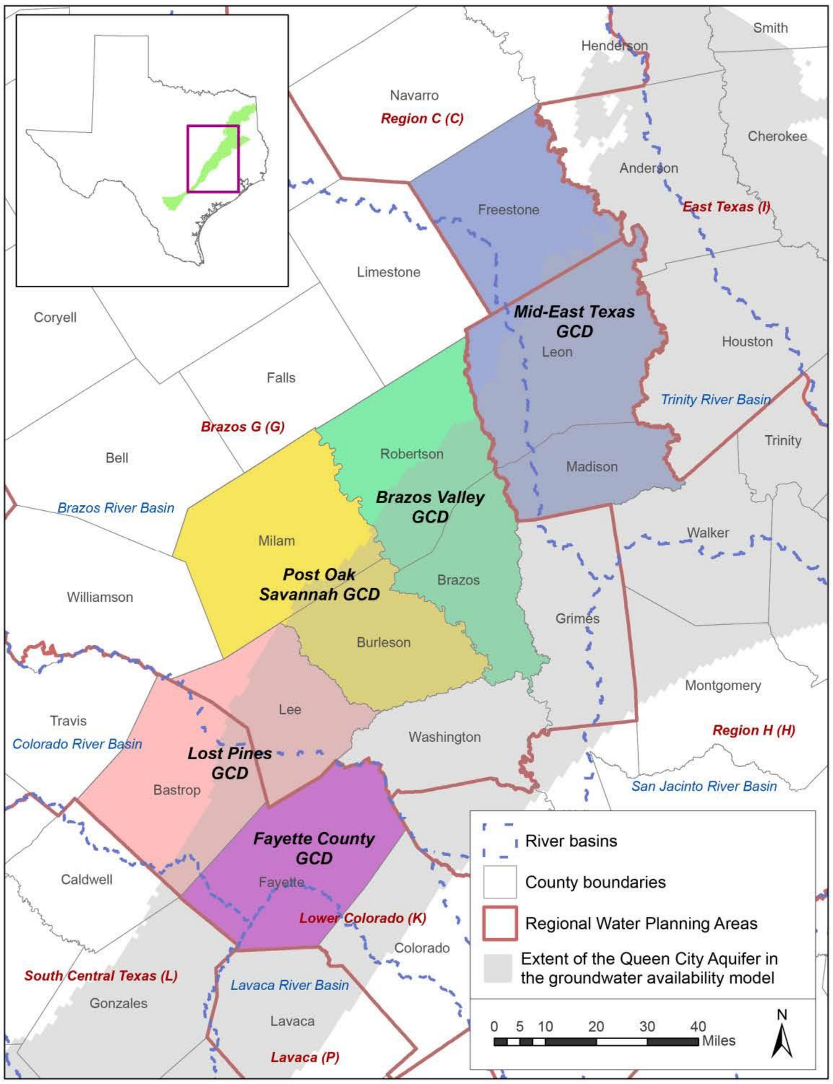

FIGURE 3. REGIONAL WATER PLANNING AREAS), RIVER BASINS, GROUNDWATER CONSERVATION DISTRICTS (GCDS), AND COUNTIES OVERLAIN ON THE EXTENT OF THE QUEEN CITY AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL FOR THE CENTRAL PORTION OF THE CARRIZO-WILCOX, QUEEN CITY, AND SPARTA AQUIFERS.

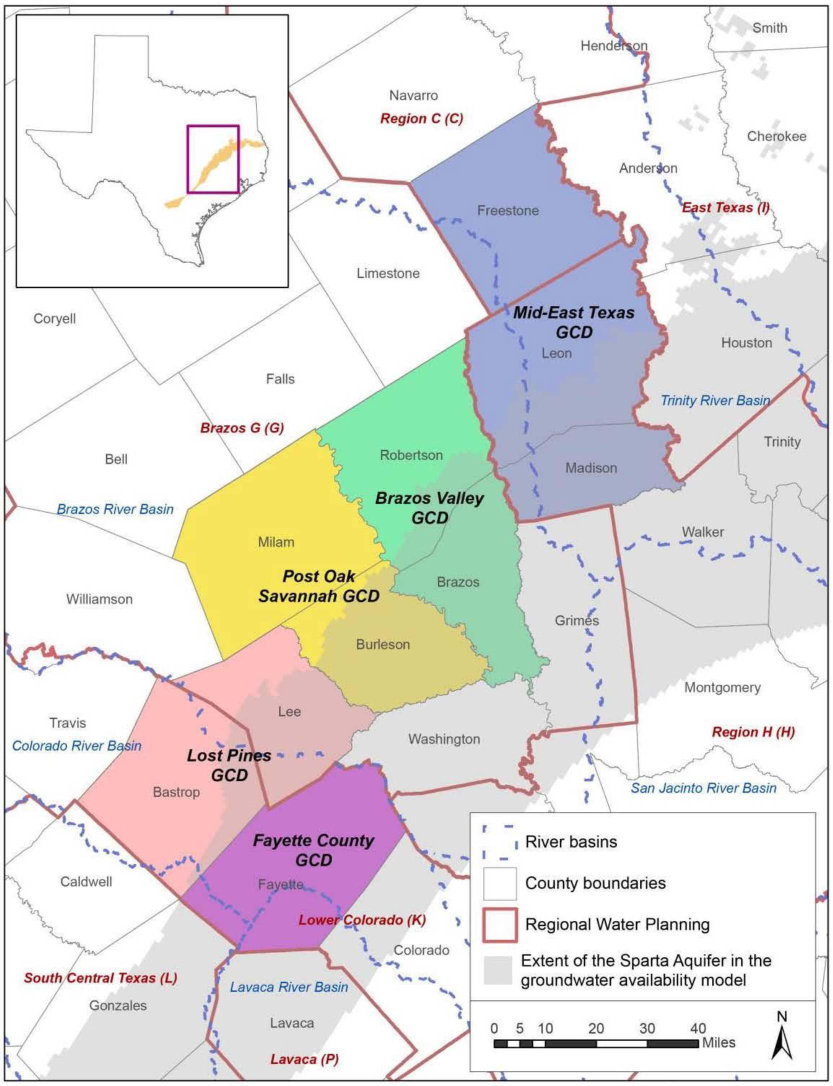

FIGURE 4. REGIONAL WATER PLANNING AREAS, RIVER BASINS, GROUNDWATER CONSERVATION DISTRICTS (GCDS), AND COUNTIES OVERLAIN ON THE EXTENT OF THE SPARTA AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL FOR THE CENTRAL PORTION OF THE CARRIZO-WILCOX, QUEEN CITY, AND SPARTA AQUIFERS.

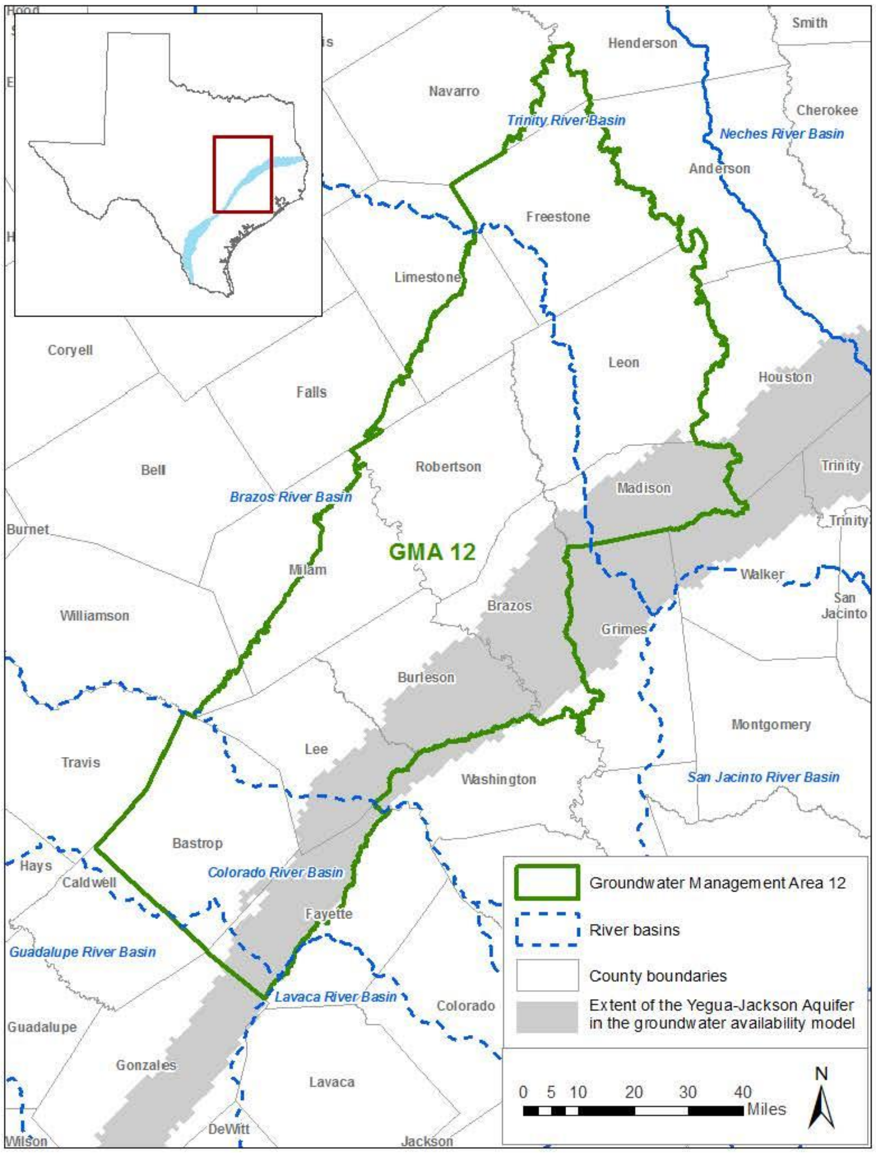

FIGURE 5. GROUNDWATER MANAGEMENT AREA 12 BOUNDARY, RIVER BASINS, AND COUNTIES OVERLAIN ON THE EXTENT OF THE YEGUA-JACKSON AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL.

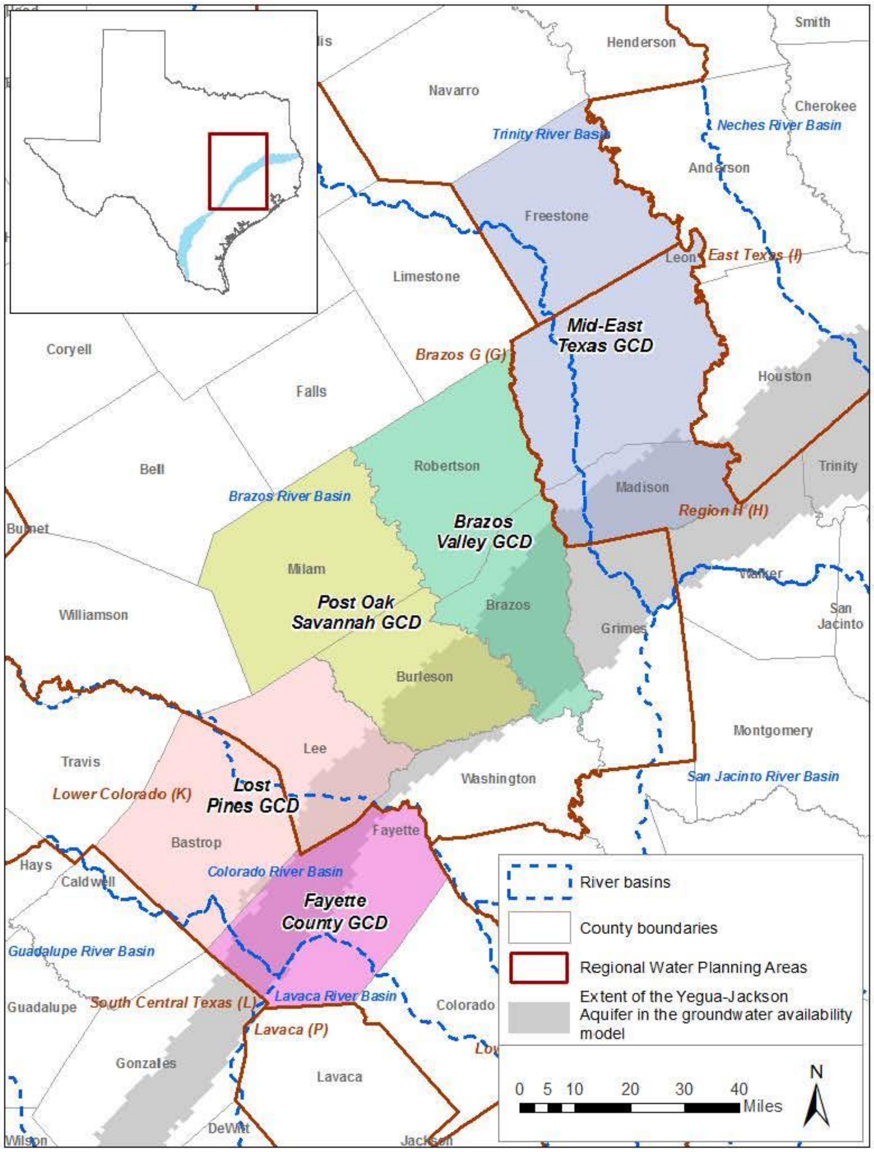

FIGURE 6. REGIONAL WATER PLANNING AREAS, RIVER BASINS, GROUNDWATER CONSERVATION DISTRICTS (GCDS), AND COUNTIES OVERLAIN ON THE EXTENT OF THE YEGUA-JACKSON AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL.

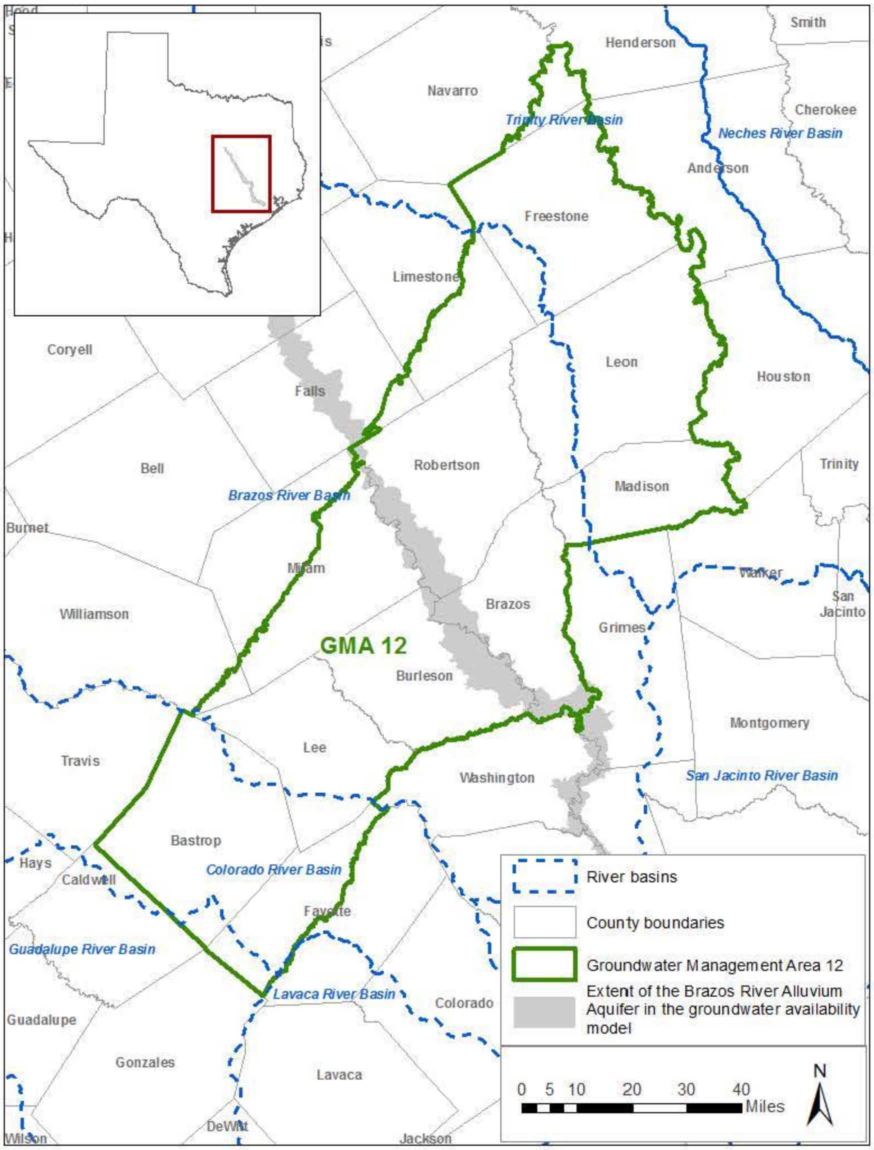

FIGURE 7. GROUNDWATER MANAGEMENT AREA 12 BOUNDARY, RIVER BASINS, AND COUNTIES OVERLAIN ON THE EXTENT OF THE BRAZOS RIVER ALLUVIUM AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL.

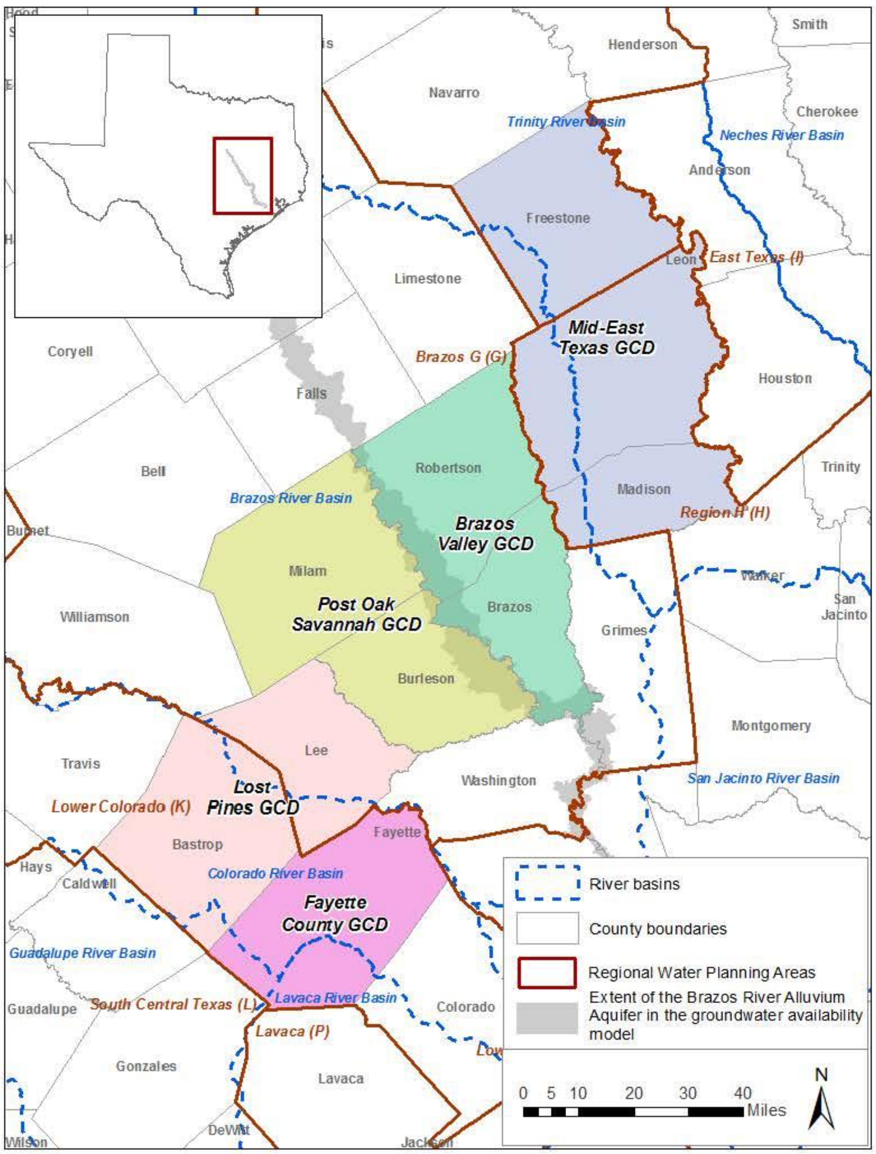

FIGURE 8 **REGIONAL WATER PLANNING AREAS, RIVER BASINS, GROUNDWATER CONSERVATION DISTRICTS (GCDS), AND COUNTIES OVERLAIN ON THE EXTENT OF THE BRAZOS RIVER ALLUVIUM AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL.**

TABLE 4 MODELED AVAILABLE GROUNDWATER FOR THE HOOPER AQUIFER IN GROUNDWATER MANAGEMENT AREA 12 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2010 AND 2069. VALUES ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District	County	Aquifer	2010	2020	2030	2040	2050	2060	2069
Brazos Valley GCD	Brazos	Hooper	0	0	0	0	0	0	0
Brazos Valley GCD	Robertson	Hooper	836	1,446	1,884	1,942	2,000	2,000	2,000
Brazos Valley GCD Total[1]		**Hooper**	**836**	**1,447**	**1,884**	**1,942**	**2,000**	**2,000**	**2,000**
Fayette County GCD[1,2]	**Fayette**	**Hooper**	NR	NR	NR	NR	NR	NR	NR
Lost Pines GCD	Bastrop	Hooper	357	651	781	953	1,176	1,179	1,139
Lost Pines GCD	Lee	Hooper	17	62	76	95	119	117	116
Lost Pines GCD Total[1]		**Hooper**	**374**	**713**	**857**	**1,048**	**1,295**	**1,296**	**1,255**
Mid-East Texas GCD	Freestone	Hooper	3,006	4,341	4,578	4,814	5,051	5,288	5,501
Mid-East Texas GCD	Leon	Hooper	0	0	0	0	0	0	0
Mid-East Texas GCD	Madison	Hooper	0	0	0	0	0	0	0
Mid-East Texas GCD Total[1]		**Hooper**	**3,006**	**4,341**	**4,578**	**4,814**	**5,051**	**5,288**	**5,501**
Post Oak Savannah GCD	Burleson	Hooper	19	1,085	1,515	1,623	1,623	1,623	1,623
Post Oak Savannah GCD	Milam	Hooper	5,366	1,874	2,623	2,811	2,811	2,800	2,800
Post Oak Savannah GCD Total[1]		**Hooper**	**5,385**	**2,960**	**4,139**	**4,433**	**4,433**	**4,422**	**4,422**

Groundwater Conservation District	County	Aquifer	2010	2020	2030	2040	2050	2060	2069
No District-County	Falls	Hooper	726	727	734	741	749	749	749
No District-County	Limestone	Hooper	1,488	1,382	1,410	1,444	1,496	1,496	1,414
No District-County	Navarro	Hooper	16	11	11	11	11	11	11
No District-County	Williamson	Hooper	5	5	5	5	5	5	5
No District-County Total[1]		**Hooper**	**2,235**	**2,125**	**2,160**	**2,201**	**2,261**	**2,261**	**2,178**
GMA 12 Total[1]		**Hooper**	**11,836**	**11,586**	**13,617**	**14,439**	**15,040**	**15,267**	**15,357**

1. Individual estimates are rounded and may not always sum up to the total value displayed.
2. NR: Groundwater Management Area 12 declared the Hooper Aquifer not relevant in these areas.

TABLE 5 MODELED AVAILABLE GROUNDWATER FOR THE SIMSBORO AQUIFER IN GROUNDWATER MANAGEMENT AREA 12 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2010 AND 2069. VALUES ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District	County	Aquifer	2010	2020	2030	2040	2050	2060	2069
Brazos Valley GCD	Brazos	Simsboro	35,086	41,115	44,120	45,681	50,208	53,404	53,404
Brazos Valley GCD	Robertson	Simsboro	37,236	41,673	42,061	42,468	42,794	42,794	42,794
Brazos Valley GCD Total[1]		**Simsboro**	**72,322**	**82,788**	**86,182**	**88,149**	**93,002**	**96,198**	**96,198**
Fayette County GCD [2]	**Fayette**	**Simsboro**	**NR**	**NR**	**NR**	**NR**	**NR**	**NR**	**NR**
Lost Pines GCD	Bastrop	Simsboro	8,508	14,253	15,673	16,311	17,334	15,947	16,279
Lost Pines GCD	Lee	Simsboro	1,860	17,993	17,221	17,031	17,179	14,896	14,024
Lost Pines GCD Total[1]		**Simsboro**	**10,368**	**32,246**	**32,895**	**33,342**	**34,513**	**30,843**	**30,304**
Mid-East Texas GCD	Freestone	Simsboro	1,254	3,582	3,589	3,585	3,552	3,550	3,550
Mid-East Texas GCD	Leon	Simsboro	263	3,359	3,457	3,538	3,617	3,623	3,623
Mid-East Texas GCD	Madison	Simsboro	0	0	0	0	0	0	0
Mid-East Texas GCD Total[1]		**Simsboro**	**1,517**	**6,941**	**7,046**	**7,124**	**7,169**	**7,173**	**7,173**

Groundwater Conservation District	County	Aquifer	2010	2020	2030	2040	2050	2060	2069
Post Oak Savannah GCD	Burleson	Simsboro	627	17,687	21,616	25,103	28,858	30,409	30,409
Post Oak Savannah GCD	Milam	Simsboro	10,702	20,783	16,284	14,940	17,171	18,094	18,094
Post Oak Savannah GCD Total[1]		**Simsboro**	**11,329**	**38,470**	**37,900**	**40,042**	**46,028**	**48,503**	**48,503**
No District-County	Falls	Simsboro	139	140	141	143	146	146	146
No District-County	Limestone	Simsboro	9,801	9,753	9,850	9,992	10,235	10,235	10,235
No District-County	Navarro	Simsboro	6	4	4	4	4	4	4
No District-County	Williamson	Simsboro	2	2	2	2	2	2	2
No District Total		**Simsboro**	**9,948**	**9,899**	**9,997**	**10,141**	**10,387**	**10,387**	**10,387**
GMA 12 Total[1]		**Simsboro**	**105,484**	**170,343**	**174,020**	**178,799**	**191,099**	**193,104**	**192,565**

1. Individual estimates are rounded and may not always sum up to the total value displayed.
2. NR: Groundwater Management Area 12 declared the Simsboro Aquifer not relevant in these areas.

TABLE 6 MODELED AVAILABLE GROUNDWATER FOR THE CALVERT BLUFF AQUIFER IN GROUNDWATER MANAGEMENT AREA 12 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2010 AND 2069. VALUES ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District	County	Aquifer	2010	2020	2030	2040	2050	2060	2069
Brazos Valley GCD	Brazos	Calvert Bluff	0	0	0	0	0	0	0
Brazos Valley GCD	Robertson	Calvert Bluff	776	1,764	1,757	1,758	1,757	1,757	1,757
Brazos Valley GCD Total[1]		**Calvert Bluff**	**776**	**1,764**	**1,757**	**1,758**	**1,757**	**1,757**	**1,757**
Fayette County GCD[2]	**Fayette**	**Calvert Bluff**	**NR**	**NR**	**NR**	**NR**	**NR**	**NR**	**NR**
Lost Pines GCD	Bastrop	Calvert Bluff	1,534	2,063	2,462	2,970	3,613	3,774	3,873
Lost Pines GCD	Lee	Calvert Bluff	50	161	169	211	296	209	111
Lost Pines GCD Total[1]		**Calvert Bluff**	**1,584**	**2,224**	**2,631**	**3,181**	**3,909**	**3,983**	**3,984**
Mid-East Texas GCD	Freestone	Calvert Bluff	878	754	734	728	714	714	714
Mid-East Texas GCD	Leon	Calvert Bluff	2,817	2,819	2,953	3,065	3,189	3,201	3,201
Mid-East Texas GCD	Madison	Calvert Bluff	4	0	0	0	0	0	0
Mid-East Texas GCD Total[1]		**Calvert Bluff**	**3,698**	**3,573**	**3,687**	**3,793**	**3,903**	**3,915**	**3,915**

Groundwater Conservation District	County	Aquifer	2010	2020	2030	2040	2050	2060	2069
Post Oak Savannah GCD	Burleson	Calvert Bluff	0	87	87	87	87	87	87
Post Oak Savannah GCD	Milam	Calvert Bluff	1,713	949	949	949	949	949	949
Post Oak Savannah GCD Total[1]		**Calvert Bluff**	**1,713**	**1,036**	**1,036**	**1,036**	**1,036**	**1,036**	**1,036**
No District-County	Limestone	Calvert Bluff	248	218	223	228	235	235	235
No District-County	Navarro	Calvert Bluff	0	0	0	0	0	0	0
No District-County	Williamson	Calvert Bluff	1	2	2	2	3	2	1
No District Total		**Calvert Bluff**	**248**	**220**	**225**	**230**	**237**	**237**	**236**
GMA 12 Total[1]		**Calvert Bluff**	**8,020**	**8,817**	**9,336**	**9,998**	**10,842**	**10,927**	**10,927**

1. Individual estimates are rounded and may not always sum up to the total value displayed.
2. NR: Groundwater Management Area 12 declared the Calvert Bluff Aquifer not relevant in these areas.

TABLE 7 MODELED AVAILABLE GROUNDWATER FOR THE CARRIZO AQUIFER IN GROUNDWATER MANAGEMENT AREA 12 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2010 AND 2069. VALUES ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District	County	Aquifer	2010	2020	2030	2040	2050	2060	2069
Brazos Valley GCD	Brazos	Carrizo	1,196	3,717	3,724	3,737	3,761	3,763	3,763
Brazos Valley GCD	Robertson	Carrizo	887	1,707	1,698	1,713	1,730	1,731	1,731
Brazos Valley GCD Total[1]		**Carrizo**	**2,083**	**5,425**	**5,422**	**5,450**	**5,491**	**5,494**	**5,494**
Fayette County GCD	**Fayette[2]**	**Carrizo**	**37**	**5,474**	**5,474**	**5,474**	**5,474**	**5,474**	**5,474**
Lost Pines GCD	Bastrop	Carrizo	2,408	4,692	5,308	6,042	7,929	8,205	8,295
Lost Pines GCD	Lee	Carrizo	2,089	2,926	3,050	3,221	3,871	3,847	3,757
Lost Pines GCD Total[1]		**Carrizo**	**4,496**	**7,618**	**8,358**	**9,263**	**11,800**	**12,052**	**12,052**
Mid-East Texas GCD	Freestone	Carrizo	44	369	366	357	347	346	346
Mid-East Texas GCD	Leon	Carrizo	694	8,108	8,051	8,110	8,193	8,200	8,200
Mid-East Texas GCD	Madison	Carrizo	1,478	2,861	2,770	2,656	2,554	2,543	2,543
Mid-East Texas GCD Total[1]		**Carrizo**	**2,216**	**11,339**	**11,187**	**11,123**	**11,095**	**11,090**	**11,090**
Post Oak Savannah GCD	Burleson	Carrizo	647	4,383	4,821	5,698	5,917	6,575	6,575
Post Oak Savannah GCD	Milam	Carrizo	23	322	355	419	435	484	484
Post Oak Savannah GCD Total[1]		**Carrizo**	**670**	**4,705**	**5,176**	**6,117**	**6,352**	**7,058**	**7,058**
GMA 12 Total[1]		**Carrizo**	**9,502**	**34,560**	**35,616**	**37,427**	**40,211**	**41,167**	**41,167**

1. Individual estimates are rounded and may not always sum up to the total value displayed.
2. Modeled available groundwater values for Fayette County include all of the county (GMA 12 and GMA 15 portions)

TABLE 8 MODELED AVAILABLE GROUNDWATER FOR THE QUEEN CITY AQUIFER IN GROUNDWATER MANAGEMENT AREA 12 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2010 AND 2069. VALUES ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District	County	Aquifer	2010	2020	2030	2040	2050	2060	2069
Brazos Valley GCD	Brazos	Queen City	541	836	883	887	891	891	891
Brazos Valley GCD	Robertson	Queen City	0	368	309	309	309	309	309
Brazos Valley GCD Total[1]		**Queen City**	**541**	**1,204**	**1,192**	**1,196**	**1,200**	**1,200**	**1,200**
Fayette County GCD	**Fayette[2]**	**Queen City**	**268**	**2,708**	**2,708**	**2,708**	**2,708**	**2,708**	**2,708**
Lost Pines GCD	Bastrop	Queen City	192	558	541	523	505	486	467
Lost Pines GCD	Lee	Queen City	394	757	774	792	810	829	848
Lost Pines GCD Total[1]		**Queen City**	**587**	**1,315**	**1,315**	**1,315**	**1,315**	**1,315**	**1,315**
Mid-East Texas GCD	Freestone	Queen City	0	0	0	0	0	0	0
Mid-East Texas GCD	Leon	Queen City	624	594	594	594	594	594	594
Mid-East Texas GCD	Madison	Queen City	148	380	380	380	380	380	380
Mid-East Texas GCD Total[1]		**Queen City**	**772**	**974**	**974**	**974**	**974**	**974**	**974**
Post Oak Savannah GCD	Burleson	Queen City	685	416	447	447	447	447	447
Post Oak Savannah GCD	Milam	Queen City	20	53	56	56	56	56	56
Post Oak Savannah GCD Total[1]		**Queen City**	**705**	**469**	**504**	**504**	**504**	**504**	**504**
GMA 12 Total[1]		**Queen City**	**2,873**	**6,669**	**6,693**	**6,696**	**6,700**	**6,701**	**6,700**

1. Individual estimates are rounded and may not always sum up to the total value displayed.
2. Modeled available groundwater values for Fayette County include all of the county (GMA 12 and GMA 15 portions)

TABLE 9 MODELED AVAILABLE GROUNDWATER FOR THE SPARTA AQUIFER IN GROUNDWATER MANAGEMENT AREA 12 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2010 AND 2069. VALUES ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District	County	Aquifer	2010	2020	2030	2040	2050	2060	2069
Brazos Valley GCD	Brazos	Sparta	3,745	5,404	6,505	7,507	8,509	8,509	8,509
Brazos Valley GCD	Robertson	Sparta	16	510	510	510	510	510	510
Brazos Valley GCD Total[1]		**Sparta**	**3,760**	**5,914**	**7,015**	**8,017**	**9,019**	**9,019**	**9,019**
Fayette County GCD	**Fayette[2]**	**Sparta**	**1,176**	**2,831**	**2,825**	**2,803**	**2,794**	**2,802**	**2,802**
Lost Pines GCD	Bastrop	Sparta	81	907	904	902	898	896	895
Lost Pines GCD	Lee	Sparta	218	1,483	1,487	1,490	1,492	1,495	1,498
Lost Pines GCD Total[1]		**Sparta**	**299**	**2,390**	**2,391**	**2,391**	**2,391**	**2,391**	**2,392**
Mid-East Texas GCD	Leon	Sparta	86	21	21	21	21	21	21
Mid-East Texas GCD	Madison	Sparta	1,401	3,320	3,322	3,322	3,322	3,322	3,322
Mid-East Texas GCD Total[1]		**Sparta**	**1,487**	**3,341**	**3,343**	**3,343**	**3,343**	**3,343**	**3,343**
Post Oak Savannah GCD	**Burleson**	**Sparta**	**988**	**2,246**	**4,042**	**5,613**	**6,735**	**6,735**	**6,735**
GMA 12 Total[1]		**Sparta**	**7,709**	**16,721**	**19,616**	**22,167**	**24,282**	**24,291**	**24,292**

1. Individual estimates are rounded and may not always sum up to the total value displayed.
2. Modeled available groundwater values for Fayette County include all of the county (GMA 12 and GMA 15 portions)

TABLE 10 MODELED AVAILABLE GROUNDWATER FOR THE YEGUA-JACKSON AQUIFER IN GROUNDWATER MANAGEMENT AREA 12 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2010 AND 2069. VALUES ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District	County	Aquifer	2010	2020	2030	2040	2050	2060	2069
Brazos Valley GCD	Brazos	Jackson	4,411	4,404	4,402	4,402	4,402	4,402	4,402
Brazos Valley GCD	Brazos	Yegua	2,452	2,452	2,452	2,452	2,452	2,452	2,452
Brazos Valley GCD Total[1]		**Yegua-Jackson**	**6,863**	**6,856**	**6,854**	**6,854**	**6,854**	**6,854**	**6,854**
Fayette County GCD[1]	**Fayette[3]**	**Yegua-Jackson**	**9,262**	**9,262**	**9,262**	**9,262**	**9,262**	**9,261**	**9,261**
Lost Pines GCD[2]	Bastrop	Yegua-Jackson	NR	NR	NR	NR	NR	NR	NR
Lost Pines GCD[2]	Lee	Yegua-Jackson	NR	NR	NR	NR	NR	NR	NR
Lost Pines GCD Total[1,2]		**Yegua-Jackson**	**NR**	**NR**	**NR**	**NR**	**NR**	**NR**	**NR**
Mid-East Texas GCD	Leon	Yegua-Jackson	0	0	0	0	0	0	0
Mid-East Texas GCD	Madison	Yegua-Jackson	809	809	809	809	809	809	809
Mid-East Texas GCD Total[1]		**Yegua-Jackson**	**809**	**809**	**809**	**809**	**809**	**809**	**809**
Post Oak Savannah GCD[1]	**Burleson**	**Yegua-Jackson**	**14,544**	**14,544**	**12,576**	**12,564**	**12,478**	**12,326**	**10,200**
GMA 12 Total[1]		**Yegua-Jackson**	**31,478**	**31,471**	**29,501**	**29,489**	**29,403**	**29,250**	**27,124**

1. Individual estimates are rounded and may not always sum up to the total value displayed.
2. NR: Groundwater Management Area 12 declared the Yegua-Jackson Aquifer not relevant in these areas .
3. Modeled available groundwater values for Fayette County include all of the county (GMA 12 and GMA 15 portions)

TABLE 11 MODELED AVAILABLE GROUNDWATER FOR THE BRAZOS RIVER ALLUVIUM AQUIFER IN GROUNDWATER MANAGEMENT AREA 12 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2013 AND 2070. VALUES ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District	County	Aquifer	2013	2020	2030	2040	2050	2060	2070
Brazos Valley GCD	Brazos	Brazos River Alluvium	122,785	81,581	80,311	80,081	79,976	79,913	79,872
Brazos Valley GCD	Robertson	Brazos River Alluvium	66,608	61,161	57,959	57,633	57,544	57,503	57,480
Brazos Valley GCD Total[1]		Brazos River Alluvium	**189,393**	**142,742**	**138,270**	**137,714**	**137,520**	**137,416**	**137,351**
Post Oak Savannah GCD	Burleson	Brazos River Alluvium	28,515	28,472	28,418	28,414	28,414	28,414	28,413
Post Oak Savannah GCD	Milam	Brazos River Alluvium	50,626	47,818	47,785	47,779	47,775	47,773	47,771
Post Oak Savannah GCD Total[1]		Brazos River Alluvium	**79,142**	**76,290**	**76,203**	**76,193**	**76,189**	**76,186**	**76,185**
No District-County[2]	Falls	Brazos River Alluvium	NR	NR	NR	NR	NR	NR	NR
GMA 12 Total1		**Brazos River Alluvium**	**268,535**	**219,032**	**214,473**	**213,907**	**213,709**	**213,602**	**213,536**

1. Individual estimates are rounded and may not always sum up to the total value displayed.
2. NR: Groundwater Management Area 12 declared the Brazos River Alluvium Aquifer not relevant in these areas.

TABLE 12 MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE HOOPER AQUIFER IN GROUNDWATER MANAGEMENT AREA 12. VALUES ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), RIVER BASIN, AND AQUIFER.

County	RWPA	River Basin	Aquifer	2020	2030	2040	2050	2060
Bastrop	K	Brazos	Hooper	0	0	0	0	0
Bastrop	K	Colorado	Hooper	651	781	953	1,176	1,179
Bastrop	K	Guadalupe	Hooper	0	0	0	0	0
Brazos	G	Brazos	Hooper	0	0	0	0	0
Burleson	G	Brazos	Hooper	1,085	1,515	1,623	1,623	1,623
Falls	G	Brazos	Hooper	727	734	741	749	749
Fayette	K	Colorado	Hooper	NR	NR	NR	NR	NR
Fayette	K	Guadalupe	Hooper	NR	NR	NR	NR	NR
Fayette	K	Lavaca	Hooper	NR	NR	NR	NR	NR
Freestone	C	Brazos	Hooper	518	543	568	593	619
Freestone	C	Trinity	Hooper	3,823	4,035	4,246	4,458	4,669
Lee	G	Brazos	Hooper	59	72	90	112	111
Lee	G	Colorado	Hooper	3	4	5	7	6
Leon	H	Brazos	Hooper	0	0	0	0	0
Leon	H	Trinity	Hooper	0	0	0	0	0
Limestone	G	Brazos	Hooper	1,382	1,410	1,444	1,496	1,496
Madison	H	Brazos	Hooper	0	0	0	0	0
Madison	H	Trinity	Hooper	0	0	0	0	0
Milam	G	Brazos	Hooper	1,874	2,623	2,811	2,811	2,800
Navarro	C	Trinity	Hooper	11	11	11	11	11
Robertson	G	Brazos	Hooper	1,446	1,884	1,942	2,000	2,000

Williamson	G	Brazos	Hooper	5	5	5	5	5
Williamson	G	Colorado	Hooper	0	0	0	0	0
GMA 12 Total			**Hooper**	**11,584**	**13,617**	**14,439**	**15,041**	**15,268**

NR: Groundwater Management Area 12 declared the Hooper Aquifer not relevant in these areas.

TABLE 13 MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE SIMSBORO AQUIFER IN GROUNDWATER MANAGEMENT AREA 12. VALUES ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), RIVER BASIN, AND AQUIFER.

County	RWPA	River Basin	Aquifer	2020	2030	2040	2050	2060
Bastrop	K	Brazos	Simsboro	398	529	653	776	765
Bastrop	K	Colorado	Simsboro	13,855	15,145	15,658	16,558	15,182
Bastrop	K	Guadalupe	Simsboro	0	0	0	0	0
Brazos	G	Brazos	Simsboro	41,115	44,120	45,681	50,208	53,404
Burleson	G	Brazos	Simsboro	17,687	21,616	25,103	28,858	30,409
Falls	G	Brazos	Simsboro	140	141	143	146	146
Fayette	K	Colorado	Simsboro	NR	NR	NR	NR	NR
Fayette	K	Guadalupe	Simsboro	NR	NR	NR	NR	NR
Fayette	K	Lavaca	Simsboro	NR	NR	NR	NR	NR
Freestone	C	Brazos	Simsboro	685	673	668	657	657
Freestone	C	Trinity	Simsboro	2,897	2,916	2,917	2,895	2,893
Lee	G	Brazos	Simsboro	17,993	17,221	17,031	17,179	14,896
Lee	G	Colorado	Simsboro	0	0	0	0	0
Leon	H	Brazos	Simsboro	553	555	563	575	576
Leon	H	Trinity	Simsboro	2,807	2,902	2,976	3,042	3,047
Limestone	G	Brazos	Simsboro	9,753	9,850	9,992	10,235	10,235
Madison	H	Brazos	Simsboro	0	0	0	0	0
Madison	H	Trinity	Simsboro	0	0	0	0	0
Milam	G	Brazos	Simsboro	20,783	16,284	14,940	17,171	18,094
Navarro	C	Trinity	Simsboro	4	4	4	4	4

Robertson	G	Brazos	Simsboro	41,673	42,061	42,468	42,794	42,794
Williamson	G	Brazos	Simsboro	2	2	2	2	2
GMA 12 Total			**Simsboro**	**170,345**	**174,019**	**178,799**	**191,100**	**193,104**

NR: Groundwater Management Area 12 declared the Simsboro Aquifer not relevant in these areas.

TABLE 14 MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE CALVERT BLUFF AQUIFER IN GROUNDWATER MANAGEMENT AREA 12. VALUES ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), RIVER BASIN, AND AQUIFER.

County	RWPA	River Basin	Aquifer	2020	2030	2040	2050	2060
Bastrop	K	Brazos	Calvert Bluff	97	104	122	154	134
Bastrop	K	Colorado	Calvert Bluff	1,958	2,349	2,837	3,446	3,627
Bastrop	K	Guadalupe	Calvert Bluff	9	9	11	13	12
Brazos	G	Brazos	Calvert Bluff	0	0	0	0	0
Burleson	G	Brazos	Calvert Bluff	87	87	87	87	87
Fayette	K	Colorado	Calvert Bluff	NR	NR	NR	NR	NR
Fayette	K	Guadalupe	Calvert Bluff	NR	NR	NR	NR	NR
Fayette	K	Lavaca	Calvert Bluff	NR	NR	NR	NR	NR
Freestone	C	Brazos	Calvert Bluff	130	127	126	124	124
Freestone	C	Trinity	Calvert Bluff	624	607	602	590	590
Lee	G	Brazos	Calvert Bluff	161	169	211	296	209
Lee	G	Colorado	Calvert Bluff	0	0	0	0	0
Leon	H	Brazos	Calvert Bluff	585	589	590	590	592
Leon	H	Trinity	Calvert Bluff	2,235	2,364	2,475	2,600	2,609
Limestone	G	Brazos	Calvert Bluff	218	223	228	235	235
Madison	H	Brazos	Calvert Bluff	0	0	0	0	0
Madison	H	Trinity	Calvert Bluff	0	0	0	0	0
Milam	G	Brazos	Calvert Bluff	949	949	949	949	949
Navarro	C	Trinity	Calvert Bluff	0	0	0	0	0
Robertson	G	Brazos	Calvert Bluff	1,764	1,757	1,758	1,757	1,757
Williamson	G	Brazos	Calvert Bluff	2	2	2	3	2
GMA 12 Total			**Calvert Bluff**	**8,819**	**9,336**	**9,998**	**10,844**	**10,927**

NR: Groundwater Management Area 12 declared the Calvert Bluff Aquifer not relevant in these areas.

TABLE 15 MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE CARRIZO AQUIFER IN GROUNDWATER MANAGEMENT AREA 12. VALUES ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), RIVER BASIN, AND AQUIFER.

County	RWPA	River Basin	Aquifer	2020	2030	2040	2050	2060
Bastrop	K	Brazos	Carrizo	257	214	185	303	214
Bastrop	K	Colorado	Carrizo	4,232	4,931	5,721	7,390	7,835
Bastrop	K	Guadalupe	Carrizo	203	163	136	235	155
Brazos	G	Brazos	Carrizo	3,717	3,724	3,737	3,761	3,763
Burleson	G	Brazos	Carrizo	4,383	4,821	5,698	5,917	6,575
Fayette[1]	K	Colorado	Carrizo	4,565	4,565	4,565	4,565	4,565
Fayette[1]	K	Guadalupe	Carrizo	909	909	909	909	909
Fayette[1]	K	Lavaca	Carrizo	0	0	0	0	0
Freestone	C	Trinity	Carrizo	369	366	357	347	346
Lee	G	Brazos	Carrizo	2,249	2,268	2,335	2,881	2,752
Lee	G	Colorado	Carrizo	677	782	886	991	1,095
Leon	H	Brazos	Carrizo	2,474	2,260	2,172	2,186	2,188
Leon	H	Trinity	Carrizo	5,634	5,791	5,938	6,008	6,012
Madison	H	Brazos	Carrizo	381	371	352	335	334
Madison	H	Trinity	Carrizo	2,481	2,399	2,304	2,219	2,210
Milam	G	Brazos	Carrizo	322	355	419	435	484
Robertson	G	Brazos	Carrizo	1,707	1,698	1,713	1,730	1,731
GMA 12 Total			**Carrizo**	**34,560**	**35,617**	**37,427**	**40,212**	**41,168**

1. Modeled available groundwater values for Fayette County include all of the county (GMA 12 and GMA 15 portions)

TABLE 16 MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE QUEEN CITY AQUIFER IN GROUNDWATER MANAGEMENT AREA 12. VALUES ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), RIVER BASIN, AND AQUIFER.

County	RWPA	River Basin	Aquifer	2020	2030	2040	2050	2060
Bastrop	K	Brazos	Queen City	49	47	46	44	42
Bastrop	K	Colorado	Queen City	353	333	311	288	264
Bastrop	K	Guadalupe	Queen City	156	161	166	173	180
Brazos	G	Brazos	Queen City	836	883	887	891	891
Burleson	G	Brazos	Queen City	416	447	447	447	447
Fayette[1]	K	Colorado	Queen City	2,278	2,278	2,278	2,278	2,278
Fayette[1]	K	Guadalupe	Queen City	430	430	430	430	430
Fayette[1]	K	Lavaca	Queen City	0	0	0	0	0
Freestone	C	Trinity	Queen City	0	0	0	0	0
Lee	G	Brazos	Queen City	709	713	716	721	727
Lee	G	Colorado	Queen City	48	61	75	89	102
Leon	H	Brazos	Queen City	245	245	245	245	245
Leon	H	Trinity	Queen City	349	349	349	349	349
Madison	H	Brazos	Queen City	1	1	1	1	1
Madison	H	Trinity	Queen City	379	379	379	379	379
Milam	G	Brazos	Queen City	53	56	56	56	56
Robertson	G	Brazos	Queen City	368	309	309	309	309
GMA 12 Total			**Queen City**	**6,670**	**6,692**	**6,695**	**6,700**	**6,700**

1. Modeled available groundwater values for Fayette County include all of the county (GMA 12 and GMA 15 portions)

TABLE 17 MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE SPARTA AQUIFER IN GROUNDWATER MANAGEMENT AREA 12. VALUES ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), RIVER BASIN, AND AQUIFER.

County	RWPA	River Basin	Aquifer	2020	2030	2040	2050	2060
Bastrop	K	Brazos	Sparta	89	87	85	84	82
Bastrop	K	Colorado	Sparta	785	784	783	782	781
Bastrop	K	Guadalupe	Sparta	33	33	33	33	33
Brazos	G	Brazos	Sparta	5,404	6,505	7,507	8,509	8,509
Burleson	G	Brazos	Sparta	2,246	4,042	5,613	6,735	6,735
Fayette[1]	K	Colorado	Sparta	1,659	1,649	1,626	1,612	1,619
Fayette[1]	K	Guadalupe	Sparta	1,172	1,176	1,177	1,182	1,183
Fayette[1]	K	Lavaca	Sparta	0	0	0	0	0
Lee	G	Brazos	Sparta	1,279	1,274	1,269	1,263	1,256
Lee	G	Colorado	Sparta	204	213	221	230	238
Leon	H	Brazos	Sparta	0	0	0	0	0
Leon	H	Trinity	Sparta	21	21	21	21	21
Madison	H	Brazos	Sparta	7	9	9	9	9
Madison	H	Trinity	Sparta	3,313	3,313	3,313	3,313	3,313
Robertson	G	Brazos	Sparta	510	510	510	510	510
GMA 12 Total			**Sparta**	**16,722**	**19,616**	**22,167**	**24,283**	**24,289**

1. Modeled available groundwater values for Fayette County include all of the county (GMA 12 and GMA 15 portions)

TABLE 18 MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE YEGUA-JACKSON AQUIFER IN GROUNDWATER MANAGEMENT AREA 12. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), RIVER BASIN, AND AQUIFER.

County	RWPA	River Basin	Aquifer	2020	2030	2040	2050	2060
Bastrop	K	Colorado	Yegua-Jackson	NR	NR	NR	NR	NR
Brazos	G	Brazos	Yegua-Jackson	6,856	6,854	6,854	6,854	6,854
Burleson	G	Brazos	Yegua-Jackson	14,544	12,576	12,564	12,478	12,326
Fayette[1]	K	Colorado	Yegua-Jackson	7,075	7,075	7,075	7,075	7,074
Fayette[1]	K	Guadalupe	Yegua-Jackson	694	694	694	694	694
Fayette[1]	K	Lavaca	Yegua-Jackson	1,493	1,493	1,493	1,493	1,493
Lee	G	Brazos	Yegua-Jackson	NR	NR	NR	NR	NR
Lee	G	Colorado	Yegua-Jackson	NR	NR	NR	NR	NR
Leon	H	Trinity	Yegua-Jackson	0	0	0	0	0
Madison	H	Brazos	Yegua-Jackson	8	8	8	8	8
Madison	H	Trinity	Yegua-Jackson	802	802	802	802	802
GMA 12 Total			**Yegua-Jackson**	**31,471**	**29,501**	**29,489**	**29,403**	**29,250**

1. Modeled available groundwater values for Fayette County include all of the county (GMA 12 and GMA 15 portions)
2. NR: Groundwater Management Area 12 declared the Yegua-Jackson Aquifer not relevant in these areas.

TABLE 19 MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE BRAZOS RIVER ALLUVIUM AQUIFER IN GROUNDWATER MANAGEMENT AREA 12. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), RIVER BASIN, AND AQUIFER.

County	RWPA	River Basin	Aquifer	2020	2030	2040	2050	2060	2070
Brazos	G	Brazos	Brazos River Alluvium	81,581	80,311	80,081	79,976	79,913	79,872
Burleson	G	Brazos	Brazos River Alluvium	28,472	28,418	28,414	28,414	28,414	28,413
Falls	G	Brazos	Brazos River Alluvium	NR	NR	NR	NR	NR	NR
Milam	G	Brazos	Brazos River Alluvium	47,818	47,785	47,779	47,775	47,773	47,771
Robertson	G	Brazos	Brazos River Alluvium	61,161	57,959	57,633	57,544	57,503	57,480
GMA 12 Total			**Brazos River Alluvium**	**219,032**	**214,473**	**213,907**	**213,709**	**213,602**	**213,536**

NR: Groundwater Management Area 12 declared the Brazos River Alluvium Aquifer not relevant in these areas.

LIMITATIONS:

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

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

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

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

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

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APPENDIX E

Administrative Documents

APPENDIX F

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