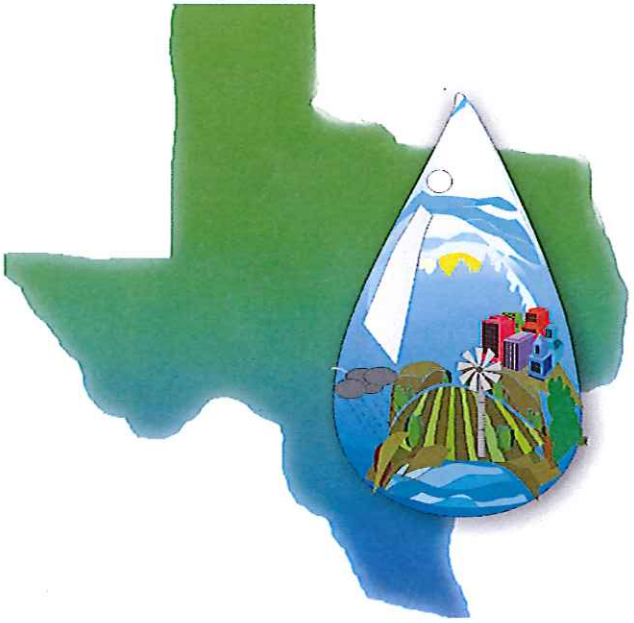
Brazos Valley Groundwater Conservation District



Groundwater Management Plan

ADOPTED

APPROVED BY THE TEXAS WATER DEVELOPMENT BOARD ON

_____.

OBJECTIVES AMENDED BY ACTION OF THE BOARD ON

FEBRUARY 12, 2015

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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 insure 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 the 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 the 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. 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 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

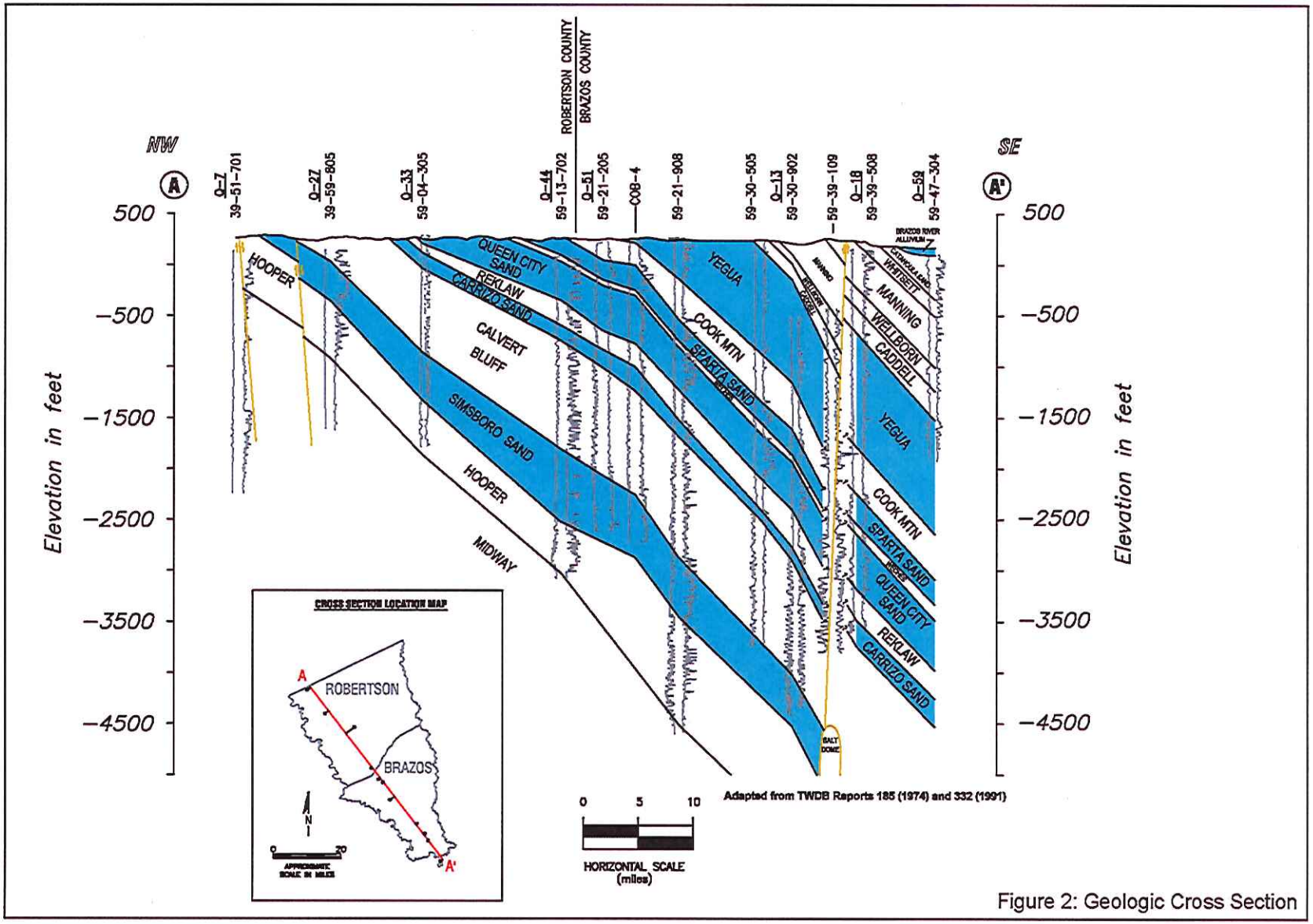
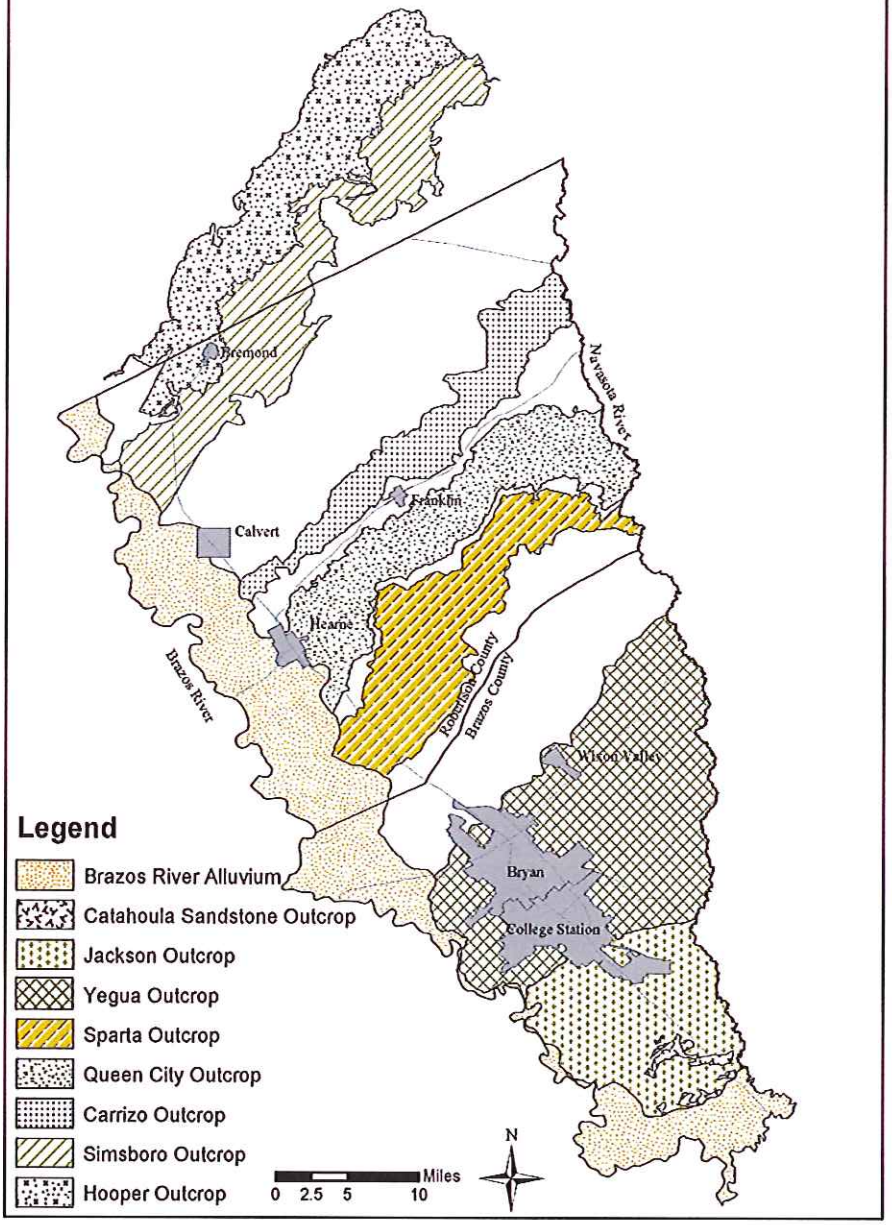


Figure 2: Geologic Cross Section

FIGURE 3: AQUIFER OUTCROPS LOCATED IN BRAZOS AND ROBERTSON COUNTIES



The Carrizo-Wilcox, Queen City, Sparta, and Yegua-Jackson aquifers outcrop within the District's 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 District into adjacent counties as shown on the map above.

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.

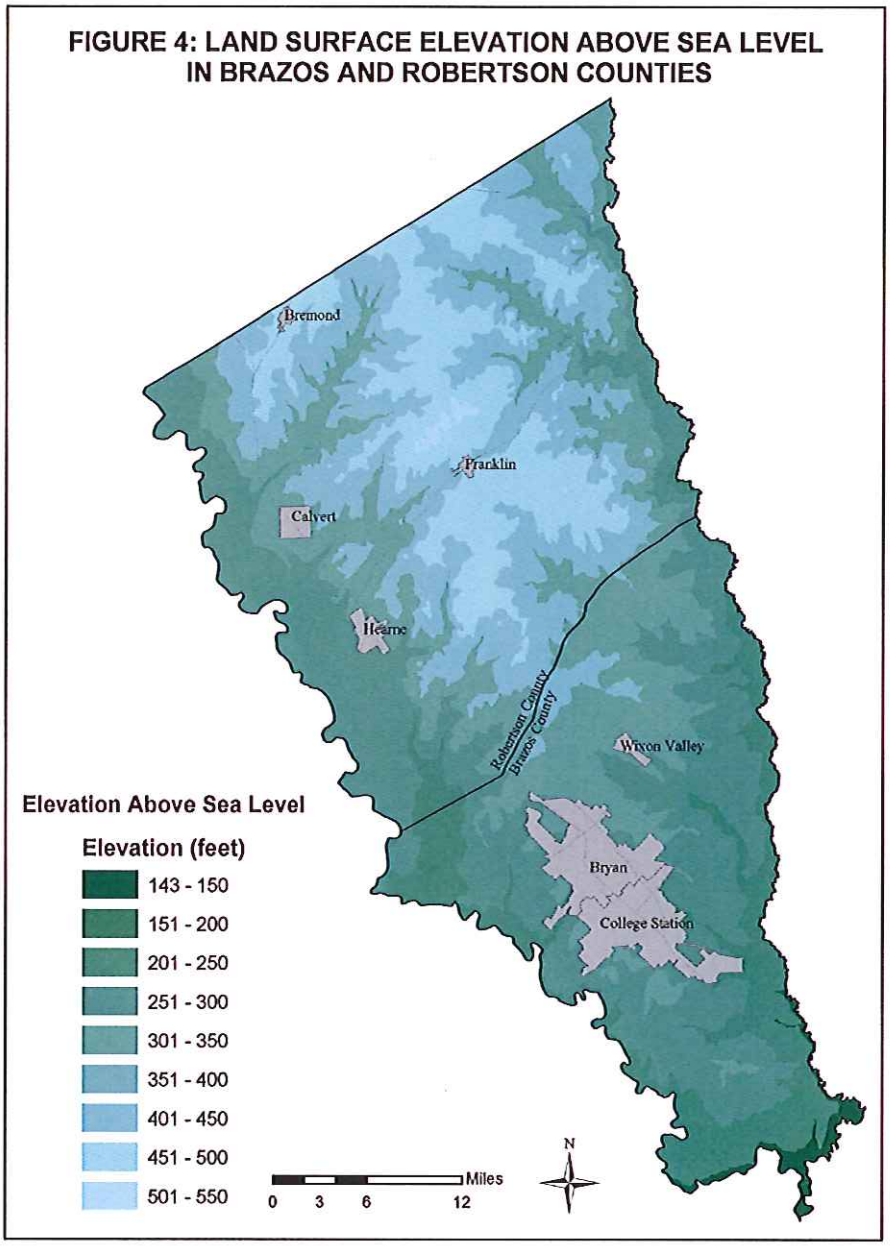
Topography and Drainage

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 to the 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.

FIGURE 4: LAND SURFACE ELEVATION ABOVE SEA LEVEL IN BRAZOS AND ROBERTSON COUNTIES



F. Surface Water Supplies of Brazos and Robertson Counties

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." 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, excluding the Brazos River Alluvium Aquifer.

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 in *Table 1* are for a 60-year period beginning January, 2000 and ending December, 2059. 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 Model for the Central Queen City and Sparta Aquifers (Kelley and others, 2004).

Table 1. Adopted Aquifer DFCs based on the Average Threshold that occurs between January, 2000 and December, 2059. Yegua-Jackson (2000-2060)	Average Drawdowns (ft)
Sparta	15
Queen City	12
Carrizo	47
Upper Wilcox (Calvert Bluff Formation)	106
Middle Wilcox (Simsboro Formation)	270
Lower Wilcox (Hooper Formation)	170
Yegua-Jackson	Yegua – 70 Jackson – 110

A. Resolution to Adopt Desired Future Conditions, August 12, 2010, letter from Gary Westbrook, General Manager, Post Oak Savannah GCD to Kevin Ward, Executive Administrator, Texas Water Development Board (Sparta, Queen City, Carrizo, Upper Wilcox, Middle Wilcox, Lower Wilcox).

B. Resolution to Adopt Desired Future Conditions, July 26, 2011, letter from Gary Westbrook, General Manager, Post Oak Savannah GCD, to Melanie Calhoun, Executive Administrator, Texas Water Development Board (Yegua-Jackson).

The District Board declared the Brazos River Alluvium Aquifer relevant for the 2016 DFC planning cycle. In doing so, a DFC will be set for the aquifer based upon saturated thickness of the water bearing layer.

The TWDB's **MAG Estimates** based on GMA-12 adopted DFCs:

Carrizo

Modeled Available Groundwater for the Carrizo Aquifer summarized by county in GMA-12 for each decade between 2010 and 2060. Results are in ac-ft/yr. MAG attached as *Appendix B1.*

County	2010	2020	2030	2040	2050	2060
Brazos	3,253	3,721	3,728	3,741	3,764	3,766
Robertson	1,732	1,707	1,697	1,712	1,729	1,730

http://www.twdb.texas.gov/groundwater/docs/GAMruns/GR10-044_MAG.pdf

Calvert Bluff

Modeled Available Groundwater for the Calvert Bluff Aquifer summarized by county in GMA-12 for each decade between 2010 and 2060. Results are in ac-ft/yr. MAG attached as *Appendix B1.*

County	2010	2020	2030	2040	2050	2060
Brazos	0	0	0	0	0	0
Robertson	1,777	1,762	1,756	1,756	1,755	1,755

http://www.twdb.texas.gov/groundwater/docs/GAMruns/GR10-044_MAG.pdf

Simsboro

Modeled Available Groundwater for the Simsboro Aquifer summarized by county in GMA-12 for each decade between 2010 and 2060. Results are in ac-ft/yr. MAG attached as *Appendix B1.*

County	2010	2020	2030	2040	2050	2060
Brazos	30,672	35,114	41,119	45,680	50,206	53,403
Robertson	41,053	41,647	42,044	42,453	42,782	42,782

http://www.twdb.texas.gov/groundwater/docs/GAMruns/GR10-044_MAG.pdf

Hooper

Modeled Available Groundwater for the Hooper Aquifer summarized by county in GMA-12 for each decade between 2010 and 2060. Results are in ac-ft/yr. MAG attached as *Appendix B1.*

County	2010	2020	2030	2040	2050	2060
Brazos	0	0	0	0	0	0
Robertson	324	319	317	317	316	316

http://www.twdb.texas.gov/groundwater/docs/GAMruns/GR10-044_MAG.pdf

Queen City

Modeled Available Groundwater for the Queen City Aquifer summarized by county in GMA-12 for each decade between 2010 and 2060. Results are in ac-ft/yr. MAG attached as *Appendix B2.*

County	2010	2020	2030	2040	2050	2060
Brazos	512	604	634	587	533	529
Robertson	0	0	0	0	0	0

http://www.twdb.texas.gov/groundwater/docs/GAMruns/GR10-045_MAG.pdf

Sparta

Modeled Available Groundwater for the Sparta Aquifer summarized by county in GMA-12 for each decade between 2010 and 2060. Results are in ac-ft/yr. MAG attached as *Appendix B3.*

County	2010	2020	2030	2040	2050	2060
Brazos	4295	5941	7308	7305	7307	7307
Robertson	200	300	400	500	616	616

http://www.twdb.texas.gov/groundwater/docs/GAMruns/GR10-046_MAG.pdf

Yegua-Jackson

Modeled Available Groundwater for the Yegua-Jackson Aquifer summarized by county in GMA-12 for each decade between 2010 and 2060. Results are in ac-ft/yr. MAG attached as *Appendix B4.*

County	2010	2020	2030	2040	2050	2060
Brazos	7,071	7,071	7,071	7,071	7,071	7,071
Robertson	--	--	--	--	--	--

http://www.twdb.texas.gov/groundwater/docs/GAMruns/GR10-060_MAG.pdf

Brazos River Alluvium - Not Relevant in 2010 DFCs.

B. Historical Water Use Data

Data from the TWDB Historical Water Use Survey, included in *Appendix C1*, provides annual historical water use projections from 2000 to 2012, 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 2009-2013 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	2009	2010	2011	2012	2013
Hooper	611	914	911	956	794
Simsboro	68,586	63,977	67,519	53,817	64,110
Calvert Bluff	13	58	20	70	80
Carrizo	730	746	1,227	810	799
Queen City	32	0	558	36	64
Sparta	3,432	3,279	4,334	3,083	3,403
Yegua-Jackson	1,599	1,396	1,659	1,408	1,298
Totals	75,003	70,370	76,228	60,180	70,548

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 14-005, attached as *Appendix D*, the annual estimated recharge is given in acre-feet per year (ac-ft/yr) in *Table 3*.

Table 3. GAM Recharge and 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	9,970
	Queen City Aquifer	6,091
	Carrizo-Wilcox Aquifer	26,906
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	1,861
	Queen City Aquifer	11,902
	Carrizo-Wilcox Aquifer	16,869

Source: TWDB GAM Run 14-005

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 14-005, attached as *Appendix D, Table 3* summarizes the flow from each aquifer to surface water springs, lakes, streams, and rivers.

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 14-005, attached as *Appendix D*, 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	12,029
	Sparta Aquifer	617
	Queen City Aquifer	1,865
	Carrizo-Wilcox Aquifer	17,840
Estimated annual volume of flow out of the District within each aquifer in the District	Gulf Coast Aquifer System	48
	Yegua-Jackson Aquifer	9,921
	Sparta Aquifer	496
	Queen City Aquifer	815
	Carrizo-Wilcox Aquifer	10,051
Estimated net annual volume of flow between each aquifer in the District	To the Gulf Coast Aquifer System from the confined portion of the Yegua and Jackson groups[1]	423
	To the Yegua-Jackson Aquifer from the confined portion of the Yegua and Jackson groups	178
	To the Sparta Aquifer from overlying stratigraphic units	714
	From the Sparta Aquifer to the Weches Formation confining unit	599
	From the Sparta Aquifer to the down-dip portion of the Sparta Formation	76
	Weches Formation confining unit into the Queen City Aquifer	209
	Reklaw Formation confining unit into the Queen City Aquifer	148
	From the Queen City Aquifer to the down-dip portion of the Queen City Formation	83
	To the Carrizo-Wilcox Aquifer from the Reklaw Formation confining Unit	62
	To the Carrizo-Wilcox Aquifer from the down-dip portions of the equivalent formations	10,962

Source: TWDB GAM Run 14-005

[1] Calculated using the groundwater availability model for the Yegua-Jackson Aquifer

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 the 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 2012 State Water Plan and are referenced in a table provided by the TWDB in *Appendix C2*.

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 128,906 acre-feet, by the year 2060. 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 2060 are described in *Appendix C3*. These estimates are in the current 2012 State Water Plan. However, the District has concerns that these numbers, particularly for agricultural irrigation and public water supply, are low and do not appropriately reflect actual growth or current usage within the District. It is expected that actual demands will be considerably higher than shown and projected water demands may be adjusted significantly in the 2016 Region G Plan and 2017 State Water Plan. 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.

H. Projected Water Supply Needs

Projected water supply needs, based on projections in the 2012 State Water Plan, are included in *Appendix C4*. Negative values (listed in red) indicate a projected water supply need, and additional water will be required to meet the demand. The District expects that the water supply needs may be adjusted significantly in the 2016 Region G Plan and the 2017 State Water Plan.

I. Projected Water Management Strategies to Meet Future Supply Needs

Demand and supply data developed as part of the Region G planning process in 2011, District records, and GMA-12 planning efforts indicate that groundwater and surface water supplies should be adequate to meet projected future demands. 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. The District expects the 2016 Region G Plan and the 2017 State Water Plan may include such additional strategies. 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 2012 State Water Plan, are included in *Appendix C5*. If projected demand within the District from the 2012 State Water Plan are low (as suggested above), then projected water needs are also understated.

J. Natural or Artificial Recharge of Groundwater Resources

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 14-005, found in *Appendix D*, 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 26,906 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 14-005, found in *Appendix D*, estimates the recharge to the Queen City Aquifer within the District is about 6,091 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 9,970 ac-ft/yr in the TWDB GAM Run 14-005, found in *Appendix D*. 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 14-005 (*Appendix D*). 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 14-005 (*Appendix D*) 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 estimated to be at least 26,500 ac-ft/yr based on information from past Region G planning. A three-dimensional groundwater flow model is being developed for the Brazos River Alluvium by the TWDB. Results from the modeling project will be used to refine the estimate of recharge to the Brazos River Alluvium.

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. Historic use permits were issued

for wells in operation prior to January 1, 2007.

C. Pumping Rate Limit

The District will regulate groundwater withdrawal through permitting efforts and by setting a maximum pumping rate limit of 3,300 gpm/well. 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. Beneficial Use

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. Well Spacing

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 one gallon per minute of average annual production capacity 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 one gallon per minute of average annual production capacity from existing wells.

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

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

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, 2015. A copy of the Annual Report will be kept on file and available for public inspection at the District's offices upon adoption.

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

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 at http://brazosvalleygcd.org/rules-and-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 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's 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 volumes 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. **<u>Implement Strategies to Control and Prevent Waste of Groundwater</u>:**

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. **Implement Strategies to Address Conjunctive Surface Water Management Issues:**

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

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. **Implement Strategies to Address Drought Conditions:**

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's 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 once annually.

➢ **Performance Standard –** A report summarizing findings of the annual 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 http://www.twdb.state.tx.us/data/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's adopted 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's adopted 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** – Once annually, the District will conduct a meeting to address potential District grant funding for water conservation projects. 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. **Implement Strategies to Protect Water Quality:**

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. **Implement Strategies to Assess Adopted Desired Future Conditions**

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. Management Goals Determined Not to be Applicable to the Brazos Valley Groundwater Conservation District

1. **Controlling and Preventing Subsidence:**
The geologic formation of the aquifers within the District precludes significant subsidence from 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 2012 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 2012 State Water Plan Chapter 3 for more detail.)
Additional explanation: These are water demand volumes as projected for specific Water User Groups in the 2011 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 2012 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 2012 State Water Plan Chapter 5 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 2012 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 2012 State Water Plan Chapter 6 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 2012 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 2012 State Water Plan Chapter 7 for more detail.)
Additional explanation: These are the specific water management strategies (with associated water volumes) that were recommended in the 2011 Regional Water Plans.
**Terminology used by TWDB staff in providing data for 'Estimated Historical Water Use And 2012 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

GAM Run 10-044 MAG

GAM Run 10-044 MAG

by Mr. Wade Oliver

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

Texas Water Development Board
Groundwater Availability Modeling Section
(512) 936-0883
July 9, 2012

Cynthia K. Ridgeway, the Manager of the Groundwater Availability Modeling Section, is responsible for oversight of work performed by employees under her direct supervision. The seal appearing on this document was authorized by Cynthia K. Ridgeway, P.G. 471 on July 9, 2012.

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EXECUTIVE SUMMARY:

The modeled available groundwater for the Carrizo-Wilcox Aquifer as a result of the desired future conditions adopted by the districts within Groundwater Management Area 12 increases from approximately 196,000 acre-feet per year to 257,000 acre-feet per year between 2010 and 2060. This is shown divided by county, regional water planning area, and river basin in Table 2 for use in the regional water planning process. The modeled available groundwater has been summarized by county (Tables 3 through 7), regional water planning area (Tables 8 through 12), river basin (Tables 13 through 17), and groundwater conservation district (Tables 18 through 22). The modeled available groundwater estimates were taken from model simulation "GAM12_7B" completed for Groundwater Management Area 12 by consultants retained by the districts to assist in developing desired future conditions. The Texas Water Development Board confirmed that this model simulation achieves the desired future conditions adopted by the districts of Groundwater Management Area 12.

REQUESTOR:

Mr. Gary Westbrook of Post Oak Savannah Groundwater Conservation District on behalf of Groundwater Management Area 12.

DESCRIPTION OF REQUEST:

In a letter dated August 12, 2010, Mr. Gary Westbrook provided the Texas Water Development Board (TWDB) with the desired future conditions of the Carrizo-Wilcox Aquifer adopted by the districts of Groundwater Management Area 12. The desired future conditions for the Carrizo-Wilcox Aquifer, as presented in Appendix B of the resolution and adopted August 11, 2010 by the groundwater conservation districts within Groundwater Management Area 12, are shown in Table 1 (Groundwater Management Area 12, 2010).

Table 1. Desired future conditions (in feet of average aquifer drawdown measured from January 2000 to December 2059) for the Carrizo-Wilcox Aquifer adopted by districts of Groundwater Management Area 12. Negative values indicate a water-level rise.

Groundwater Conservation District or County	Carrizo	Calvert Bluff (Upper Wilcox)	Simsboro (Middle Wilcox)	Hooper (Lower Wilcox)
Brazos Valley	47	106	270	170
Fayette County	60	-	-	-
Lost Pines	47	99	237	129
Mid-East Texas	55	70	115	95
Post Oak Savannah	65	140	300	180
Falls County	-	-	0	20
Limestone County	-	9	43	40
Navarro County	-	0	1	1
Williamson County	-	-10	50	55

As stated in Appendix B of the resolution adopted by the districts of Groundwater Management Area 12, the desired future conditions are considered to be "compatible and physically possible if the difference between modeled drawdown results for model Run 12_7B and the [desired future condition] drawdown targets are within 5 feet or 5 percent of the [desired future condition] drawdown targets" (Groundwater Management Area 12, 2010).

In response to receiving the adopted desired future conditions, the TWDB has estimated the modeled available groundwater for the Carrizo-Wilcox Aquifer that is consistent with the above desired future conditions for each groundwater conservation district within Groundwater Management Area 12.

METHODS:

Groundwater Management Area 12 contains the central portion of the Carrizo-Wilcox Aquifer, a major aquifer in Texas as defined in the 2007 State Water Plan (TWDB, 2007). The location of Groundwater Management Area 12, the Carrizo-Wilcox Aquifer, and the groundwater availability model cells that represent the aquifer are shown in Figure 1.

The groundwater conservation districts making up Groundwater Management Area 12 retained several consultants for assistance in developing desired future conditions for the Carrizo-Wilcox Aquifer. Through this process, a model simulation was performed using the groundwater availability model for the central portion of the Carrizo-Wilcox, Queen City, and Sparta aquifers. The pumping used for this model simulation, referred to as "GAM12_7B" (Groundwater Management Area 12, 2010) in Appendix B of the resolution adopted by the districts of Groundwater Management Area 12, was delivered to the TWDB on September 10, 2010 by James Beach of LBG-Guyton Associates. The TWDB then performed an independent analysis confirming that the desired future conditions are physically possible and that the levels of pumping considered by the districts of Groundwater Management Area 12 in the pumping file for "GAM12_7B" (Groundwater Management Area 12, 2010) achieve the desired future conditions within the tolerances stated above. A comparison of the desired future conditions and the drawdowns calculated by the TWDB using the pumping file from model simulation "GAM12_7B" (Groundwater Management Area 12, 2010) is shown as an appendix to this report.

Since the model results using the pumping file for "GAM12_7B" (Groundwater Management Area 12, 2010) were consistent with the above desired future conditions they were used for the modeled available groundwater below. This pumping was then divided by county, regional water planning area, river basin, and groundwater conservation district. These areas are shown in Figure 2.

PARAMETERS AND ASSUMPTIONS:

The parameters and assumptions for the model run using the groundwater availability model for the central portion of the Carrizo-Wilcox, Queen City, and Sparta aquifers are described below:

- Version 2.02 of the groundwater availability model for the central portion of the Carrizo-Wilcox, Queen City, and Sparta aquifers was used for this analysis. See Dutton and others (2003) and Kelley and others (2004) for assumptions and limitations of the groundwater availability model.

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

  1. the Sparta Aquifer (Layer 1),
  2. the Weches Confining Unit (Layer 2),
  3. the Queen City Aquifer (Layer 3),
  4. the Reklaw Confining Unit (Layer 4),
  5. the Carrizo Aquifer (Layer 5),
  6. the Upper Wilcox Aquifer (Calvert Bluff Formation Layer 6),
  7. the Middle Wilcox Aquifer (Simsboro Formation Layer 7), and
  8. the Lower Wilcox Aquifer (Hooper Formation Layer 8).

- The root mean squared error (a measure of the difference between simulated and measured water levels during model calibration) in the groundwater availability model is 22 feet for the Sparta Aquifer, 27 feet for the Queen City Aquifer, 36 feet for the Carrizo Aquifer, and 31 feet for the Simsboro Aquifer for the calibration period (1980 through 1989) and 24, 33, 32, and 43 feet for the same aquifers, respectively, in the verification period (1990 through 1999) (Kelley and others, 2004).

- Cells were assigned to individual counties, river basins, regional water planning areas, and groundwater conservation districts as shown in the August 3, 2010 version of the file that associates the model grid to political and natural boundaries for the Carrizo-Wilcox, Queen City, and Sparta aquifers. Note that some minor adjustments were made to the file to better reflect the relationship of model cells to political boundaries.

- The recharge used for the model run represents average recharge as described in Kelley and others (2004).

Modeled Available Groundwater and Permitting

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

RESULTS:

The modeled available groundwater for the Carrizo-Wilcox Aquifer in Groundwater Management Area 12 consistent with the above desired future conditions increases from approximately 196,000 acre-feet per year to 257,000 acre-feet per year between 2010 and 2060. This has been divided by county,

regional water planning area, and river basin for each decade between 2010 and 2060 for use in the regional water planning process (Table 2).

The modeled available groundwater is also summarized for the Carrizo-Wilcox Aquifer as a whole and each unit of the aquifer shown in the above desired future conditions (Carrizo, Calvert Bluff, Simsboro, and Hooper). In Tables 3 through 7, the modeled available groundwater in the aquifer as a whole and each unit of the aquifer is summarized by county. In Tables 8 through 12, modeled available groundwater is summarized by regional water planning area. Tables 13 through 17 contain modeled available groundwater summarized by river basin. Finally, Tables 18 through 22 contain modeled available groundwater in each unit summarized by groundwater conservation district. In Tables 18 through 22, note that the modeled available groundwater has been totaled both excluding and including areas outside of a groundwater conservation district.

LIMITATIONS:

The groundwater model used in developing estimates of modeled available groundwater is the best available scientific tool that can be used to estimate the pumping that will achieve the desired future conditions. Although the groundwater model used in this analysis is the best available scientific tool for this purpose, it, like all models, has limitations. In reviewing the use of models in environmental regulatory decision-making, the National Research Council (2007) noted:

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

A key aspect of using the groundwater model to develop estimates of modeled available groundwater is the need to make assumptions about the location in the aquifer where future pumping will occur. As actual pumping changes in the future, it will be necessary to evaluate the amount of that pumping as well as its location in the context of the assumptions associated with this analysis. Evaluating the amount and location of future pumping is as important as evaluating the changes in groundwater levels, spring flows, and other metrics that describe the condition of the groundwater resources in the area that relate to the adopted desired future condition.

Given these limitations, users of this information are cautioned that the modeled available groundwater numbers should not be considered a definitive, permanent description of the amount of groundwater that can be pumped to meet the adopted desired future condition. Because the application of the groundwater model was designed to address regional scale questions, the results are most effective on a regional scale. The TWDB makes no warranties or representations relating to the actual conditions of any aquifer at a particular location or at a particular time.

It is important for groundwater conservation districts to monitor future groundwater pumping as well as whether or not they are achieving their desired future conditions. Because of the limitations of the model and the assumptions in this analysis, it is important that the groundwater conservation districts work with the TWDB to refine the modeled available groundwater numbers given the reality of how the aquifer responds to the actual amount and location of pumping now and in the future.

REFERENCES AND ASSOCIATED MODEL RUNS:

Dutton, A.R., Harden, B., Nicot, J.P., and O'Rourke, D., 2003, Groundwater availability model for the central part of the Carrizo-Wilcox Aquifer in Texas: Contract report to the Texas Water Development Board, 295 p.

Groundwater Management Area 12, 2010, Resolution to Adopt Desired Future Conditions for Aquifer(s) in Groundwater Management Area 12, 62 p.

Kelley, V. A., Deeds, N. E., Fryar, D. G., and Nicot, J. P., 2004, Groundwater availability models for the Queen City and Sparta aquifers: Contract report to the Texas Water Development Board, 867 p.

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

Table 2. Modeled available groundwater in acre-feet for the Carrizo-Wilcox Aquifer in Groundwater Management Area 12 by county, regional water planning area, and river basin.

County	Regional Water Planning Area	Basin	Year					
			2010	2020	2030	2040	2050	2060
Bastrop	K	Brazos	6,302	4,864	4,013	4,497	4,293	4,372
		Colorado	10,559	15,109	16,647	19,641	22,360	22,734
		Guadalupe	5	6	6	695	1,365	1,392
Brazos	G	Brazos	33,925	38,835	44,847	49,421	53,970	57,169
Burleson	G	Brazos	3,750	23,249	28,047	32,518	36,492	38,701
Falls	G	Brazos	865	867	875	884	895	895
Fayette	K	Colorado	683	683	683	683	683	683
		Guadalupe	317	317	317	317	317	317
Freestone	C	Brazos	874	885	869	863	848	848
		Trinity	4,264	4,420	4,448	4,452	4,414	4,411
Lee	G	Brazos	21,363	23,036	22,341	23,513	25,464	25,989
		Colorado	896	987	1,061	1,111	1,363	1,391
Leon	H	Brazos	4,431	3,612	3,403	3,325	3,351	3,356
		Trinity	10,251	10,863	11,244	11,567	11,821	11,840
Limestone	G	Brazos	11,321	11,306	11,436	11,616	11,918	11,918
Madison	H	Brazos	377	379	369	350	333	332
		Trinity	2,461	2,480	2,399	2,304	2,219	2,210
Milam	G	Brazos	38,183	23,923	20,206	19,112	21,359	22,319
Navarro	C	Trinity	15	15	15	15	15	15
Robertson	G	Brazos	44,886	45,435	45,814	46,238	46,582	46,583
Williamson	G	Brazos	7	7	7	7	7	7
		Colorado	0	0	0	0	0	0
Total			**195,735**	**211,278**	**219,047**	**233,129**	**250,069**	**257,482**

Table 3. Modeled available groundwater for the Carrizo-Wilcox Aquifer summarized by county in Groundwater Management Area 12 for each decade between 2010 and 2060. Results are in acre-feet per year.

County	Year					
	2010	2020	2030	2040	2050	2060
Bastrop	16,866	19,979	20,666	24,833	28,018	28,498
Brazos	33,925	38,835	44,847	49,421	53,970	57,169
Burleson	3,750	23,249	28,047	32,518	36,492	38,701
Falls	865	867	875	884	895	895
Fayette	1,000	1,000	1,000	1,000	1,000	1,000
Freestone	5,138	5,305	5,317	5,315	5,262	5,259
Lee	22,259	24,023	23,402	24,624	26,827	27,380
Leon	14,682	14,475	14,647	14,892	15,172	15,196
Limestone	11,321	11,306	11,436	11,616	11,918	11,918
Madison	2,838	2,859	2,768	2,654	2,552	2,542
Milam	38,183	23,923	20,206	19,112	21,359	22,319
Navarro	15	15	15	15	15	15
Robertson	44,886	45,435	45,814	46,238	46,582	46,583
Williamson	7	7	7	7	7	7
Total	**195,735**	**211,278**	**219,047**	**233,129**	**250,069**	**257,482**

Table 4. Modeled available groundwater for the Carrizo portion of the Carrizo-Wilcox Aquifer summarized by county in Groundwater Management Area 12 for each decade between 2010 and 2060. Results are in acre-feet per year.

County	Year					
	2010	2020	2030	2040	2050	2060
Bastrop	1,646	2,143	2,446	2,999	3,769	3,845
Brazos	3,253	3,721	3,728	3,741	3,764	3,766
Burleson	3,706	4,385	4,824	5,701	5,920	6,578
Falls	-	-	-	-	-	-
Fayette	1,000	1,000	1,000	1,000	1,000	1,000
Freestone	200	199	197	195	191	190
Lee	4,964	5,475	5,912	6,264	8,031	8,207
Leon	8,717	8,278	8,220	8,272	8,349	8,356
Limestone	-	-	-	-	-	-
Madison	2,838	2,859	2,768	2,654	2,552	2,542
Milam	319	321	353	417	433	481
Navarro	-	-	-	-	-	-
Robertson	1,732	1,707	1,697	1,712	1,729	1,730
Williamson	-	-	-	-	-	-
Total	**28,375**	**30,088**	**31,145**	**32,955**	**35,738**	**36,695**

Table 5. Modeled available groundwater for the Calvert Bluff portion of the Carrizo-Wilcox Aquifer summarized by county in Groundwater Management Area 12 for each decade between 2010 and 2060. Results are in acre-feet per year.

County	Year					
	2010	2020	2030	2040	2050	2060
Bastrop	1,510	1,943	2,343	2,888	3,613	3,685
Brazos	0	0	0	0	0	0
Burleson	42	91	91	91	91	91
Falls	-	-	-	-	-	-
Fayette	0	0	0	0	0	0
Freestone	756	741	724	719	707	707
Lee	275	283	290	295	299	300
Leon	2,649	2,824	2,957	3,069	3,194	3,205
Limestone	215	218	223	228	235	235
Madison	0	0	0	0	0	0
Milam	460	947	947	947	947	947
Navarro	0	0	0	0	0	0
Robertson	1,777	1,762	1,756	1,756	1,755	1,755
Williamson	0	0	0	0	0	0
Total	**7,684**	**8,809**	**9,331**	**9,993**	**10,841**	**10,925**

Table 6. Modeled available groundwater for the Simsboro portion of the Carrizo-Wilcox Aquifer summarized by county in Groundwater Management Area 12 for each decade between 2010 and 2060. Results are in acre-feet per year.

County	Year					
	2010	2020	2030	2040	2050	2060
Bastrop	12,585	14,514	14,209	16,900	18,094	18,423
Brazos	30,672	35,114	41,119	45,680	50,206	53,403
Burleson	1	17,687	21,616	25,103	28,858	30,409
Falls	139	140	141	143	146	146
Fayette	0	0	0	0	0	0
Freestone	3,348	3,560	3,570	3,569	3,536	3,535
Lee	16,971	18,217	17,153	18,016	18,450	18,826
Leon	3,316	3,373	3,470	3,551	3,629	3,635
Limestone	9,652	9,706	9,803	9,944	10,187	10,187
Madison	0	0	0	0	0	0
Milam	36,506	20,781	16,283	14,938	17,169	18,092
Navarro	4	4	4	4	4	4
Robertson	41,053	41,647	42,044	42,453	42,782	42,782
Williamson	2	2	2	2	2	2
Total	**154,249**	**164,745**	**169,414**	**180,303**	**193,063**	**199,444**

Table 7. Modeled available groundwater for the Hooper portion of the Carrizo-Wilcox Aquifer summarized by county in Groundwater Management Area 12 for each decade between 2010 and 2060. Results are in acre-feet per year.

County	Year					
	2010	2020	2030	2040	2050	2060
Bastrop	1,125	1,379	1,668	2,046	2,542	2,545
Brazos	0	0	0	0	0	0
Burleson	1	1,086	1,516	1,623	1,623	1,623
Falls	726	727	734	741	749	749
Fayette	0	0	0	0	0	0
Freestone	834	805	826	832	828	827
Lee	49	48	47	49	47	47
Leon	0	0	0	0	0	0
Limestone	1,454	1,382	1,410	1,444	1,496	1,496
Madison	0	0	0	0	0	0
Milam	898	1,874	2,623	2,810	2,810	2,799
Navarro	11	11	11	11	11	11
Robertson	324	319	317	317	316	316
Williamson	5	5	5	5	5	5
Total	**5,427**	**7,636**	**9,157**	**9,878**	**10,427**	**10,418**

Table 8. Modeled available groundwater for the Carrizo-Wilcox Aquifer summarized by regional water planning area in Groundwater Management Area 12 for each decade between 2010 and 2060. Results are in acre-feet per year.

Regional Water Planning Area	Year					
	2010	2020	2030	2040	2050	2060
C	5,153	5,320	5,332	5,330	5,277	5,274
G	155,196	167,645	174,634	184,420	198,050	204,972
H	17,520	17,334	17,415	17,546	17,724	17,738
K	17,866	20,979	21,666	25,833	29,018	29,498
Total	**195,735**	**211,278**	**219,047**	**233,129**	**250,069**	**257,482**

Table 9. Modeled available groundwater for the Carrizo portion of the Carrizo-Wilcox Aquifer summarized by regional water planning area in Groundwater Management Area 12 for each decade between 2010 and 2060. Results are in acre-feet per year.

Regional Water Planning Area	Year					
	2010	2020	2030	2040	2050	2060
C	200	199	197	195	191	190
G	13,974	15,609	16,514	17,835	19,877	20,762
H	11,555	11,137	10,988	10,926	10,901	10,898
K	2,646	3,143	3,446	3,999	4,769	4,845
Total	**28,375**	**30,088**	**31,145**	**32,955**	**35,738**	**36,695**

Table 10. Modeled available groundwater for the Calvert Bluff portion of the Carrizo-Wilcox Aquifer summarized by regional water planning area in Groundwater Management Area 12 for each decade between 2010 and 2060. Results are in acre-feet per year.

Regional Water Planning Area	Year					
	2010	2020	2030	2040	2050	2060
C	756	741	724	719	707	707
G	2,769	3,301	3,307	3,317	3,327	3,328
H	2,649	2,824	2,957	3,069	3,194	3,205
K	1,510	1,943	2,343	2,888	3,613	3,685
Total	**7,684**	**8,809**	**9,331**	**9,993**	**10,841**	**10,925**

Table 11. Modeled available groundwater for the Simsboro portion of the Carrizo-Wilcox Aquifer summarized by regional water planning area in Groundwater Management Area 12 for each decade between 2010 and 2060. Results are in acre-feet per year.

Regional Water Planning Area	Year					
	2010	2020	2030	2040	2050	2060
C	3,352	3,564	3,574	3,573	3,540	3,539
G	134,996	143,294	148,161	156,279	167,800	173,847
H	3,316	3,373	3,470	3,551	3,629	3,635
K	12,585	14,514	14,209	16,900	18,094	18,423
Total	**154,249**	**164,745**	**169,414**	**180,303**	**193,063**	**199,444**

Table 12. Modeled available groundwater for the Hooper portion of the Carrizo-Wilcox Aquifer summarized by regional water planning area in Groundwater Management Area 12 for each decade between 2010 and 2060. Results are in acre-feet per year.

Regional Water Planning Area	Year					
	2010	2020	2030	2040	2050	2060
C	845	816	837	843	839	838
G	3,457	5,441	6,652	6,989	7,046	7,035
H	0	0	0	0	0	0
K	1,125	1,379	1,668	2,046	2,542	2,545
Total	**5,427**	**7,636**	**9,157**	**9,878**	**10,427**	**10,418**

Table 13. Modeled available groundwater for the Carrizo-Wilcox Aquifer summarized by river basin in Groundwater Management Area 12 for each decade between 2010 and 2060. Results are in acre-feet per year.

Basin	Year					
	2010	2020	2030	2040	2050	2060
Brazos	166,284	176,398	182,227	192,344	205,512	212,489
Colorado	12,138	16,779	18,391	21,435	24,406	24,808
Guadalupe	322	323	323	1,012	1,682	1,709
Trinity	16,991	17,778	18,106	18,338	18,469	18,476
Total	**195,735**	**211,278**	**219,047**	**233,129**	**250,069**	**257,482**

Table 14. Modeled available groundwater for the Carrizo portion of the Carrizo-Wilcox Aquifer summarized by river basin in Groundwater Management Area 12 for each decade between 2010 and 2060. Results are in acre-feet per year.

Basin	Year					
	2010	2020	2030	2040	2050	2060
Brazos	16,871	17,602	18,221	19,376	21,148	22,007
Colorado	3,118	3,682	4,047	3,970	4,337	4,413
Guadalupe	320	321	321	1,010	1,680	1,707
Trinity	8,066	8,483	8,556	8,599	8,573	8,568
Total	**28,375**	**30,088**	**31,145**	**32,955**	**35,738**	**36,695**

Table 15. Modeled available groundwater for the Calvert Bluff portion of the Carrizo-Wilcox Aquifer summarized by river basin in Groundwater Management Area 12 for each decade between 2010 and 2060. Results are in acre-feet per year.

Basin	Year					
	2010	2020	2030	2040	2050	2060
Brazos	3,505	4,083	4,104	4,125	4,122	4,127
Colorado	1,462	1,875	2,260	2,795	3,531	3,601
Guadalupe	1	1	1	1	1	1
Trinity	2,716	2,850	2,966	3,072	3,187	3,196
Total	**7,684**	**8,809**	**9,331**	**9,993**	**10,841**	**10,925**

Table 16. Modeled available groundwater for the Simsboro portion of the Carrizo-Wilcox Aquifer summarized by river basin in Groundwater Management Area 12 for each decade between 2010 and 2060. Results are in acre-feet per year.

Basin	Year					
	2010	2020	2030	2040	2050	2060
Brazos	142,336	149,143	153,108	161,705	173,057	179,179
Colorado	6,478	9,902	10,489	12,704	14,068	14,323
Guadalupe	1	1	1	1	1	1
Trinity	5,434	5,699	5,816	5,893	5,937	5,941
Total	**154,249**	**164,745**	**169,414**	**180,303**	**193,063**	**199,444**

Table 17. Modeled available groundwater for the Hooper portion of the Carrizo-Wilcox Aquifer summarized by river basin in Groundwater Management Area 12 for each decade between 2010 and 2060. Results are in acre-feet per year.

Basin	Year					
	2010	2020	2030	2040	2050	2060
Brazos	3,572	5,570	6,794	7,138	7,185	7,176
Colorado	1,080	1,320	1,595	1,966	2,470	2,471
Guadalupe	0	0	0	0	0	0
Trinity	775	746	768	774	772	771
Total	**5,427**	**7,636**	**9,157**	**9,878**	**10,427**	**10,418**

Table 18. Modeled available groundwater for the Carrizo-Wilcox Aquifer summarized by groundwater conservation district (GCD) in Groundwater Management Area 12 for each decade between 2010 and 2060. Results are in acre-feet per year.

Groundwater Conservation District	Year					
	2010	2020	2030	2040	2050	2060
Brazos Valley GCD	78,811	84,270	90,661	95,659	100,552	103,752
Fayette County GCD	1,000	1,000	1,000	1,000	1,000	1,000
Lost Pines GCD	39,125	44,002	44,068	49,457	54,845	55,878
Mid-East Texas GCD	22,658	22,639	22,732	22,861	22,986	22,997
Post Oak Savannah GCD	41,933	47,172	48,253	51,630	57,851	61,020
Total (excluding non-district areas)	**183,527**	**199,083**	**206,714**	**220,607**	**237,234**	**244,647**
No District	12,208	12,195	12,333	12,522	12,835	12,835
Total (including non-district areas)	**195,735**	**211,278**	**219,047**	**233,129**	**250,069**	**257,482**

Table 19. Modeled available groundwater for the Carrizo portion of the Carrizo-Wilcox Aquifer summarized by groundwater conservation district (GCD) in Groundwater Management Area 12 for each decade between 2010 and 2060. Results are in acre-feet per year.

Groundwater Conservation District	Year					
	2010	2020	2030	2040	2050	2060
Brazos Valley GCD	4,985	5,428	5,425	5,453	5,493	5,496
Fayette County GCD	1,000	1,000	1,000	1,000	1,000	1,000
Lost Pines GCD	6,610	7,618	8,358	9,263	11,800	12,052
Mid-East Texas GCD	11,755	11,336	11,185	11,121	11,092	11,088
Post Oak Savannah GCD	4,025	4,706	5,177	6,118	6,353	7,059
Total (excluding non-district areas)	**28,375**	**30,088**	**31,145**	**32,955**	**35,738**	**36,695**
No District	-	-	-	-	-	-
Total (including non-district areas)	**28,375**	**30,088**	**31,145**	**32,955**	**35,738**	**36,695**

Table 20. Modeled available groundwater for the Calvert Bluff portion of the Carrizo-Wilcox Aquifer summarized by groundwater conservation district (GCD) in Groundwater Management Area 12 for each decade between 2010 and 2060. Results are in acre-feet per year.

Groundwater Conservation District	Year					
	2010	2020	2030	2040	2050	2060
Brazos Valley GCD	1,777	1,762	1,756	1,756	1,755	1,755
Fayette County GCD	0	0	0	0	0	0
Lost Pines GCD	1,785	2,226	2,633	3,183	3,912	3,985
Mid-East Texas GCD	3,405	3,565	3,681	3,788	3,901	3,912
Post Oak Savannah GCD	502	1,038	1,038	1,038	1,038	1,038
Total (excluding non-district areas)	**7,469**	**8,591**	**9,108**	**9,765**	**10,606**	**10,690**
No District	215	218	223	228	235	235
Total (including non-district areas)	**7,684**	**8,809**	**9,331**	**9,993**	**10,841**	**10,925**

Table 21. Modeled available groundwater for the Simsboro portion of the Carrizo-Wilcox Aquifer summarized by groundwater conservation district (GCD) in Groundwater Management Area 12 for each decade between 2010 and 2060. Results are in acre-feet per year.

Groundwater Conservation District	Year					
	2010	2020	2030	2040	2050	2060
Brazos Valley GCD	71,725	76,761	83,163	88,133	92,988	96,185
Fayette County GCD	0	0	0	0	0	0
Lost Pines GCD	29,556	32,731	31,362	34,916	36,544	37,249
Mid-East Texas GCD	6,664	6,933	7,040	7,120	7,165	7,170
Post Oak Savannah GCD	36,507	38,468	37,899	40,041	46,027	48,501
Total (excluding non-district areas)	**144,452**	**154,893**	**159,464**	**170,210**	**182,724**	**189,105**
No District	9,797	9,852	9,950	10,093	10,339	10,339
Total (including non-district areas)	**154,249**	**164,745**	**169,414**	**180,303**	**193,063**	**199,444**

Table 22. Modeled available groundwater for the Hooper portion of the Carrizo-Wilcox Aquifer summarized by groundwater conservation district (GCD) in Groundwater Management Area 12 for each decade between 2010 and 2060. Results are in acre-feet per year.

Groundwater Conservation District	Year					
	2010	2020	2030	2040	2050	2060
Brazos Valley GCD	324	319	317	317	316	316
Fayette County GCD	0	0	0	0	0	0
Lost Pines GCD	1,174	1,427	1,715	2,095	2,589	2,592
Mid-East Texas GCD	834	805	826	832	828	827
Post Oak Savannah GCD	899	2,960	4,139	4,433	4,433	4,422
Total (excluding non-district areas)	**3,231**	**5,511**	**6,997**	**7,677**	**8,166**	**8,157**
No District	2,196	2,125	2,160	2,201	2,261	2,261
Total (including non-district areas)	**5,427**	**7,636**	**9,157**	**9,878**	**10,427**	**10,418**

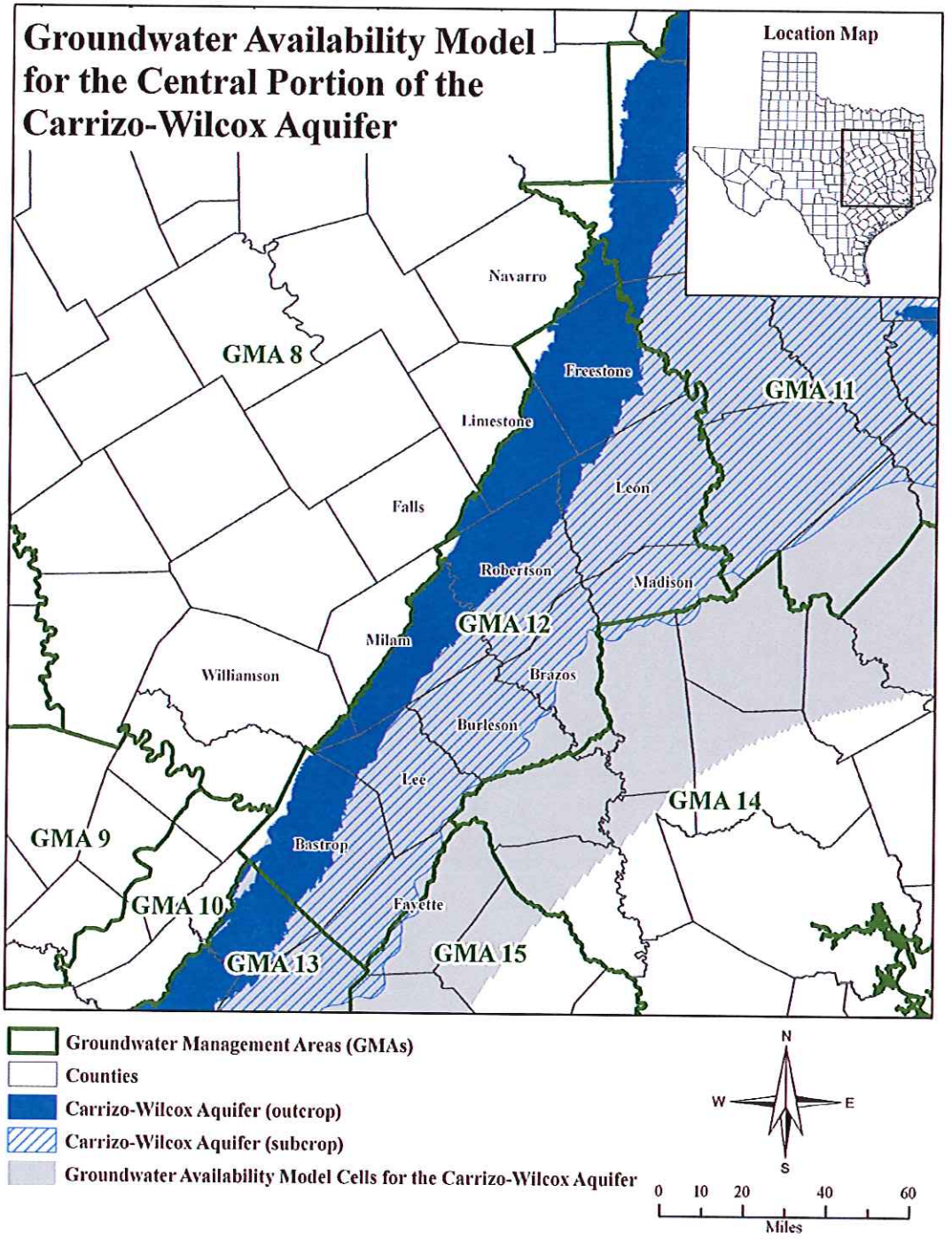

Figure 1. Map showing the areas covered by the groundwater availability model for the central portion of the Carrizo-Wilcox Aquifer and the boundary of Groundwater Management Area 12.

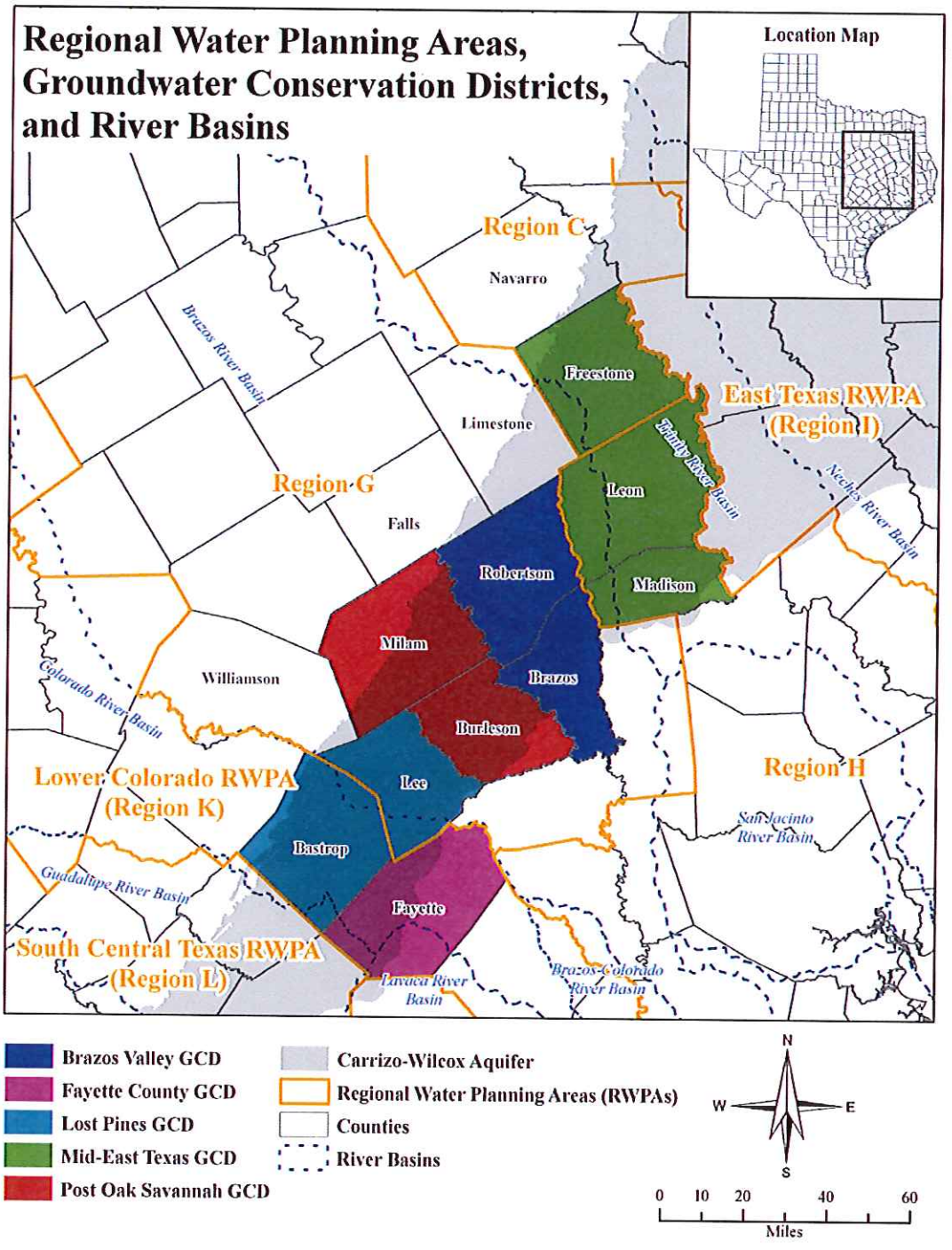

Figure 2. Map showing regional water planning areas (RWPAs), groundwater conservation districts (GCDs), counties, and river basins in and neighboring Groundwater Management Area 12.

Appendix

Comparison of Model Results to Desired Future Conditions

Table A-1. Comparison table showing Groundwater Management Area 12 adopted desired future conditions for the units of the Carrizo-Wilcox Aquifer, associated drawdowns presented in Appendix B of the desired future condition resolution, and the drawdowns calculated by the TWDB using the same pumping (well) file (Groundwater Management Area 12, 2010). All values are in feet of drawdown between January 2000 and December 2059.

Groundwater Conservation District or County	Aquifer Unit	Desired Future Condition	Calculated Drawdowns in Appendix B of Resolution	TWDB Calculated Drawdowns	Difference Between Desired Future Condition and TWDB Calculated Drawdowns
Brazos Valley	Carrizo	47	48	48	-1
	Calvert Bluff	106	109	109	-3
	Simsboro	270	271	271	-1
	Hooper	170	177	177	-7
Fayette County	Carrizo	60	59	59	1
	Calvert Bluff	-	126	126	-
	Simsboro	-	220	219	-
	Hooper	-	172	172	-
Lost Pines	Carrizo	47	47	47	0
	Calvert Bluff	99	94	94	5
	Simsboro	237	236	236	1
	Hooper	129	133	133	-4
Mid-East Texas	Carrizo	55	53	53	2
	Calvert Bluff	70	67	67	3
	Simsboro	115	114	114	1
	Hooper	95	96	96	-1
Post Oak Savannah	Carrizo	65	61	61	4
	Calvert Bluff	140	137	136	4
	Simsboro	300	298	297	3
	Hooper	180	178	178	2
Falls County	Carrizo	-	-	-	-
	Calvert Bluff	-	-	-	-
	Simsboro	0	-1	-1	1
	Hooper	20	20	20	0
Limestone County	Carrizo	-	-	-	-
	Calvert Bluff	9	9	10	-1
	Simsboro	43	43	43	0
	Hooper	40	40	40	0
Navarro County	Carrizo	-	-	-	-
	Calvert Bluff	0	-1	-1	1
	Simsboro	1	1	4	-3
	Hooper	1	1	4	-3
Williamson County	Carrizo	-	-	-	-
	Calvert Bluff	-10	-11	-11	1
	Simsboro	50	47	47	3
	Hooper	55	56	55	0

APPENDIX B2

GAM Run 10-045 MAG

GAM Run 10-045 MAG

by Mr. Wade Oliver

Edited and finalized by Shirley Wade, Ph.D., P.G., to reflect statutory changes effective September 1, 2011

Texas Water Development Board
Groundwater Availability Modeling Section
(512) 936-0883
July 9, 2012

Cynthia K. Ridgeway, the Manager of the Groundwater Availability Modeling Section, is responsible for oversight of work performed by employees under her direct supervision. The seal appearing on this document was authorized by Cynthia K. Ridgeway, P.G. 471 on July 9, 2012.

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EXECUTIVE SUMMARY:

The modeled available groundwater for the Queen City Aquifer as a result of the desired future conditions adopted by the districts of Groundwater Management Area 12 increases from approximately 3,600 acre-feet per year to 5,500 acre-feet per year between 2010 and 2030, then declines to approximately 3,700 acre-feet per year between 2030 and 2060. This is shown divided by county, regional water planning area, and river basin in Table 2. The modeled available groundwater estimates were taken from model simulation "GAM12_7B" completed for Groundwater Management Area 12 by consultants retained by the districts to assist in developing desired future conditions. The Texas Water Development Board confirmed that this model simulation achieves the desired future conditions adopted by the districts of Groundwater Management Area 12.

REQUESTOR:

Mr. Gary Westbrook of Post Oak Savannah Groundwater Conservation District on behalf of Groundwater Management Area 12

DESCRIPTION OF REQUEST:

In a letter dated August 12, 2010, Mr. Gary Westbrook provided the Texas Water Development Board (TWDB) with the desired future conditions of the Queen City Aquifer adopted by the districts of Groundwater Management Area 12. The desired future conditions for the Queen City Aquifer, as presented in Appendix B of the resolution and adopted August 11, 2010 by the groundwater conservation districts within Groundwater Management Area 12, are shown in Table 1 (Groundwater Management Area 12, 2010).

Table 1. Desired future conditions (in feet of drawdown) for the Queen City Aquifer adopted by districts of Groundwater Management Area 12 (Groundwater Management Area 12, 2010).

Groundwater Conservation District or County	Queen City Aquifer
Brazos Valley	12
Fayette County	60
Lost Pines	13
Mid-East Texas	0
Post Oak Savannah	30
Falls County	-
Limestone County	-
Navarro County	-
Williamson County	-

As stated in Appendix B of the resolution adopted by the districts of Groundwater Management Area 12, the desired future conditions are considered to be "compatible and physically possible if

the difference between modeled drawdown results for model Run 12_7B and the [desired future condition] drawdown targets are within 5 feet or 5 percent of the [desired future condition] drawdown targets" (Groundwater Management Area 12, 2010).

In response to receiving the adopted desired future conditions, the TWDB has estimated the modeled available groundwater consistent with the above desired future conditions for each groundwater conservation district within Groundwater Management Area 12.

METHODS:

Groundwater Management Area 12 contains the central portion of the Queen City Aquifer, a minor aquifer in Texas as defined in the 2007 State Water Plan (TWDB, 2007). The location of Groundwater Management Area 12, the Queen City Aquifer, and the groundwater availability model cells that represent the aquifer are shown in Figure 1.

The groundwater conservation districts making up Groundwater Management Area 12 retained several consultants for assistance in developing desired future conditions for the Queen City Aquifer. Through this process, a model simulation was performed using the groundwater availability model for the central portion of the Carrizo-Wilcox, Queen City, and Sparta aquifers. The pumping used for this model simulation, referred to as "GAM12_7B" in Appendix B of the resolution adopted by the districts of Groundwater Management Area 12 (Groundwater Management Area 12, 2010), was delivered to the TWDB on September 10, 2010 by James Beach of LBG-Guyton Associates. The TWDB then performed an independent analysis confirming that the desired future conditions are physically possible and that the levels of pumping considered by the districts of Groundwater Management Area 12 in the pumping file for "GAM12_7B" (Groundwater Management Area 12, 2010) achieve the desired future conditions within the tolerances stated above. A comparison of the desired future conditions and the drawdowns calculated by the TWDB using the pumping file from model simulation "GAM12_7B" (Groundwater Management Area 12, 2010) is shown as an appendix to this report.

Since the model results using the pumping file for "GAM12_7B" (Groundwater Management Area 12, 2010) were consistent with the above desired future conditions they were used for the modeled available groundwater below. This pumping assumed by the districts' consultants was then divided by county, regional water planning area, river basin, and groundwater conservation district. These areas are shown in Figure 2.

PARAMETERS AND ASSUMPTIONS:

The parameters and assumptions for the model run using the groundwater availability model for the central portion of the Carrizo-Wilcox, Queen City, and Sparta aquifers are described below:

- Version 2.02 of the groundwater availability model for the central portion of the Carrizo-Wilcox, Queen City, and Sparta aquifers was used for this analysis. See Dutton and others (2003) and Kelley and others (2004) for assumptions and limitations of the groundwater availability model.

- This groundwater availability model includes eight layers that generally correspond to (from top to bottom):

    1. the Sparta Aquifer (Layer 1),
    2. the Weches Confining Unit (Layer 2),
    3. the Queen City Aquifer (Layer 3),
    4. the Reklaw Confining Unit (Layer 4),
    5. the Carrizo Aquifer (Layer 5),
    6. the Upper Wilcox Aquifer (Calvert Bluff Formation Layer 6),
    7. the Middle Wilcox Aquifer (Simsboro Formation Layer 7), and
    8. the Lower Wilcox Aquifer (Hooper Formation Layer 8).

- The root mean squared error (a measure of the difference between simulated and measured water levels during model calibration) in the groundwater availability model is 22 feet for the Sparta Aquifer, 27 feet for the Queen City Aquifer, 36 feet for the Carrizo Aquifer, and 31 feet for the Simsboro Aquifer for the calibration period (1980 through 1989) and 24, 33, 32, and 43 feet for the same aquifers, respectively, in the verification period (1990 through 1999) (Kelley and others, 2004).

- Cells were assigned to individual counties, river basins, regional water planning areas, and groundwater conservation districts as shown in the August 3, 2010 version of file that associates the model grid to political and natural boundaries for the Carrizo-Wilcox, Queen City, and Sparta aquifers. Note that some minor adjustments were made to the file to better reflect the relationship of model cells to political boundaries.

- The recharge used for the model run represents average recharge as described in Kelley and others (2004).

Modeled Available Groundwater and Permitting

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

RESULTS:

The modeled available groundwater for the Queen City Aquifer in Groundwater Management Area 12 consistent with the above desired future conditions increases from approximately 3,600 acre-feet per year to 5,500 acre-feet per year between 2010 and 2030, then declines to

approximately 3,700 acre-feet per year from 2030 to 2060. This has been divided by county, regional water planning area, and river basin for each decade between 2010 and 2060 for use in the regional water planning process (Table 2). The modeled available groundwater is also summarized by county, regional water planning area, river basin, and groundwater conservation district in Tables 3, 4, 5, and 6, respectively.

LIMITATIONS:

The groundwater model used in developing estimates of modeled available groundwater is the best available scientific tool that can be used to estimate the pumping that will achieve the desired future conditions. Although the groundwater model used in this analysis is the best available scientific tool for this purpose, it, like all models, has limitations. In reviewing the use of models in environmental regulatory decision-making, the National Research Council (2007) noted:

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

A key aspect of using the groundwater model to develop estimates of modeled available groundwater is the need to make assumptions about the location in the aquifer where future pumping will occur. As actual pumping changes in the future, it will be necessary to evaluate the amount of that pumping as well as its location in the context of the assumptions associated with this analysis. Evaluating the amount and location of future pumping is as important as evaluating the changes in groundwater levels, spring flows, and other metrics that describe the condition of the groundwater resources in the area that relate to the adopted desired future condition.
Given these limitations, users of this information are cautioned that the modeled available groundwater numbers should not be considered a definitive, permanent description of the amount of groundwater that can be pumped to meet the adopted desired future condition. Because the application of the groundwater model was designed to address regional scale questions, the results are most effective on a regional scale. The TWDB makes no warranties or representations relating to the actual conditions of any aquifer at a particular location or at a particular time.
It is important for groundwater conservation districts to monitor future groundwater pumping as well as whether or not they are achieving their desired future conditions. Because of the limitations of the model and the assumptions in this analysis, it is important that the groundwater conservation districts work with the TWDB to refine the modeled available groundwater numbers given the reality of how the aquifer responds to the actual amount and location of pumping now and in the future.

REFERENCES AND ASSOCIATED MODEL RUNS:

Dutton, A.R., Harden, B., Nicot, J.P., and O'Rourke, D., 2003, Groundwater availability model for the central part of the Carrizo-Wilcox Aquifer in Texas: Contract report to the Texas Water Development Board, 295 p.

Groundwater Management Area 12, 2010, Resolution to Adopt Desired Future Conditions for Aquifer(s) in Groundwater Management Area 12, 62 p.

Kelley, V. A., Deeds, N. E., Fryar, D. G., and Nicot, J. P., 2004, Groundwater availability models for the Queen City and Sparta aquifers: Contract report to the Texas Water Development Board, 867 p.

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

Table 2. Modeled Available Groundwater in acre-feet for the Queen City Aquifer in Groundwater Management Area 12 by county, regional water planning area, and river basin.

County	Regional Water Planning Area	Basin	Year					
			2010	2020	2030	2040	2050	2060
Bastrop	K	Brazos	284	244	598	219	216	216
		Colorado	714	659	1,626	599	591	590
		Guadalupe	197	192	541	213	216	216
Brazos	G	Brazos	512	604	634	587	533	529
Burleson	G	Brazos	382	415	446	446	446	446
Fayette	K	Colorado	387	436	478	513	565	570
		Guadalupe	0	0	0	0	0	0
Freestone	C	Trinity	0	0	0	0	0	0
Lee	G	Brazos	72	72	61	58	54	54
		Colorado	48	48	54	55	57	57
Leon	H	Brazos	245	245	245	245	245	245
		Trinity	349	349	349	349	349	349
Madison	H	Brazos	1	1	1	1	1	1
		Trinity	379	379	379	379	379	379
Milam	G	Brazos	48	53	56	56	56	56
Robertson	G	Brazos	0	0	0	0	0	0
Total			**3,618**	**3,697**	**5,468**	**3,720**	**3,708**	**3,708**

Table 3. Modeled Available Groundwater for the Queen City Aquifer summarized by county in Groundwater Management Area 12 for each decade between 2010 and 2060. Results are in acre-feet per year.

County	Year					
	2010	2020	2030	2040	2050	2060
Bastrop	1,195	1,095	2,765	1,031	1,023	1,022
Brazos	512	604	634	587	533	529
Burleson	382	415	446	446	446	446
Fayette	387	436	478	513	565	570
Freestone	0	0	0	0	0	0
Lee	120	120	115	113	111	111
Leon	594	594	594	594	594	594
Madison	380	380	380	380	380	380
Milam	48	53	56	56	56	56
Robertson	0	0	0	0	0	0
Total	**3,618**	**3,697**	**5,468**	**3,720**	**3,708**	**3,708**

Table 4. Modeled Available Groundwater for the Queen City Aquifer summarized by regional water planning area in Groundwater Management Area 12 for each decade between 2010 and 2060. Results are in acre-feet per year.

Regional Water Planning Area	Year					
	2010	2020	2030	2040	2050	2060
C	0	0	0	0	0	0
G	1,062	1,192	1,251	1,202	1,146	1,142
H	974	974	974	974	974	974
K	1,582	1,531	3,243	1,544	1,588	1,592
Total	**3,618**	**3,697**	**5,468**	**3,720**	**3,708**	**3,708**

Table 5. Modeled Available Groundwater for the Queen City Aquifer summarized by river basin in Groundwater Management Area 12 for each decade between 2010 and 2060. Results are in acre-feet per year.

Basin	Year					
	2010	2020	2030	2040	2050	2060
Brazos	1,544	1,634	2,041	1,612	1,551	1,547
Colorado	1,149	1,143	2,158	1,167	1,213	1,217
Guadalupe	197	192	541	213	216	216
Trinity	728	728	728	728	728	728
Total	**3,618**	**3,697**	**5,468**	**3,720**	**3,708**	**3,708**

Table 6. Modeled Available Groundwater for the Queen City Aquifer summarized by groundwater conservation district (GCD) in Groundwater Management Area 12 for each decade between 2010 and 2060. Results are in acre-feet per year.

Groundwater Conservation District	Year					
	2010	2020	2030	2040	2050	2060
Brazos Valley GCD	512	604	634	587	533	529
Fayette County GCD	387	436	478	513	565	570
Lost Pines GCD	1,315	1,215	2,880	1,144	1,134	1,133
Mid-East Texas GCD	974	974	974	974	974	974
Post Oak Savannah GCD	430	468	502	502	502	502
Total	**3,618**	**3,697**	**5,468**	**3,720**	**3,708**	**3,708**

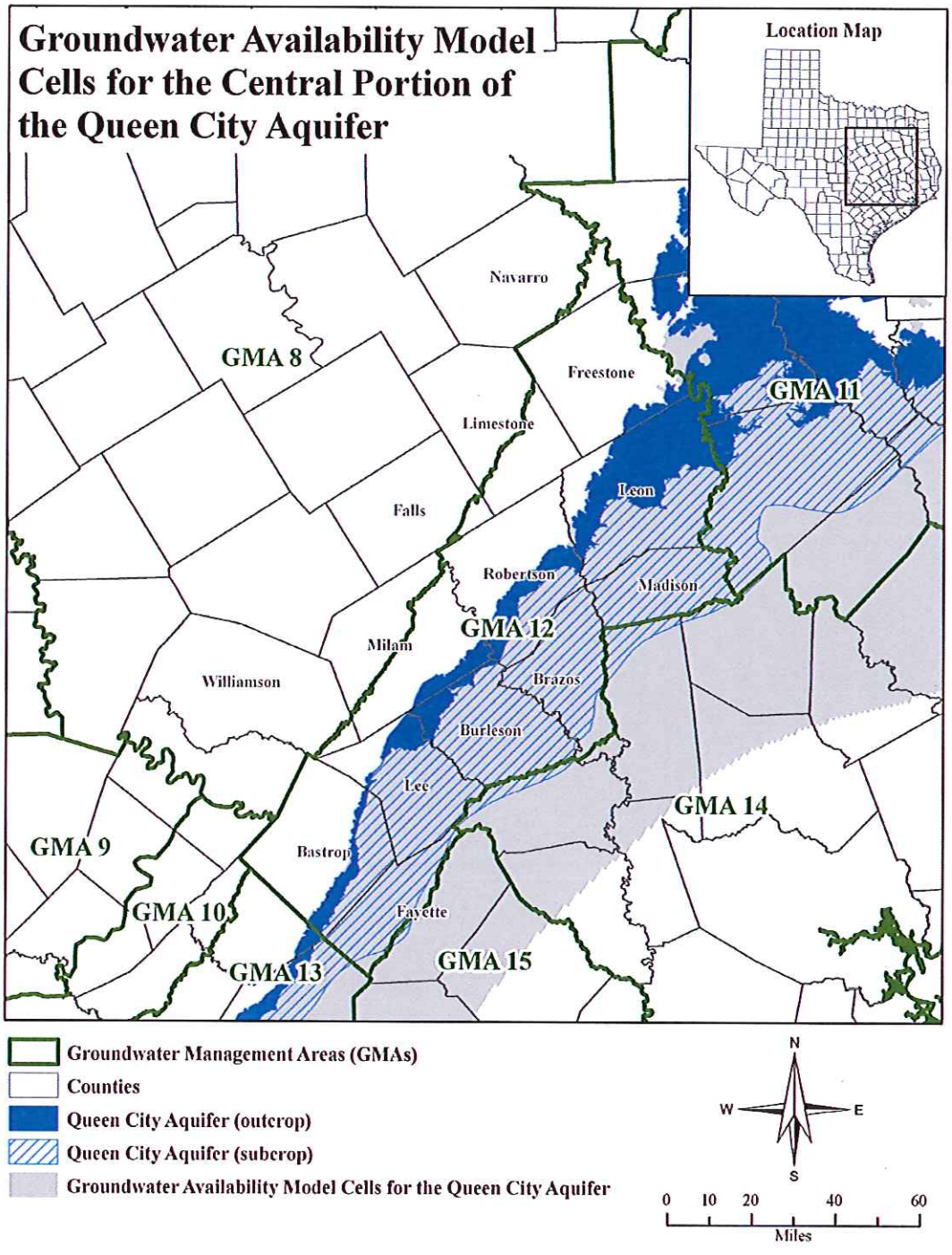


Figure 1. Map showing the areas covered by the groundwater availability model for the central portion of the Queen City Aquifer and the boundary of Groundwater Management Area 12.

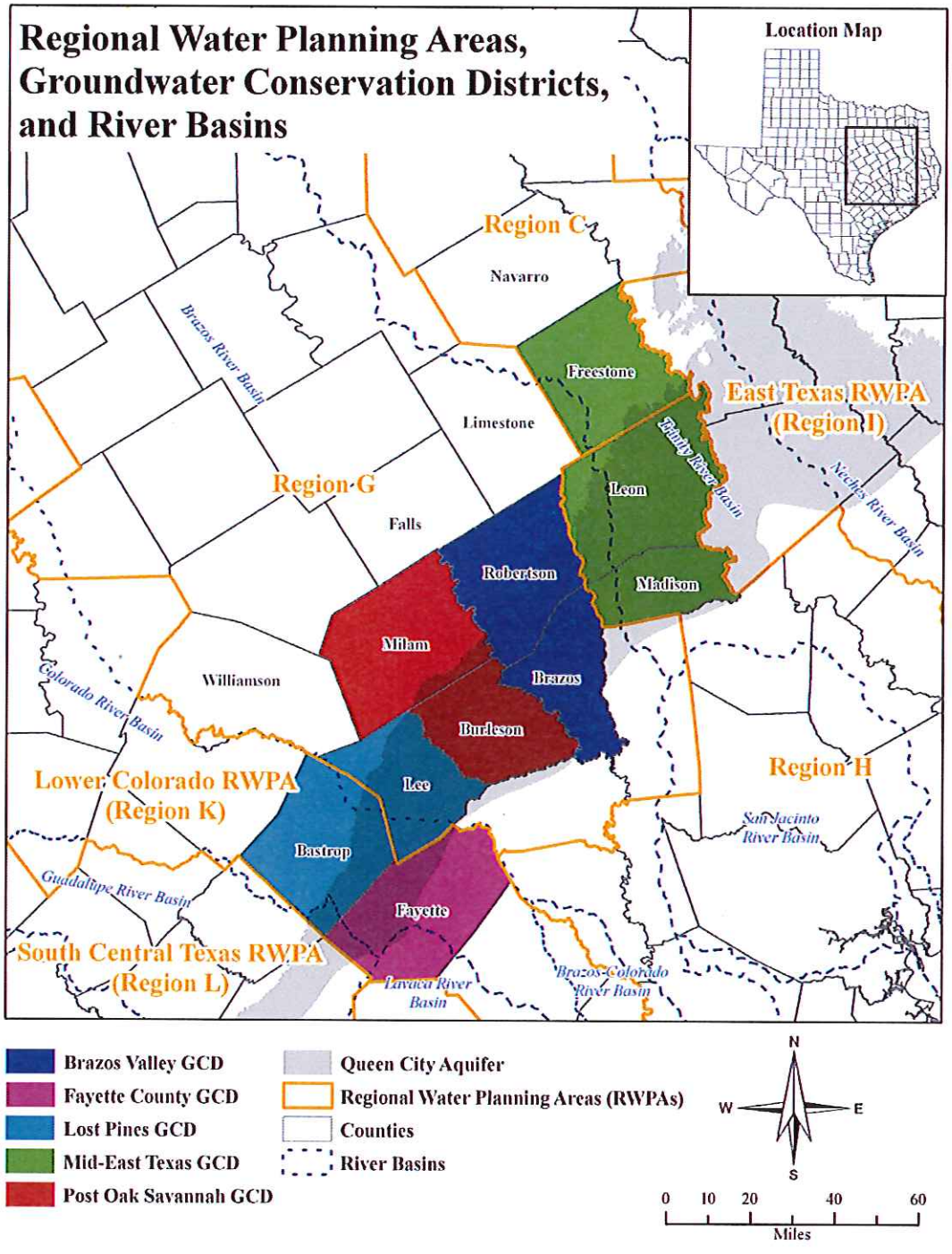


Figure 2. Map showing regional water planning areas (RWPAs), groundwater conservation districts (GCDs), counties, and river basins in and neighboring Groundwater Management Area 12.

Appendix

Comparison of Model Results to Desired Future Conditions

Table A-1. Comparison table showing Groundwater Management Area 12 adopted desired future conditions for the Queen City Aquifer, associated drawdowns presented in Appendix B of the desired future condition resolution (Groundwater Management Area 12, 2010), and the drawdowns calculated by the TWDB using the same pumping (well) file. All values are in feet of drawdown between January 2000 and December 2059. Negative values indicate a water level rise.

Groundwater Conservation District or County	Aquifer Unit	Desired Future Condition	Calculated Drawdowns in Appendix B of Resolution	TWDB Calculated Drawdowns	Difference Between Desired Future Condition and TWDB Calculated Drawdowns
Brazos Valley	Carrizo	47	48	48	-1
	Calvert Bluff	106	109	109	-3
	Simsboro	270	271	271	-1
	Hooper	170	177	177	-7
Fayette County	Carrizo	60	59	59	1
	Calvert Bluff	-	126	126	-
	Simsboro	-	220	219	-
	Hooper	-	172	172	-
Lost Pines	Carrizo	47	47	47	0
	Calvert Bluff	99	94	94	5
	Simsboro	237	236	236	1
	Hooper	129	133	133	-4
Mid-East Texas	Carrizo	55	53	53	2
	Calvert Bluff	70	67	67	3
	Simsboro	115	114	114	1
	Hooper	95	96	96	-1
Post Oak Savannah	Carrizo	65	61	61	4
	Calvert Bluff	140	137	136	4
	Simsboro	300	298	297	3
	Hooper	180	178	178	2
Falls County	Carrizo	-	-	-	-
	Calvert Bluff	-	-	-	-
	Simsboro	0	-1	-1	1
	Hooper	20	20	20	0
Limestone County	Carrizo	-	-	-	-
	Calvert Bluff	9	9	10	-1
	Simsboro	43	43	43	0
	Hooper	40	40	40	0
Navarro County	Carrizo	-	-	-	-
	Calvert Bluff	0	-1	-1	1
	Simsboro	1	1	4	-3
	Hooper	1	1	4	-3
Williamson County	Carrizo	-	-	-	-
	Calvert Bluff	-10	-11	-11	1
	Simsboro	50	47	47	3
	Hooper	55	56	55	0

APPENDIX B3

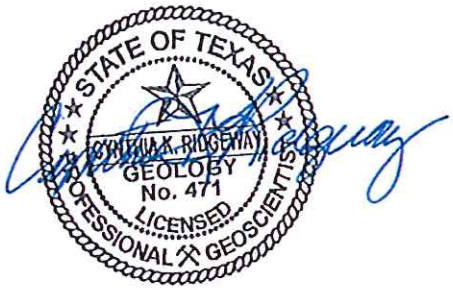
GAM Run 10-046 MAG

GAM Run 10-046 MAG

by Mr. Wade Oliver

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

Texas Water Development Board
Groundwater Availability Modeling Section
(512) 936-0883
July 9, 2012



Cynthia K. Ridgeway, the Manager of the Groundwater Availability Modeling Section, is responsible for oversight of work performed by employees under her direct supervision. The seal appearing on this document was authorized by Cynthia K. Ridgeway, P.G. 471 on July 9, 2012.

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EXECUTIVE SUMMARY:

The modeled available groundwater for the Sparta Aquifer as a result of the desired future conditions adopted by the districts of Groundwater Management Area 12 increases from approximately 15,000 acre-feet per year to 24,000 acre-feet per year between 2010 and 2060. This is shown divided by county, regional water planning area and river basin in Table 2. The modeled available groundwater estimates were taken from model simulation "GAM12_7B" completed for Groundwater Management Area 12 by consultants retained by the districts to assist in developing desired future conditions. The Texas Water Development Board confirmed that this model simulation achieves the desired future conditions adopted by the districts of Groundwater Management Area 12.

REQUESTOR:

Mr. Gary Westbrook of Post Oak Savannah Groundwater Conservation District on behalf of Groundwater Management Area 12

DESCRIPTION OF REQUEST:

In a letter dated August 12, 2010, Mr. Gary Westbrook provided the Texas Water Development Board (TWDB) with the desired future conditions of the Sparta Aquifer adopted by the districts of Groundwater Management Area 12 (Groundwater Management Area 12, 2010). The desired future conditions for the Sparta Aquifer, as presented in Appendix B of the resolution and adopted August 11, 2010 by the groundwater conservation districts within Groundwater Management Area 12, are shown in Table 1.

Table 1. Desired future conditions (in feet of drawdown) for the Sparta Aquifer adopted by districts of Groundwater Management Area 12 (Groundwater Management Area 12, 2010).

Groundwater Conservation District or County	Sparta Aquifer
Brazos Valley	15
Fayette County	60
Lost Pines	7
Mid-East Texas	0
Post Oak Savannah	30
Falls County	-
Limestone County	-
Navarro County	-
Williamson County	-

As stated in Appendix B of the resolution adopted by the districts of Groundwater Management Area 12, the desired future conditions are considered to be "compatible and physically possible if the difference between modeled drawdown results for model Run 12_7B and the [desired future

condition] drawdown targets are within 5 feet or 5 percent of the [desired future condition] drawdown targets" (Groundwater Management Area 12, 2010).

In response to receiving the adopted desired future conditions, the TWDB has estimated the modeled available groundwater consistent with the above desired future conditions for each groundwater conservation district within Groundwater Management Area 12.

METHODS:

Groundwater Management Area 12 contains the central portion of the Sparta Aquifer, a minor aquifer in Texas as defined in the 2007 State Water Plan (TWDB, 2007). The location of Groundwater Management Area 12, the Sparta Aquifer, and the groundwater availability model cells that represent the aquifer are shown in Figure 1.

The groundwater conservation districts making up Groundwater Management Area 12 retained several consultants for assistance in developing desired future conditions for the Sparta Aquifer. Through this process, a model simulation was performed using the groundwater availability model for the central portion of the Carrizo-Wilcox, Queen City, and Sparta aquifers. The pumping used for this model simulation, referred to as "GAM12_7B" in Appendix B of the resolution adopted by the districts of Groundwater Management Area 12 (Groundwater Management Area 12, 2010), was delivered to the TWDB on September 10, 2010 by James Beach of LBG-Guyton Associates. The TWDB then performed an independent analysis confirming that the desired future conditions are physically possible and that the levels of pumping considered by the districts of Groundwater Management Area 12 in the pumping file for "GAM12_7B" (Groundwater Management Area 12, 2010) achieve the desired future conditions within the tolerances stated above. A comparison of the desired future conditions and the drawdowns calculated by the TWDB using the pumping file from model simulation "GAM12_7B" (Groundwater Management Area 12, 2010) is shown as an appendix to this report.

Since the model results using the pumping file for "GAM12_7B" (Groundwater Management Area 12, 2010) were consistent with the above desired future conditions they were used for the modeled available groundwater below. This pumping was then divided by county, regional water planning area, river basin, and groundwater conservation district. These areas are shown in Figure 2.

PARAMETERS AND ASSUMPTIONS:

The parameters and assumptions for the model run using the groundwater availability model for the central portion of the Carrizo-Wilcox, Queen City, and Sparta aquifers are described below:

- Version 2.02 of the groundwater availability model for the central portion of the Carrizo-Wilcox, Queen City, and Sparta aquifers was used for this analysis. See Dutton and others (2003) and Kelley and others (2004) for assumptions and limitations of the groundwater availability model.

- This groundwater availability model includes eight layers that generally correspond to (from top to bottom):

    1. the Sparta Aquifer (Layer 1),
    2. the Weches Confining Unit (Layer 2),
    3. the Queen City Aquifer (Layer 3),
    4. the Reklaw Confining Unit (Layer 4),
    5. the Carrizo Aquifer (Layer 5),
    6. the Upper Wilcox Aquifer (Calvert Bluff Formation Layer 6),
    7. the Middle Wilcox Aquifer (Simsboro Formation Layer 7), and
    8. the Lower Wilcox Aquifer (Hooper Formation Layer 8).

- The root mean squared error (a measure of the difference between simulated and measured water levels during model calibration) in the groundwater availability model is 22 feet for the Sparta Aquifer, 27 feet for the Queen City Aquifer, 36 feet for the Carrizo Aquifer, and 31 feet for the Simsboro Aquifer for the calibration period (1980 through 1989) and 24, 33, 32, and 43 feet for the same aquifers, respectively, in the verification period (1990 through 1999) (Kelley and others, 2004).

- Cells were assigned to individual counties, river basins, regional water planning areas, and groundwater conservation districts as shown in the August 3, 2010 version of file that associates the model grid to political and natural boundaries for the Carrizo-Wilcox, Queen City, and Sparta aquifers. Note that some minor adjustments were made to the file to better reflect the relationship of model cells to political boundaries.

- The recharge used for the model run represents average recharge as described in Kelley and others (2004).

Modeled Available Groundwater and Permitting

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

RESULTS:

The modeled available groundwater for the Sparta Aquifer in Groundwater Management Area 12 consistent with the above desired future conditions increases from approximately 15,000 acre-feet per year to 24,000 acre-feet per year between 2010 and 2060. This pumping has been

divided by county, regional water planning area, and river basin for each decade between 2010 and 2060 for use in the regional water planning process (Table 2). The total pumping estimates are also summarized by county, regional water planning area, river basin, and groundwater conservation district as shown in Tables 3, 4, 5, and 6, respectively.

LIMITATIONS:

The groundwater model used in developing estimates of modeled available groundwater is the best available scientific tool that can be used to estimate the pumping that will achieve the desired future conditions. Although the groundwater model used in this analysis is the best available scientific tool for this purpose, it, like all models, has limitations. In reviewing the use of models in environmental regulatory decision-making, the National Research Council (2007) noted:

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

A key aspect of using the groundwater model to develop estimates of modeled available groundwater is the need to make assumptions about the location in the aquifer where future pumping will occur. As actual pumping changes in the future, it will be necessary to evaluate the amount of that pumping as well as its location in the context of the assumptions associated with this analysis. Evaluating the amount and location of future pumping is as important as evaluating the changes in groundwater levels, spring flows, and other metrics that describe the condition of the groundwater resources in the area that relate to the adopted desired future condition.
Given these limitations, users of this information are cautioned that the modeled available groundwater numbers should not be considered a definitive, permanent description of the amount of groundwater that can be pumped to meet the adopted desired future condition. Because the application of the groundwater model was designed to address regional scale questions, the results are most effective on a regional scale. The TWDB makes no warranties or representations relating to the actual conditions of any aquifer at a particular location or at a particular time.
It is important for groundwater conservation districts to monitor future groundwater pumping as well as whether or not they are achieving their desired future conditions. Because of the limitations of the model and the assumptions in this analysis, it is important that the groundwater conservation districts work with the TWDB to refine the modeled available groundwater numbers given the reality of how the aquifer responds to the actual amount and location of pumping now and in the future.

REFERENCES AND ASSOCIATED MODEL RUNS:

Dutton, A.R., Harden, B., Nicot, J.P., and O'Rourke, D., 2003, Groundwater availability model for the central part of the Carrizo-Wilcox Aquifer in Texas: Contract report to the Texas Water Development Board, 295 p.

Groundwater Management Area 12, 2010, Resolution to Adopt Desired Future Conditions for Aquifer(s) in Groundwater Management Area 12, 62 p.

Kelley, V. A., Deeds, N. E., Fryar, D. G., and Nicot, J. P., 2004, Groundwater availability models for the Queen City and Sparta aquifers: Contract report to the Texas Water Development Board, 867 p.

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

Table 2. Modeled Available Groundwater in acre-feet for the Sparta Aquifer in Groundwater Management Area 12 by county, regional water planning area, and river basin.

County	Regional Water Planning Area	Basin	Year					
			2010	2020	2030	2040	2050	2060
Bastrop	K	Brazos	73	65	170	58	55	55
		Colorado	1,903	1,761	4,606	1,538	1,460	1,453
		Guadalupe	97	87	228	79	76	75
Brazos	G	Brazos	4,295	5,941	7,308	7,305	7,307	7,307
Burleson	G	Brazos	1,570	2,245	4,041	5,612	6,734	6,734
Fayette	K	Colorado	3,078	3,161	3,206	3,226	3,278	3,294
		Guadalupe	429	431	431	430	433	435
Lee	G	Brazos	154	151	143	141	135	135
		Colorado	178	172	168	164	159	159
Leon	H	Brazos	0	0	0	0	0	0
		Trinity	21	21	21	21	21	21
Madison	H	Brazos	0	0	0	0	0	0
		Trinity	3,313	3,313	3,313	3,313	3,313	3,313
Robertson	G	Brazos	200	300	400	500	616	616
Total			**15,311**	**17,648**	**24,035**	**22,387**	**23,587**	**23,597**

Table 3. Modeled Available Groundwater for the Sparta Aquifer summarized by county in Groundwater Management Area 12 for each decade between 2010 and 2060. Results are in acre-feet per year.

County	Year					
	2010	2020	2030	2040	2050	2060
Bastrop	2,073	1,913	5,004	1,675	1,591	1,583
Brazos	4,295	5,941	7,308	7,305	7,307	7,307
Burleson	1,570	2,245	4,041	5,612	6,734	6,734
Fayette	3,507	3,592	3,637	3,656	3,711	3,729
Lee	332	323	311	305	294	294
Leon	21	21	21	21	21	21
Madison	3,313	3,313	3,313	3,313	3,313	3,313
Robertson	200	300	400	500	616	616
Total	**15,311**	**17,648**	**24,035**	**22,387**	**23,587**	**23,597**

Table 4. Modeled Available Groundwater for the Sparta Aquifer summarized by regional water planning area in Groundwater Management Area 12 for each decade between 2010 and 2060. Results are in acre-feet per year.

Regional Water Planning Area	Year					
	2010	2020	2030	2040	2050	2060
G	6,397	8,809	12,060	13,722	14,951	14,951
H	3,334	3,334	3,334	3,334	3,334	3,334
K	5,580	5,505	8,641	5,331	5,302	5,312
Total	**15,311**	**17,648**	**24,035**	**22,387**	**23,587**	**23,597**

Table 5. Modeled Available Groundwater for the Sparta Aquifer summarized by river basin in Groundwater Management Area 12 for each decade between 2010 and 2060. Results are in acre-feet per year.

Basin	Year					
	2010	2020	2030	2040	2050	2060
Brazos	6,292	8,702	12,062	13,616	14,847	14,847
Colorado	5,159	5,094	7,980	4,928	4,897	4,906
Guadalupe	526	518	659	509	509	510
Trinity	3,334	3,334	3,334	3,334	3,334	3,334
Total	**15,311**	**17,648**	**24,035**	**22,387**	**23,587**	**23,597**

Table 6. Modeled Available Groundwater for the Sparta Aquifer summarized by groundwater conservation district (GCD) in Groundwater Management Area 12 for each decade between 2010 and 2060. Results are in acre-feet per year.

Groundwater Conservation District	Year					
	2010	2020	2030	2040	2050	2060
Brazos Valley GCD	4,495	6,241	7,708	7,805	7,923	7,923
Fayette County GCD	3,507	3,592	3,637	3,656	3,711	3,729
Lost Pines GCD	2,405	2,236	5,315	1,980	1,885	1,877
Mid-East Texas GCD	3,334	3,334	3,334	3,334	3,334	3,334
Post Oak Savannah GCD	1,570	2,245	4,041	5,612	6,734	6,734
Total	**15,311**	**17,648**	**24,035**	**22,387**	**23,587**	**23,597**

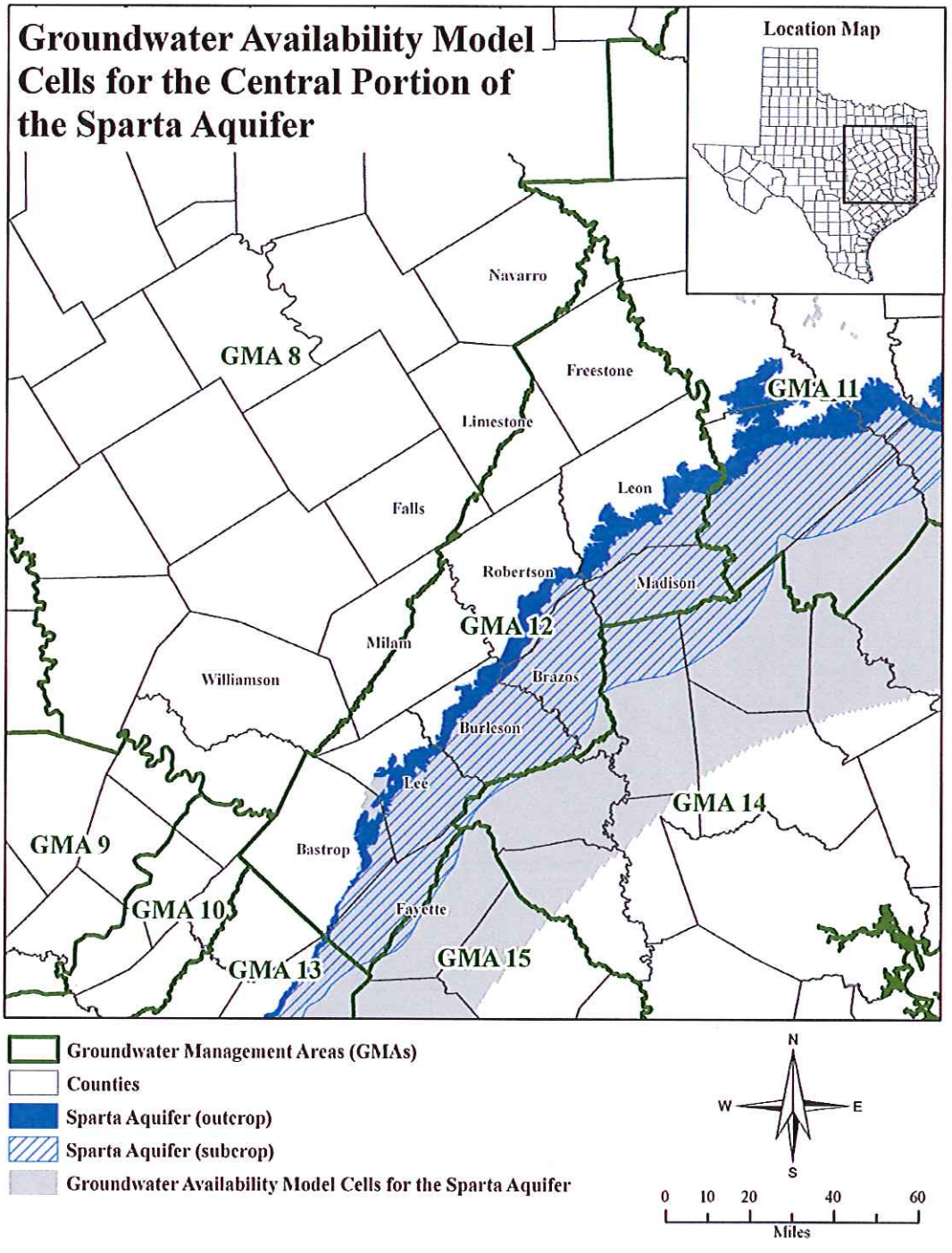

Figure 1. Map showing the areas covered by the groundwater availability model for the central portion of the Sparta Aquifer and the boundary of Groundwater Management Area 12.

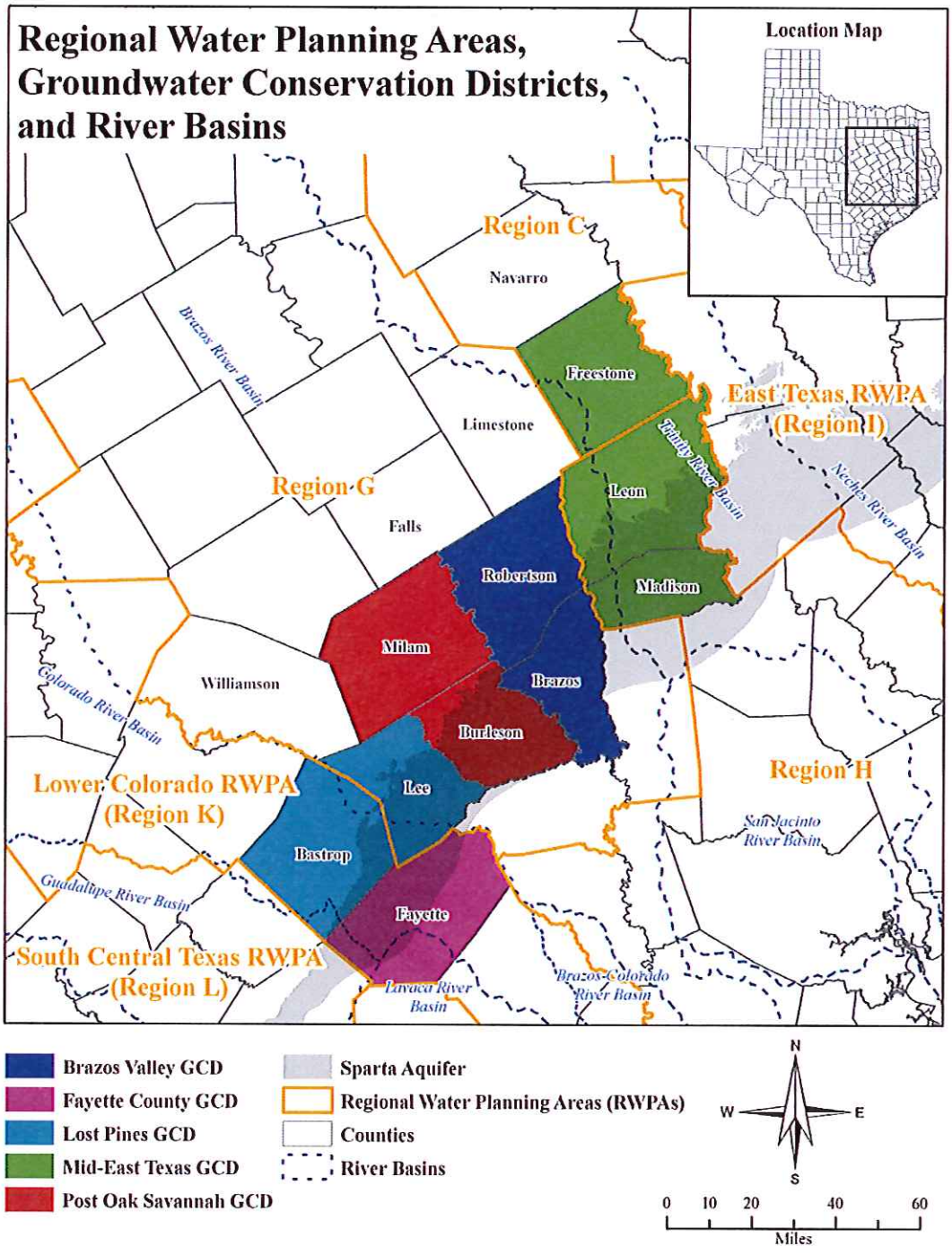

Figure 2. Map showing regional water planning areas (RWPAs), groundwater conservation districts (GCDs), counties, and river basins in and neighboring Groundwater Management Area 12.

Appendix

Comparison of Model Results to Desired Future Conditions

Table A-1. Comparison table showing Groundwater Management Area 12 adopted desired future conditions for the Sparta Aquifer, associated drawdowns presented in Appendix B of the desired future condition resolution (Groundwater Management Area 12, 2010), and the drawdowns calculated by the TWDB using the same pumping (well) file. All values are in feet of drawdown between January 2000 and December 2059.

Groundwater Conservation District or County	Desired Future Condition	Calculated Drawdowns in Appendix B of Resolution	TWDB Calculated Drawdowns	Difference Between Desired Future Condition and TWDB Calculated Drawdowns
Brazos Valley	15	14	14	1
Fayette County	60	59	59	1
Lost Pines	7	4	4	3
Mid-East Texas	0	0	0	0
Post Oak Savannah	30	28	27	3
Falls County	-	-	-	-
Limestone County	-	-	-	-
Navarro County	-	-	-	-
Williamson County	-	-	-	-

APPENDIX B4

GAM Run 10-060 MAG

GAM Run 10-060 MAG: Modeled Available Groundwater for the Yegua-Jackson Aquifer in Groundwater Management Area 12

by Wade Oliver

Edited and Finalized by Shirley Wade, Ph.D., P.G.

Texas Water Development Board
Groundwater Resources Division
Groundwater Availability Modeling Section
(512) 936-0883
July 9, 2012

Cynthia K. Ridgeway, the Manager of the Groundwater Availability Modeling Section, is responsible for oversight of work performed by employees under her direct supervision. The seal appearing on this document was authorized by Cynthia K. Ridgeway, P.G. 471 on July 9, 2012.

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GAM Run 10-060 MAG: Modeled Available Groundwater for the Yegua-Jackson Aquifer in Groundwater Management Area 12

by Wade Oliver

Edited and Finalized by Shirley Wade, Ph.D., P.G.

Texas Water Development Board
Groundwater Resources Division
Groundwater Availability Modeling Section
(512) 936-0883
July 9, 2012

EXECUTIVE SUMMARY:

The modeled available groundwater for the Yegua-Jackson Aquifer as a result of the desired future conditions adopted by the districts of Groundwater Management Area 12 is approximately 27,000 acre-feet per year and is summarized by county, river basin, and regional water planning area in Table 1. Using the groundwater availability model for the Yegua-Jackson Aquifer, The Texas Water Development Board confirmed that this pumping estimate, developed by LBG-Guyton Associates, meets the desired future conditions.

REQUESTOR:

Mr. Gary Westbrook of Post Oak Savannah Groundwater Conservation District on behalf of Groundwater Management Area 12

DESCRIPTION OF REQUEST:

In a letter dated July 26, 2011, Mr. Westbrook provided the Texas Water Development Board (TWDB) with the desired future conditions of the Yegua-Jackson Aquifer in Groundwater Management Area 12 (Groundwater Management Area 12, 2011). The desired future conditions for the Yegua-Jackson Aquifer, as

adopted June 30, 2011 and shown in Appendix B of the resolution by the groundwater conservation districts within Groundwater Management Area 12, are described below:

Brazos Valley Groundwater Conservation District (Yegua portion):
Average drawdown between 2010 and 2060 of 70 feet.

Brazos Valley Groundwater Conservation District (Jackson portion):
Average drawdown between 2010 and 2060 of 110 feet.

Fayette County Groundwater Conservation District (Yegua-Jackson):
Average drawdown between 2010 and 2060 of 75 feet.

Lost Pines Groundwater Conservation District (Yegua-Jackson):
Declared as non-relevant.

Mid-East Texas Groundwater Conservation District (Yegua-Jackson):
Average drawdown between 2010 and 2060 of 5 feet.

Post Oak Savannah Groundwater Conservation District (Yegua-Jackson):
Average drawdown between 2010 and 2060 of 100 feet.

As described in the resolution, the districts consider the desired future conditions to be compatible and physically possible if the drawdowns simulated in the groundwater availability model are within 5 feet or 5 percent of the adopted values above (Groundwater Management Area 12, 2011).

METHODS:

The locations of Groundwater Management Area 12, the Yegua-Jackson Aquifer, and the groundwater availability model cells that represent the aquifer are shown in Figure 1. Figure 2 shows the location of the Yegua-Jackson Aquifer relative to regional water planning areas, river basins, and groundwater conservation districts.

LBG-Guyton Associates assisted with the development of the desired future conditions of the Yegua-Jackson Aquifer for Groundwater Management Area 12 using the groundwater availability model for the Yegua-Jackson Aquifer. On May 20, 2011, Mr. David O'Rourke of LBG-Guyton Associates delivered a MODFLOW Well

Package file to the TWDB containing pumping information for the groundwater conservation districts within Groundwater Management Area 12 (Groundwater Management Area 12, 2011). The pumping in this Well Package file, with minor modifications by the TWDB, results in drawdowns over 50 years that match each of the above desired future conditions within 5 feet or 5 percent. The modifications made by TWDB were to move and/or remove any pumping that was assigned to "conduit" cells included in the model to allow connection between the outcrop areas in Layer 1 and the downdip portions of each unit of the aquifer in layers 2 through 5 (Deeds and others, 2010).

PARAMETERS AND ASSUMPTIONS:

- 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.
- The model includes five layers representing the Yegua-Jackson Aquifer and the overlying Catahoula unit.
- As reported in Deeds and others (2010), the mean absolute errors (a measure of the difference between simulated and measured water levels during model calibration) for the Jackson Group (combined upper and lower Jackson units), Upper Yegua, and Lower Yegua portions of the aquifer for the historical-calibration period of the model are 31.1, 23.9, and 24.5 feet, respectively. These represent 10.3, 5.7, and 6.3 percent of the hydraulic head drop across each model area, respectively.
- The recharge used for the model simulation represents average recharge as described in Deeds and others (2010).

Modeled Available Groundwater and Permitting

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

pumping exempt from permitting, existing permits, and a reasonable estimate of actual groundwater production under existing permits. The estimated amount of pumping exempt from permitting, which the TWDB is required to develop after soliciting input from applicable groundwater conservation districts, will be provided in a separate report.

RESULTS:

The modeled available groundwater for the Yegua-Jackson Aquifer in Groundwater Management Area 12 as a result of the above desired future conditions is approximately 27,000 acre-feet per year between 2010 and 2060. Table 1 contains the modeled available groundwater subdivided by county, regional water planning area, and river basin for use in the regional water planning process. Tables 2, 3, 4, and 5 show the modeled available groundwater for the Yegua-Jackson Aquifer summarized by county, regional water planning area, river basin, and groundwater conservation district, respectively, within Groundwater Management Area 14.

LIMITATIONS:

The groundwater model used in developing estimates of modeled available groundwater is the best available scientific tool that can be used to estimate the pumping that will achieve the desired future conditions. Although the groundwater model used in this analysis is the best available scientific tool for this purpose, it, like all models, has limitations. In reviewing the use of models in environmental regulatory decision-making, the National Research Council (2007) noted:

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

A key aspect of using the groundwater model to develop estimates of modeled available groundwater is the need to make assumptions about the location in the aquifer where future pumping will occur. As actual pumping changes in the future,

it will be necessary to evaluate the amount of that pumping as well as its location in the context of the assumptions associated with this analysis. Evaluating the amount and location of future pumping is as important as evaluating the changes in groundwater levels, spring flows, and other metrics that describe the condition of the groundwater resources in the area that relate to the adopted desired future condition.

Given these limitations, users of this information are cautioned that the modeled available groundwater numbers should not be considered a definitive, permanent description of the amount of groundwater that can be pumped to meet the adopted desired future condition. Because the application of the groundwater model was designed to address regional scale questions, the results are most effective on a regional scale. The TWDB makes no warranties or representations relating to the actual conditions of any aquifer at a particular location or at a particular time.

It is important for groundwater conservation districts to monitor future groundwater pumping as well as whether or not they are achieving their desired future conditions. Because of the limitations of the model and the assumptions in this analysis, it is important that the groundwater conservation districts work with the TWDB to refine the modeled available groundwater numbers given the reality of how the aquifer responds to the actual amount and location of pumping now and in the future.

REFERENCES:

Deeds, N.E., Yan, T., Singh, A., Jones, T.L., Kelley, V.A., Knox, P.R., Young, S.C., 2010, Groundwater Availability Model for the Yegua-Jackson Aquifer: Final Report Prepared for the Texas Water Development Board by INTERA, Inc., 582 p.

Groundwater Management Area 12, 2011, Resolution to Adopt Desired Future Conditions for Groundwater Management, 36 p.

National Research Council, 2007, Models in Environmental Regulatory Decision Making. Committee on Models in the Regulatory Decision Process, National Academies Press, Washington D.C., 287 p.

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

TABLE 1: MODELED AVAILABLE GROUNDWATER FOR THE YEGUA-JACKSON AQUIFER IN GROUNDWATER MANAGEMENT AREA 12. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE DIVIDED BY COUNTY, REGIONAL WATER PLANNING AREA, AND RIVER BASIN.

County	Region	Basin	Year					
			2010	2020	2030	2040	2050	2060
Brazos	G	Brazos	7,071	7,071	7,071	7,071	7,071	7,071
Burleson	G	Brazos	12,923	12,923	12,923	12,923	12,923	12,923
Fayette	K	Colorado	5,065	5,065	5,065	5,065	5,065	5,065
		Guadalupe	650	650	650	650	650	650
		Lavaca	47	47	47	47	47	47
Leon	H	Trinity	4	4	4	4	4	4
Madison	H	Brazos	63	63	63	63	63	63
		Trinity	1,055	1,055	1,055	1,055	1,055	1,055
Total			**26,878**	**26,878**	**26,878**	**26,878**	**26,878**	**26,878**

TABLE 2: MODELED AVAILABLE GROUNDWATER FOR THE YEGUA-JACKSON AQUIFER BY COUNTY FOR EACH DECADE BETWEEN 2010 AND 2060. RESULTS ARE IN ACRE-FEET PER YEAR.

County	Year					
	2010	2020	2030	2040	2050	2050
Brazos	7,071	7,071	7,071	7,071	7,071	7,071
Burleson	12,923	12,923	12,923	12,923	12,923	12,923
Fayette	5,762	5,762	5,762	5,762	5,762	5,762
Leon	4	4	4	4	4	4
Madison	1,118	1,118	1,118	1,118	1,118	1,118
Total	**26,878**	**26,878**	**26,878**	**26,878**	**26,878**	**26,878**

TABLE 3: MODELED AVAILABLE GROUNDWATER FOR THE YEGUA-JACKSON AQUIFER BY REGIONAL WATER PLANNING AREA FOR EACH DECADE BETWEEN 2010 AND 2060. RESULTS ARE IN ACRE-FEET PER YEAR.

Region	Year					
	2010	2020	2030	2040	2050	2060
G	19,994	19,994	19,994	19,994	19,994	19,994
H	1,122	1,122	1,122	1,122	1,122	1,122
K	5,762	5,762	5,762	5,762	5,762	5,762
Total	**26,878**	**26,878**	**26,878**	**26,878**	**26,878**	**26,878**

TABLE 4: MODELED AVAILABLE GROUNDWATER FOR THE YEGUA-JACKSON AQUIFER BY RIVER BASIN FOR EACH DECADE BETWEEN 2010 AND 2060. RESULTS ARE IN ACRE-FEET PER YEAR.

Basin	Year					
	2010	2020	2030	2040	2050	2060
Brazos	20,057	20,057	20,057	20,057	20,057	20,057
Colorado	5,065	5,065	5,065	5,065	5,065	5,065
Guadalupe	650	650	650	650	650	650
Lavaca	47	47	47	47	47	47
Trinity	1,059	1,059	1,059	1,059	1,059	1,059
Total	**26,878**	**26,878**	**26,878**	**26,878**	**26,878**	**26,878**

TABLE 5: MODELED AVAILABLE GROUNDWATER FOR THE YEGUA-JACKSON AQUIFER BY GROUNDWATER CONSERVATION DISTRICT (GCD) FOR EACH DECADE BETWEEN 2010 AND 2060. RESULTS ARE IN ACRE-FEET PER YEAR.

District	Year					
	2010	2020	2030	2040	2050	2060
Brazos Valley GCD	7,071	7,071	7,071	7,071	7,071	7,071
Fayette County GCD	5,762	5,762	5,762	5,762	5,762	5,762
Mid-East Texas GCD	1,122	1,122	1,122	1,122	1,122	1,122
Post Oak Savannah GCD	12,923	12,923	12,923	12,923	12,923	12,923
Total	**26,878**	**26,878**	**26,878**	**26,878**	**26,878**	**26,878**

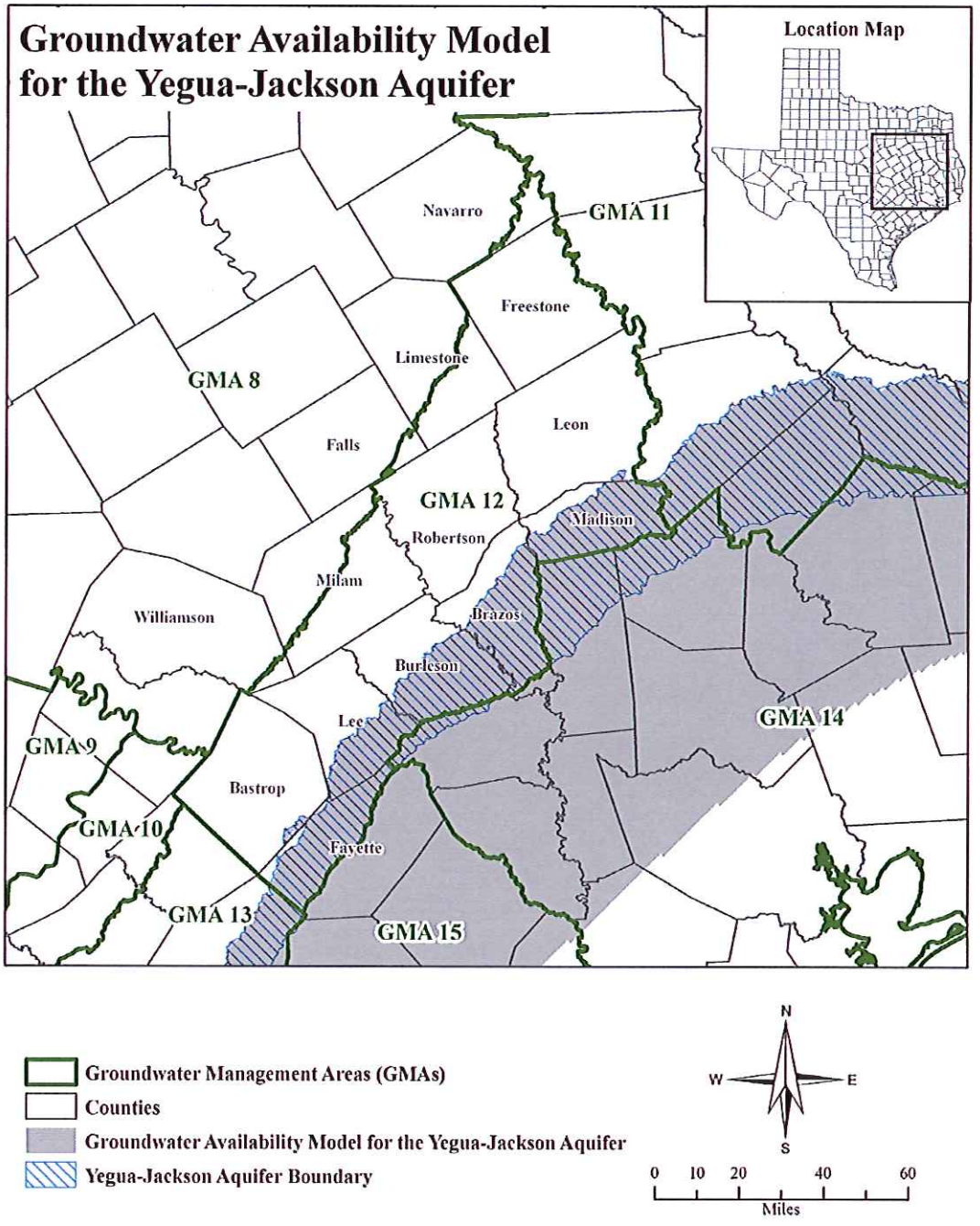


FIGURE 1: MAP SHOWING GROUNDWATER MANAGEMENT AREA 12 AND THE BOUNDARY OF THE YEGUA-JACKSON AQUIFER ACCORDING TO THE 2007 STATE WATER PLAN (TWDB, 2007).

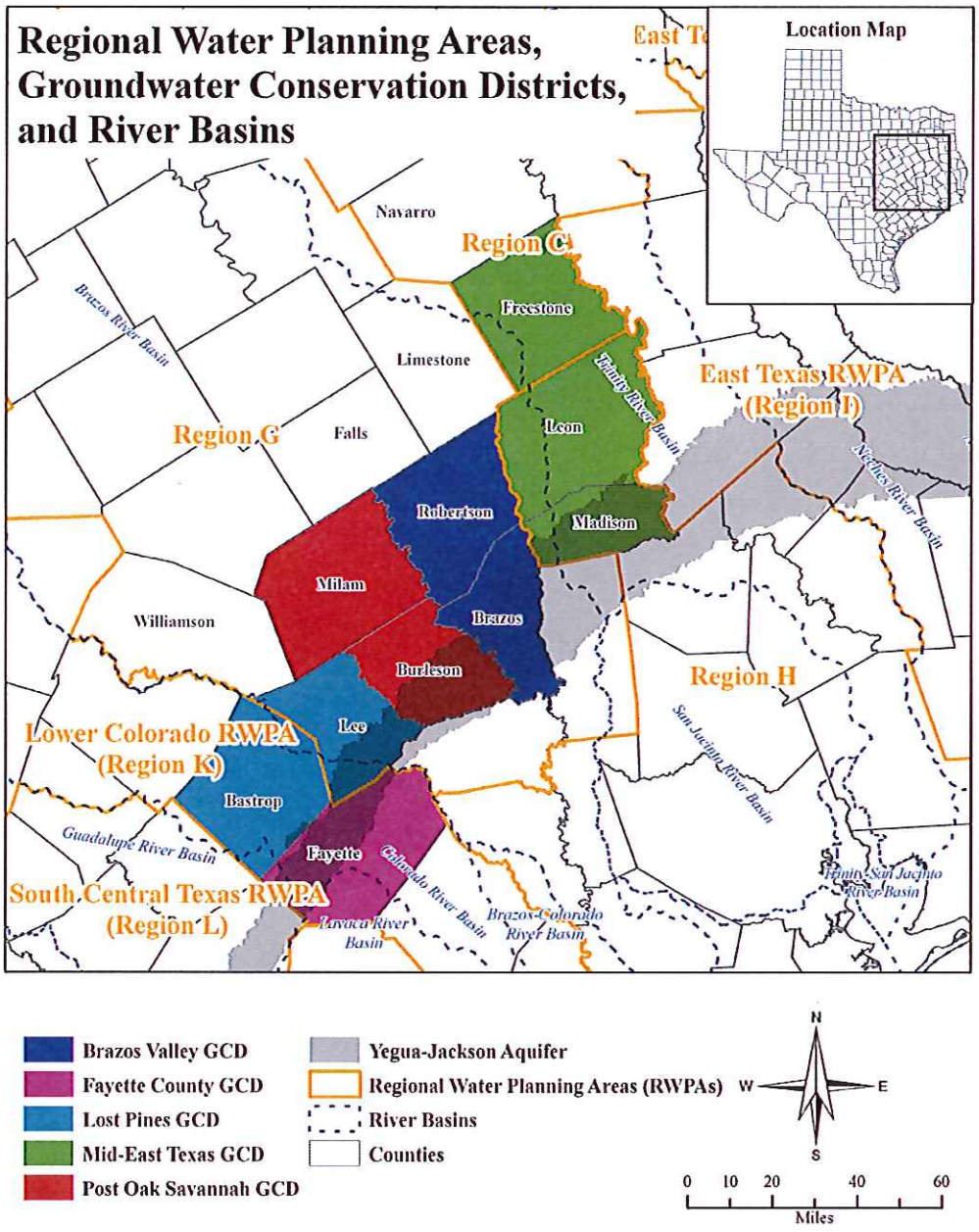


FIGURE 2: MAP SHOWING GROUNDWATER CONSERVATION DISTRICTS, REGIONAL WATER PLANNING AREAS, COUNTIES, AND RIVER BASINS IN AND NEIGHBORING GROUNDWATER MANAGEMENT AREA 12.

APPENDIX C1

Estimated Historical Water Use

Estimated Historical Water Use And 2012 State Water Plan Datasets:

Brazos Valley Groundwater Conservation District

by Stephen Allen
Texas Water Development Board
Groundwater Resources Division
Groundwater Technical Assistance Section
stephen.allen@twdb.texas.gov
(512) 463-7317
November 20, 2014

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 part 1 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)
   reports 2-5 are from the 2012 Texas State Water Plan (SWP)

Part 2 of the 2-part package is the groundwater availability model (GAM) report. 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 2012 SWP data available as of 11/20/2014. Although it does not happen frequently, neither of these datasets are static so they are subject to change pending the availability of more accurate WUS data or an amendment to the 2012 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 2012 SWP dataset can be verified by contacting Sabrina Anderson (sabrina.anderson@twdb.texas.gov or 512-936-0886).

For additional questions regarding this data, please contact Stephen Allen(stephen.allen@twdb.texas.gov or 512-463-7317) or Rima Petrossian (rima.petrossian@twdb.texas.gov or 512-936-2420).

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

Groundwater and surface water historical use estimates are currently unavailable for calendar year 2013. TWDB staff anticipates the calculation and posting of these estimates at a later date.

BRAZOS COUNTY

All values are in acre-feet/year

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2012	GW	33,826	1,422	52	114	34,442	307	70,163
	SW	943	0	4	307	2,873	569	4,696
2011	GW	38,521	1,770	134	114	38,700	407	79,646
	SW	974	0	349	307	3,702	756	6,088
2010	GW	32,667	1,666	82	123	31,834	402	66,774
	SW	0	0	211	112	3,707	747	4,777
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
2000	GW	30,264	137	78	844	5,660	413	37,396
	SW	221	0	0	341	1,258	619	2,439

ROBERTSON COUNTY

All values are in acre-feet/year

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2012	GW	2,387	39	213	3,952	62,023	498	69,112
	SW	0	0	77	29,327	2,051	1,163	32,618
2011	GW	2,632	44	415	5,206	93,264	793	102,354
	SW	0	0	6	40,660	4,586	1,851	47,103
2010	GW	2,375	51	15,185	342	76,833	759	95,545
	SW	0	4,725	114	17,334	2,780	1,771	26,724
2009	GW	2,709	88	14,821	190	62,036	484	80,328
	SW	0	4,735	113	1,483	7,750	1,130	15,211
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
2000	GW	3,060	4,480	1	0	14,535	603	22,679
	SW	0	0	0	0	2,037	905	2,942

APPENDIX C2

Projected Surface Water Supplies

Projected Surface Water Supplies
TWDB 2012 State Water Plan Data

BRAZOS COUNTY

All values are in acre-feet/year

RWPG	WUG	WUG Basin	Source Name	2010	2020	2030	2040	2050	2060
G	IRRIGATION	BRAZOS	BRAZOS RIVER COMBINED RUN-OF-RIVER IRRIGATION	4,379	4,399	4,420	4,440	4,460	4,480
G	LIVESTOCK	BRAZOS	LIVESTOCK LOCAL SUPPLY	1,032	1,032	1,032	1,032	1,032	1,032
G	MANUFACTURING	BRAZOS	BRAZOS RIVER AUTHORITY MAIN STEM LAKE/RESERVOIR SYSTEM	14,720	14,720	14,720	14,720	14,720	14,720
G	STEAM ELECTRIC POWER	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	4,000	4,000	4,000	4,000	4,000	4,000
	Sum of Projected Surface Water Supplies (acre-feet/year)			**24,216**	**24,236**	**24,257**	**24,277**	**24,297**	**24,317**

ROBERTSON COUNTY

All values are in acre-feet/year

RWPG	WUG	WUG Basin	Source Name	2010	2020	2030	2040	2050	2060
G	IRRIGATION	BRAZOS	BRAZOS RIVER COMBINED RUN-OF-RIVER IRRIGATION	9,103	9,124	9,146	9,168	9,190	9,212
G	LIVESTOCK	BRAZOS	LIVESTOCK LOCAL SUPPLY	1,508	1,508	1,508	1,508	1,508	1,508
G	MINING	BRAZOS	BRAZOS RIVER COMBINED RUN-OF-RIVER MINING	9	9	9	9	9	9
G	STEAM ELECTRIC POWER	BRAZOS	BRAZOS RIVER AUTHORITY MAIN STEM LAKE/RESERVOIR SYSTEM	25,150	25,165	25,181	25,196	25,211	25,226
G	STEAM ELECTRIC POWER	BRAZOS	BRAZOS RIVER COMBINED RUN-OF-RIVER STEAM ELECTRIC POWER	1	1	1	1	1	1
G	STEAM ELECTRIC POWER	BRAZOS	TWIN OAK LAKE/RESERVOIR	2,741	2,718	2,694	2,671	2,647	2,624
	Sum of Projected Surface Water Supplies (acre-feet/year)			**38,512**	**38,525**	**38,539**	**38,553**	**38,566**	**38,580**

APPENDIX C3

Projected Water Demands

Projected Water Demands
TWDB 2012 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/year

RWPG	WUG	WUG Basin	2010	2020	2030	2040	2050	2060
G	COUNTY-OTHER	BRAZOS	808	695	593	510	422	395
G	BRYAN	BRAZOS	11,957	13,179	14,221	15,022	16,096	16,493
G	COLLEGE STATION	BRAZOS	20,032	22,977	25,779	27,844	30,432	31,342
G	STEAM ELECTRIC POWER	BRAZOS	526	488	394	446	303	393
G	MANUFACTURING	BRAZOS	316	365	413	462	506	549
G	MINING	BRAZOS	27	28	29	30	31	31
G	IRRIGATION	BRAZOS	6,584	6,267	5,964	5,676	5,403	5,142
G	LIVESTOCK	BRAZOS	1,032	1,032	1,032	1,032	1,032	1,032
G	WICKSON CREEK SUD	BRAZOS	1,126	1,451	1,701	1,924	2,206	2,301
G	WELLBORN SUD	BRAZOS	1,069	1,285	1,482	1,637	1,820	1,886
	Sum of Projected Water Demands (acre-feet/year)		**43,477**	**47,767**	**51,608**	**54,583**	**58,251**	**59,564**

ROBERTSON COUNTY

All values are in acre-feet/year

RWPG	WUG	WUG Basin	2010	2020	2030	2040	2050	2060
G	TRI-COUNTY SUD	BRAZOS	77	82	83	84	83	83
G	ROBERTSON COUNTY WSC	BRAZOS	258	315	348	370	368	365
G	STEAM ELECTRIC POWER	BRAZOS	15,789	17,882	31,113	36,369	48,118	50,319
G	MANUFACTURING	BRAZOS	85	101	117	134	150	163
G	LIVESTOCK	BRAZOS	1,508	1,508	1,508	1,508	1,508	1,508
G	IRRIGATION	BRAZOS	16,175	16,019	15,561	15,115	14,682	14,261
G	MINING	BRAZOS	10,300	10,300	10,300	78	77	76
G	COUNTY-OTHER	BRAZOS	567	594	609	616	613	611
G	HEARNE	BRAZOS	1,124	1,108	1,093	1,077	1,066	1,066
G	FRANKLIN	BRAZOS	344	373	389	397	396	395
G	BREMOND	BRAZOS	157	154	151	148	146	146
G	CALVERT	BRAZOS	327	323	318	313	310	310
G	WICKSON CREEK SUD	BRAZOS	20	30	35	39	39	39
	Sum of Projected Water Demands (acre-feet/year)		**46,731**	**48,789**	**61,625**	**56,248**	**67,556**	**69,342**

APPENDIX C4

Projected Water Supply Needs

Projected Water Supply Needs

TWDB 2012 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/year

RWPG	WUG	WUG Basin	2010	2020	2030	2040	2050	2060
G	BRYAN	BRAZOS	5,227	4,005	2,963	2,162	1,088	691
G	COLLEGE STATION	BRAZOS	5,679	2,734	-68	-2,133	-4,721	-5,631
G	COUNTY-OTHER	BRAZOS	735	848	950	1,033	1,121	1,148
G	IRRIGATION	BRAZOS	9,928	10,265	10,589	10,897	11,190	11,471
G	LIVESTOCK	BRAZOS	0	0	0	0	0	0
G	MANUFACTURING	BRAZOS	16,879	16,830	16,782	16,733	16,689	16,646
G	MINING	BRAZOS	5	4	3	2	1	1
G	STEAM ELECTRIC POWER	BRAZOS	19	57	151	99	242	152
G	WELLBORN SUD	BRAZOS	4,626	4,410	4,213	4,058	3,875	3,809
G	WICKSON CREEK SUD	BRAZOS	384	59	-191	-414	-696	-791
	Sum of Projected Water Supply Needs (acre-feet/year)		**0**	**0**	**-259**	**-2,547**	**-5,417**	**-6,422**

ROBERTSON COUNTY

All values are in acre-feet/year

RWPG	WUG	WUG Basin	2010	2020	2030	2040	2050	2060
G	BREMOND	BRAZOS	234	237	240	243	245	245
G	CALVERT	BRAZOS	186	190	195	200	203	203
G	COUNTY-OTHER	BRAZOS	118	91	76	69	72	74
G	FRANKLIN	BRAZOS	284	255	239	231	232	233
G	HEARNE	BRAZOS	1,807	1,823	1,838	1,854	1,865	1,865
G	IRRIGATION	BRAZOS	5,357	5,534	6,014	6,482	6,937	7,380
G	LIVESTOCK	BRAZOS	0	0	0	0	0	0
G	MANUFACTURING	BRAZOS	80	64	48	31	15	2
G	MINING	BRAZOS	9	9	9	9	9	9
G	ROBERTSON COUNTY WSC	BRAZOS	159	102	69	47	49	52
G	STEAM ELECTRIC POWER	BRAZOS	18,086	15,985	2,746	-2,518	-14,276	-16,485
G	TRI-COUNTY SUD	BRAZOS	18	13	12	11	12	12
G	WICKSON CREEK SUD	BRAZOS	0	0	0	0	0	0
	Sum of Projected Water Supply Needs (acre-feet/year)		**0**	**0**	**0**	**-2,518**	**-14,276**	**-16,485**

APPENDIX C5

Projected Water Management Strategies

Projected Water Management Strategies
TWDB 2012 State Water Plan Data

BRAZOS COUNTY

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

Water Management Strategy	Source Name [Origin]	2010	2020	2030	2040	2050	2060
BRYAN, BRAZOS (G)							
MUNICIPAL WATER CONSERVATION	CONSERVATION [BRAZOS]	0	0	0	0	122	248
WASTEWATER REUSE	DIRECT REUSE [BRAZOS]	0	0	0	0	605	605
COLLEGE STATION, BRAZOS (G)							
ADDITIONAL CARRIZO AQUIFER DEVELOPMENT (INCLUDES	CARRIZO-WILCOX AQUIFER [BRAZOS]	0	0	0	3,000	3,000	3,000
BRA SYSTEM OPERATIONS PERMIT	BRAZOS RIVER AUTHORITY MAIN STEM LAKE/RESERVOIR SYSTEM	0	0	0	2,500	2,500	2,500
MUNICIPAL WATER CONSERVATION	CONSERVATION [BRAZOS]	545	1,378	1,320	1,177	1,149	1,184
WASTEWATER REUSE	DIRECT REUSE [BRAZOS]	0	0	0	312	312	312
WICKSON CREEK SUD, BRAZOS (G)							
PURCHASE WATER FROM CITY OF BRYAN	CARRIZO-WILCOX AQUIFER [BRAZOS]	900	900	900	900	900	900
Sum of Projected Water Management Strategies (acre-feet/year)		**1,445**	**2,278**	**2,220**	**7,889**	**8,588**	**8,749**

ROBERTSON COUNTY

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

Water Management Strategy	Source Name [Origin]	2010	2020	2030	2040	2050	2060
STEAM-ELECTRIC CONSERVATION	CONSERVATION [ROBERTSON]	474	894	2,178	2,546	3,368	3,522
WASTEWATER REUSE	DIRECT REUSE [ROBERTSON]	0	0	0	1,791	13,314	15,479
Sum of Projected Water Management Strategies (acre-feet/year)		**474**	**894**	**2,178**	**4,337**	**16,682**	**19,001**

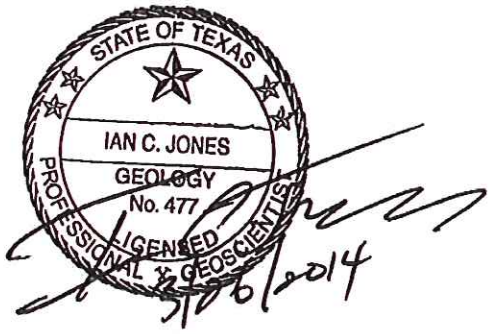
STEAM ELECTRIC POWER, BRAZOS (G)

APPENDIX D

TWDB GAM Run 14-005

GAM Run 14-005: Brazos Valley Groundwater Conservation District Management Plan

by Ian C. Jones, Ph.D., P.G.
Texas Water Development Board
Groundwater Resources Division
Groundwater Availability Modeling Section
(512) 463-6641
March 26, 2014



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GAM Run 14-005: Brazos Valley Groundwater Conservation District Management Plan

by Ian C. Jones, Ph.D., P.G.
Texas Water Development Board
Groundwater Resources Division
Groundwater Availability Modeling Section
(512) 463-6641
March 26, 2014

EXECUTIVE SUMMARY:

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

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

This report—Part 2 of a two-part package of information from the TWDB to Brazos Valley Groundwater Conservation District—fulfills the requirements noted above. Part 1 of the two-part package is the Historical Water Use/State Water Plan data report. The district will receive the Historical Water Use/State Water Plan data report from the TWDB Groundwater Technical Assistance Section. Questions about the data report can be directed to Mr. Stephen Allen, stephen.allen@twdb.texas.gov, (512) 463-7317.

The groundwater management plan for Brazos Valley Groundwater Conservation District should be adopted by the district on or before March 9, 2015 and submitted to the executive administrator of the TWDB on or before April 8, 2015. The current management plan for Brazos Valley Groundwater Conservation District expires on June 7, 2015.

This report discusses the methods, assumptions, and results from model runs using the groundwater availability models for the Carrizo-Wilcox, Queen City, Sparta, and Yegua-Jackson aquifers, and the Gulf Coast Aquifer System. This model run replaces the results of GAM Run 10-013 (Wade and Aschenbach, 2011). GAM Run 14-005 meets current standards set after the release of GAM Run 10-013 including use of the official aquifer boundaries within the district rather than the entire active area of the model within the district. This GAM Run also includes results from the recently updated groundwater availability model for the northern portion of the Gulf Coast Aquifer System (Kasmarek, 2013). Tables 1 through 5 summarize the groundwater availability model data required by statute, and Figures 1 through 5 show the area of the models from which the values in the tables were extracted. If after review of the figures, Brazos Valley Groundwater Conservation District determines that the district boundaries used in the assessment do not reflect current conditions, please notify the TWDB immediately.

Although the Brazos River Alluvium Aquifer occurs within the Brazos Valley Groundwater Conservation District, a groundwater availability model for this aquifer has not been developed at this time. If the district would like information for the Brazos River Alluvium Aquifer, the district may request it from the Groundwater Technical Assistance Section of the TWDB.

METHODS:

In accordance with the provisions of the Texas State Water Code, Section 36.1071, Subsection (h), the groundwater availability models for the central portion of the Carrizo-Wilcox, Queen City, and Sparta aquifers, the Yegua-Jackson Aquifer, and the northern portion of the Gulf Coast Aquifer System were run for this analysis. Water budgets for Brazos Valley Groundwater Conservation District were extracted for the historical model periods (1980-2000 for the central portion of the Carrizo-Wilcox, Queen City, and Sparta aquifers, 1980-1997 for the Yegua-Jackson Aquifer, and 1980-2009 for the northern portion of the Gulf Coast Aquifer System) using ZONEBUDGET Version 3.01 (Harbaugh, 2009). The average annual water budget values for recharge, surface water outflow, inflow to the district, outflow from the district, net inter-aquifer flow (upper), and net inter-aquifer flow (lower) for the portion of each aquifer located within the district is summarized in this report.

The groundwater availability model for the northern portion of the Gulf Coast Aquifer System uses MODFLOW's General-Head Boundary Package to simulate groundwater recharge and groundwater-surface water interaction. The general-head boundary was assigned over the outcrop areas of the aquifer. To estimate groundwater recharge and groundwater-surface water interaction separately, we assumed groundwater recharge to be inflow through the general-head boundary while discharge from the aquifer to surface water bodies was assumed to be outflow through the general-head boundary. We then calculated the water budget of these zones using ZONEBUDGET Version 3.01 (Harbaugh, 2009).

PARAMETERS AND ASSUMPTIONS:

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 Formation confining unit (Layer 2), the Queen City Aquifer (Layer 3), the Reklaw Formation confining unit (Layer 4), the Carrizo Formation (Layer 5), the Calvert Bluff Formation (Layer 6), the Simsboro Formation (Layer 7), and the Hooper Formation (Layer 8). Individual water budgets for the district were determined for the Sparta Aquifer (Layer 1), the Queen City Aquifer (Layer 3), and the Carrizo-Wilcox Aquifer (Layer 5 through Layer 8, collectively).

- Groundwater in the Carrizo-Wilcox, Queen City, and Sparta aquifers ranges from fresh to brackish in composition (Kelley and others, 2004). Groundwater with total dissolved solids of less than 1,000 milligrams per liter are considered fresh and total dissolved solids of 1,000 to 10,000 milligrams per liter are considered brackish.

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

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). In separate water budget calculations we calculated groundwater flow between the Catahoula Formation and the underlying 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).

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

RESULTS:

A groundwater budget summarizes the amount of water entering and leaving the aquifer according to the groundwater availability model. Selected groundwater budget components listed below were extracted from the model results for the respective aquifers located within the district and averaged over the duration of the calibration and verification portion of the model run in the district, as shown in Tables 1 through 5.

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

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

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

- Flow between aquifers—The net vertical flow between aquifers or confining units. This flow is controlled by the relative water levels in each aquifer or confining unit and aquifer properties of each aquifer or confining unit that define the amount of leakage that occurs. "Inflow" to an aquifer from an overlying or underlying aquifer will always equal the "Outflow" from the other aquifer.

The information needed for the district's management plan is summarized in Tables 1 through 5. It is important to note that sub-regional water budgets are not exact. This is due to the size of the model cells and the approach used to extract data from the model. To avoid double accounting, a model cell that straddles a political boundary, such as 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 (Figures 1 through 5).

TABLE 1: SUMMARIZED INFORMATION FOR THE CARRIZO-WILCOX AQUIFER THAT IS NEEDED 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	26,906
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	16,869
Estimated annual volume of flow into the district within each aquifer in the district	Carrizo-Wilcox Aquifer	17,840
Estimated annual volume of flow out of the district within each aquifer in the district	Carrizo-Wilcox Aquifer	10,051
Estimated net annual volume of flow between each aquifer in the district	To the Carrizo-Wilcox Aquifer from the Reklaw Formation confining unit	62
	To the Carrizo-Wilcox Aquifer from the down-dip portions of the equivalent formations	10,962

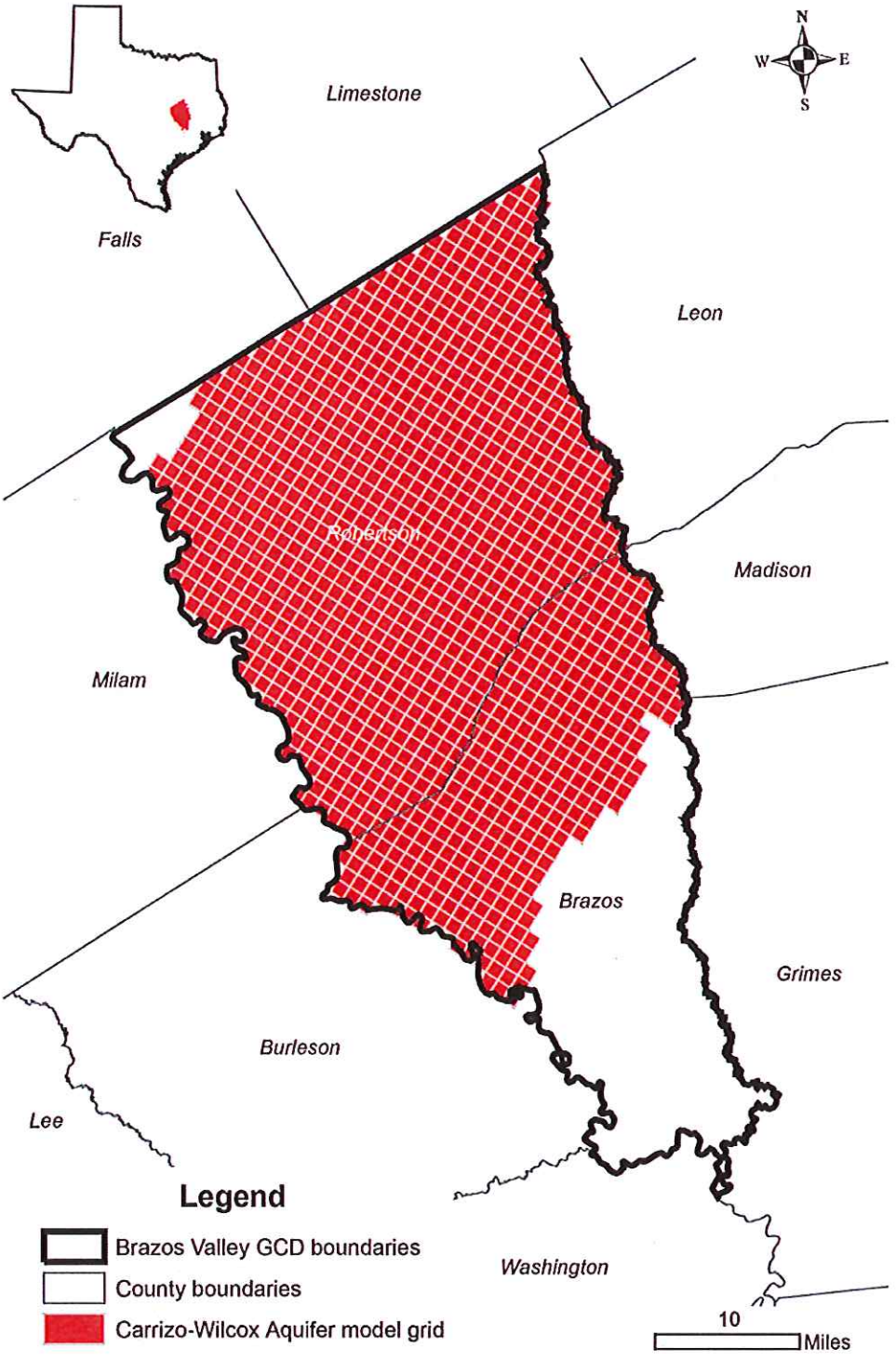

FIGURE 1: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE CARRIZO-WILCOX AQUIFER FROM WHICH THE INFORMATION IN TABLE 1 WAS EXTRACTED (THE CARRIZO-WILCOX AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).

TABLE 2: SUMMARIZED INFORMATION FOR THE QUEEN CITY AQUIFER THAT IS NEEDED FOR 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	6,091
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	11,902
Estimated annual volume of flow into the district within each aquifer in the district	Queen City Aquifer	1,865
Estimated annual volume of flow out of the district within each aquifer in the district	Queen City Aquifer	815
Estimated net annual volume of flow between each aquifer in the district	To the Queen City Aquifer from the Weches Formation confining unit	209
	To the Queen City Aquifer from the Reklaw Formation confining unit	148
	From the Queen City Aquifer to the down-dip portion of the Queen City Formation	83

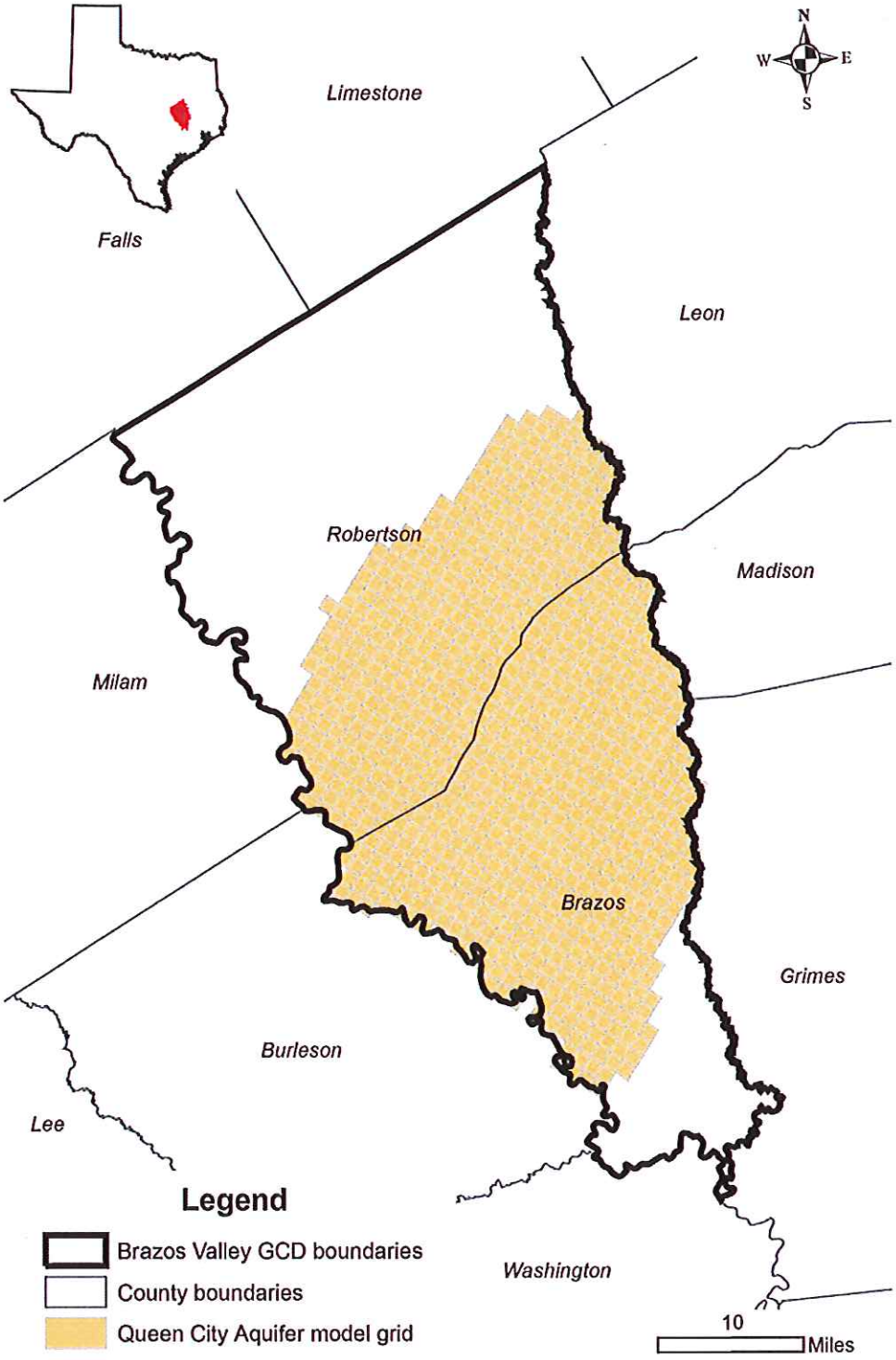

FIGURE 2: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE QUEEN CITY AQUIFER FROM WHICH THE INFORMATION IN TABLE 2 WAS EXTRACTED (THE QUEEN CITY AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).

TABLE 3: SUMMARIZED INFORMATION FOR THE SPARTA AQUIFER THAT IS NEEDED FOR 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	9,970
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Sparta Aquifer	1,861
Estimated annual volume of flow into the district within each aquifer in the district	Sparta Aquifer	617
Estimated annual volume of flow out of the district within each aquifer in the district	Sparta Aquifer	496
Estimated net annual volume of flow between each aquifer in the district	To the Sparta Aquifer from overlying stratigraphic units	714
	From the Sparta Aquifer to the Weches Formation confining unit	599
	From the Sparta Aquifer to the down-dip portion of the Sparta Formation	76

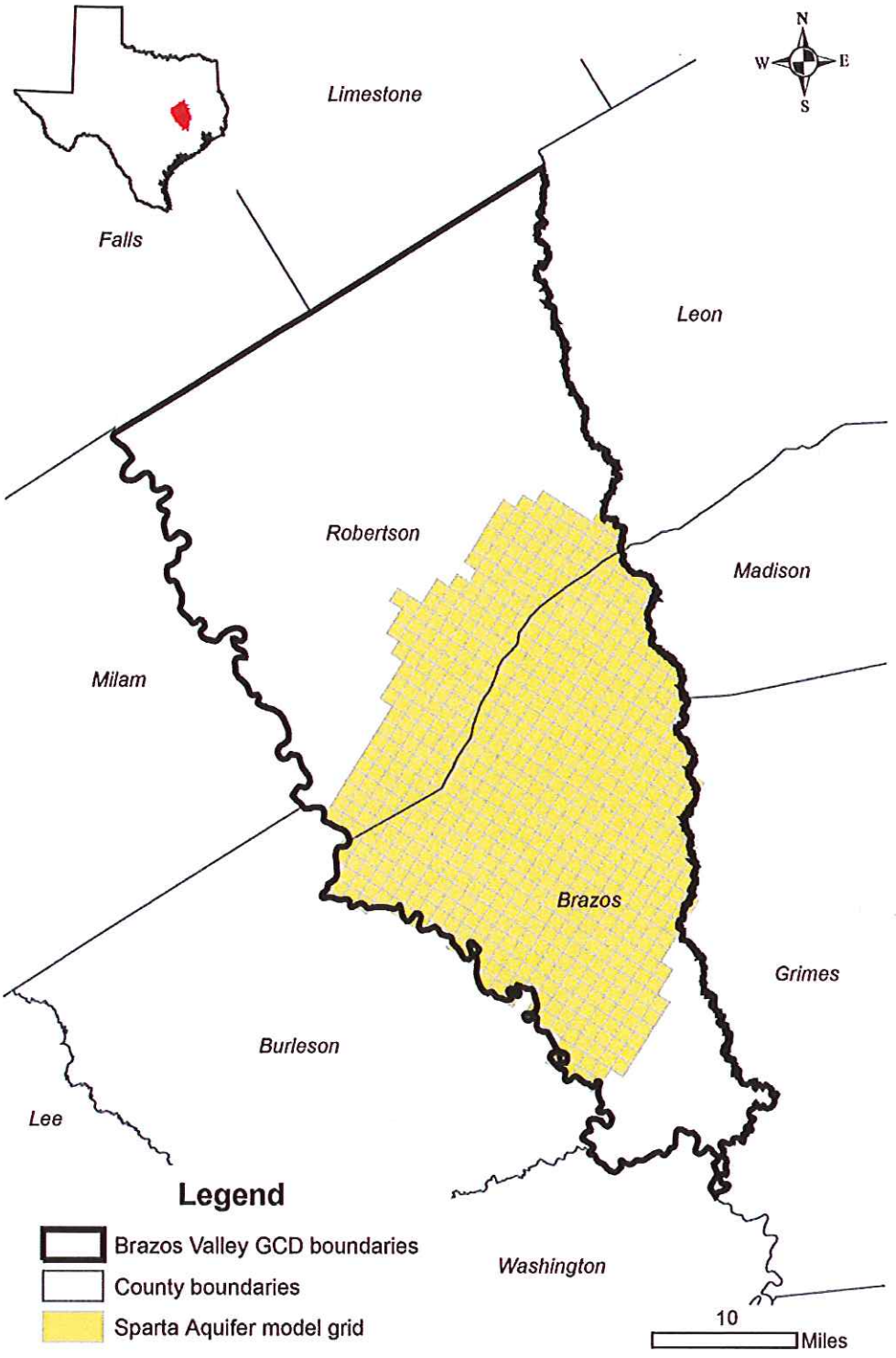

FIGURE 3: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE SPARTA AQUIFER FROM WHICH THE INFORMATION IN TABLE 3 WAS EXTRACTED (THE SPARTA AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).

TABLE 4: SUMMARIZED INFORMATION FOR THE YEGUA-JACKSON AQUIFER THAT IS NEEDED FOR 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	12,029
Estimated annual volume of flow out of the district within each aquifer in the district	Yegua-Jackson Aquifer	9,921
Estimated net annual volume of flow between each aquifer in the district	To the Yegua-Jackson Aquifer from the confined portion of the Yegua and Jackson groups	178

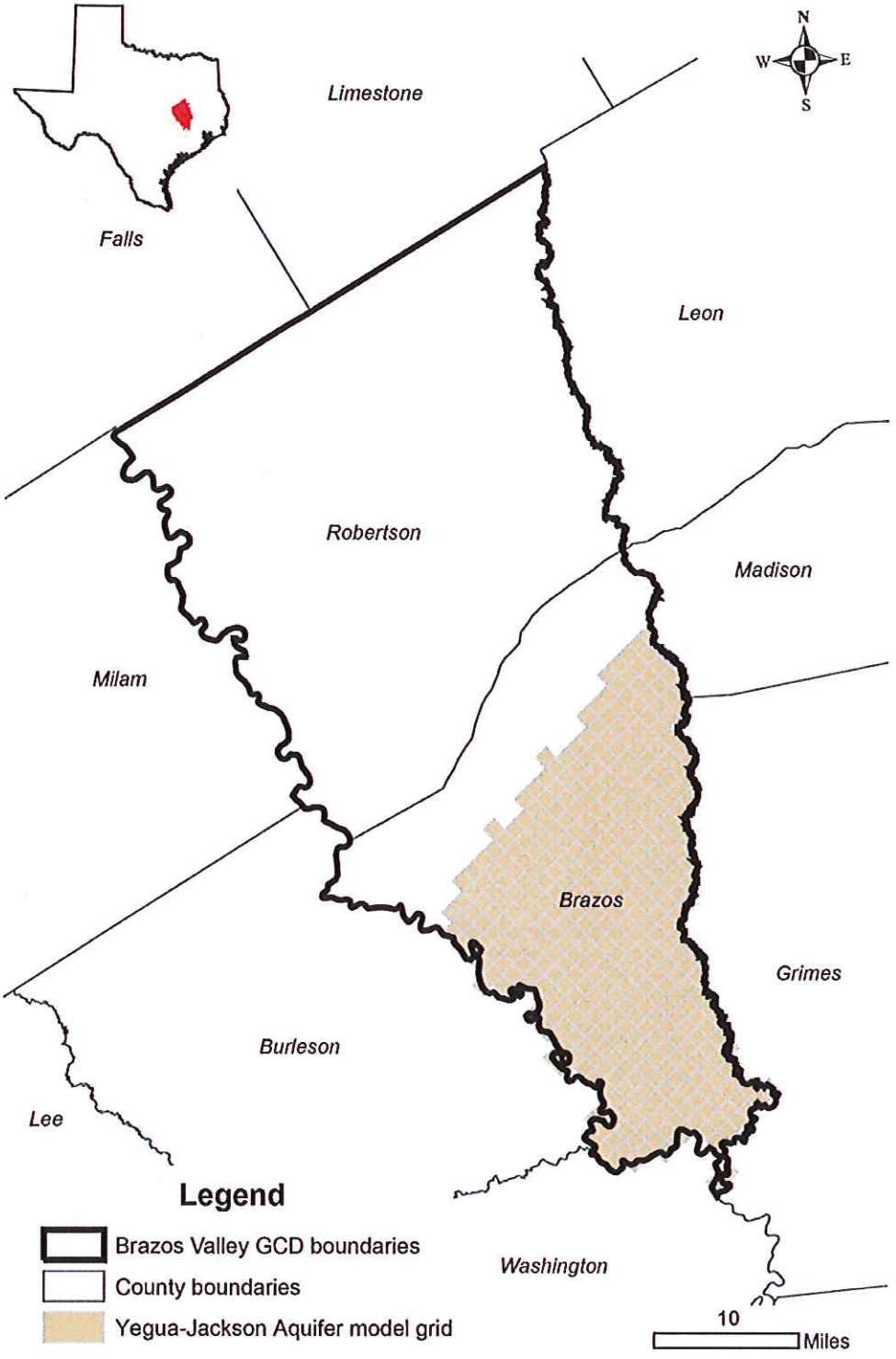

FIGURE 4: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE YEGUA-JACKSON AQUIFER FROM WHICH THE INFORMATION IN TABLE 4 WAS EXTRACTED (THE YEGUA-JACKSON AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).

TABLE 5: SUMMARIZED INFORMATION FOR THE GULF COAST AQUIFER SYSTEM THAT IS NEEDED 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	To the Gulf Coast Aquifer System from the confined portion of the Yegua and Jackson groups [1]	423

[1] Calculated using the groundwater availability model for the Yegua-Jackson Aquifer.

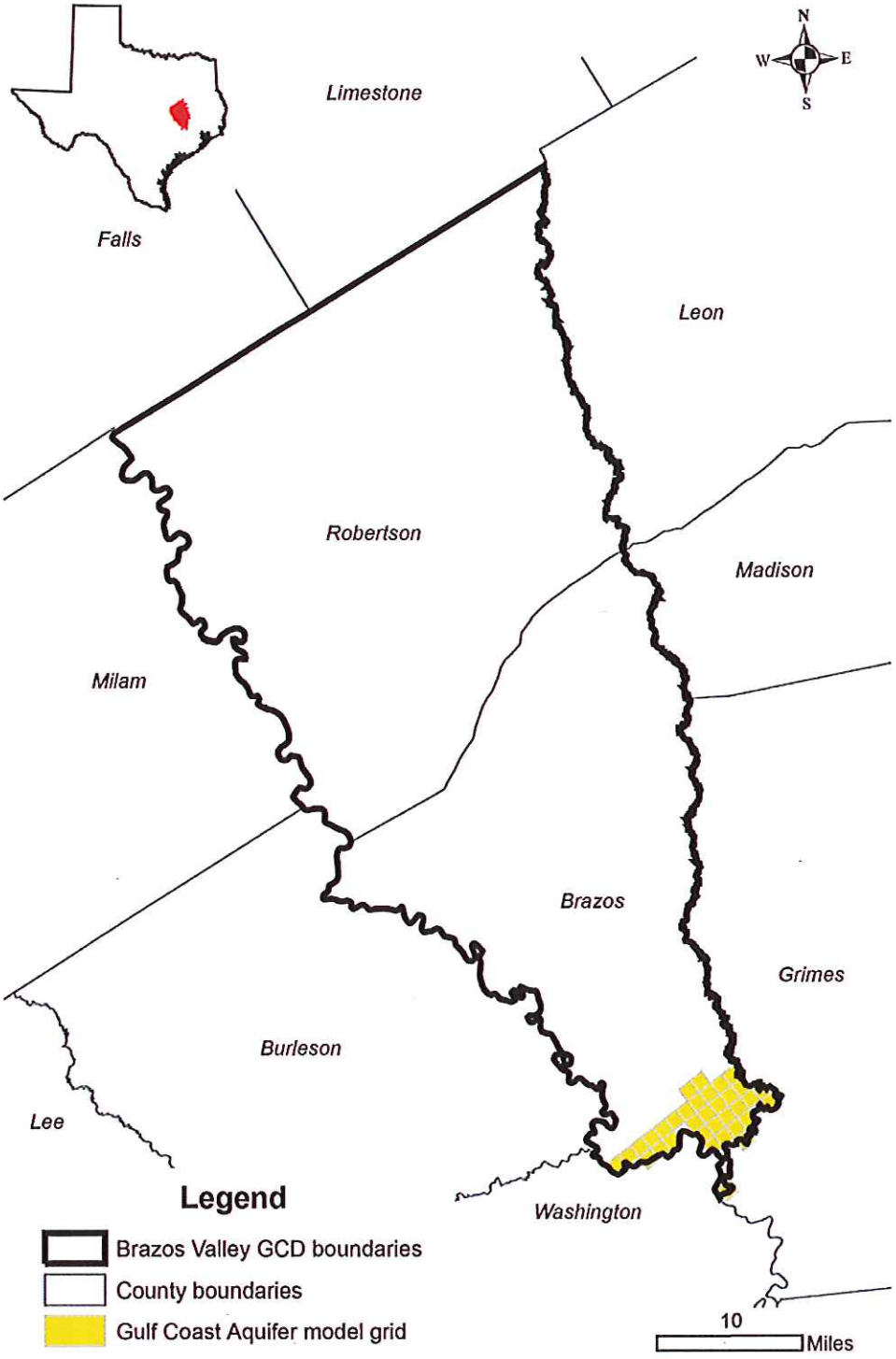

FIGURE 5: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE GULF COAST AQUIFER SYSTEM FROM WHICH THE INFORMATION IN TABLE 5 WAS EXTRACTED (THE GULF COAST AQUIFER SYSTEM EXTENT WITHIN THE DISTRICT BOUNDARY).

LIMITATIONS:

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

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

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

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

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

REFERENCES:

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Dutton, A. R., Harden, B., Nicot, J. P., and O'Rourke, D., 2003, Groundwater availability model for the central part of the Carrizo-Wilcox Aquifer in Texas: Contract report to the Texas Water Development Board, 295 p., http://www.twdb.texas.gov/groundwater/models/gam/czwx_c/czwx_c.asp.

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Harbaugh, A. W., Banta, E. R., Hill, M. C., and McDonald, M. G., 2000, MODFLOW-2000, The U.S. Geological Survey modular ground-water model-User guide to modularization concepts and the ground-water flow process: U.S. Geological Survey, Open-File Report 00-92.

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

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

Kelley, V. A., Deeds, N. E., Fryar, D. G., and Nicot, J. P., 2004, Groundwater availability models for the Queen City and Sparta aquifers: Contract report to the Texas Water Development Board, 867 p., http://www.twdb.texas.gov/groundwater/models/gam/qcsp/qcsp.asp.

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

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

Wade, S. and Aschenbach, E., 2011, GAM Run 10-013: Texas Water Development Board, GAM Run 10-013 Report, 6 p., http://www.twdb.texas.gov/groundwater/docs/GAMruns/GR10-013.pdf.

APPENDIX E

Public Notices Regarding Hearing

Related to Plan Adoption

Public Hearing

BRAZOS VALLEY GROUNDWATER CONSERVATION DISTRICT
112 West Third Street
Hearne, Texas

July 17, 2014 at 3:00 p.m.

FILED
2014 JUL 14 A 9:50

Public Hearing on the Brazos Valley Groundwater Conservation District's proposed groundwater Management Plan update, as required by chapter 36.1071 of the Texas Water Code.

Copies of the District Management Plan may be obtained at the District office.

Signed this 14th, day of July, 2014

Alan M. Day
General Manager

The Board of Directors may meet in closed session, pursuant to the Texas Open Meetings Act, Texas Government Code §§ 551.071-551.076, to:

(1) consult with attorney;
(2) deliberate regarding the purchase, exchange, lease, or value of real property if deliberation in an open meeting would have a detrimental effect on the position of the District in negotiations with a third person;
(3) deliberate a negotiated contract for a prospective gift or donation to the District if deliberation in an open meeting would have a detrimental effect on the position of the District in negotiations with a third person;
(4) to deliberate the appointment, employment, evaluation, reassignment, duties, discipline or dismissal of a Board member or District employee;
(5) to receive information from employees or question employees, but not deliberate public business or agency policy that affects public business; and
(6) to deliberate the deployment or specific occasions for implementation of security personnel or devices.

The Board may also meet in open session on these matters as required by the Texas Open Meetings Act, Texas Government Code § 551.102.

** Agenda items may be taken out of order at the discretion of the Board Chairman

Public Hearing

BRAZOS VALLEY GROUNDWATER CONSERVATION DISTRICT
112 West Third Street
Hearne, Texas

July 17, 2014 at 3:00 p.m.

Public Hearing on the Brazos Valley Groundwater Conservation District's proposed groundwater Management Plan update, as required by chapter 36.1071 of the Texas Water Code.

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Public Hearing

BRAZOS VALLEY GROUNDWATER CONSERVATION DISTRICT
112 West Third Street
Hearne, Texas

FILED FOR RECORD
DATE 1-27-15
AT 4:00 O'CLOCK P M
KAREN MCQUEEN
BRAZOS COUNTY CLERK
By Karen McQueen

District Office
February 12, 2015 at 3:00 p.m.

Public Hearing on the Brazos Valley Groundwater Conservation District's proposed Groundwater Management Plan update, as required by Chapter 36.1071 of the Texas Water Code.

Copies of the Draft District Management Plan may be obtained at the District office.

The Draft District Management Plan may also be downloaded from the District website at https://brazosvalleygcd.org/.

Signed this 27th day of January, 2015.

Alan M. Day
General Manager

The Board of Directors may meet in closed session, pursuant to the Texas Open Meetings Act, Texas Government Code §§ 551.071-551.076, to:

(1) consult with attorney ;
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Public Hearing

BRAZOS VALLEY GROUNDWATER CONSERVATION DISTRICT
112 West Third Street
Hearne, Texas

District Office
February 12, 2015 at 3:00 p.m.

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Signed this 27th day of January, 2015.

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General Manager

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The Board may also meet in open session on these matters as required by the Texas Open Meetings Act, Texas Government Code § 551.102.

** **Agenda items may be taken out of order at the discretion of the Board Chairman**

AFFIDAVIT OF PUBLICATION

THE STATE OF TEXAS
COUNTY OF BRAZOS

On this 29th day of, January 2015, Personally, appeared before me the Undersigned a Notary Public in and for said county and State, Marilyn Green of THE EAGLE, a newspaper published in Bryan, County of Brazos, State of Texas, and generally circulated in Brazos, Grimes, Robertson, Milam, Leon, Burleson, Madison, and Lee, who, being by me duly sworn, on oath states that:

NOTICE OF PUBLIC HEARING

Was published in said newspaper in 1 issues thereof on the following dates: January 29th, 2015

Marilyn Green

Subscribed and sworn to before me, this the 29th day of, January 2015.

Lynne J. Tavano
Notary Public Brazos County, Texas

LYNNE J. TAVANO
Notary Public, State of Texas
My Commission Expires
APRIL 21, 2016

1/29 Brazos Valley Groundwater Conservation District

Commercial | **Manufactured** | **Boats** | **Cars** | **SUV** $10k-$15k | **4x4 Trucks** Over $12k

Group | swer, pls leave message

NOTICE OF PUBLIC HEARING

BRAZOS VALLEY GROUNDWATER CONSERVATION DISTRICT
112 West Third Street
Hearne, Texas

District Office
February 12, 2015 at 3:00 p.m.

Public Hearing on the Brazos Valley Groundwater Conservation District's proposed Groundwater Management Plan update, as required by Chapter 36.1071 of the Texas Water Code.

Copies of the Draft District Management Plan may be obtained at the District office.

The Draft District Management Plan may also be downloaded from the District website at https://brazosvalleygcd.org/.

Signed this 27th day of January, 2015.

/s/ Alan M. Day
Alan M. Day
General Manager

1-29-15

COLLEGE STATION INDEPENDENT SCHOOL DISTRICT

The Bryan Independent School District is soliciting competitive sealed bids from vendors to provide high school commencement pictures for Rudder High School on June 6, 2015, Bryan High School on June 6, 2015, Bryan Collegiate HS on June 5, 2015, and MC Harris on June 3, 2015. Copies of the bid documents may be obtained from the district website, (www.bryanisd.org, < Departments, < Finance, < Competitive Bidding), from the Business Services Office, 101 North Texas Avenue, Bryan, Texas 77803 or by calling (979) 209-1008. Bid #15-3667 - High School Commencement Ceremony Pictures will be received until 1:00 PM on February 5, 2015 in the Business Services Office. Bids will be opened at 2:00 PM on that same date in Room 207 of the same location.

Questions concerning the bids should be referred to Melissa Martin, Purchasing & Document Coordinator, at (979) 209-1048 or melissa.martin@bryanisd.org.

1/22/15 & 1/29/15

PUBLIC NOTICE
REQUEST FOR PROPOSALS

JOERIS GENERAL CONTRACTORS, LTD.,
Construction Manager, will be accepting

on January 13, 2015, under Cause No. 15,227-PC, pending in the County Court-at-Law No. 1, Brazos County, Texas, to Jon Miller, Temporary Administrator.

Claims may be presented, addressed as follows:

Jon Miller
Temporary Administrator
P.O. Box 4884
BRYAN, TEXAS 77805

All persons having claims against this Estate which is currently being administered are required to present them within the time and in the manner prescribed by law.

Jon Miller
TEMPORARY ADMINISTRATOR
1-29-15

REQUEST FOR BIDS

NOTICE TO BIDDERS FOR THE INTENTION OF WICKSON CREEK SPECIAL UTILITY DISTRICT TO LET CONTRACT FOR CONSTRUCTION OF WELL NO. 7.

SEALED PROPOSALS addressed to Mr. Kent B. Watson, General Manager, Wickson Creek SUD will be received until Thursday, February 19, 2015 at 2:00 p.m. for construction of Well No. 7 and associated appurtenances, according

APPENDIX F

Letters Coordinating with Regional

Surface Water Management

BRAZOS VALLEY GROUNDWATER CONSERVATION DISTRICT
P.O. BOX 528 · HEARNE, TX 77859 · (979)279-9350 · FAX: (979)279-0035
WWW.BRAZOSVALLEYGCD.ORG

October 13, 2014

Trey Buzbee
Brazos River Authority
P.O. Box 7555
Waco, TX 76714

Dear Trey,

The Brazos Valley Groundwater Conservation District is currently updating its Management Plan as required by Chapter 36 of the Texas Water Code. One of the specific objectives contained in the plan addresses conjunctive use of surface and groundwater assets.

Enclosed is a copy of the body of the plan. Please review and make any suggestions or comments to the District office by November 1, 2014. The adoption of the draft will be an action item on the November 13, 2014 Regular Board Meeting.

If you have any questions concerning the plan, please feel free to contact me at your convenience.

Best regards,

Alan M. Day
General Manager
979-279-9350 (office)
817-774-6412 (cell)
aday@brazosvalleygcd.org

BRAZOS VALLEY GROUNDWATER CONSERVATION DISTRICT
P.O. BOX 528 · HEARNE, TX 77859 · (979)279-9350 · FAX: (979)279-0035
WWW.BRAZOSVALLEYGCD.ORG

October 13, 2014

Stephen Cast, General Manager
Wellborn Special Utility District
P. O. Box 250
Wellborn, Texas 77881

Dear Stephen,

The Brazos Valley Groundwater Conservation District is currently updating its Management Plan as required by Chapter 36 of the Texas Water Code. One of the specific objectives contained in the plan addresses conjunctive use of surface and groundwater assets.

Enclosed is a copy of the body of the plan. Please review and make any suggestions or comments to the District office by November 1, 2014. The adoption of the draft will be an action item on the November 13, 2014 Regular Board Meeting.

If you have any questions concerning the plan, please feel free to contact me at your convenience.

Best regards,

Alan M. Day
General Manager
979-279-9350 (office)
817-774-6412 (cell)
aday@brazosvalleygcd.org

BRAZOS VALLEY GROUNDWATER CONSERVATION DISTRICT

P.O. BOX 528 · HEARNE, TX 77859 · (979)279-9350 · FAX: (979)279-0035

WWW.BRAZOSVALLEYGCD.ORG

February 13, 2015

David Collinsworth
Central and Lower Basin Region Manager
Brazos River Authority
P.O. Box 7555
Waco, TX 76714

Re: Brazos Valley Groundwater Conservation District Management Plan

Dear Mr. Hoffman:

Enclosed you will find a copy of the Brazos Valley Groundwater Conservation District's Management Plan. After a Public Hearing, this Management Plan was adopted by the Brazos Valley County Groundwater Conservation District Board of Directors on February 12, 2015.

This Management Plan is forwarded for your review and comment in accordance with 31 Texas Administrative Code § 356.6(a)(4). We look forward to hearing your comments.

If you have any questions or need additional information, please feel free to contact the District.

Sincerely,

Alan M. Day
General Manager
Brazos Valley Groundwater Conservation District

Enclosure: BVGCD District Management Plan (adopted 2/12/2015).

BRAZOS VALLEY GROUNDWATER CONSERVATION DISTRICT

P.O. BOX 528 · HEARNE, TX 77859 · (979)279-9350 · FAX: (979)279-0035
WWW.BRAZOSVALLEYGCD.ORG

February 13, 2015

Stephen Cast
General Manager
Wellborn Special Utility District
P.O. Box 250
Wellborn, TX 77881

Re: Brazos Valley Groundwater Conservation District Management Plan

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This Management Plan is forwarded for your review and comment in accordance with 31 Texas Administrative Code § 356.6(a)(4). We look forward to hearing your comments.

If you have any questions or need additional information, please feel free to contact the District.

Sincerely,

Alan M. Day
General Manager
Brazos Valley Groundwater Conservation District

Enclosure: BVGCD District Management Plan (adopted 2/12/2015).

BRAZOS VALLEY GROUNDWATER CONSERVATION DISTRICT

P.O. BOX 528 · HEARNE, TX 77859 · (979)279-9350 · FAX: (979)279-0035
WWW.BRAZOSVALLEYGCD.ORG

February 13, 2015

Brazos G Water Planning Group
c/o Trey Buzbee, Brazos River Authority
P.O. Box 7555
Waco, TX 76714

Re: Brazos Valley Groundwater Conservation District Management Plan

Dear Trey:

Enclosed you will find a copy of the Brazos Valley Groundwater Conservation District's Management Plan. After a Public Hearing, this Management Plan was adopted by the Brazos Valley County Groundwater Conservation District Board of Directors on February 12, 2015.

This Management Plan is forwarded for your review and comment in accordance with 31 Texas Administrative Code § 356.6(a)(4). We look forward to hearing your comments.

If you have any questions or need additional information, please feel free to contact the District.

Sincerely,

Alan M. Day
General Manager
Brazos Valley Groundwater Conservation District

Enclosure: BVGCD District Management Plan (adopted 2/12/2015).

APPENDIX G

Brazos Valley GCD Board of Directors Resolution

Adopting Revised Management Plan

BRAZOS VALLEY GROUNDWATER CONSERVATION DISTRICT

P.O. BOX 528 · HEARNE, TX 77859 · (979)279-9350 · FAX: (979)279-0035
WWW.BRAZOSVALLEYGCD.ORG

A RESOLUTION OF THE
BRAZOS VALLEY GROUNDWATER CONSERVATION DISTRICT
ADOPTING AMENDMENTS TO ITS MANAGEMENT PLAN FOR SUBMITTAL
TO THE TEXAS WATER DEVOLOPMENT BOARD FOR APPROVAL

WHEREAS, the Brazos Valley Groundwater Conservation District ("District") is charged by the Texas Legislature with providing for the conservation, preservation, protection, and prevention of waste of groundwater, and of groundwater resources in Brazos and Robertson counties, Texas, under §36.0015, Tex. Water Code;

WHEREAS, the District is authorized to make and enforce fair and impartial rules to manage groundwater resources as scientifically necessary to conserve and protect groundwater resources in the area under §36.101, Tex. Water Code;

WHEREAS, pursuant to §§36.1071 and 36.1072, Tex. Water Code, following notice and hearing, the District developed a comprehensive management plan that addresses the required management goals, as applicable and shall submit its Board-approved amendments to the Texas Water Development Board as provided under §36.1073, Tex. Water Code

NOW, THEREFORE, BE IT RESOLVED BY THE BOARD OF DIRECTORS OF THE BRAZOS VALLEY GROUNDWATER CONSERVATION DISTRICT THAT

The District adopts the Brazos Valley Groundwater Conservation District Management Plan and submits it to the Texas Water Development Board for review and approval.

PASSED AND APPROVED this the 12th day of February, 2015

BRAZOS VALLEY GROUNDWATER CONSERVATION DISTRICT

Pete Brien, President

David Stratta, Secretary

B. L. Harris

Bill Harris, Director

APPENDIX H

Minutes of Brazos Valley GCD Board of Directors Meetings Related to Public Hearings for and Adoption of the Management Plan

Agenda

BRAZOS VALLEY GROUNDWATER CONSERVATION DISTRICT
112 W. 3rd Street – Hearne, Texas

Regular Board Meeting
Thursday, February 12, 2015
3:00 p.m.

FILED FOR RECORD
DATE 2-9-15
AT 11:47 O'CLOCK A M
KAREN MCQUEEN
BRAZOS COUNTY CLERK
BY [signature]
NO.

Call meeting to order
Pledge of Allegiance
Declare quorum present
Public Comment
a) Non-agenda items
b) Agenda items

1. Discussion and possible action on the Minutes from the January 15, 2015 Regular Board Meeting.

2. Review and authorization of payments made for services rendered for the months of January, 2015.

3. Financial Reports.

4. Discussion and possible action on a resolution to adopt the revised District Management Plan prepared for the Texas Water Development Board and required under Chapter 36 of the Texas Water Code.

5. Discussion and possible action on the adoption of the 2014 Annual Report.

6. Discussion and possible action on the use of both a shallow and overall Desired Future Conditions for all District aquifers during the 2016 GMA planning process.

7. Discussion and possible action on giving the GMA-12 representative direction on preliminary Desired Future Condition levels for all District aquifers for use in the 2016 GMA planning process.

8.. Discussion and possible action on recommendations from the Procedures Subcommittee addressing new wells, re-drilled wells, or existing well refurbishments that are not permitted or registered by the District.

9. Legal Report – Legislative Update

10. General Manager's Report

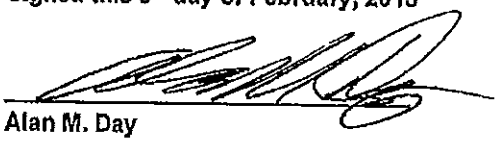
- Drought Monitor Report
- Well Monitoring Report

- Wells permitted pursuant to District Rule 8.3(j)
- District Activities
- Management Plan Update

11. Discussion and possible future agenda items.

12. Adjourn

Signed this 9th day of February, 2015



Alan M. Day
General Manager

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(1) consult with attorney;

(2) deliberate regarding the purchase, exchange, lease, or value of real property if deliberation in an open meeting would have a detrimental effect on the position of the District in negotiations with a third person;

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The Board may also meet in open session on these matters as required by the Texas Open Meetings Act, Texas Government Code § 551.102.

** **Agenda items may be taken out of order at the discretion of the Board Chairman**

Agenda

BRAZOS VALLEY GROUNDWATER CONSERVATION DISTRICT
112 W. 3rd Street – Hearne, Texas

Regular Board Meeting
Thursday, February 12, 2015
3:00 p.m.

Call meeting to order
Pledge of Allegiance
Declare quorum present
Public Comment
a) Non-agenda items
b) Agenda items

1. Discussion and possible action on the Minutes from the January 15, 2015 Regular Board Meeting.

2. Review and authorization of payments made for services rendered for the months of January, 2015.

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- Well Monitoring Report

- Wells permitted pursuant to District Rule 8.3(j)
- District Activities
- Management Plan Update

11. Discussion and possible future agenda items.

12. Adjourn

Signed this 9th day of February, 2015

Alan M. Day
General Manager

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** **Agenda items may be taken out of order at the discretion of the Board Chairman**

Minutes

BRAZOS VALLEY GROUNDWATER
CONSERVATION DISTRICT
112 W 3rd Street
Hearne, TX 77859

Regular Board Meeting
Thursday, February 12, 2015 at 3:00 p.m.

President, Pete Brien called the Regular Board Meeting to order at 3:00 p.m.

Directors present:	Pete Brien,	President
	Bill L. Harris,	Vice-President
	David Stratta,	Secretary
	Mark J. Carrabba,	Treasurer
	Tom McDonald,	Director
	Jan A. Roe,	Director
Directors Absent:	Bryan F. Russ, Jr.,	Director
	Kent Watson,	Director
Staff present:	Alan M. Day,	General Manager
	Monique Norman,	Attorney
	Cynthia Lopez,	Office Manager
	Carlos Rodriquez,	Field Technician

Call meeting to order
Pledge of Allegiance
Declare quorum present
Public Comment
a) Non-agenda items
b) Agenda items

1. Discussion and possible action on the Minutes from the January 15, 2015 Regular Board Meeting. **A motion was made by Mark J. Carrabba, second by David Stratta to approve the Minutes from the January 15, 2015 Regular Board Meeting as presented. The motion passed unanimously.**

2. Review and authorization of payments made for services rendered for the month of January, 2015. **A motion was made by David Stratta, second by Mark J. Carrabba to approve the authorization of payments made for services rendered for the month of January 2015. The motion passed unanimously.**

3. Financial Reports. **Financial reports were presented by the General Manager Alan M. Day.**

4. Discussion and possible action on a resolution to adopt the revised District Management Plan prepared for the Texas Water Development Board and required under Chapter 36 of the Texas Water Code. **A motion was made by David Stratta, second by Mark J. Carrabba, on a resolution to adopt the revised District Management Plan as presented. The motion passed unanimously**.

5. Discussion and possible action on the adoption of the 2014 Annual Report. **A motion was made by David Stratta, second by Jan A. Roe to adopt the 2014 Annual Report as presented. The motion passed unanimously.**

6. Discussion and possible action on the use of both a shallow and overall Desired Future Conditions for all District aquifers during the 2016 GMA planning process. **A motion was made by Tom McDonald, second by Jan Roe, not to develop a shallow DFC for the managed aquifers during the 2016 DFC planning process but to begin development of data relative to the shallow zones for the following round of planniing. The motion passed unanimously.**

7. Discussion and possible action on giving the GMA-12 representative direction on preliminary Desired Future Condition levels for all District aquifers for use in the 2016 GMA planning process. **A motion was made by Tom McDonald, second by David Stratta, to use the DFC's developed by the current groundwater availability model (Scenario 2 run) as a beginning point in DFC discussions at GMA-12. The motion passed unanimously.**

8.. Discussion and possible action on recommendations from the Procedures Subcommittee addressing new wells, re-drilled wells, or existing well refurbishments that are not permitted or registered by the District. **A motion was made by Jan A. Roe, second by Mark J. Carrabba to approve the recommendations from the Procedures Subcommittee addressing new wells, re-drilled wells, or existing well refurbishments that are not permitted or registered by the District. The motion passed with one (1) Director, Pete Brien abstaining.**

9. Legal Report – Legislative Update

Monique Norman briefed the Board on legislative updates.

10. General Manager's Report

- Drought Monitor Report
- Well Monitoring Report
- Wells permitted pursuant to District Rule 8.3(j)
- District Activities
- Management Plan Update

General Manager, Alan M. Day presented the Board with the General's Manager Report (see attached) Carlos Rodriguez gave the Board a brief update on the monitoring of wells in Brazos and Robertson counties.

11. Discussion and possible future agenda items.

12. Adjourn

Signed this 12th, day of March, 2015

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David Stratta, Secretary

ıe Board of Directors may meet in closed session, pursuant to the Texas Open Meetings Act, Texas Government Code §§ 551.071-551.076, to:

) consult with attorney ;

) deliberate regarding the purchase, exchange, lease, or value of real property if deliberation in an open meeting would have a detrimental effect on the position of the District in negotiations with a third person;

) deliberate a negotiated contract for a prospective gift or donation to the District if deliberation in an open meeting would have a detrimental effect on the position of the District in negotiations with a third person;

) to deliberate the appointment, employment, evaluation, reassignment, duties, discipline or dismissal of a Board member or District employee;

) to receive information from employees or question employees, but not deliberate public business or agency policy that affects public business; and

) to deliberate the deployment or specific occasions for implementation of security personnel or devices.

The Board may also meet in open session on these matters as required by the Texas Open Meetings Act, Texas Government Code § 551.102.

Agenda items may be taken out of order at the discretion of the Board Chairman

APPENDIX I

Brazos Valley GCD Contact Information

BRAZOS VALLEY GROUNDWATER CONSERVATION DISTRICT

District Staff

Alan M. Day, General Manager
Cynthia Lopez, Office Manager
Carlos Rodriguez, Field Technician

Physical Address:

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