



*Clearwater Underground Water  
Conservation District*

*District  
Management  
Plan*

**Original Plan Adopted October 24, 2000**

(Certified by TWDB February 21, 2001)

**Revisions Adopted**

**December 13, 2005** (Approved by TWDB March 6, 2006)

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**Round 2 DFC/MAG Revisions Adopted**

**January 9, 2019**

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## **I. DISTRICT MISSION**

The mission of the Clearwater Underground Water Conservation District (District) is to develop and implement an efficient, economical and environmentally sound groundwater management program to protect and enhance the water resources of the District.

## **II. PURPOSE OF THE MANAGEMENT PLAN**

Senate Bill 1 (SB 1), enacted by the 75<sup>th</sup> Texas Legislature in 1997, and Senate Bill 2 (SB 2), enacted by the 77<sup>th</sup> Texas Legislature in 2001, established a comprehensive statewide planning process and the actions necessary for districts to manage and conserve the groundwater resources of the state of Texas. These bills required all underground water conservation districts to develop a management plan which defines the water needs and supply within each district and the goals each district will use to manage the underground water in order to meet their needs. In addition, the 79<sup>th</sup> Texas Legislature enacted HB 1763 in 2005 that requires joint planning among districts that are in the same Groundwater Management Area (GMA). These districts must establish the desired future conditions of the aquifers within their respective GMAs. Through this process, the districts will submit the desired future conditions to the executive administrator of the Texas Water Development Board (TWDB) who will provide each district with the managed available groundwater in the management area based on the desired future conditions of the aquifers in the area. Technical information, such as the desired future conditions of the aquifers within the District's jurisdiction and the amount of managed available groundwater from such aquifers is required to be included in the District's management plan and will guide the District's regulatory and management policies.

The District's management plan satisfies the requirements of SB 1, SB 2, HB 1763, the statutory requirements of Texas Water Code (TWC) Chapter 36, and the rules and requirements of the TWDB.

## **III. DISTRICT INFORMATION**

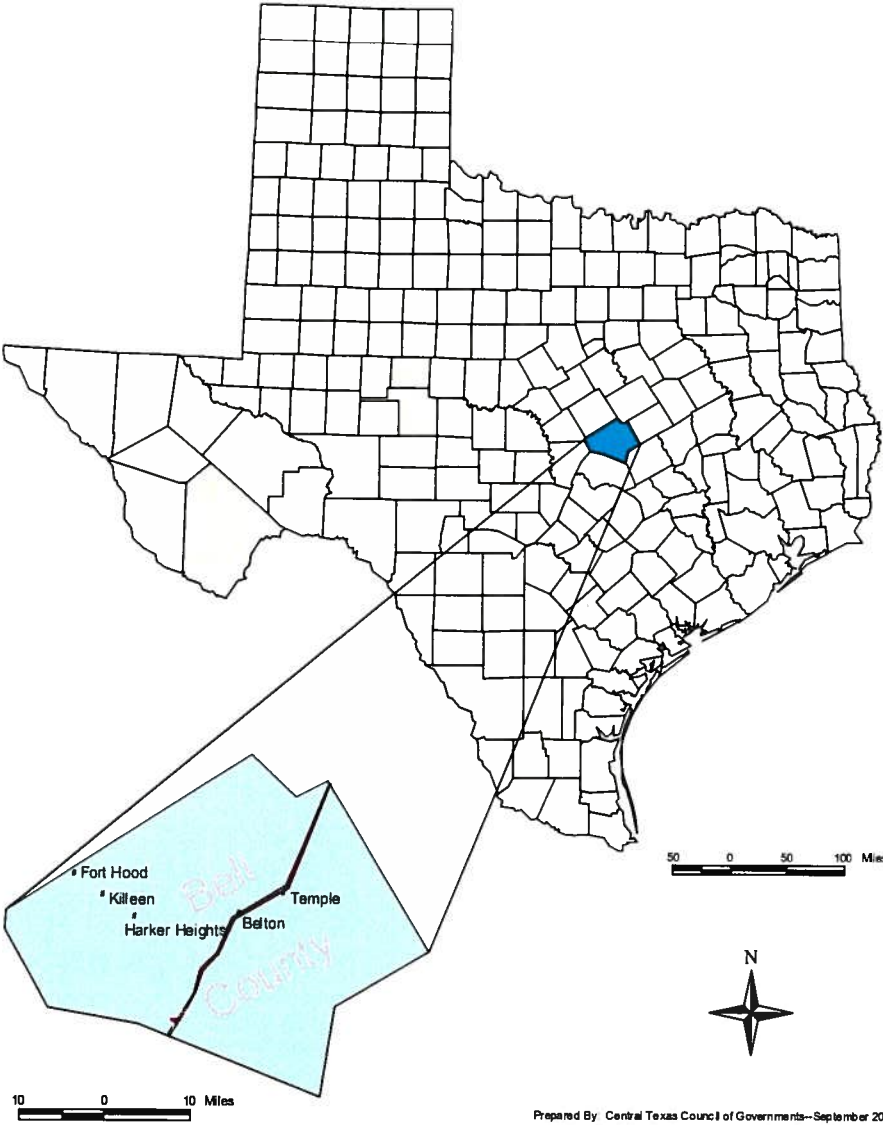
### **A. Creation**

Clearwater Underground Water Conservation District (CUWCD) is a political subdivision of the State of Texas and underground water conservation district created and operating under and by virtue of Article XVI, Section 59, of the Texas Constitution; Texas Water Code Chapter 36; the District's enabling act, Act of May 27, 1989, 71<sup>st</sup> Legislature, Regular Session, Chapter 524 (House Bill 3172), as amended by Act of April 25, 2001, 77<sup>th</sup> Legislature, Regular Session, Chapter 22 (Senate Bill 404), Act of May 7, 2009, 81<sup>st</sup> Legislature, Regular Session, Chapter 64 (Senate Bill 1755), and Act of May 27, 2015, 84<sup>th</sup> Legislature, Regular Session, Chapter 1196, Section 2 (Senate Bill 1336)(omnibus districts bill); and the applicable general laws of the State of Texas; and confirmed by voters of Bell County on August 21, 1999.

The District was formed to protect the underground water resources for the citizens of Bell County. Beyond its enabling legislation, the District is governed primarily by the provisions of Chapter 36 of the Texas Water Code, the District's Management Plan, and the District Rules.

**Exhibit A**

**CLEARWATER UNDERGROUND WATER  
CONSERVATION DISTRICT BOUNDARY**



## **B. Directors**

The Board of Directors consists of five members. These five directors are elected by the voters of Bell County and serve a four year term. CUWCD observes the same precincts as the Bell County Commissioners—four precincts with one at-large position. Director terms are staggered with a two year interval. Directors from Precincts 1 and 3 serve the same term while directors from Precincts 2, 4 and the at-large position serve the same term. Elections are held in November in even numbered years.

## **C. Authority**

CUWCD is governed by the provisions of TWC Chapter 36. CUWCD has the power and authority to undertake various hydrogeological studies, to adopt a management plan, to establish a program for the permitting of certain water wells, and to implement programs to achieve its statutory mandates. CUWCD has rule-making authority to implement its policies and procedures and to help ensure the management of the groundwater resources of Bell County.

## **D. Location and Extent**

The jurisdiction of CUWCD includes all territory located within Bell County (Exhibit A). This area encompasses approximately 1,055 square miles. CUWCD is bounded by McLennan County to the north; Falls and Milam Counties to the east; Williamson County to the south; and Burnet, Lampasas, and Coryell Counties to the west. Bell County has a vibrant economy dominated by the military, medical, manufacturing, and agricultural communities. Based on the 2012 Census of Agriculture, approximately 421,362 of Bell County's 675,200 acres, or 62.4% of this area, is farmland.

## **E. Topography and Drainage**

Bell County is divided into two separate ecological regions by the Balcones Escarpment, which runs from the southeast part of the county to the northwest. The region east of the Balcones Escarpment is the Blackland Prairie while the Grand Prairie is located to the west.

In the Grand Prairie area drainage flows to the Little River and its tributaries. The Leon and Lampasas Rivers and Salado Creek converge at Three Forks.

## **F. Groundwater Resources of Bell County**

Bell County enjoys a variety of groundwater resources. The two primary sources of groundwater in Bell County are the Edwards Balcones Fault Zone (BFZ) Aquifer and the Trinity Aquifer. These aquifers are recognized as major aquifers by the TWDB. The Edwards (BFZ) Aquifer is the source of Salado Springs and is the primary source of water supply for the City of Salado. The Trinity Aquifer consists of three distinct subdivisions. It is the primary source of groundwater in much of western Bell County. The deepest subdivision of the Trinity Aquifer also serves or has served the Cities of Rogers, Holland,

and Bartlett in eastern Bell County. The portion of Bell County east of IH-35 also has a number of groundwater sources that are not widely recognized as aquifers outside of the County but are of vital importance. Approximately 40 percent of the wells registered with the District are located in eastern Bell County and produce water from alluvium, the Lake Waco Formation (Fm), the Kemp Fm, the Ozan Fm, the Pecan Gap Fm, the Austin Chalk, or the Buda Limestone. Additionally there are wells which produce water from the Edwards Fm and associated limestones outside of the recognized limits of the Edwards (BFZ) Aquifer which are recognized by CUWCD as producing water from the Edwards Equivalent Aquifer.

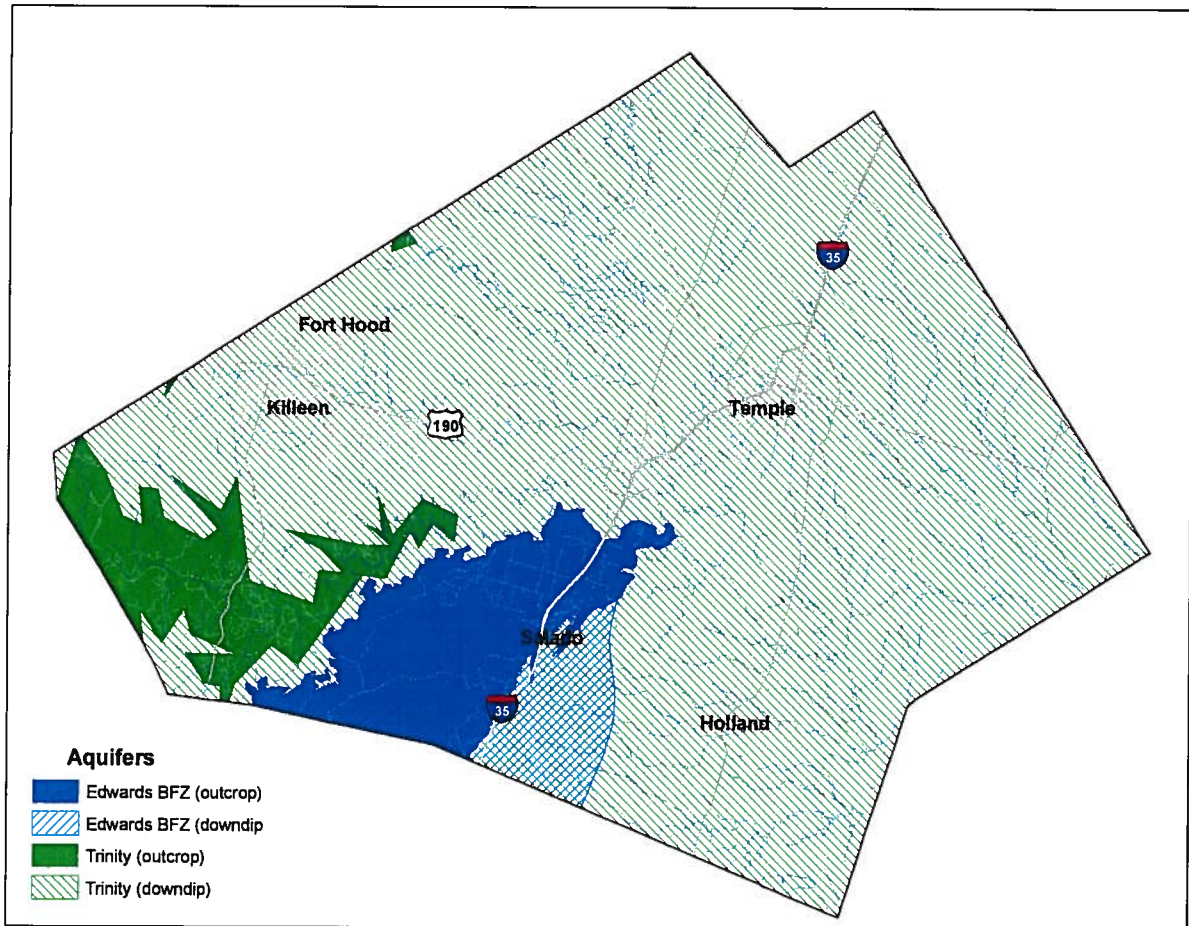
*See Appendix A: Groundwater Resources of Bell County*

*See Appendix B: CUWCD - Bell County Historical Groundwater use (2011-2015).*

*See Appendix C: TWDB Estimated Historical Water Use for Bell County.*

*See Appendix D: TWDB Data Definitions*

### Exhibit B -- Major Aquifers in Bell County



#### **IV. STATEMENT OF GUIDING PRINCIPLES**

CUWCD recognizes that the groundwater resources of Bell County and the Central Texas region are of vital importance and that local management provides essential localized leadership, local discernment, local accountability, based on local oversight, and local expert understanding of the resource. Preservation of this most valuable resource can be managed in a prudent and cost effective manner through education, cooperation, and developing a comprehensive understanding of the aquifers. The greatest threat to CUWCD in achieving its stated mission is the misunderstanding of the resource by elected officials, property owners, and water users. Scientific understanding can support localized management of the groundwater resources, if the district continues to invest in science based research to bolster understanding of local conditions. CUWCD's management plan is intended to serve as a tool to focus the thoughts and actions of those given the responsibility for the execution of the District's activities.

#### **V. CRITERIA FOR PLAN APPROVAL**

##### **A. Planning Horizon**

The time period for this plan is five years from the date of approval by the executive administrator or, if appealed, on approval by the TWDB. The original management plan was certified by the TWDB in February 2001. The District's Board of Directors adopted a revised groundwater management plan on December 13, 2005 and approved by TWDB in March 2006. This plan was revised and amended by the Board of Directors on February 8, 2011 and approved by TWDB April 13, 2011, will expire on April 13, 2016. The current plan was revised and amended by the Board of Directors on January 13, 2016 and approved by TWDB February 19, 2016 and will expire on February 19, 2021. The current plan is being amended for the sole purpose of incorporating the language of the second round of joint planning by GMA 8, effective December 12, 2018. This plan is being submitted as part of the next five-year review for final approval by TWDB Executive Administrator 60 days and re-adoption process as required by TWC 36.1072(e). This management plan will remain in effect until a revised management plan is approved by the Executive Administrator or the TWDB. The Plan shall be reviewed (annually), and updated and readopted in accordance with the requirements of the Texas Water Code and remain effective for five years from the approval date by the Executive Administrator.

##### **B. Board Resolution**

*Copy of the Clearwater Underground Water Conservation District resolution adopting the plan.*

A copy of the Clearwater Underground Water Conservation District resolution adopting the plan is located. *See Appendix E: CUWCD Resolution*

##### **C. Plan Adoption**

*Evidence that the plan was adopted after notice and hearing.*



Public notices documenting that the plan was adopted following appropriate public meetings and hearings are located. *See Appendix F: CUWCD Notice of Public Hearing*

**D. Coordination with Surface Water Management Entities**

*Evidence that following notice and hearing the District coordinated in the development of its management plan with (BRA) surface water management entities.*

CUWCD reference letter documenting transmitting a copy of this plan to surface water management entities after adoption of the plan. *See Appendix G: Notice to BRA Surface Water Management Entities.*

**VI. ESTIMATES OF TECHNICAL INFORMATION REQUIRED BY TEXAS WATER CODE CHAPTER 36.**

**A. Modeled available groundwater in the district based on the desired future condition established**

Modeled available groundwater is defined in TWC §36.001 as the amount of water the Executive Administrator determines may be produced on an average annual basis to achieve a desired future condition established under section 36.108. The desired future condition of the aquifer may only be determined through joint planning with other groundwater conservation districts (GCDs) in the same groundwater management area (GMA) as required by the 79<sup>th</sup> Legislature with the passage of HB 1763 into law. The District is located in GMA 8. The GCDs of GMA 8 have completed the joint planning process to determine the desired future condition of the aquifers in the GMA.

To determine the desired future conditions, the District conducted a series of simulations using the TWDB's Groundwater Availability Models (GAMs) for the Northern Edwards (BFZ) and the Northern Trinity/Woodbine Aquifers. Each series of GAM simulations was conducted by iteratively applying varying amounts of simulated groundwater pumping from the aquifer over a predictive period that included a simulated repeat of the drought of record. Pumping was increased until the amount of pumping that could be sustained by the aquifer without impairing the aquifer conditions selected for consideration as the indicator of the aquifer desired future condition was identified.

*See Appendix H: TWDB Map of the GMA boundaries*

**1. Edwards (BFZ) Aquifer**

**a. Desired Future Conditions**

The desired future condition of the Edwards (BFZ) Aquifer is based on maintaining Salado Spring discharge into Salado Creek during a repeat of conditions similar to the 1950's drought of record. Under the drought of record conditions, a spring discharge of 200 acre-feet per month is preferred and 100 acre-feet per month is the minimum acceptable spring flow.

**b. Modeled Available Groundwater**

The modeled available groundwater value for the Edwards (BFZ) Aquifer in Bell County, as given in TWDB GAM Run 10-065 MAG, is 6,469 acre-feet per year, and is based on the desired future condition discussed above. CUWCD estimates that by year 2070, exempt use of the Edwards (BFZ) Aquifer may reach approximately 825 acre-feet per year and that volume of water is allocated for exempt well users on an annual basis. This leaves approximately **5,644 acre-feet per year as the volume of groundwater available for permitting in the Edwards (BFZ) aquifer.** See Appendix I: TWDB GAM Run 10-065 MAG

## 2. Trinity Aquifer

### a. Desired Future Conditions

There are three recognized subdivisions in the Trinity Aquifer: the Upper, Middle and Lower Trinity Aquifers. In Bell County the three subdivisions of the Trinity Aquifer are made up of several geologic units. The geologic units are: the Paluxy Sand; the Glen Rose Limestone and; the Hensell Sand and Hosston Conglomerate of the Travis Peak Formation. GMA 8 developed a desired future condition for each of the water-bearing geologic units which make up the Trinity Aquifer in Bell County. The desired future conditions for the several water-bearing units describe the amount of water-level draw down which may occur after 60 years when the draw down is averaged across the area of occurrence of the water bearing unit in the District. The amount of draw down described in the desired future conditions is indexed to year 2010 water levels.

- From estimated year 2010 conditions, the average draw down of the Paluxy Aquifer should not exceed approximately 19 feet after 60 years.
- From estimated year 2010 conditions, the average draw down of the Glen Rose Aquifer should not exceed approximately 83 feet after 60 years.
- From estimated year 2010 conditions, the average draw down of the Hensell Aquifer should not exceed approximately 137 feet after 60 years.
- From estimated year 2010 conditions, the average draw down of the Hosston Aquifer should not exceed approximately 330 feet after 60 years.

For the purpose of managing groundwater in the District, CUWCD groups the water-bearing geologic units into the three Trinity Aquifer subdivisions as follows: the Upper Trinity Aquifer (Paluxy Sand + Glen Rose Limestone); the Middle Trinity Aquifer (Hensell Sand); and the Lower Trinity Aquifer (Hosston Conglomerate).

### b. Modeled Available Groundwater 2020

The total of modeled available groundwater values for the Trinity Aquifer in Bell County, as given in GAM Run 17-029 MAG is 9,266acre-feet per year which is based on the amounts of groundwater that could be pumped while maintaining the desired future conditions in each water-bearing geologic unit discussed above. CUWCD estimates that by year 2070, exempt use of the Trinity Aquifer may reach approximately 1,419 acre-feet per year and that volume of water is allocated for exempt well users on an annual basis. This leaves approximately **7,847acre-feet**

**per year as the volume of groundwater available for permitting in the Trinity Aquifer.**

The modeled available groundwater values of the several water-bearing geologic units of the Trinity Aquifer in Bell County, as given in TWDB GAM Run 17-029 MAG, are as follows:

- a. Paluxy – 0 ac-ft per year
- b. Glen Rose – 974 ac-ft per year
- c. Hensell – 1,099 ac-ft per year
- d. Hosston – 7,193 ac-ft per year

The modeled available groundwater values are for 2020, for a full listing of values for every year, please refer to the MAG reports in Appendices I and J. CUWCD intends through its rules to regulate the Trinity Aquifer within the District, however, at some time in the future and within the duration of the effectiveness of this plan, CUWCD may consider management of the Trinity Aquifer within the District by aquifer subdivision or geologic water-bearing unit, if determined appropriate. If management by subdivision or geologic unit is implemented through the District's rules, the modeled available groundwater values for each Trinity Aquifer subdivision or geologic water-bearing unit will require a separate allocation of water for exempt well use. *See Appendix J: TWDB GAM Run 17-029 MAG*

**3. Other Water Bearing Formations**

Other groundwater sources in Bell County include Alluvium, the Austin Chalk, the Buda Limestone, the Edwards Group and equivalent rocks outside the recognized bounds of the Edwards (BFZ) Aquifer (Edwards Equivalent Aquifer), the Kemp Fm., the Lake Waco Fm., the Ozan Fm., and the Pecan Gap Fm. These sources of groundwater produce limited water supply in limited areas in the District. GMA 8 did not find these aquifers relevant for planning purposes at the present time or develop desired future conditions for them; as a result there are no modeled available groundwater values for these sources of groundwater. *See Appendix A* for a more detailed discussion of these water bearing formations.

**B. Amount of groundwater being used within the district on an annual basis.**

The amount of groundwater used in Bell County from 2011 to 2015 is shown in the *Appendix B*. Data from 2000-2013 is provided by the Texas Water Development Board from their Water Use Survey database, *Appendix C*. The CUWCD data, *Appendix B*, does distinguish between exempt and non-exempt wells. Exempt wells are wells that are used for domestic use or livestock watering (including certain additional uses defined in State law) and not capable of producing more than approximately 17 gallons per minute. Groundwater use data for 2011 through 2015 is provided from the District's records. The District began registering wells in February 2002 and began recording production from non-exempt wells during 2003. At the end of September 2015, approximately 5,117 wells were registered. Although CUWCD has made considerable progress in registering wells,

it is likely there are still 1-2% of wells in Bell County that are not registered, and are therefore not considered in *Appendix B*. The District requires monthly production reports for all Classification 2 non-exempt wells (commercial). Classification 1 non-exempt wells are wells that would otherwise be considered exempt but are located on a tract of land of less than 10 acres and greater than 2 acres subdivided after March 1, 2004. Production reports are not required for Classification 1 wells; however, production cannot exceed 25,000 gallons per day. In 2004, the District began estimating production from exempt wells. See *Appendix B: CUWCD - Bell County Historical Groundwater Use (2011-2015)*

**C. Annual amount of recharge from precipitation to the groundwater resources within the district.**

The estimates of the annual amount of recharge to the groundwater resources of the District that are recognized as Major Aquifers by TWDB are based on the GAM simulations provided by TWDB to the District for use in this plan. The District has made no estimate of the amount of annual recharge to the local sources of groundwater in the District.

1. Edwards (BFZ) Aquifer Recharge 27,565 acre-feet per year
2. Trinity Aquifer Recharge 2,816 acre-feet per year

*Estimate source: TWDB GAM Run 15-003; November 24, 2015*

**D. For each aquifer, annual volume of water that discharges from the aquifer to springs and any surface water bodies, including lakes, streams, and rivers.**

The estimates of the annual amount of water discharged to surface water systems by the groundwater resources of the District recognized as Major Aquifers by TWDB are based on the GAM simulations provided by TWDB to the District for use in this plan. The District has made no estimate of the amount of the annual discharge to surface water systems by the minor sources of groundwater in the District.

1. Edwards (BFZ) Aquifer 27,556 acre-feet per year
2. Trinity Aquifer 11,131 acre-feet per year

*Estimate source: TWDB GAM Run 15-003; November 24, 2015*

**E. Annual volume of flow into and out of the district within each aquifer and between aquifers in the district, if a groundwater availability model is available**

There are two aquifers in the District for which a TWDB GAM is available; the Trinity and the Edwards (BFZ) Aquifers. The estimates of the amount of water flowing into and out of the District within each aquifer and between aquifers in the District are based on the GAM simulations provided by TWDB to the District for use in this plan.

1. Edwards (BFZ) Aquifer

<u>Flow into the aquifer within the District:</u>	5,853 acre-feet/year
<u>Flow out of the aquifer in the District:</u>	1,090 acre-feet/year
<u>Net flow out of the aquifer to overlying units in the District:</u>	121 acre-feet/year

## 2. Trinity Aquifer

<u>Flow into the aquifer within the District:</u>	7,230 acre-feet/year
<u>Flow out of the aquifer within the District:</u>	5,659 acre-feet/year
<u>Net flow into the aquifer from the overlying Washita-Fredericksburg Confining Unit in the District:</u>	5,587 acre-feet/year

*Estimate source: TWDB GAM Run 15-003; November 24, 2015*

### **F. Projected surface water supply in the district, according to the most recently adopted state water plan.**

The most recently adopted state water plan is the 2012 State Water Plan. The 2012 State Water Plan indicates a projected surface water supply for Bell County of 98,187 acre-feet/year for year 2060.

Two major water reservoirs located in Bell County are Lake Belton and Lake Stillhouse Hollow. The 2011 Brazos G Initially Prepared Regional Water Plan (*Appendix L: Table 3.1-1, Major Reservoirs of the Brazos River Basin*) identifies 100,257 acre-feet/year as the authorized diversion, or permitted yield, from Lake Belton, and 67,768 acre-feet/year for Lake Stillhouse Hollow. This provides a total yield of 168,025 acre-feet/year for the two lakes. Currently, the Brazos River Authority has under contract approximately 113,906 acre-feet/year to Bell County entities. The US Corps of Engineers is the owner and operator of Lakes Belton and Stillhouse Hollow. The Brazos River Authority manages water rights in both lakes. The Department of the Army (Fort Hood) also manages the water rights from Lake Belton.

*Source Appendix C: TWDB 2012 State Water Plan Datasets for Bell County (p. 4-6)*

### **G. Projected total demand for water in the district according to the most recently adopted state water plan.**

The most recently adopted state water plan is the 2012 State Water Plan. The 2012 State Water Plan indicates a projected total water demand for Bell County of 63,783 acre-feet/year for year 2010. The projections are from year 2010 to 2060 and include demands that may be met by water from either or both surface water and groundwater. District records indicate that actual groundwater usage in Bell County during year 2011 by the

Water Utility Groups totaled 3,655.52 acre-feet or approximately 5.7% of the County's projected 2010 total demand for water in the 2012 State Water Plan.

*Source Appendix C: TWDB 2012 State Water Plan Datasets for Bell County (page 7)*

## **VII. CONSIDER THE WATER SUPPLY NEEDS AND WATER MANAGEMENT STRATEGIES INCLUDED IN THE ADOPTED STATE WATER PLAN.**

The most recently adopted state water plan is the 2012 State Water Plan. In the 2012 State Water Plan, water needs were identified for eight Water User Groups (WUGs) in Bell County. Water needs are identified when the projected water demand of a WUG exceeds the projected water supplies of the WUG, *Appendix C*. Positive values given in the tables indicate a water surplus and negative values (expressed as values with a “ – “ symbol) indicate a water need.

In the 2012 State Water Plan thirteen water management strategies (WMSs) were recommended for the eleven Bell County WUGs with identified water needs. Two of the WMSs involved conservation of existing water supplies. Each of the remaining eight recommended WMSs involve the redistribution and/or increase of surface water supplies of the respective WUGs. The City of Temple has been identified as a WUG with the need for an increase in surface water treatment capacity in the Regional Water Planning process. There is one conjunctive use strategy for Chisholm Trail SUD to increase groundwater with surface water based on the WMS, yet Chisholm Trail SUD has no groundwater wells in Bell County with no delivery of public water supply to the 65,000 acres of their respective CCN that lies in Bell County. This strategy is recommended in the 2012 State Water plan but does not supply or enhance the WUGs in Bell County who serve in other counties with conjunctive use of groundwater and surface water from Bell County. The desired future conditions and amounts of groundwater available for annual use in modeled available groundwater values for the Edwards (BFZ) and Trinity Aquifers in the District will not prevent the implementation of any recommended WMS or restrict the amount of groundwater considered available in the 2012 State Water Plan.

*Source Appendix C: TWDB 2012 State Water Plan Datasets for Bell County (page 8)*

### **A. Water Shortages**

Of the 30 Bell County WUGs identified in the 2012 State Water Plan, seven were projected to have water shortages by the year 2060. The projected shortage of water for these seven users ranges from approximately 243 acre-feet in 2010 to approximately 10,943 acre-feet/year in 2060. Three of these users use only surface water (City of Temple; City of Morgan's Point Resort, Steam Electric Power), two use a mixture of groundwater and surface water (Bell-Milam-Falls WSC; City of Little River-Academy), and two use only groundwater (City of Bartlett, Jarrell-Schwertner WSC). The source of groundwater for these users is identified as the Trinity Aquifer and the Edwards (BFZ) Aquifer. Some of the management strategies involve purchasing additional surface water, implementing

conservation measures, direct reuse and groundwater from the Carrizo-Wilcox Aquifer in Burleson County. Additional use of groundwater from the Trinity and Edwards BFZ Aquifers within CUWCD's jurisdiction have not been identified as a management strategy. Jarrell-Schwertner WSC's service area includes southern Bell County and northern Williamson County. The State Water Plan identifies them as a water user in Williamson County. In the 2012 Brazos G Regional Water Plan, by the year 2060 they are projected to have a shortage of water of 140 acre-feet/year. Their water supply is groundwater from the Edwards (BFZ) Aquifer. Their recommended management strategies include implementing conservation measures and purchasing surface water. Additional use of groundwater in Bell County is not identified as part of the management strategies. Through participation in a local water supply planning initiative, Jarrell-Schwertner WSC is participating in the Lake Granger Conjunctive Use Project.

*Source Appendix C: TWDB 2012 State Water Plan Datasets for Bell County (page 8)*

## **B. Water Surplus**

Twenty two of the Water User Groups identified in the Brazos G Regional Water Plan are projected to have surplus water through the year 2060. Four of these are identified as using both surface water and groundwater (East Bell WSC; Moffat WSC; Salado WSC; City of Troy). With the exception of Salado WSC, the source of groundwater is identified as the Trinity Aquifer. Salado WSC uses water from the Edwards (BFZ) Aquifer. However, District records indicate six others also use or have the potential to use groundwater (City of Holland; Pendleton WSC; City of Rogers; Mining; Irrigation; Livestock). Since these users are projected to have a surplus of water or no projected needs, no changes in water supply are recommended.

*Source Appendix C: TWDB 2012 State Water Plan Datasets for Bell County (page 9-10)*

## **VII. MANAGEMENT OF GROUNDWATER SUPPLIES**

TWC Section 36.0015 states that groundwater conservation districts (GCDs) are the state's preferred method of groundwater management and establishes that GCDs will manage groundwater resources through rules developed and implemented in accordance with TWC Chapter 36. Chapter 36 gives directives to GCDs and the statutory authority to carry out such directives, so that GCDs are provided the proper tools to protect and manage the groundwater resources within their boundaries.

CUWCD will manage the supply of groundwater within the District in order to conserve the groundwater resources while seeking to maintain the economic viability of all groundwater user groups - public and private. In consideration of the economic and cultural activities occurring within the District, CUWCD will identify and engage in such activities and practices which, if implemented, would result in a reduction of groundwater use. The existing observation network of groundwater wells will be used to monitor the changing conditions of the groundwater resources within the District. If necessary, the observation network may be expanded.

The regulatory tools granted to GCDs by TWC Chapter 36 enable GCD's to preserve historic and existing users of groundwater. CUWCD protects historic and existing users by granting such groundwater users historic and existing use permits that have priority over operating permits. TWC Chapter 36 also allows GCDs to establish management zones within an aquifer or aquifer subdivision. The District's rules provide for the designation of management areas as needed to better manage and regulate the groundwater resources of Bell County.

CUWCD may deny a water well drilling permit or limit groundwater withdrawals in accordance with the requirements stated in the rules of the District. In making a determination to deny a permit or limit groundwater withdrawals, the District will consider criteria identified in TWC Section 36.113.

In accordance with CUWCD's mission of protecting the groundwater resources of Bell County, the District may require reduction of groundwater withdrawals to amounts that will not cause harm to the aquifer when considering the desired future condition of the District's aquifers and the amount of modeled available groundwater within the District. To achieve this purpose, the District may, at the discretion of the Board, amend or revoke any permits after notice and hearing. The determination to seek the amendment or revocation of a permit by the District will be based on aquifer conditions as observed by the District. The District will enforce the terms and conditions of permits and the rules of the District by injunction or other appropriate relief in a court of competent jurisdiction as provided for in TWC §36.102.

A contingency plan to cope with the effects of water supply deficits due to climatic or other conditions may be developed by CUWCD and adopted by the Board after notice and hearing. In developing the contingency plan, CUWCD will consider the economic effect of conservation measures upon all water resource user groups, the local implications of the extent and effect of changes in water storage conditions, the unique hydrogeologic conditions of the aquifers within the District, and the appropriate conditions under which the contingency plan will be implemented. CUWCD will evaluate the groundwater resources available within the District and determine the effectiveness of regulatory or conservation measures. A public or private user may appeal to the Board for discretion in enforcement of the provisions of the water supply deficit contingency plan on grounds of adverse economic hardship or unique local conditions. The exercise of said discretion by the Board shall not be construed as limiting the power of the Board.

## **IX. ACTIONS, PROCEDURES, PERFORMANCE AND AVOIDANCE FOR PLAN IMPLEMENTATION**

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

Rules adopted by the District for the permitting of wells and the production of groundwater shall comply with TWC Chapter 36, including §36.113, and the provisions of this management plan. All rules will be adhered to and enforced. The promulgation and enforcement of the rules will be



based on the best technical evidence available to the District. District Rules are available on the District website at <http://www.cuwcd.org/regulatory-program/district-rules/>.

## **X. METHODOLOGY FOR TRACKING DISTRICT PROGRESS IN ACHIEVING MANAGEMENT GOALS.**

CUWCD general manager will prepare a draft Annual Report to the Board of Directors on District performance in regards to achieving management goals and objectives in each fiscal year for consideration for adoption by the Board of Directors. The report will be presented within 180 days following the completion of each fiscal year of the District. The Board will maintain the report on file for public inspection at the District's offices upon adoption.

## **XI. GOALS, MANAGEMENT OBJECTIVES and PERFORMANCE STANDARDS**

The management goals, objectives, and performance standards of the District in the areas specified in 31TAC§356.5 are addressed below.

### **Management Goals**

#### **A. Providing the Most Efficient Use of Groundwater –31TAC 356.52(a)(1)(A) (Implementing TWC §36.1071(a)(1))**

1. **Objective:** Each year, CUWCD will require the registration of all wells within the District's jurisdiction.

**Performance Standard:** Each year, the number of new and existing wells registered with CUWCD will be presented in the District's annual report.

2. **Objective:** Each year, CUWCD will require permits for all non-exempt use of groundwater in the District as defined in the District rules, in accordance with adopted procedures.

**Performance Standard:** Each year, CUWCD will prepare a summary of the number of applications for the drilling of non-exempt wells, the number of applications for the permitted use of groundwater and the disposition of the applications will be presented in the District's annual report.

3. **Objective:** Each year, CUWCD will maintain a groundwater database to include information relating to well location, production volume, and other pertinent information deemed necessary by the District to enable effective monitoring of groundwater in Bell County.

**Performance Standard:**

- a. Each year, CUWCD's annual report will include a status report of the database development.

- b. Each year, CUWCD's annual report will include a summary of changes in the water-level condition of the aquifers included in the district water-level monitoring program.
4. Objective: Each year, CUWCD will disseminate educational information on groundwater through publication of a District newsletter.

Performance Standard: The CUWCD annual report will include a copy of the District newsletter published each year.

**B. Controlling and Preventing Waste of Groundwater –31TAC 356.52(a)(1)(B) ((Implementing TWC §36.1071(a)(2))**

Objective: Each year, CUWCD will disseminate educational information on controlling and preventing the waste of groundwater focusing on water quality protection through at least one classroom or public presentation.

Performance Standard: The CUWCD annual report will include a summary of the District presentation to disseminate educational information on controlling and preventing the waste of groundwater focusing on water quality protection.

**C. Addressing Conjunctive Surface Water Management Issues-31TAC356.52 (a)(1)(D) ((Implementing TWC §36.1071(a)(4))**

Objective: Each year, CUWCD will participate in the regional planning process by attending a minimum of two meetings of the Brazos G Regional Water Planning Group per fiscal year.

Performance Standard: Each year, CUWCD will report attendance at Region G meetings by a representative of the District will be reflected in the District's annual report and will include the number of meetings attended and the dates.

**D. Addressing Natural Resource Issues that Impact the Use and Availability of Groundwater, and which are Impacted by the Use of Groundwater – 31TAC§356.52 (a)(1)(E) ((Implementing TWC §36.1071(a)(5))**

Objective: Each year CUWCD will monitor water quality within the District by obtaining water samples from wells and testing the water quality of at least 15 wells.

Performance Standard: Each year, CUWCD's Annual Report will provide a status report on the number of wells tested and the testing results.

**E. Addressing Drought Conditions – 31TAC356.52 (a)(1)(F) ((Implementing TWC §36.1071(a)(6))**

1. Objective: Each year, CUWCD will monitor drought conditions in the Edwards (BFZ) Aquifer through the process established in the drought management plan for

the Edwards (BFZ) Aquifer adopted by the Board of Directors.

Performance Standard: Each year, a summary of CUWCD's monitoring of drought conditions in the Edwards (BFZ) Aquifer and the implementation of any conservation measures will be provided in the annual report.

2. Objective: Each year, CUWCD will monitor drought conditions in the Trinity Aquifer through the process established in the drought management plan for the Trinity Aquifer adopted by the Board of Directors.

Performance Standard: Each year, a summary of CUWCD's monitoring of drought conditions in the Trinity Aquifer and the implementation of any conservation measures will be provided in the annual report.

**F. Addressing Conservation, Recharge Enhancement, Rainwater Harvesting, Precipitation Enhancement, and Brush Control, Where Appropriate and Cost-Effective – 31TAC356.52 (a)(1)(G) (Implementing TWC §36.1071(a)(7))**

**Conservation**

Objective: Each year, CUWCD will promote conservation by conducting an annual scholastic contest on water conservation or by distributing conservation brochures and literature to the public.

Performance Standard: Each year, CUWCD's annual report will include a summary of the District activity during the year to promote conservation.

**Rainwater Harvesting**

Objective: Each year, CUWCD will promote rainwater harvesting by posting information on rainwater harvesting on the District website.

Performance Standard: Each year, CUWCD's annual report will include a copy of the information on rainwater harvesting that is provided on the District website.

**Brush Control**

Objective: Each year, the District will provide information relating to brush control on the District website.

Performance Standard: Each year, the District annual report will include a copy of the information that has been provided on the District website relating to brush control.

**Recharge Enhancement**

Objective: Each year, CUWCD will provide information relating to recharge enhancement on the District website.

Performance Standard: Each year, CUWCD’s annual report will include a copy of the information that has been provided on the District website relating to recharge enhancement.

**G. Addressing in a Quantitative Manner the Desired Future Conditions of the Groundwater Resources – TWC §36.108, 31TAC 356.52(a)(1)(H), (Implementing TWC §36.1071(a)(8))**

1. Objective – Each year, CUWCD will operate a gauge system on Salado Creek by contract with USGS Water Science Team in Austin Texas, to accurately record the estimates of the discharge from the Edwards (BFZ) Aquifer at the Salado Springs Complex (Big Boiling, Little Bubbly, Critchfield, Benedict and Anderson Springs).

Performance Standard – Each year, CUWCD will include a summary of the monthly average discharge rate of Salado Springs and a discussion of the conservation measures implemented (if any are necessary) to avoid impairment of the Desired Future Conditions for the Edwards (BFZ) Aquifer established by GMA 8, in the Annual Report to the Board of Directors.

2. Objective – Each year, CUWCD will collect at least 5 water-level measurements from the Trinity Aquifer monitor wells located in the District.

Performance Standard

- a. Each year, the CUWCD Annual Report to the Board of Directors will post the water-level measurements collected from the Trinity Aquifer and identify the aquifer subdivision from which the measurement is taken.
- b. Each year, the CUWCD Annual Report to the Board of Directors will include a discussion of the change in water-levels in each Trinity Aquifer subdivision for which a Desired Future Condition is established by GMA 8.
- b. Every five years, the CUWCD Annual Report to the Board of Directors will include a discussion of the change in water-levels in each Trinity Aquifer subdivision for which a Desired Future Condition is established by GMA 8 comparing the change to the incremental time-appropriate change in water-levels indicated by the established Desired Future Condition of the aquifer.

**XII. MANAGEMENT GOALS DETERMINED NOT-APPLICABLE TO THE DISTRICT**

**A. Controlling and Preventing Subsidence 31TAC§356.52(a)(1)(C), TWC §36.1071(a)(6)**

This category of management goal is not applicable to the District because the major water producing formations in the District are composed primarily of competent limestone. The structural competency of the aquifer materials significantly limits the potential for the

occurrence of land surface subsidence in the District.

**B. Precipitation Enhancement – 31TAC§356.52(a)(1)(G), TWC §36.107(a)(7)**

Precipitation enhancement is not an appropriate or cost-effective program for the District at this time because there is not an existing precipitation enhancement program operating in nearby counties in which the District could participate and share costs. The cost of operating a single-county precipitation enhancement program is prohibitive and would require the District to increase taxes in Bell County.

## **APPENDIX A**

## **Groundwater Resources of Bell County**

The Texas Water Development Board classifies groundwater sources as major or minor aquifers. Major aquifers are aquifers that are capable of producing large yields to wells or that produce groundwater over a large area. Minor aquifers are aquifers that may be capable of producing only limited yields to wells or that produce groundwater over a limited area. Many localized sources of groundwater may not be listed as a major or minor aquifer by TWDB. However, TWDB recognizes that whether an aquifer is classified as a major aquifer, a minor aquifer or not included in either list may have no bearing on the local importance of a particular source of groundwater.

### **Major Aquifers**

Two major aquifers are located in Bell County. They are the Trinity and Edwards Balcones Fault Zone (BFZ) aquifers (Exhibit I). Several water supply corporations in Bell County have the ability to utilize groundwater in an emergency situation.

### **Edwards (BFZ) aquifer**

The Edwards (BFZ) aquifer is composed of the Edwards and Associated Limestones. It is located in the southern part of the county and serves as the water supply for the City of Salado and other communities in the area. The outcrop of the aquifer is generally found to the west of I-35 and the down-dip portion of the aquifer is generally to the east of I-35. Recharge to the Edwards aquifer generally is from percolation of storm run-off water in intermittent streams flowing across the outcrop area, as well as direct infiltration of rainfall over the outcrop area. Water quality in the Edwards aquifer is generally high; however, within a relatively short distance east of IH 35 the water quality is rapidly reduced. In Bell County water in the aquifer generally moves from the recharge zone toward natural discharge via the Salado Springs. Within Bell County the availability of groundwater from the Edwards aquifer water is based on maintaining at least a minimum spring flow at Salado Springs during a repeat of the drought of record.

### **Trinity aquifer**

The Trinity aquifer is composed of three subdivisions; the Upper Trinity; the Middle Trinity and the Lower Trinity aquifers. The Upper Trinity aquifer is composed of the Glen Rose Formation; the Middle Trinity aquifer is composed of the Hensell Sand and Cow Creek Limestone; and the Lower Trinity aquifer is composed of the Sligo Limestone and Hosston Sand. The Upper Trinity aquifer crops out in western Bell County and is located generally west of the Edwards aquifer outcrop. The Middle and Lower Trinity aquifers do not outcrop in Bell County. However, the Trinity aquifer underlies all of Bell County. Water quality in the Trinity aquifer is good to moderate in western Bell County. East of IH 35 the water quality in the Upper and Middle Trinity aquifers deteriorates, but the water quality of the Lower Trinity aquifer remains useable for most purposes over most of Bell County. The availability of groundwater from the subdivisions of the Trinity aquifer is based on the management of aquifer pumping to maintain the resulting draw down within acceptable limits. The Trinity aquifer has established management targets for the limit of acceptable draw down.

### **Other Local Sources of Groundwater**

The local sources of groundwater which are not recognized as major or minor aquifers by TWDB are particularly important to Bell County. A significant percentage of the wells registered with CUWCD are completed in formations which are not widely recognized as aquifers but are vitally important sources of water. In the area of Bell County east of IH-35, the majority of wells registered with CUWCD are completed in these water bearing formations. A brief description of these groundwater sources follows:

#### **Alluvium / Terrace deposits**

Alluvium and Terrace deposits consist of sand, gravel, silt and clay deposited by streams. Alluvium deposits are unconsolidated; terrace deposits may have some cement. Alluvium is closely associated with stream channels and terrace deposits are found at higher elevation across the broader floodplain of the stream. Well yields range from low to moderate.

#### **Austin Chalk**

The Austin Chalk consists of nodular chalk and marl with some clay seams. Well yields are typically low with generally fresh water.

#### **Buda Limestone**

The Buda Limestone is a fine grained hard limestone with abundant fossils or fossil fragments. Wells completed in this formation may yield little or no water.

#### **Edwards Equivalent**

The term Edwards Equivalent aquifer refers to the areas in Bell County where the limestones and associated formations of the Edwards Group are productive of generally limited volumes of groundwater and which are located outside of the TWDB recognized bounds of the Edwards (BFZ) aquifer.

#### **Kemp Clay-Marlbrook Marl / Pecan Gap Fm / Ozan Fm**

These three geologic units are distinguishable from each other but consist of similar materials and have similar water bearing properties. They consist of thick beds of marl, chalky marl or calcareous clays containing thin beds of silt. Well yields are typically low with fresh to moderately saline water. These geologic units are all associated as members of the Taylor Marl.

#### **Lake Waco Fm**

The Lake Waco Fm is a member of the Eagle Ford Group. The formation consists of limestone and shale. While not generally recognized as productive of water it appears to produce limited amounts of useable quality water in limited areas of Bell County.



**Exhibit I -- Geologic and Hydrologic Units of Bell County**

<b>Group</b>	<b>Formation</b>	<b>Member</b>	<b>Hydrologic Unit</b>	
N/A	Alluvium		Alluvium and terrace deposits	
	Terrace deposits			
Navarro/Taylor	Kemp Clay / Marlbrook Marl		Kemp Clay/ Marlbrook Marl	
	Pecan Gap Chalk		Pecan Gap Formation	
	Ozan Formation		Ozan Formation	
Austin	Austin Chalk		Austin Chalk	
Eagle Ford	Eagle Ford Shale Lake Waco Fm		Eagle Ford not recognized as a groundwater source; Lake Waco has limited production in limited areas	
Washita	Buda Formation		Buda Limestone	
	Del Rio Clay		Not recognized as a groundwater source	
Edwards	Georgetown		Edwards (Balcones Fault Zone) aquifer	
	Kiamichi			
	Edwards			
	Comanche Peak			
	Walnut		Not recognized as a groundwater source	
Trinity	Paluxy		Upper Trinity aquifer	
	Glen Rose			
	Travis Peak	Hensell Sand		Middle Trinity aquifer
		Cow Creek Limestone		
		Hammett Shale		Not recognized as a groundwater source
		Sligo limestone		Lower Trinity aquifer
		Hosston Sand/Conglomerate		

Source: *Geologic and Hydrologic Units of Bell County, after Duffin and Musick, 1991*

**Exhibit I -- Geologic and Hydrologic Units of Bell County**

<b>Group</b>	<b>Formation</b>	<b>Member</b>	<b>Hydrologic Unit</b>	
N/A	Alluvium		Alluvium and terrace deposits	
	Terrace deposits			
Navarro/Taylor	Kemp Clay / Marlbrook Marl		Kemp Clay/ Marlbrook Marl	
	Pecan Gap Chalk		Pecan Gap Formation	
	Ozan Formation		Ozan Formation	
Austin	Austin Chalk		Austin Chalk	
Eagle Ford	Eagle Ford Shale Lake Waco Fm		Eagle Ford not recognized as a groundwater source; Lake Waco has limited production in limited areas	
Washita	Buda Formation		Buda Limestone	
	Del Rio Clay		Not recognized as a groundwater source	
Edwards	Georgetown		Edwards (Balcones Fault Zone) aquifer	
	Kiamichi			
	Edwards			
	Comanche Peak			
	Walnut		Not recognized as a groundwater source	
Trinity	Paluxy		Upper Trinity aquifer	
	Glen Rose			
	Travis Peak	Hensell Sand		Middle Trinity aquifer
		Cow Creek Limestone		
		Hammett Shale		Not recognized as a groundwater source
		Sligo limestone		Lower Trinity aquifer
		Hosston Sand/Conglomerate		

Source: *Geologic and Hydrologic Units of Bell County, after Duffin and Musick, 1991*

## **APPENDIX B**



# Clearwater Underground Water Conservation District

P.O. Box 1989, Belton, Texas 76513  
 Phone: 254/933-0120 Fax: 254/933-8396  
 www.cuwcd.org

*Every drop counts!*

## 2011-2015 Historical Groundwater Use by WUG's All Values in acre-feet/year (Non-Exempt and Exempt Use Combined)

Table 1

Year	Municipal	Manu	Mining	Steam Electric	Irrigation	Livestock	Domestic	*Other	Total GW USE
2015 YTD	1,929.78	.42	53.69	0	327.56	558.71	1,572.33	16.97	4,444.91
2014	2,091.85	1.03	70.28	0	424.59	529.76	1,572.28	35.96	4,665.11
2013	2,170.80	1.99	31.45	0	504.18	529.36	1,559.81	66.64	4,864.23
2012	2,472.07	1.86	53.35	0	587.42	618.95	1,629.58	36.11	5,399.34
2011	2,762.52	1.08	62.23	0	632.80	818.77	2,345.57	74.55	6,697.52

## 2011-2015 Historical Groundwater Use by Non-Exempt Permittees All Values in acre-feet/year

Table 2

Year	Edwards BFZ Aquifer	Trinity Aquifer Glen Rose Layer	Trinity Aquifer Hensell Layer	Trinity Aquifer Hosston Layer	Other	Total GW USE
2015 YTD	1,521.00	119.90	58.07	521.69	105.25	2,325.91
2014	1,724.71	74.70	87.08	540.87	172.75	2,600.11
2013	1,878.79	105.14	55.25	689.12	70.93	2,799.23
2012	1,998.14	106.77	81.47	772.84	280.12	3,239.34
2011	2,069.93	123.15	92.15	1,005.39	364.90	3,655.52

## 2011-2015 Historical (Estimates) of Groundwater Use by Source Aquifer by Exempt Well Owners All Values in acre-feet/year

Table 3

Year	Edwards BFZ Aquifer	Trinity Aquifer Glen Rose Layer	Trinity Aquifer Hensell Layer	Trinity Aquifer Hosston Layer	Other Formations	Total GW USE
2015	438	327	363	67	924	2,119
2014	385	491	386	52	751	2,065
2013	384	494	384	54	749	2,065
2012	478	495	384	53	750	2,160
2011	468	753	450	68	1303	3,042

## 2011-2015 Historical Groundwater Beneficial Use By Exempt Well Owners All Values in acre-feet/year

Table 4

Year	Domestic Use	Livestock & Poultry	Total GW USE
2015	1,561	558	2,119
2014	1,541	524	2,065
2013	1,542	523	2,065
2012	1,554	606	2,160
2011	2,236	806	3,042

Source: CUWCD annual estimates and CUWCD annual production reports

\*represents production for small business, restaurants, funeral homes, auto repairs,

## **APPENDIX C**

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# Estimated Historical Water Use And 2012 State Water Plan Datasets: Clearwater Underground Water Conservation District

by Stephen Allen  
Texas Water Development Board  
Groundwater Resources Division  
Groundwater Technical Assistance Section  
stephen.allen@twdb.texas.gov  
(512) 463-7317  
October 19, 2015

## ***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 10/19/2015. 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 2014. TWDB staff anticipates the calculation and posting of these estimates at a later date.

### BELL COUNTY

All values are in acre-feet/year

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2013	GW	3,616	0	8	0	1,259	232	5,115
	SW	48,444	608	0	0	1,500	543	51,095
2012	GW	4,046	0	6	0	897	242	5,191
	SW	52,415	601	10	0	1,618	564	55,208
2011	GW	4,619	0	1,052	0	1,474	524	7,669
	SW	56,505	559	1,270	0	1,658	1,221	61,213
2010	GW	3,568	0	1,155	0	1,560	510	6,793
	SW	46,242	521	1,514	0	1,300	1,190	50,767
2009	GW	3,110	0	1,106	0	583	311	5,110
	SW	47,284	652	1,562	0	1,836	727	52,061
2008	GW	2,592	0	1,056	0	63	293	4,004
	SW	49,250	664	1,515	0	1,769	684	53,882
2007	GW	2,158	0	0	0	308	292	2,758
	SW	41,932	706	140	0	2,013	681	45,472
2006	GW	2,489	0	0	0	60	311	2,860
	SW	46,584	818	306	0	2,119	727	50,554
2005	GW	2,182	50	0	0	222	306	2,760
	SW	43,771	490	305	0	2,103	715	47,384
2004	GW	2,305	0	0	0	173	92	2,570
	SW	39,872	542	193	0	749	828	42,184
2003	GW	2,550	0	0	0	454	92	3,096
	SW	42,117	517	456	0	2,553	828	46,471
2002	GW	2,551	0	0	0	611	94	3,256
	SW	42,248	491	552	0	1,241	846	45,378
2001	GW	2,379	0	0	0	564	95	3,038
	SW	41,155	442	578	0	1,144	853	44,172
2000	GW	2,471	0	258	0	558	95	3,382
	SW	41,529	429	30	0	1,121	858	43,967



# Projected Surface Water Supplies

## TWDB 2012 State Water Plan Data

### BELL COUNTY

All values are in acre-feet/year

RWPG	WUG	WUG Basin	Source Name	2010	2020	2030	2040	2050	2060
G	439 WSC	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	1,195	1,195	1,195	1,195	1,195	1,195
G	BELL-MILAM FALLS WSC	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	196	196	196	196	196	196
G	BELTON	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	2,824	3,199	3,542	3,723	3,875	3,920
G	CHISHOLM TRAIL SUD	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	366	366	365	365	364	364
G	COUNTY-OTHER	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	1,088	1,088	1,088	1,088	1,088	1,088
G	DOG RIDGE WSC	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	671	671	671	671	671	671
G	DOG RIDGE WSC	BRAZOS	BRAZOS RIVER AUTHORITY MAIN STEM LAKE/RESERVOIR SYSTEM	1,500	1,500	1,500	1,500	1,500	1,500
G	EAST BELL COUNTY WSC	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	235	235	235	235	235	235
G	ELM CREEK WSC	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	178	215	247	275	293	317
G	FORT HOOD	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	6,144	6,144	6,144	6,144	6,144	6,144

# Projected Surface Water Supplies

## TWDB 2012 State Water Plan Data

RWPG	WUG	WUG Basin	Source Name	2010	2020	2030	2040	2050	2060
G	HARKER HEIGHTS	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	3,904	4,959	5,800	6,507	6,698	6,815
G	HOLLAND	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	258	258	258	258	258	258
G	IRRIGATION	BRAZOS	BRAZOS RIVER COMBINED RUN-OF- RIVER IRRIGATION	5,682	5,712	5,741	5,770	5,799	5,829
G	JARRELL-SCHWERTNER WSC	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	264	264	264	264	264	238
G	KEMPNER WSC	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	1,809	1,781	1,713	1,654	1,667	1,636
G	KILLEEN	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	19,530	25,462	27,985	30,141	32,207	34,432
G	LITTLE RIVER- ACADEMY	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	68	68	68	68	68	68
G	LIVESTOCK	BRAZOS	LIVESTOCK LOCAL SUPPLY	953	953	953	953	953	953
G	MINING	BRAZOS	BRAZOS RIVER COMBINED RUN-OF- RIVER MINING	1	1	2	2	2	2
G	MOFFAT WSC	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	826	854	881	892	901	912
G	MORGANS POINT RESORT	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	291	291	291	291	291	291
G	NOLANVILLE	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	349	359	365	365	369	374

# Projected Surface Water Supplies

## TWDB 2012 State Water Plan Data

RWPG	WUG	WUG Basin	Source Name	2010	2020	2030	2040	2050	2060
G	PENDLETON WSC	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	250	265	273	278	282	287
G	ROGERS	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	368	368	368	368	368	368
G	SALADO WSC	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	1,600	1,600	1,600	1,600	1,600	1,600
G	TEMPLE	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	22,925	22,919	22,912	22,906	22,900	22,840
G	TEMPLE	BRAZOS	LEON RIVER RUN- OF-RIVER	4,524	4,530	4,537	4,543	4,549	4,609
G	TROY	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	124	124	124	124	124	124
G	WEST BELL COUNTY WSC	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	921	921	921	921	921	921
<b>Sum of Projected Surface Water Supplies (acre-feet/year)</b>				<b>79,044</b>	<b>86,498</b>	<b>90,239</b>	<b>93,297</b>	<b>95,782</b>	<b>98,187</b>

# 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.

### BELL COUNTY

All values are in acre-feet/year

RWPG	WUG	WUG Basin	2010	2020	2030	2040	2050	2060
G	439 WSC	BRAZOS	803	909	999	1,057	1,090	1,122
G	CHISHOLM TRAIL SUD	BRAZOS	103	127	149	166	176	183
G	DOG RIDGE WSC	BRAZOS	715	799	876	926	955	982
G	ELM CREEK WSC	BRAZOS	184	206	224	236	243	249
G	BARTLETT	BRAZOS	184	196	206	211	216	220
G	BELTON	BRAZOS	2,824	3,199	3,542	3,723	3,875	3,920
G	FORT HOOD	BRAZOS	4,395	4,337	4,279	4,221	4,182	4,182
G	HARKER HEIGHTS	BRAZOS	3,904	4,959	5,800	6,507	6,698	6,815
G	HOLLAND	BRAZOS	125	121	117	114	111	111
G	KILLEEN	BRAZOS	19,530	25,462	27,985	30,141	32,207	34,432
G	LITTLE RIVER-ACADEMY	BRAZOS	275	285	292	294	297	301
G	MORGANS POINT RESORT	BRAZOS	473	520	563	591	607	623
G	NOLANVILLE	BRAZOS	349	359	365	365	369	374
G	MANUFACTURING	BRAZOS	980	1,085	1,180	1,273	1,355	1,463
G	STEAM ELECTRIC POWER	BRAZOS	0	3,674	4,296	5,053	5,977	7,102
G	ROGERS	BRAZOS	195	191	188	184	181	181
G	SALADO WSC	BRAZOS	1,195	1,334	1,461	1,544	1,594	1,636
G	TEMPLE	BRAZOS	21,033	23,018	25,170	26,892	28,804	30,613
G	TROY	BRAZOS	185	181	176	171	168	168
G	COUNTY-OTHER	BRAZOS	200	187	174	167	161	159
G	MINING	BRAZOS	155	150	147	144	141	139
G	IRRIGATION	BRAZOS	1,656	1,634	1,611	1,591	1,569	1,546
G	LIVESTOCK	BRAZOS	953	953	953	953	953	953
G	BELL-MILAM FALLS WSC	BRAZOS	342	371	398	415	425	435
G	EAST BELL COUNTY WSC	BRAZOS	263	271	276	279	282	286
G	JARRELL-SCHWERTNER WSC	BRAZOS	308	344	376	395	409	420
G	KEMPNER WSC	BRAZOS	1,142	1,297	1,443	1,535	1,591	1,636
G	MOFFAT WSC	BRAZOS	402	430	457	468	477	488
G	PENDLETON WSC	BRAZOS	250	265	273	278	282	287
G	WEST BELL COUNTY WSC	BRAZOS	660	642	623	605	599	599
<b>Sum of Projected Water Demands (acre-feet/year)</b>			<b>63,783</b>	<b>77,506</b>	<b>84,599</b>	<b>90,499</b>	<b>95,994</b>	<b>101,625</b>

# Projected Water Supply Needs

## TWDB 2012 State Water Plan Data

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

### BELL COUNTY

All values are in acre-feet/year

RWPG	WUG	WUG Basin	2010	2020	2030	2040	2050	2060
G	439 WSC	BRAZOS	392	286	196	138	105	73
G	BARTLETT	BRAZOS	-58	-70	-80	-85	-90	-94
G	BELL-MILAM FALLS WSC	BRAZOS	9	-20	-47	-64	-74	-84
G	BELTON	BRAZOS	0	0	0	0	0	0
G	CHISHOLM TRAIL SUD	BRAZOS	278	254	231	214	203	196
G	COUNTY-OTHER	BRAZOS	901	914	927	934	940	942
G	DOG RIDGE WSC	BRAZOS	1,456	1,372	1,295	1,245	1,216	1,189
G	EAST BELL COUNTY WSC	BRAZOS	99	91	86	83	80	76
G	ELM CREEK WSC	BRAZOS	67	82	96	112	123	141
G	FORT HOOD	BRAZOS	1,749	1,807	1,865	1,923	1,962	1,962
G	HARKER HEIGHTS	BRAZOS	0	0	0	0	0	0
G	HOLLAND	BRAZOS	133	137	141	144	147	147
G	IRRIGATION	BRAZOS	4,790	4,842	4,894	4,943	4,994	5,047
G	JARRELL-SCHWERTNER WSC	BRAZOS	-2	-38	-70	-89	-103	-140
G	KEMPNER WSC	BRAZOS	667	484	270	119	76	0
G	KILLEEN	BRAZOS	0	0	0	0	0	0
G	LITTLE RIVER-ACADEMY	BRAZOS	-1	-11	-18	-20	-23	-27
G	LIVESTOCK	BRAZOS	0	0	0	0	0	0
G	MANUFACTURING	BRAZOS	483	378	283	190	108	0
G	MINING	BRAZOS	27	32	36	39	42	44
G	MOFFAT WSC	BRAZOS	562	562	562	562	562	562
G	MORGANS POINT RESORT	BRAZOS	-182	-229	-272	-300	-316	-332
G	NOLANVILLE	BRAZOS	0	0	0	0	0	0
G	PENDLETON WSC	BRAZOS	0	0	0	0	0	0
G	ROGERS	BRAZOS	173	177	180	184	187	187
G	SALADO WSC	BRAZOS	2,415	2,276	2,149	2,066	2,016	1,974
G	STEAM ELECTRIC POWER	BRAZOS	0	-3,674	-4,296	-5,053	-5,977	-7,102
G	TEMPLE	BRAZOS	6,416	4,431	2,279	557	-1,355	-3,164
G	TROY	BRAZOS	29	33	38	43	46	46
G	WEST BELL COUNTY WSC	BRAZOS	261	279	298	316	322	322
<b>Sum of Projected Water Supply Needs (acre-feet/year)</b>			<b>-243</b>	<b>-4,042</b>	<b>-4,783</b>	<b>-5,611</b>	<b>-7,938</b>	<b>-10,943</b>

# Projected Water Management Strategies

## TWDB 2012 State Water Plan Data

### BELL COUNTY

WUG, Basin (RWPG)

All values are in acre-feet/year

Water Management Strategy	Source Name [Origin]	2010	2020	2030	2040	2050	2060
<b>BARTLETT, BRAZOS (G)</b>							
BRA SUPPLY THROUGH THE EWCRWTS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM [RESERVOIR]	90	90	90	90	90	90
MUNICIPAL WATER CONSERVATION	CONSERVATION [BELL]	12	30	25	19	18	18
<b>BELL-MILAM FALLS WSC, BRAZOS (G)</b>							
VOLUNTARY REDISTRIBUTION	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM [RESERVOIR]	0	20	47	64	74	84
<b>CHISHOLM TRAIL SUD, BRAZOS (G)</b>							
GROUNDWATER/SURFACE WATER CONJUNCTIVE USE (LAKE GRANGER AUGMENTATION)	CARRIZO-WILCOX AQUIFER [BURLESON]	0	0	0	0	10	10
<b>HARKER HEIGHTS, BRAZOS (G)</b>							
WASTEWATER REUSE	DIRECT REUSE [BELL]	185	185	185	185	185	185
<b>JARRELL-SCHWERTNER WSC, BRAZOS (G)</b>							
BRA SUPPLY THROUGH THE EWCRWTS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM [RESERVOIR]	0	13	13	13	13	13
MUNICIPAL WATER CONSERVATION	CONSERVATION [WILLIAMSON]	12	73	84	87	107	127
<b>KEMPNER WSC, BRAZOS (G)</b>							
VOLUNTARY REDISTRIBUTION	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM [RESERVOIR]	0	0	0	0	10	10
<b>KILLEEN, BRAZOS (G)</b>							
WASTEWATER REUSE	DIRECT REUSE [BELL]	2,488	2,488	2,488	2,488	2,488	2,488
<b>LITTLE RIVER-ACADEMY, BRAZOS (G)</b>							
VOLUNTARY REDISTRIBUTION	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM [RESERVOIR]	50	50	50	50	50	50

# Projected Water Management Strategies

## TWDB 2012 State Water Plan Data

**WUG, Basin (RWPG)**

All values are in acre-feet/year

Water Management Strategy	Source Name [Origin]	2010	2020	2030	2040	2050	2060
<b>MORGANS POINT RESORT, BRAZOS (G)</b>							
VOLUNTARY REDISTRIBUTION	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM [RESERVOIR]	206	255	300	330	346	363
<b>STEAM ELECTRIC POWER, BRAZOS (G)</b>							
WASTEWATER REUSE	DIRECT REUSE [BELL]	0	8,407	8,407	8,407	8,407	8,407
<b>TEMPLE, BRAZOS (G)</b>							
INCREASE TREATMENT CAPACITY	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM [RESERVOIR]	7,584	7,535	15,330	15,300	15,284	15,267
<b>Sum of Projected Water Management Strategies (acre-feet/year)</b>		<b>10,627</b>	<b>19,146</b>	<b>27,019</b>	<b>27,033</b>	<b>27,082</b>	<b>27,112</b>

## **APPENDIX D**



## Data Definitions\*

### 1. 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.

### 2. 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.

### 3. 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.

### 4. 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.*

**APPENDIX E**

**RESOLUTION  
OF THE BOARD OF DIRECTORS OF THE  
CLEARWATER UNDERGROUND WATER CONSERVATION DISTRICT  
MEETING HELD January 9, 2019**

**A RESOLUTION ADOPTING AMENDED MANAGEMENT PLAN**

**WHEREAS**, Clearwater Underground Water Conservation District is a political subdivision of the State of Texas and underground water conservation district created and operating under and by virtue of Article XVI, Section 59, of the Texas Constitution; Texas Water Code Chapter 36; the District's enabling act, Act of May 27, 1989, 71<sup>st</sup> Legislature, Regular Session, Chapter 524 (House Bill 3172), as amended by Act of April 25, 2001, 77<sup>th</sup> Legislature, Regular Session, Chapter 22 (Senate Bill 404), Act of May 7, 2009, 81<sup>st</sup> Legislature, Regular Session, Chapter 64 (Senate Bill 1755), and Act of May 27, 2015, 84<sup>th</sup> Legislature, Regular Session, Chapter 1196, Section 2 (Senate Bill 1336)(omnibus districts bill); and the applicable general laws of the State of Texas; and confirmed by voters of Bell County in 1999.

**WHEREAS**, under the direction of the Board of Directors, and in accordance with Texas Water Code §§ 36.1071 and 36.1072, Title 31, Chapter 356 of the Texas Administrative Code, and the District's rules, the District has timely undertaken the requisite five-year review of its existing Management Plan, initially adopted by the District's Board on October 24, 2000, and certified by the Texas Water Development Board (the "TWDB") on February 21, 2001, and revised and readopted by the District's Board on December 13, 2005, and certified by TWDB on March 6, 2006; and revised and readopted by the District's Board on February 8, 2011 and certified by TWDB on April 13, 2011, and revised and readopted by the Districts Board on January 13, 2016 and certified by TWDB on February 19, 2016.

**WHEREAS**, in conducting a review of its existing Management Plan, the District and its consultants reviewed, analyzed, and factored in the District's best available data, the groundwater availability modeling information provided by the TWDB, the technical information and estimates required by the TWDB, the Second Round of Desired Future Conditions GMA8 of the aquifers within the District, and the available site-specific information that has previously been provided by the District to the TWDB for review and comment;

**WHEREAS**, the District issued the appropriate notice and held a public hearing to receive public comments on the proposed amendments to the Management Plan at the District's office located at 2180 North Main, Belton, Texas, on January 9, 2019;

**WHEREAS**, the District obtained comments from the TWDB through a preliminary review of the District's Management Plan conducted by TWDB staff, and the District has considered and addressed all such comments in the development of its Management Plan;

**WHEREAS**, the District requested, received, reviewed, and took into consideration comments from the Brazos River Authority during preparation of its Management Plan;

**WHEREAS**, the Board of Directors finds that the Management Plan meets all of the requirements of Chapter 36 of the Texas Water Code, the District's enabling act, Chapter 356, Title 31, Texas Administrative Code, and the District's rules; and

**WHEREAS**, the Board of Directors, upon proper notice and in an open meeting, seeks to readopt its existing Management Plan pursuant to Texas Water Code § 36.1072(e).

**NOW THEREFORE BE IT RESOLVED THAT:**

The above recitals are true and correct;

The Management Plan is hereby readopted with those changes reflected in the proposed, draft Management Plan before the District's Board of Directors on this date, along with those changes agreed upon during deliberation and after formal action on this date by the District's Board of Directors;

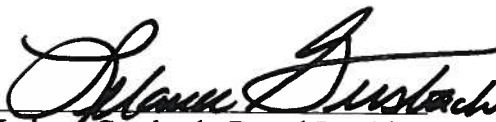
The Board of Directors further instructs the General Manager to compile a final, readopted Management Plan, and file it with the TWDB's Executive Director within 60 calendar days from the date of re-adoption, pursuant to Texas Water Code § 36.1072(e); and

The Board of Directors and General Manager are further authorized to take any and all action necessary to coordinate with the TWDB as may be required in furtherance of TWDB's approval pursuant to the provisions of § 36.1072 of the Texas Water Code.

**AND IT IS SO ORDERED.**

Upon motion duly made by Scott Brooks, and seconded by Director Gary Young and upon discussion, the Board of Directors voted 5 in favor and 0 opposed, 0 abstained, and 0 absent, and the motion thereby PASSED on this 9<sup>th</sup> day of January 2019.

**CLEARWATER UNDERGROUND WATER CONSERVATION DISTRICT**

By:   
Leland Gersbach, Board President

ATTEST:

  
\_\_\_\_\_  
Dirk Aaron, Board Assistant Secretary

## **APPENDIX F**

**CLEARWATER UNDERGROUND WATER CONSERVATION DISTRICT  
NOTICE OF PUBLIC HEARING ON  
PROPOSED ADOPTION OF AMENDMENTS TO DISTRICT  
MANAGEMENT PLAN**

The Clearwater Underground Water Conservation District (CUWCD)) will hold a public hearing on the proposed adoption of amendments to the CUWCD's Groundwater Management Plan on Wednesday, January 9, 2019, at 1:30 p.m. at the District office located at 700 Kennedy Court, Belton, Texas. **The sole purpose of this minor amendment to our existing plan is to incorporate the language of the second round of joint planning by GMA8.** All interested parties are invited to attend.

**PUBLIC HEARING AGENDA:**

1. Call to Order.
2. Summary presentation of the proposed amendments to the CUWCD Management Plan as required by Chapter 36 of the Texas Water Code and Chapter 356 of the Texas Water Development Board's (TWDB) rules contained in Title 30 of the Texas Administrative Code.
3. Public Comment on the Groundwater Management Plan proposed for adoption
4. Adjourn

At the conclusion of the hearing, or any time or date thereafter, the proposed management plan may be adopted in the form presented or as amended based upon comments received from the public, the Texas Water Development Board, District staff, attorneys, geoscientists, or members of the Board of Directors without any additional notice.

Copies of the proposed amended CUWCD Management Plan will be available as of December 13, 2018 at the CUWCD office located at 700 Kennedy Court, Belton, Texas or on the CUWCD's website at [www.cuwcd.org](http://www.cuwcd.org).

The CUWCD is committed to compliance with the Americans with Disabilities Act (ADA). Reasonable accommodations and equal opportunity for effective communications will be provided upon request. Please call 254-933-0120 at least 24 hours in advance if accommodation is needed.

**For more information about the public hearing or CUWCD  
Contact: Dirk Aaron, General Manager, at 254-933-0120.**

FILED FOR RECORD  
2018 DEC 20 P 1:14  
SHERIFF'S OFFICE  
COMMISSIONER'S OFFICE  
BELTON, TEXAS

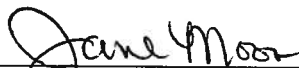
# Publisher's Affidavit

State of Texas  
County of Bell

Before Me, The Undersigned Authority, this day personally appeared Jane Moon after being by me duly sworn, says that she is the Classified Inside Sales Manager of the Temple Daily Telegram, a newspaper published in Bell County, Texas and that the stated advertisement was published in said newspaper on the following date(s):

December 17, 2018

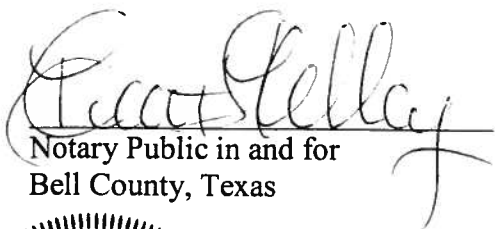
For: Clearwater UWCD  
Ad #: 16639584  
Ad Cost: \$62.25  
Times Published: 1



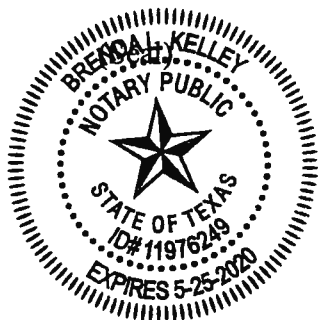
Jane Moon  
Classified Manager Inside Sales

**NOTICE OF PUBLIC HEARING**  
The Clearwater Under-ground Water Conservation District (CUWCD) will hold a public hearing and consider adopting proposed revisions to the District Management Plan at 1:30 p.m., January 9, 2019 at the District headquarters located at 700 Kennedy Court, Belton, Texas. The purpose of this amendment to our existing plan is to incorporate the language of the second round of joint planning by GMA8 and comments related to subsidence. Copies of the revised Management Plan are available for review at the CUWCD office and on the CUWCD website at <http://www.cuwcd.org>. Contact CUWCD at 254-933-0120 for additional information.

Subscribed and sworn to before me,  
this day: January 3, 2019



Brenda Kelley  
Notary Public in and for  
Bell County, Texas



**CROSSWORD**

By THOMAS JOSEPH

**ACROSS**      **DOWN**

- 1 Clumps of grass
- 6 New parents' choices
- 11 Mosque faith
- 12 Rust compound
- 13 Perhaps
- 14 Brink
- 15 Take it easy
- 17 Mouse-spotting cry
- 18 Nevertheless
- 22 "Carpe —"
- 23 Blood component
- 27 Ryan of "Paper Moon"
- 29 Dogpatch fellow
- 30 Submitted
- 32 Sunrise site
- 33 Women's workplace right
- 35 Mouth part
- 38 "E Pluri-bus —"
- 39 Suspect's defense
- 41 Prince of India
- 1 Bob Cratchit's son
- 2 Much of N. Amer.
- 3 Go by air
- 4 Neighbor in the cafeteria
- 5 Lipstick slip
- 6 Short book
- 7 Chopping tool
- 8 Deep mud
- 9 Border for
- 16 Ray-gun sound
- 18 Commo-tions
- 19 Of high quality
- 20 New driver, often
- 21 Artist for the same
- 24 Ginger cookie
- 25 Butte's kin
- 26 Showily preten-tious
- 28 Water and wine, for two
- 31 Convent resident
- 34 Mystiques
- 35 Face card
- 36 Arkin of "Argo"
- 37 Hidden mike
- 40 Hive resident
- 42 Coffee, in slang
- 43 Linking word
- 44 "You there!"

S	T	I	N	G	A	L	I	S	T
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I	R	A	T	E	A	B	H	O	R
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**Saturday's answer**

1	2	3	4	5	6	7	8	9	10
						12			
							14		
			15		16			17	
							21		
22					23			24	25
27				28			29		
30					31			32	
				33				34	

**Houses Unfurnished 14**

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\*Unfurnished 2BR Duplex, 1301 South 43rd. \$600.  
\*Furnished Apartment 1212 South 2nd, \$450. Call 254-541-4562

Belton Schools- Nice 2BR, 1BA, CH&A, W-D connections, shady lot, fenced back yard, water & trash paid. \$750 month, \$500 deposit. 254-760-6160.

WATERFORD COMMONS AREA. 3/2/2. Large family room. Fireplace. Dishwasher. 2606 Alamo Trail, Temple \$1050/\$800. 254-913-8808

104 N B Hwy 95, Academy. 3BR/ 1BA, CA/ CH, stove only, gas/ electric. Rent \$795, Deposit \$397.50. Hegler Real Estate 512-352-8518 ext 203 or Marsha Hegler 512-846-4884

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**Mobile Homes, Lots & Acreage 16**

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**Sport Leases, Lake Property 17**

Hunt with your dog or gilded, Quail/Chukar hunt 40 miles northeast of Austin. Training area. Quail for sale. centxshop.com

**Announcements**

**Public Notices & Legals 30**

**NOTICE OF PUBLIC HEARING**

The Clearwater Underground Water Conservation District (CUWCD) will hold a public hearing and consider adopting proposed revisions to the District Management Plan at 1:30 p.m., January 9, 2019 at the District headquarters located at 700 Kennedy Court, Belton, Texas. The purpose of this amendment to our existing plan is to incorporate the language of the second round of joint planning by GMA8 and comments related to sub-sidence. Copies of the revised Management Plan are available for review at the CUWCD office and on the CUWCD website at http://www.cuwcd.org Contact CUWCD at 254-933-0120 for additional information.

**Entertainment & Recreation 32**

**BINGO**

Sponsored by: American Legion Post #133  
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\*\*DOUBLE SESSIONS\*\* Wednesdays and Fridays  
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**General 132**

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**General 132**

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**General 132**

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Experienced CDL driver wanted. Full or part time. Hauling grain around Rosebud. 254-721-0731

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is looking to hire automotive tire/ lube tech. Apply in person 103 Lake Road in Belton, or 603 South First in Temple. Pay based on experience.

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PART-TIME BARTENDER: VFW Post 10377, TABC certified preferred but not necessary. Approximately 20 hrs per wk. Pay DOE. 254-780-2593 after 5pm. Ask for canteen manager.

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**Equipment, Misc. 170**

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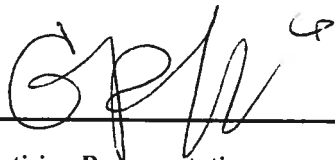
## PUBLISHER'S AFFIDAVIT

THE STATE OF TEXAS

COUNTY OF BELL

Personally appeared before the undersigned authority

Gertrude Peacock who being sworn says that the attached ad for: **CLEARWATER UNDERGROUND** published in the *Killeen Daily Herald* on the following dates to-wit: **DECEMBER 17, 2018** at a cost of **\$42.90**.



Advertising Representative

Subscribed and sworn before me on **DECEMBER 17, 2018**

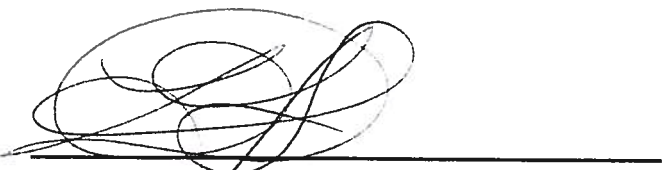


### 127 Legal Notices

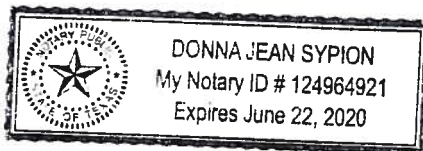
**NOTICE OF PUBLIC HEARING**

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(Legal Notice published in the *Killeen Daily Herald* on December 17, 2018.)



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## 127 Legal Notices

**NOTICE OF PUBLIC HEARING**

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(Legal Notice published in the Killeen Daily Herald on December 17, 2018.)

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### 184 Computer Office Equip.

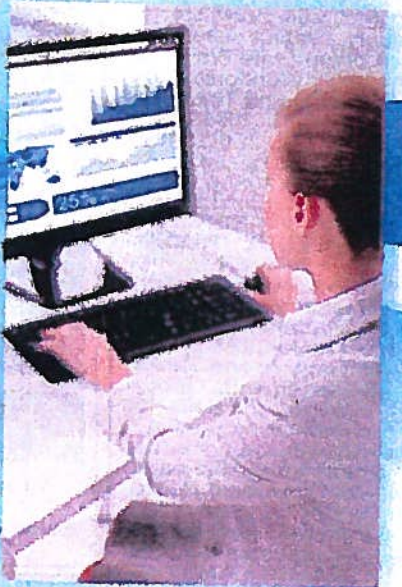
# N O W H I R I N G

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## **APPENDIX G**



Every drop counts!

## Clearwater Underground Water Conservation District

P.O. Box 1989, Belton, Texas 76513

Phone: 254/933-0120 Fax: 254/933-8396

[www.cuwcd.org](http://www.cuwcd.org)

**Leland Gersbach, President**

**Vacant**

**Scott A. Brooks**

**David Cole**

**C. Gary Young**

December 17, 2018

David Collinsworth, General Manager [david.Collinsworth@brazos.org](mailto:david.Collinsworth@brazos.org)

(via email)

Brazos River Authority

P.O. Box 7555

Waco, TX 76714-7555

Dear Mr. Collinsworth,

The Clearwater Underground Water Conservation District (CUWCD) is conducting a review of its management plan as required by Texas Water Code (TWC) Chapter 36.1072(e). Minor amendments to the desired future conditions sections are the only revisions proposed at this time. Texas Water Development Board staff have also provided a pre-review of the changes thus are in concurrence with the District. Current plan can be viewed at: [view CUWCD-MPlan\\_13JAN16.pdf](#)

One major component of the plan is evidence of its coordination with surface water management entities pursuant to TWC 36.1071 (a):

*Evidence that following notice and hearing the Clearwater Underground Water Conservation District coordinated in the development of its Management plan with surface water management entities.*

Attached you will find a draft copy of the revised management plan and notice that the District is conducting a public hearing on the plan on January 9, 2019 at 1:30 p.m., at our District Headquarters located at 700 Kennedy Court in Belton. We are looking forward to your input regarding this plan. After your review, please provide us with a letter confirming your review of the revised plan and any comments or concerns you may have.

Sincerely,

Dirk Aaron

General Manager

Clearwater UWCD

Email copy to: Brad Brunett ([bradb@brazos.org](mailto:bradb@brazos.org))

Stephen Allen [stephen.allen@twdb.texas.gov](mailto:stephen.allen@twdb.texas.gov)

Clearwater Underground Water Conservation District (CUWCD) is a political subdivision of the State of Texas and underground water conservation district created and operating under and by virtue of Article XVI, Section 59, of the Texas Constitution; Texas Water Code Chapter 36; the District's enabling act, Act of May 27, 1989, 71<sup>st</sup> Legislature, Regular Session, Chapter 524 (House Bill 3172), as amended by Act of April 25, 2001, 77<sup>th</sup> Legislature, Regular Session, Chapter 22 (Senate Bill 404), Act of May 7, 2009, 81<sup>st</sup> Legislature, Regular Session, Chapter 64 (Senate Bill 1755), and Act of May 27, 2015, 84<sup>th</sup> Legislature, Regular Session, Chapter 1196, Section 2 (Senate Bill 1336)(omnibus districts bill); and the applicable general laws of the State of Texas; and confirmed by voters of Bell County on August 21, 1999.



**From:** [Dirk Aaron](#)  
**To:** [David Collinsworth](#)  
**Cc:** "[stephen.allen@twdb.texas.gov](mailto:stephen.allen@twdb.texas.gov)"; [Brad Brunett \(bradb@brazos.org\)](mailto:bradb@brazos.org); [Scott Brooks \(sbrooks@cuwcd.org\)](mailto:sbrooks@cuwcd.org); [David Cole \(rcole26@hotmail.com\)](mailto:rcole26@hotmail.com); [G Young](#); [L Gersbach](#); [Tristin Smith](#); [Shelly Chapman](#)  
**Bcc:** [Leland Gersbach](#)  
**Subject:** CUWCD notice of intent to amend Management Plan  
**Date:** Monday, December 17, 2018 10:36:00 AM  
**Attachments:** [image001.png](#)  
[CUWCD\\_Agenda\\_MP\\_Public\\_Hearing\\_09JAN19.pdf](#)  
[CUWCD notice to BRA\\_17DEC18.pdf](#)  
[draft\\_CUWCD\\_Management\\_Plan\\_update03Dec18.pdf](#)  
**Importance:** High

---

December 17, 2018

David Collinsworth, General Manager [david.Collinsworth@brazos.org](mailto:david.Collinsworth@brazos.org) (via email)  
Brazos River Authority  
P.O. Box 7555  
Waco, TX 76714-7555

Dear Mr. Collinsworth,

The Clearwater Underground Water Conservation District (CUWCD) is conducting a review of its management plan as required by Texas Water Code (TWC) Chapter 36.1072(e). Minor amendments to the desired future conditions sections are the only revisions proposed at this time. Texas Water Development Board staff have also provided a pre-review of the changes thus are in concurrence with the District.

One major component of the plan is evidence of its coordination with surface water management entities pursuant to TWC 36.1071 (a):

Evidence that following notice and hearing the Clearwater Underground Water Conservation District coordinated in the development of its Management plan with surface water management entities.

Attached you will find a draft copy of the revised management plan with updated section J (TWDB GR17-029 GMA8 \_MAG Run) and notice that the District is conducting a public hearing on the plan on January 13, 2016 at 1:30 p.m., at our District Headquarters located at 700 Kennedy Court in Belton. We are looking forward to your input regarding this plan. After your review, please provide us with a letter confirming your review of the revised plan and any comments or concerns you may have.

Dirk Aaron  
General Manager  
Clearwater Underground Water Conservation District  
[daaron@cuwcd.org](mailto:daaron@cuwcd.org)  
<http://www.cuwcd.org>  
254-933-0120 office  
254-534-4047 cell



Brazos River Authority



QUALITY • CONSERVATION • SERVICE

---

January 9, 2019

Dirk Aaron  
General Manager  
Clearwater UWCD  
P.O. Box 1989  
Belton, Texas 76513

Re: Review of Revised Management Plan

Dear Mr. Aaron,

Thank you for the opportunity to review Clearwater Underground Water Conservation District's (CUWCD) revised management plan. The Brazos River Authority (BRA) believes that it is important to continue working together to manage water resources in the basin and to gain a better understanding of the relationships and interactions between surface water and adjacent groundwater sources.

The BRA has reviewed the proposed minor amendments to the desired future conditions section of the CUWCD management plan, and we have no comments or concerns with the recommended changes. We look forward to continued dialogue and working together with the CUWCD to manage water resources in our respective areas.

Sincerely,

DAVID COLLINSWORTH  
General Manager/CEO

DC:kld



*Every drop counts!*

**Clearwater Underground Water Conservation District**

P.O. Box 1989, Belton, Texas 76513

Phone: 254/933-0120 Fax: 254/933-8396

[www.cuwcd.org](http://www.cuwcd.org)

*Leland Gersbach, President*

*David Cole, Vice President*

*C. Gary Young, Secretary*

*Jody Williams*

*Scott A. Brooks*

January 10, 2019

TO: Surface Water Management Entities

(via email)

RE: Revised Management Plan

Dear Manager:

Attached is the revised District Management Plan for the Clearwater Underground Water Conservation District (CUWCD). As required in Texas Water Code §36.1072, we have conducted a five year review and update of our Management Plan. One component of the plan is evidence of its coordination with surface water management entities pursuant to TWC 36.1071 (a):

*Evidence that following notice and hearing the Clearwater Underground Water Conservation District coordinated in the development of its Management plan with surface water management entities.*

The Directors of the CUWCD approved the revised Management Plan on January 9, 2019 and are submitting it for review and approval by the Texas Water Development Board.

Please feel free to contact me if you have any questions regarding the Management Plan or need additional information.

Sincerely,

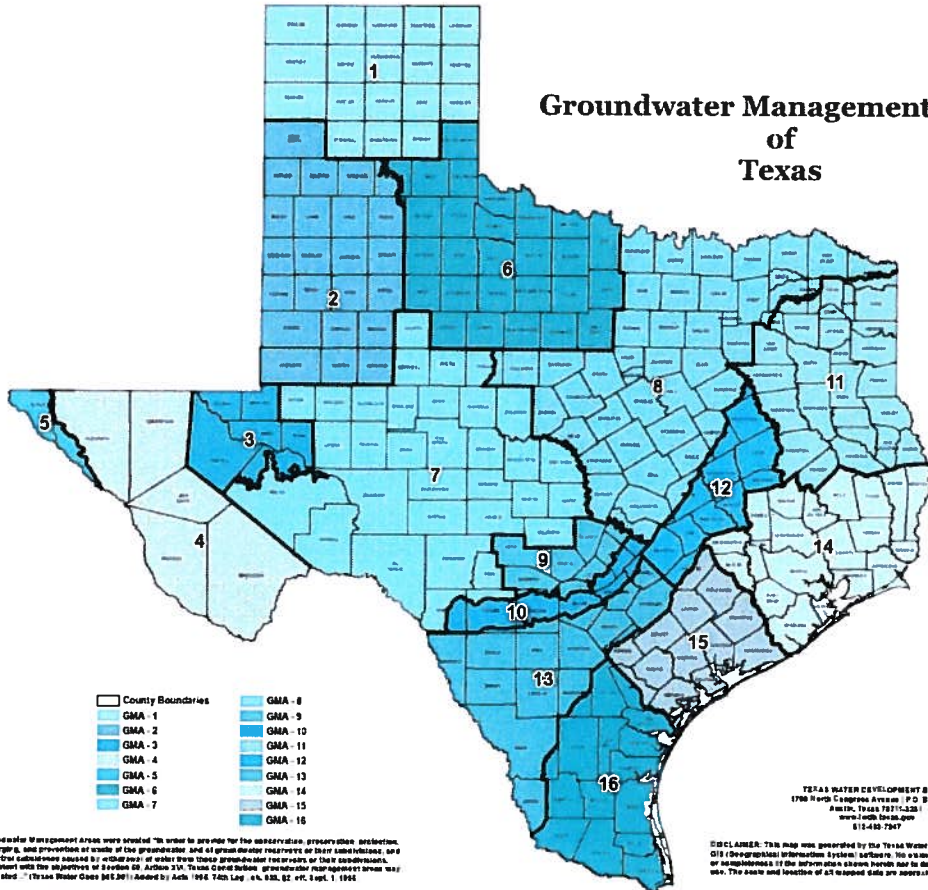
Dirk Aaron  
General Manager  
Clearwater UWCD

WSC	Contact	Phone	Address	City	State	Zip	Email
439 WSC	Glen Grandy	254-933-2133	5041 West Dr	Belton	TX	76513	439water@439watersupply.com
Armstrong WSC	Jerry Mays	254-657-2429	P.O. Box 155	Holland	Texas	76534	gliles@embarqmail.com
Bell County WCID #1	Jerry Atkinson	254-501-9243	201 S. 38th Street	Killeen	Texas	76543	j.atkinson@wcid1.org
Bell County WCID #2	Bill Easley	254-982-4685	P.O. Box 338	Little River	Texas	76554	belcountywater@embarqmail.com
Bell Coounty WCID #5	Dwayne Jekel	254-697-4016	P. O. Drawer 150	Cameron	Texas	76520	dlservice@farm-market.net
Bell Milam Falls WSC	Dwayne Jekel	254-697-4016	P. O. Drawer 150	Cameron	Texas	76520	dlservice@farm-market.net
Bluebonnet WSC	Jim Lilly	254-986-2949	6100 Water Supply Rd	Temple	Texas	76502	unavaiable
Central Texas WSC	Lee Kelley	254-698-3583	4020 Lakecliff Drive	Harker Heights	Texas	76548	ctwscgm@embarqmail.com
Chisholm Trail SUD	Delton Robinson	254-793-3103	P.O. Box 249	Florence	Texas	76527	info@ctsud.org
City of Troy	David Lowry	254-938-2505	P.O. Box 389	Troy	Texas	76579	dlowry@cityoftroy.us
Dog Ridge WSC	Dennis Rabroker	254-939-6533	P.O. Box 232	Belton	Texas	76513	unavaiable
East Bell WSC	Cheryl Walden	254-985-2611	16490 Hwy 53	Temple	Texas	76501	eastbellwsc@embarqmail.com
Elm Creek WSC	Steve Hubbard	254-853-3838	603 Avenue E.	Moody	Texas	76557	unavaiable
Jarrell Schwertner WSC	David Yohe	512-746-2114	P.O. Box 40	Jarrell	Texas	76537	office@jswatersupply.com
Kempner WSC	Delores Goode	512-932-3701	PO Box 103	Kempner	Texas	76539	delores@kempnerwsc.com
Little Elm Valley WSC	Dwayne Jekel	254-697-4016	P. O. Drawer 150	Cameron	Texas	76520	dlservice@farm-market.net
Moffat WSC	Mark Truelove	254-986-2457	5456 Lakeaire Blvd	Temple	Texas	76502	moffatwsc@embarqmail.com
Oenavile & Belfalls WSC	Randy Frei	254-985-2243	11821 State Hwy 53	Temple	Texas	76501	freienterprises@embarqmail.com
Pendleton WSC	Velva Moody	254-773-5876	P.O. Box 100	Pendleton	Texas	76564	pwsc@vvm.com
Salado WSC	Ricky Preston	254-947-5425	P.O. Box 1283	Salado	Texas	76571	swsc1@embarqmail.com
The Grove WSC	Justin Veazey	254-865-5567	103 Robert H Evetts Dr	Gatesville	Texas	76528	justin.veazey@yahoo.com
West Bell County WSC	John Whitson	254-634-1727	4201 Chaparral Road	Killeen	Texas	76542	westbellwater@hotmail.com
Brazos River Authority	Phil Ford	254-761-3100	4600 Cobbs Drive	Waco	Texas	76710	pford@brazos.org
City of Bartlett	Sabrina Pope	254-527-0196	P.O. Drawer H	Bartlett	Texas	76511	sabrina.pope@bartlett-tx.us
City of Belton	Sam Listi	254-933-5818	P.O. Box 120	Belton	Texas	76513	slisti@ci.belton.tx.us
City of Harker Heights	David Mitchell	254-953-5600	305 Millers Crossing	Harker Heights	Texas	76548	dmitchell@ci.harker-heights.tx.us
City of Holland	Mae Smith	254-657-2460	P.O. Box 157	Holland	Texas	76534	mae.smith@thecityofholland.org
City of Killeen	Glenn Morrison	254-501-7600	101 N. College Street	Killeen	Texas	76541	gmorrison@killeentexas.gov
City of Morgan's Point Resort	David Huseman	254-780-1334	8 Morgan's Point Blvd.	Morgan's Point Resort	Texas	76513	David.Huseman@mprtx.us
City of Rogers	Ann McCord	254-642-3312	P.O. Box 250	Rogers	Texas	76569	ctyhall@vvm.com
City of Temple	Jonathan Graham	254-298-5600	2 North Main Street	Temple	Texas	76501	jgraham@templetx.gov



## **APPENDIX H**

# Groundwater Management Areas of Texas



- |                     |            |
|---------------------|------------|
| □ County Boundaries | ■ GMA - 8  |
| ■ GMA - 1           | ■ GMA - 9  |
| ■ GMA - 2           | ■ GMA - 10 |
| ■ GMA - 3           | ■ GMA - 11 |
| ■ GMA - 4           | ■ GMA - 12 |
| ■ GMA - 5           | ■ GMA - 13 |
| ■ GMA - 6           | ■ GMA - 14 |
| ■ GMA - 7           | ■ GMA - 15 |
|                     | ■ GMA - 16 |

Groundwater Management Areas were created "in order to provide for the observation, preservation, protection, recharge, and protection of wells of the groundwater and of groundwater resources as their contribution, and to meet the objectives of Article 16, Section 51A, Texas Constitution, groundwater management areas may be created." (Texas Water Code §46.001, Added by Acts 1996, 74th Leg., ch. 530, §2, eff. Sept. 1, 1996)

The responsibility for Groundwater Management Area creation was delegated to the Texas Water Development Board (TWDB) by Chapter 56, Title 2, Texas Water Code. The first Groundwater Management Area subordinator was adopted on December 16, 2003 (2003 TWDB Panel)

TEXAS WATER DEVELOPMENT BOARD  
 1700 North Campbell Street, P.O. Box 13221  
 Austin, Texas 78713-3221  
 www.twdb.com  
 512-438-7947

DISCLAIMER: This map was generated by the Texas Water Development Board using GIS (Geographical Information System) software. No warranty is made in the accuracy or completeness of the information shown herein and no liability for a particular use. The name and location of all named cities are approximate. Map date: JULY 22 16

MISSION: The Texas Water Development Board (TWDB) mission is to provide leadership, planning, financial assistance, and education for the observation and responsible development of water for Texas.



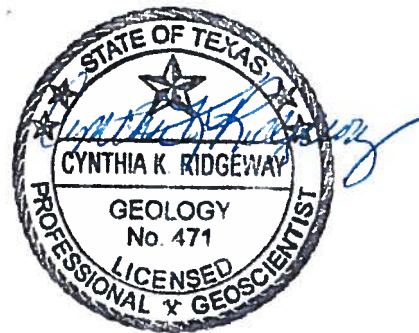
## **APPENDIX I**

# GAM Run 10-065 MAG

by **Mohammad Masud Hassan, P.E.**

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

Texas Water Development Board  
Groundwater Availability Modeling Section  
(512) 463-3132  
December 14, 2011



Cynthia K. Ridgeway, the Manager of the Groundwater Availability Modeling Section and Interim Director of the Groundwater Resources Division, is responsible for oversight of work performed by employees under her direct supervision. The seal appearing on this document was authorized by Cynthia K. Ridgeway, P.G. 471 on December 14, 2011.

*This page is intentionally left blank.*

## **EXECUTIVE SUMMARY:**

The modeled available groundwater for the Edwards (Balcones Fault Zone) Aquifer as a result of the desired future conditions adopted by the members of Groundwater Management Area 8 is approximately 15,200 acre-feet per year between 2010 and 2060. This is summarized by county, regional water planning area, and river basin as shown in Table 1 for use in the regional water planning process. The modeled available groundwater is also summarized by county, regional water planning area, river basin, and groundwater conservation district in tables 2 through 5.

## **REQUESTOR:**

Mr. Eddy Daniel of the North Texas Groundwater Conservation District on behalf of the groundwater conservation districts within Groundwater Management Area 8

## **DESCRIPTION OF REQUEST:**

In a letter dated August 31, 2011, Mr. Eddy Daniel provided the Texas Water Development Board (TWDB) with the desired future conditions for the northern segment of the Edwards (Balcones Fault Zone) Aquifer that were adopted in a resolution, dated April 27, 2011, by the members of Groundwater Management Area 8. This resolution referenced the desired future conditions previously adopted for the aquifer on December 17, 2007 by the groundwater conservation districts within Groundwater Management Area 8. These are described below:

- *Maintain at least 100 acre-feet per month of stream/spring flow in Salado Creek during a repeat of the Drought of Record in Bell County.*
- *Maintain at least 42 acre-feet per month of aggregated stream/spring flow during a repeat of the Drought of Record in Travis County.*
- *Maintain at least 60 acre-feet per month of aggregated stream/spring flow during a repeat of the Drought of Record in Williamson County.*

Because the desired future conditions were identical to the previous submission, the modeled available groundwater estimates in this report are identical to the previously released “managed available groundwater” estimates that were in Groundwater Availability Model (GAM) Run 08-10mag (Anaya, 2008).

## **METHODS:**

The location of Groundwater Management Area 8, the northern segment of the Edwards (Balcones Fault Zone) Aquifer, and the groundwater availability model cells that represent the aquifer are shown in Figure 1. The modeled available groundwater for Groundwater Management Area 8 presented in this report was divided by county, regional water planning area, river basin, and groundwater conservation district. These areas are shown in Figure 2.

## **Modeled Available Groundwater and Permitting**

As defined in Chapter 36 of the Texas Water Code, “modeled available groundwater” is the estimated average amount of water that may be produced annually to achieve a desired future condition. This is distinct from “managed available groundwater,” shown in the draft version of

this report dated December 21, 2010, which was a permitting value and accounted for the estimated use of the aquifer exempt from permitting. This change was made to reflect changes in statute by the 82<sup>nd</sup> Texas Legislature, effective September 1, 2011.

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

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

The parameters and assumptions for the model run using the groundwater availability model for the northern segment of the Edwards (Balcones Fault Zone) Aquifer are described below:

- The results for modeled available groundwater presented here are taken from the results reported as “managed available groundwater” in GAM Run 08-10mag (Anaya, 2008). See GAM Run 08-10mag for a full description of the methods and assumptions associated with the model simulation.
- Version 1.01 of the groundwater availability model for the northern segment of the Edwards (Balcones Fault Zone) Aquifer (Jones, 2003) was used for this analysis. See Jones (2003) for a more detailed discussion of assumptions and limitations of the groundwater availability model.
- The model consists of one layer representing the northern segment of the Edwards (Balcones Fault Zone) Aquifer and assumes no hydraulic communication with the underlying Trinity Aquifer.
- 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 32 feet for the 1980 steady-state calibration period (Jones, 2003).

#### **RESULTS:**

The modeled available groundwater for the northern segment of the Edwards (Balcones Fault Zone) Aquifer in Groundwater Management Area 8 as a result of the desired future conditions is approximately 15,200 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 1). The modeled available groundwater is also summarized by county, regional water planning area, river basin, and groundwater conservation district as shown in tables 2, 3, 4, and 5, respectively. Note that the only district within Groundwater Management Area 8 that contains the aquifer is Clearwater Underground Water 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(s).

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

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



**REFERENCES:**

Anaya, Robert, 2008, GAM Run 08-010mag: Texas Water Development Board GAM Run 0810mag Report, 7 p.

Jones, I.C., 2003, Groundwater availability modeling: Northern Segment of the Edwards Aquifer: Texas Water Development Board, Report 358, 75 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.

Table 1. Modeled available groundwater for the northern segment of the Edwards (Balcones Fault Zone) Aquifer in Groundwater Management Area 8. Results are in acre-feet per year and are divided by county, regional water planning area, and river basin.

County	Regional Water Planning Area	River Basin	Year					
			2010	2020	2030	2040	2050	2060
Bell	G	Brazos	6,469	6,469	6,469	6,469	6,469	6,469
Williamson	G	Brazos	3,351	3,351	3,351	3,351	3,351	3,351
		Colorado	101	101	101	101	101	101
	K	Brazos	6	6	6	6	6	6
		Colorado	4	4	4	4	4	4
Travis	K	Brazos	275	275	275	275	275	275
		Colorado	4,962	4,962	4,962	4,962	4,962	4,962
<b>Total</b>			<b>15,168</b>	<b>15,168</b>	<b>15,168</b>	<b>15,168</b>	<b>15,168</b>	<b>15,168</b>

Table 2. Modeled available groundwater pumping for the northern segment of the Edwards (Balcones Fault Zone) Aquifer summarized by county in Groundwater Management Area 8 for each decade between 2010 and 2060. Results are in acre-feet per year.

County	Year					
	2010	2020	2030	2040	2050	2060
Bell	6,469	6,469	6,469	6,469	6,469	6,469
Williamson	3,462	3,462	3,462	3,462	3,462	3,462
Travis	5,237	5,237	5,237	5,237	5,237	5,237
<b>Total</b>	<b>15,168</b>	<b>15,168</b>	<b>15,168</b>	<b>15,168</b>	<b>15,168</b>	<b>15,168</b>

Table 3. Modeled available groundwater for the northern segment of the Edwards (Balcones Fault Zone) Aquifer summarized by regional water planning area in Groundwater Management Area 8 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	9,921	9,921	9,921	9,921	9,921	9,921
K	5,247	5,247	5,247	5,247	5,247	5,247
<b>Total</b>	<b>15,168</b>	<b>15,168</b>	<b>15,168</b>	<b>15,168</b>	<b>15,168</b>	<b>15,168</b>

Table 4. Modeled available groundwater for the northern segment of the Edwards (Balcones Fault Zone) Aquifer summarized by river basin in Groundwater Management Area 8 for each decade between 2010 and 2060. Results are in acre-feet per year.

River Basin	Year					
	2010	2020	2030	2040	2050	2060
Brazos	10,101	10,101	10,101	10,101	10,101	10,101
Colorado	5,067	5,067	5,067	5,067	5,067	5,067
<b>Total</b>	<b>15,168</b>	<b>15,168</b>	<b>15,168</b>	<b>15,168</b>	<b>15,168</b>	<b>15,168</b>

Table 5. Modeled available groundwater for the northern segment of the Edwards (Balcones Fault Zone) Aquifer summarized by groundwater conservation district (GCD) in Groundwater Management Area 8 for each decade between 2010 and 2060. Results are in acre-feet per year. UWCD refers to Underground Water Conservation District.

Groundwater Conservation District	Year					
	2010	2020	2030	2040	2050	2060
Clearwater UWCD	6,469	6,469	6,469	6,469	6,469	6,469
No District	8,699	8,699	8,699	8,699	8,699	8,699
<b>Total</b>	<b>15,168</b>	<b>15,168</b>	<b>15,168</b>	<b>15,168</b>	<b>15,168</b>	<b>15,168</b>

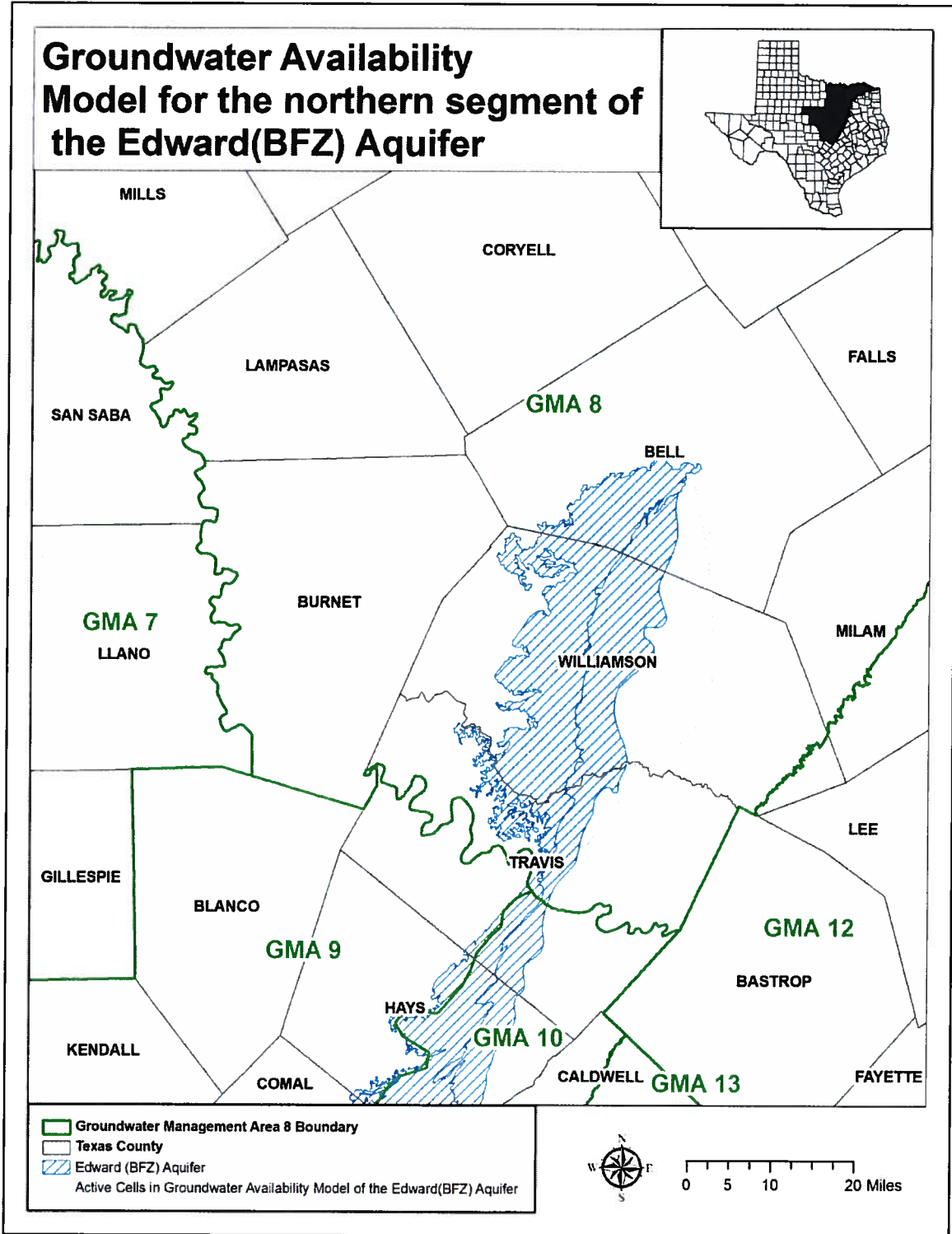


Figure 1. Map showing the areas covered by the groundwater availability model for the Edwards (Balcones Fault Zone) Aquifer.

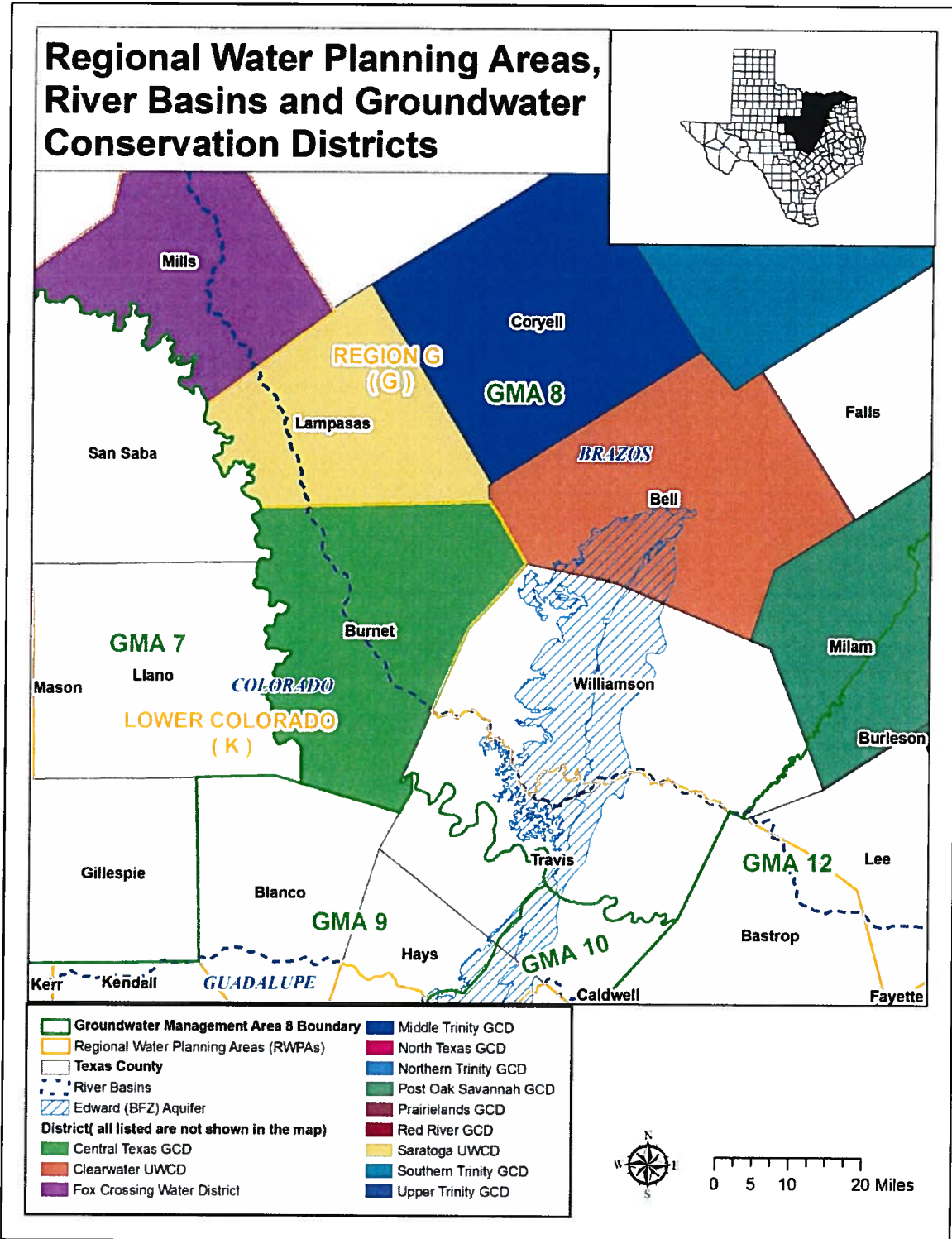


Figure 2. Map showing regional water planning areas (RWPAs), groundwater conservation districts (GCDs), counties, and river basins in Groundwater Management Area 8. UWCD refers to Underground Water Conservation District.

**APPENDIX J**

# Texas Water Development Board

P.O. Box 13231, 1700 N. Congress Ave.  
Austin, TX 78711-3231, [www.twdb.texas.gov](http://www.twdb.texas.gov)  
Phone (512) 463-7847, Fax (512) 475-2053

January 19, 2018

Mr. Dirk Aaron  
General Manager  
Clearwater Underground Water Conservation District  
P.O. Box 1989  
Belton, TX 76513

Dear Mr. Aaron:

Texas Water Code, Section 36.1084, Subsection (b) states that the Texas Water Development Board's (TWDB) Executive Administrator shall provide each groundwater conservation district and regional water planning group located wholly or partly in the groundwater management area with the modeled available groundwater in the management area based upon the desired future conditions adopted by the districts. This letter and the attached report (GAM Run 17-029 MAG) are in response to this directive.

District representatives in Groundwater Management Area 8 adopted desired future conditions for the Trinity, Woodbine, Edwards (Balcones Fault Zone), Marble Falls, Ellenburger-San Saba, and Hickory aquifers on January 31, 2017. The TWDB received the desired future condition explanatory report and related material from the Groundwater Management Area 8 designated representative, Mr. Drew Satterwhite, on March 1, 2017.

Texas Water Code, Section 36.001, Subsection (25) defines modeled available groundwater as "the amount of water that the executive administrator determines may be produced on an average annual basis to achieve a desired future condition established under Section 36.108." We report modeled available groundwater estimates by aquifer, groundwater conservation district, county, regional water planning area, and river basin for use by groundwater conservation districts and for use in the regional water planning process.

I encourage open communication and coordination between groundwater conservation districts, regional water planning groups, and the TWDB to ensure that the modeled available groundwater reported in regional water plans and groundwater management plans are not in conflict. The estimates of modeled available groundwater are the pumping volumes that would have to occur to achieve the desired future conditions using the best available scientific tools. However, these estimates are based on assumptions of the magnitude and distribution of projected pumping in the aquifer. It is, therefore, important for groundwater conservation districts to monitor whether their management of pumping

## Our Mission

To provide leadership, information, education, and support for planning, financial assistance, and outreach for the conservation and responsible development of water for Texas

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## Board Members

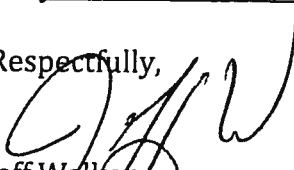
Kathleen Jackson, Board Member | Peter Lake, Board Member

Jeff Walker, Executive Administrator

is achieving their desired future conditions. I encourage districts to continue to work with us to better define modeled available groundwater as additional information may help better assess responses of the aquifer to pumping and the distribution of pumping now and in the future.

Please contact Mr. Larry French of our Groundwater staff at 512-463-5067 or [larry.french@twdb.texas.gov](mailto:larry.french@twdb.texas.gov) if you have any questions or need any further information.

Respectfully,



Jeff Walker  
Executive Administrator

Attachment: GAM Run 17-029 MAG

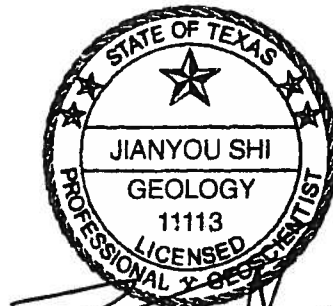
c w/att.: Curtis Campbell, Red River Authority of Texas  
J. Kevin Ward, Trinity River Authority  
Trey Buzbee, Brazos River Authority  
David Wheelock, Lower Colorado River Authority  
Kerry Maroney, Biggs & Mathews  
Amy Kaarlela, Freese & Nichols, Inc.  
David Dunn, HDR, Inc.  
Jaime Burke, AECOM, Inc.  
L'Oreal Stepney, Deputy Director, Office of Water, Texas Commission on Environmental Quality  
Kim Wilson, Texas Commission on Environmental Quality  
Kelly Mills, Texas Commission on Environmental Quality  
Abiy Berehe, Texas Commission on Environmental Quality  
Sam Marie Hermitte, Interim Deputy Executive Administrator, Water Science and Conservation  
Larry French, Groundwater Division  
Temple McKinnon, Water Use, Projections, & Planning  
Sarah Backhouse, Water Use, Projections, & Planning  
Sabrina Anderson, Water Use, Projections, & Planning



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**GAM RUN 17-029 MAG:  
MODELED AVAILABLE GROUNDWATER FOR THE  
TRINITY, WOODBINE, EDWARDS  
(BALCONES FAULT ZONE), MARBLE  
FALLS, ELLENBURGER-SAN SABA, AND  
HICKORY AQUIFERS IN  
GROUNDWATER MANAGEMENT AREA 8**

Jerry Shi, Ph.D., P.G.  
Texas Water Development Board  
Groundwater Division  
Groundwater Availability Modeling Department  
(512) 463-5076  
January 19, 2018



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**GAM RUN 17-029 MAG:  
MODELED AVAILABLE GROUNDWATER FOR THE  
TRINITY, WOODBINE, EDWARDS  
(BALCONES FAULT ZONE), MARBLE  
FALLS, ELLENBURGER-SAN SABA, AND  
HICKORY AQUIFERS IN  
GROUNDWATER MANAGEMENT AREA 8**

Jerry Shi, Ph.D., P.G.  
Texas Water Development Board  
Groundwater Division  
Groundwater Availability Modeling Department  
(512) 463-5076  
January 19, 2018

***EXECUTIVE SUMMARY:***

The Texas Water Development Board (TWDB) has calculated the modeled available groundwater estimates for the Trinity, Woodbine, Edwards (Balcones Fault Zone), Marble Falls, Ellenburger-San Saba, and Hickory aquifers in Groundwater Management Area 8. The modeled available groundwater estimates are based on the desired future conditions for these aquifers adopted by groundwater conservation district representatives in Groundwater Management Area 8 on January 31, 2017. The district representatives declared the Nacatoch, Blossom, and Brazos River Alluvium aquifers to be non-relevant for purposes of joint planning. The TWDB determined that the explanatory report and other materials submitted by the district representatives were administratively complete on November 2, 2017.

The modeled available groundwater values for the following relevant aquifers in Groundwater Management Area 8 are summarized below:

- Trinity Aquifer (Paluxy) – The modeled available groundwater ranges from approximately 24,500 to 24,600 acre-feet per year between 2010 and 2070, and is

summarized by groundwater conservation districts and counties in [Table 1](#), and by river basins, regional planning areas, and counties in [Table 13](#).

- Trinity Aquifer (Glen Rose) – The modeled available groundwater is approximately 12,700 acre-feet per year between 2010 and 2070, and is summarized by groundwater conservation districts and counties in [Table 2](#), and by river basins, regional planning areas, and counties in [Table 14](#).
- Trinity Aquifer (Twin Mountains) – The modeled available groundwater ranges from approximately 40,800 to 40,900 acre-feet per year between 2010 and 2070, and is summarized by groundwater conservation districts and counties in [Table 3](#), and by river basins, regional planning areas, and counties in [Table 15](#).
- Trinity Aquifer (Travis Peak) – The modeled available groundwater ranges from approximately 93,800 to 94,000 acre-feet per year between 2010 and 2070, and is summarized by groundwater conservation districts and counties in [Table 4](#), and by river basins, regional planning areas, and counties in [Table 16](#).
- Trinity Aquifer (Hensell) – The modeled available groundwater is approximately 27,300 acre-feet per year from 2010 to 2070, and is summarized by groundwater conservation districts and counties in [Table 5](#), and by river basins, regional planning areas, and counties in [Table 17](#).
- Trinity Aquifer (Hosston) – The modeled available groundwater ranges from approximately 64,900 to 65,100 acre-feet per year from 2010 to 2070, and is summarized by groundwater conservation districts and counties in [Table 6](#), and by river basins, regional planning areas, and counties in [Table 18](#).
- Trinity Aquifer (Antlers) – The modeled available groundwater ranges from approximately 74,500 to 74,700 acre-feet per year between 2010 and 2070, and is summarized by groundwater conservation districts and counties in [Table 7](#), and by river basins, regional planning areas, and counties in [Table 19](#).
- Woodbine Aquifer – The modeled available groundwater is approximately 30,600 acre-feet per year from 2010 to 2070, and is summarized by groundwater conservation districts and counties in [Table 8](#), and by river basins, regional planning areas, and counties in [Table 20](#).
- Edwards (Balcones Fault Zone) Aquifer – The modeled available groundwater is 15,168 acre-feet per year from 2010 to 2060, and is summarized by groundwater conservation districts and counties in [Table 9](#), and by river basins, regional planning areas, and counties in [Table 21](#).

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- Marble Falls Aquifer – The modeled available groundwater is approximately 5,600 acre-feet per year from 2010 to 2070, and is summarized by groundwater conservation districts and counties in [Table 10](#), and by river basins, regional planning areas, and counties in [Table 22](#).
- Ellenburger-San Saba Aquifer – The modeled available groundwater is approximately 14,100 acre-feet per year between 2010 and 2070, and is summarized by groundwater conservation districts and counties in [Table 11](#), and by river basins, regional planning areas, and counties in [Table 23](#).
- Hickory Aquifer – The modeled available groundwater is approximately 3,600 acre-feet per year from 2010 to 2070, and is summarized by groundwater conservation districts and counties in [Table 12](#), and by river basins, regional planning areas, and counties in [Table 24](#).

The modeled available groundwater values for the Trinity Aquifer (Paluxy, Glen Rose, Twin Mountains, Travis Peak, Hensell, Hosston, and Antlers subunits), Woodbine Aquifer, and Edwards (Balcones Fault Zone) Aquifer are based on the official aquifer boundaries defined by the TWDB. The modeled available groundwater values for the Marble Falls, Ellenburger-San Saba, and Hickory aquifers are based on the modeled extent, as clarified by Groundwater Management Area 8 on October 9, 2017.

The modeled available groundwater values estimated for counties may be slightly different from those estimated for groundwater conservation districts because of the process for rounding the values. The modeled available groundwater values for the longer leap years (2020, 2040, and 2060) are slightly higher than shorter non-leap years (2010, 2030, 2050, and 2070).

***REQUESTOR:***

Mr. Drew Satterwhite, General Manager of North Texas Groundwater Conservation District and Groundwater Management Area 8 Coordinator.

***DESCRIPTION OF REQUEST:***

In a letter dated February 17, 2017, Mr. Drew Satterwhite provided the TWDB with the desired future conditions of the Trinity (Paluxy), Trinity (Glen Rose), Trinity (Twin Mountains), Trinity (Travis Peak), Trinity (Hensell), Trinity (Hosston), Trinity (Antlers), Woodbine, Edwards (Balcones Fault Zone), Marble Falls, Ellenburger-San Saba, and Hickory aquifers. The desired future conditions were adopted as Resolution No. 2017-01 on January 31, 2017 by the groundwater conservation district representatives in

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Groundwater Management Area 8. The following sections present the adopted desired future conditions for these aquifers:

### Trinity and Woodbine Aquifers

The desired future conditions for the Trinity and Woodbine aquifers are expressed as water level decline or drawdown in feet over the planning period 2010 to 2070 relative to the baseline year 2009, based on a predictive simulation by Beach and others (2016).

The county-based desired future conditions for the Trinity Aquifer subunits, excluding counties in the Upper Trinity Groundwater Conservation District, are listed below (dashes indicate areas where the subunits do not exist and therefore no desired future condition was proposed):

County	Adopted Desired Future Condition (feet of drawdown below 2009 levels)							
	Woodbine	Paluxy	Glen Rose	Twin Mountains	Travis Peak	Hensell	Hosston	Antlers
Bell	—	19	83	—	300	137	330	—
Bosque	—	6	49	—	167	129	201	—
Brown	—	—	2	—	1	1	1	2
Burnet	—	—	2	—	16	7	20	—
Callahan	—	—	—	—	—	—	—	1
Collin	459	705	339	526	—	—	—	570
Comanche	—	—	1	—	2	2	3	9
Cooke	2	—	—	—	—	—	—	176
Coryell	—	7	14	—	99	66	130	—
Dallas	123	324	263	463	348	332	351	—
Delta	—	264	181	—	186	—	—	—
Denton	22	552	349	716	—	—	—	395
Eastland	—	—	—	—	—	—	—	3
Ellis	61	107	194	333	301	263	310	—
Erath	—	1	5	6	19	11	31	12
Falls	—	144	215	—	462	271	465	—
Fannin	247	688	280	372	269	—	—	251
Grayson	160	922	337	417	—	—	—	348
Hamilton	—	2	4	—	24	13	35	—
Hill	20	38	133	—	298	186	337	—
Hunt	598	586	299	370	324	—	—	—

GAM Run 17-029 MAG: Modeled Available Groundwater for the Trinity, Woodbine, Edwards (Balcones Fault Zone), Marble Falls, Ellenburger-San Saba, and Hickory Aquifers in Groundwater Management Area 8

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County	Adopted Desired Future Condition (feet of drawdown below 2009 levels)							
	Woodbine	Paluxy	Glen Rose	Twin Mountains	Travis Peak	Hensell	Hosston	Antlers
Johnson	2	-61	58	156	179	126	235	—
Kaufman	208	276	269	381	323	309	295	—
Lamar	38	93	97	—	114	—	—	122
Lampasas	—	—	1	—	6	1	11	—
Limestone	—	178	271	—	392	183	404	—
McLennan	6	35	133	—	471	220	542	—
Milam	—	—	212	—	345	229	345	—
Mills	—	1	1	—	7	2	13	—
Navarro	92	119	232	—	290	254	291	—
Red River	2	21	36	—	51	—	—	13
Rockwall	243	401	311	426	—	—	—	—
Somervell	—	1	4	31	51	26	83	—
Tarrant	7	101	148	315	—	—	—	148
Taylor	—	—	—	—	—	—	—	0
Travis	—	—	85	—	141	50	146	—
Williamson	—	—	77	—	173	74	177	—

The desired future conditions for the counties in the Upper Trinity Groundwater Conservation District are further divided into outcrop and downdip areas, and are listed below (dashes indicate areas where the subunits do not exist):

Upper Trinity GCD County (crop)	Adopted Desired Future Conditions (feet of drawdown below 2009 levels)			
	Antlers	Paluxy	Glen Rose	Twin Mountains
Hood (outcrop)	—	5	7	4
Hood (downdip)	—	—	28	46
Montague (outcrop)	18	—	—	—
Montague (downdip)	—	—	—	—
Parker (outcrop)	11	5	10	1
Parker (downdip)	—	1	28	46
Wise (outcrop)	34	—	—	—
Wise (downdip)	142	—	—	—

### **Edwards (Balcones Fault Zone) Aquifer**

The desired future conditions adopted by Groundwater Management Area 8 for the Edwards (Balcones Fault Zone) Aquifer are intended to maintain minimum stream and spring flows under the drought of record in Bell, Travis, and Williamson counties over the planning period 2010 to 2070. The desired future conditions are listed below:

<b>County</b>	<b>Adopted Desired Future Condition</b>
Bell	Maintain at least 100 acre-feet per month of stream/spring flow in Salado Creek during a repeat of the drought of record
Travis	Maintain at least 42 acre-feet per month of aggregated stream/spring flow during a repeat of the drought of record
Williamson	Maintain at least 60 acre-feet per month of aggregated stream/spring flow during a repeat of the drought of record

### **Marble Falls, Ellenburger-San Saba, and Hickory Aquifers**

The desired future conditions for the Marble Falls, Ellenburger-San Saba, and Hickory aquifers in Brown, Burnet, Lampasas, and Mills counties are intended to maintain 90 percent of the aquifer saturated thickness over the planning period 2010 to 2070 relative to the baseline year 2009.

### **Supplemental Information from Groundwater Management Area 8**

After review of the explanatory report and model files, the TWDB emailed a request for clarifications to Mr. Drew Satterwhite on August 7, 2017. On September 8, 2017, Mr. Satterwhite provided the TWDB with a technical memorandum from James Beach, Jeff Davis, and Brant Konetchy of LBG-Guyton Associates. On October 9, 2017, Mr. Satterwhite sent the TWDB two emails with additional information and clarifications. The information and clarifications are summarized below:

- a. For the Trinity and Woodbine aquifers, an additional error tolerance defined as five feet of drawdown between the adopted desired future condition and the simulated drawdown is included with the original error tolerance of five percent. Thus, if the drawdown from the predictive simulation is within five feet or five percent from the desired future condition, then the predictive simulation is considered to meet the desired future condition.

Groundwater Management Area 8 provided a new MODFLOW-NWT well package, simulated head file, and simulated budget file on October 9, 2017. The TWDB determined that the distribution of pumping in the new model files was consistent with the explanatory report.



The TWDB evaluates if the simulated drawdown from the predictive simulation meets the desired future condition by county. However, Groundwater Management Area 8 also provided desired future conditions based on groundwater conservation district and the whole groundwater management area.

- b. For the Edwards (Balcones Fault Zone) Aquifer in Bell, Travis, and Williamson counties, the coordinator for Groundwater Management Area 8 clarified that TWDB uses GAM Run 08-010 MAG by Anaya (2008) from the last cycle of desired future conditions with all associated assumptions including a baseline year of 2000.
- c. For the Marble Falls, Ellenburger-San Saba, and Hickory aquifers in Brown, Burnet, Lampasas, and Mills counties, Groundwater Management Area 8 adjusted the desired future condition from “maintain 90 percent of the saturated thickness” to “maintain *at least* 90 percent of the saturated thickness”. Groundwater Management Area 8 also provided estimated pumping to use for the predictive simulation by TWDB.
- d. The Trinity, Woodbine, and Edwards (Balcones Fault Zone) aquifers are based on the official aquifer boundary while the Marble Falls, Ellenburger-San Saba, and Hickory aquifers include the portions both inside and outside the official aquifer boundaries (modeled extent).
- e. The sliver of the Edwards-Trinity (Plateau) Aquifer was declared to be non-relevant by Groundwater Management Area 8.

### ***METHODS:***

The desired future conditions for Groundwater Management Area 8 are based on multiple criteria. For the Trinity and Woodbine aquifers, the desired future conditions are defined as water-level declines or drawdowns over the course of the planning period 2010 through 2070 relative to the baseline year 2009. The desired future conditions for the Edwards (Balcones Fault Zone) Aquifer are based on stream and spring flows under the drought of record over the planning period 2010 to 2070. For the Marble Falls, Ellenburger-San Saba, and Hickory aquifers, the desired future conditions are to maintain aquifer saturated thickness between 2010 and 2070 relative to the baseline year 2009. The methods to calculate the desired future conditions are discussed below.

### **Trinity and Woodbine Aquifers**

The desired future conditions for the Trinity and Woodbine aquifers in Groundwater Management Area 8 are based on a predictive simulation by Beach and others (2016), which used the groundwater availability model for the northern portion of the Trinity and Woodbine aquifers (Kelley and others, 2014). The predictive simulation contained 61 annual stress periods corresponding to 2010 through 2070, with an initial head equal to 2009 of the calibrated groundwater availability model. The desired future conditions are the drawdowns between 2009 and 2070.

Because the baseline year 2009 for the desired future conditions falls within the calibration period 1890 to 2012 of the groundwater availability model, the water levels for the baseline year have been calibrated to observed data and, thus, they were directly used as the initial water level (head) condition of the predictive simulation.

The drawdowns between 2009 and 2070 are calculated from composite heads. [Appendix A](#) presents additional details on methods used to calculate composite head and associated average drawdown values for the Trinity and Woodbine aquifers.

### **Edwards (Balcones Fault Zone) Aquifer**

Per Groundwater Management Area 8 (clarification dated September 1, 2017), the results from GAM Run 08-010 MAG by Anaya (2008) are used for the current round of joint planning. The following summarizes the approach used:

- Ran the model for 141 years, starting with a 100-year initial stress period (pre-1980) followed by 21 years of historical monthly stress periods (1980 to 2000), then 10 years of predictive annual stress periods (2001 to 2010), and ending with 10 years of predictive monthly stress periods (2011 to 2020) to represent a simulated repeat of the 1950s' drought of record.
- Used pumpage and recharge distributions provided to TWDB by the Groundwater Management Area 8 consultant.
- Adjusted pumpage in Williamson County to meet the desired future conditions.
- Extracted projected discharge for drain cells representing Salado Creek in Bell County and drain cells representing aggregated springs and streams in Williamson and Travis counties, respectively, for each of the stress periods from 2011 through 2020 to verify that the desired future conditions were met.

- Determined which stress period reflected the worst case monthly scenario for Salado Springs during a repeat of the 1950s' drought of record.
- Generated modeled available groundwater for all three desired future conditions based on the lowest monthly springflow volume for Salado Springs during a simulated repeat of the 1950s' drought of record.

### **Marble Falls, Ellenburger-San Saba, and Hickory Aquifers**

The TWDB constructed a predictive simulation to analyze the desired future conditions for the Marble Falls, Ellenburger-San Saba, and Hickory aquifers in Brown, Burnet, Lampasas, and Mills counties within Groundwater Management Area 8. This simulation used the groundwater availability model for the minor aquifers in the Llano Uplift region by Shi and others (2016). The predictive simulation contains 61 annual stress periods corresponding to the planning period 2010 through 2070 with an initial head condition from 2009.

Because the baseline year 2009 for the desired future conditions falls within the model calibration period 1980 to 2010, and the water levels for the baseline year have been calibrated to observed data, the simulated head from 2009 of the calibrated groundwater availability model was directly used as the initial water level (head) condition of the predictive simulation.

Additional details on the predictive simulation and methods to estimate the drawdowns between 2009 and 2070 are described in [Appendix B](#).

### **Modeled Available Groundwater**

Once the predictive simulations met the desired future conditions, the modeled available groundwater values were extracted from the MODFLOW cell-by-cell budget files. Annual pumping rates were then divided by county, river basin, regional water planning area, and groundwater conservation district within Groundwater Management Area 8 ([Figures 1 through 13](#) and [Tables 1 through 24](#)).

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

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

estimated amount of pumping exempt from permitting, existing permits, and a reasonable estimate of actual groundwater production under existing permits.

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

The parameters and assumptions for the groundwater availability simulations are described below:

#### **Trinity and Woodbine Aquifers**

- Version 2.01 of the updated groundwater availability model for the northern Trinity and Woodbine aquifers by Kelley and others (2014) was used to construct the predictive model simulation for this analysis (Beach and others, 2016).
- The predictive model was run with MODFLOW-NWT (Niswonger and others, 2011).
- The model has eight layers that represent units younger than the Woodbine Aquifer and the shallow outcrop of all aquifers (Layer 1), the Woodbine Aquifer (Layer 2), the Fredericksburg and Washita units (Layer 3), and various combinations of the subunits that comprise the Trinity Aquifer (Layers 4 to 8).
- Multiple model layers could represent an aquifer where it outcrops. For example, the Woodbine Aquifer could span Layers 1 to 2 and the Trinity Aquifer (Hosston) could contain Layers 1 through 8. The aquifer designation in model layers was defined in the model grid files produced by TWDB.
- The predictive model simulation contains 61 transient annual stress periods with an initial head equal to 2009 of the calibrated groundwater availability model.
- The predictive simulation had the same hydrogeological properties and hydraulic boundary conditions as the calibrated groundwater availability model except groundwater recharge and pumping.
- The groundwater recharge for the predictive model simulation was the same as stress period 1 of the calibrated groundwater availability model (steady state period) except stress periods representing 2058 through 2060, which contained lower recharge representing severe drought conditions.
- In the predictive simulation, additional pumping was added to certain counties and some pumping in Layer 1 was moved to lower layer(s) to avoid the automatic pumping reduction enacted by the MODFLOW-NWT code (Beach and others, 2016).

- During the predictive simulation model run, some model cells went dry ([Appendix C](#)). Dry cells occur during a model run when the simulated water level in a cell falls below the bottom of the cell.
- Estimates of modeled drawdown and available groundwater from the model simulation were rounded to whole numbers.

#### **Edwards (Balcones Fault Zone) Aquifer**

- Version 1.01 of the groundwater availability model for the northern segment of the Edwards (Balcones Fault Zone) Aquifer (Jones, 2003) was used to construct the predictive model simulation for the analysis by Anaya (2008).
- The model has one layer that represents the Edwards (Balcones Fault Zone) Aquifer.
- The model was run with MODFLOW-96 (Harbaugh and McDonald, 1996).
- The predictive model simulation contains the calibrated groundwater availability model (253 monthly stress periods), stabilization (10 annual stress periods), and drought conditions (120 monthly stress periods).
- The boundary conditions for the stabilization and drought periods (except recharge and pumping) were the same in the predictive simulation as the last stress period (stress period 253) of the calibrated groundwater availability model.
- The groundwater recharge for the stabilization and drought periods and pumping information were from Groundwater Management Area 8 consultant.
- The groundwater pumping in Williamson County was adjusted as needed during the predictive model run simulation to match the desired future conditions.
- Estimates of modeled spring and stream flows from the model simulation were rounded to whole numbers.

#### **Marble Falls, Ellenburger-San Saba, and Hickory Aquifers**

- Version 1.01 of the groundwater availability model for the minor aquifers in Llano Uplift region by Shi and others (2016) was used to develop the predictive model simulation used for this analysis.
- The model has eight layers: Layer 1 (the Trinity Aquifer, Edwards-Trinity (Plateau) Aquifer, and younger alluvium deposits), Layer 2 (confining units), Layer 3 (the Marble Falls Aquifer and equivalent unit), Layer 4 (confining units), Layer 5 (Ellenburger-San Saba Aquifer and equivalent unit), Layer 6 (confining units), Layer 7 (the Hickory Aquifer and equivalent unit), and Layer 8 (Precambrian units).

- The model was run with MODFLOW-USG beta (development) version (Panday and others, 2013).
- The predictive model simulation contains 61 annual stress periods (2010 to 2070) with the initial head equal to 2009 of the calibrated groundwater availability model.
- The boundary conditions for the predictive model except recharge and pumping were the same in the predictive simulation of the last stress period of the calibrated groundwater availability model.
- The groundwater recharge for the predictive model simulation was set equal to the average of all stress periods (1982 to 2010) of the calibrated model except the first stress period.
- The groundwater pumping was initially set to the last stress period of the calibrated groundwater availability model. Additional pumping per county was then added to the model cells of the three aquifers based on the modeled extent to match the total pumping data for each aquifer provided by Groundwater Management area 8.
- During the predictive model run, some active model cells went dry ([Appendix D](#)). Dry cells occur during a model run when the simulated water level in a cell falls below the bottom of the cell.
- Estimates of modeled saturated aquifer thickness values were rounded to one decimal point.

### ***RESULTS:***

The modeled available groundwater for the Trinity Aquifer (Paluxy) that achieves the desired future condition adopted by Groundwater Management Area 8 ranges from 24,499 acre-feet per year for the non-leap (shorter) years (2010, 2030, 2050, and 2070) to 24,565 acre-feet per year for the leap (longer) years (2020, 2040, and 2060). The modeled available groundwater is summarized by groundwater conservation district and county in [Table 1](#). [Table 13](#) summarizes the modeled available groundwater by county, river basin, and regional water planning area for use in the regional water planning process.

The modeled available groundwater for the Trinity Aquifer (Glen Rose) that achieves the desired future condition adopted by Groundwater Management Area 8 ranges from 12,701 acre-feet per year for the non-leap years (2010, 2030, 2050, and 2070) to 12,736 acre-feet per year for the leap years (2020, 2040, and 2060). The modeled available groundwater is summarized by groundwater conservation district and county in [Table 2](#). [Table 14](#)

summarizes the modeled available groundwater by county, river basin, and regional water planning area for use in the regional water planning process.

The modeled available groundwater for the Trinity Aquifer (Twin Mountains) that achieves the desired future condition adopted by Groundwater Management Area 8 ranges from 40,827 acre-feet per year for the non-leap years (2010, 2030, 2050, and 2070) to 40,939 acre-feet per year for the leap years (2020, 2040, and 2060). The modeled available groundwater is summarized by groundwater conservation district and county in [Table 3](#). [Table 15](#) summarizes the modeled available groundwater by county, river basin, and regional water planning area for use in the regional water planning process.

The modeled available groundwater for the Trinity Aquifer (Travis Peak) that achieves the desired future condition adopted by Groundwater Management Area 8 ranges from 93,757 acre-feet per year for the non-leap years (2010, 2030, 2050, and 2070) to 94,016 acre-feet per year for the leap years (2020, 2040, and 2060). The modeled available groundwater is summarized by groundwater conservation district and county in [Table 4](#). [Table 16](#) summarizes the modeled available groundwater by county, river basin, and regional water planning area for use in the regional water planning process.

The modeled available groundwater for the Trinity Aquifer (Hensell) that achieves the desired future condition adopted by Groundwater Management Area 8 ranges from 27,257 acre-feet per year for the non-leap years (2010, 2030, 2050, and 2070) to 27,331 acre-feet per year for the leap years (2020, 2040, and 2060). The modeled available groundwater is summarized by groundwater conservation district and county in [Table 5](#). [Table 17](#) summarizes the modeled available groundwater by county, river basin, and regional water planning area for use in the regional water planning process.

The modeled available groundwater for the Trinity Aquifer (Hosston) that achieves the desired future condition adopted by Groundwater Management Area 8 ranges from 64,922 acre-feet per year for the non-leap years (2010, 2030, 2050, and 2070) to 65,098 acre-feet per year for the leap years (2020, 2040, and 2060). The modeled available groundwater is summarized by groundwater conservation district and county in [Table 6](#). [Table 18](#) summarizes the modeled available groundwater by county, river basin, and regional water planning area for use in the regional water planning process.

The modeled available groundwater for the Trinity Aquifer (Antlers) that achieves the desired future condition adopted by Groundwater Management Area 8 ranges from 74,471 acre-feet per year for the non-leap years (2010, 2030, 2050, and 2070) to 74,677 acre-feet per year for the leap years (2020, 2040, and 2060). The modeled available groundwater is

summarized by groundwater conservation district and county in [Table 7](#). [Table 19](#) summarizes the modeled available groundwater by county, river basin, and regional water planning area for use in the regional water planning process.

The modeled available groundwater for the Woodbine Aquifer that achieves the desired future condition adopted by Groundwater Management Area 8 ranges from 30,554 acre-feet per year for the non-leap years (2010, 2030, 2050, and 2070) to 30,636 acre-feet per year for the leap years (2020, 2040, and 2060). The modeled available groundwater is summarized by groundwater conservation district and county in [Table 8](#). [Table 20](#) summarizes the modeled available groundwater by county, river basin, and regional water planning area for use in the regional water planning process.

The modeled available groundwater for the Edwards (Balcones Fault Zone) Aquifer that achieves the desired future condition adopted by Groundwater Management Area 8 remains at 15,168 acre-feet per year from 2010 to 2060. The modeled available groundwater is summarized by groundwater conservation district and county in [Table 9](#). [Table 21](#) summarizes the modeled available groundwater by county, river basin, and regional water planning area for use in the regional water planning process.

The modeled available groundwater for the Marble Falls Aquifer that achieves the desired future condition adopted by Groundwater Management Area 8 ranges from 5,623 acre-feet per year for the non-leap years (2010, 2030, 2050, and 2070) to 5,639 acre-feet per year for the leap years (2020, 2040, and 2060). The modeled available groundwater is summarized by groundwater conservation district and county in [Table 10](#). [Table 22](#) summarizes the modeled available groundwater by county, river basin, and regional water planning area for use in the regional water planning process.

The modeled available groundwater for the Ellenburger-San Saba Aquifer that achieves the desired future condition adopted by Groundwater Management Area 8 ranges from 14,050 acre-feet per year for the non-leap years (2010, 2030, 2050, and 2070) to 14,089 acre-feet per year for the leap years (2020, 2040, and 2060). The modeled available groundwater is summarized by groundwater conservation district and county in [Table 11](#). [Table 23](#) summarizes the modeled available groundwater by county, river basin, and regional water planning area for use in the regional water planning process.

The modeled available groundwater for the Hickory Aquifer that achieves the desired future condition adopted by Groundwater Management Area 8 ranges from 3,574 acre-feet per year for the non-leap years (2010, 2030, 2050, and 2070) to 3,585 acre-feet per year for the leap years (2020, 2040, and 2060). The modeled available groundwater is



GAM Run 17-029 MAG: Modeled Available Groundwater for the Trinity, Woodbine, Edwards (Balcones Fault Zone), Marble Falls, Ellenburger-San Saba, and Hickory Aquifers in Groundwater Management Area 8

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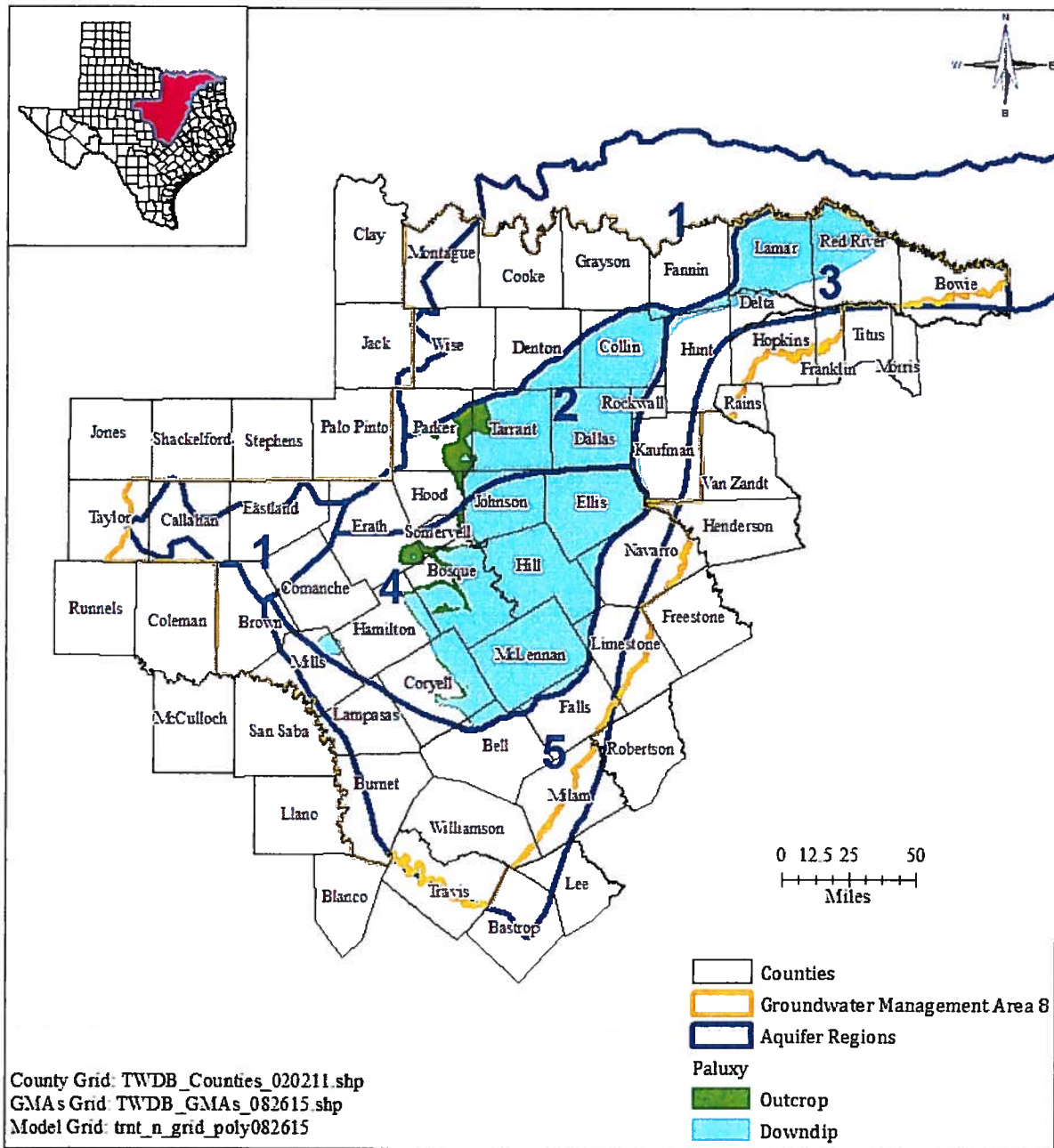
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summarized by groundwater conservation district and county in Table 12. Table 24 summarizes the modeled available groundwater by county, river basin, and regional water planning area for use in the regional water planning process.

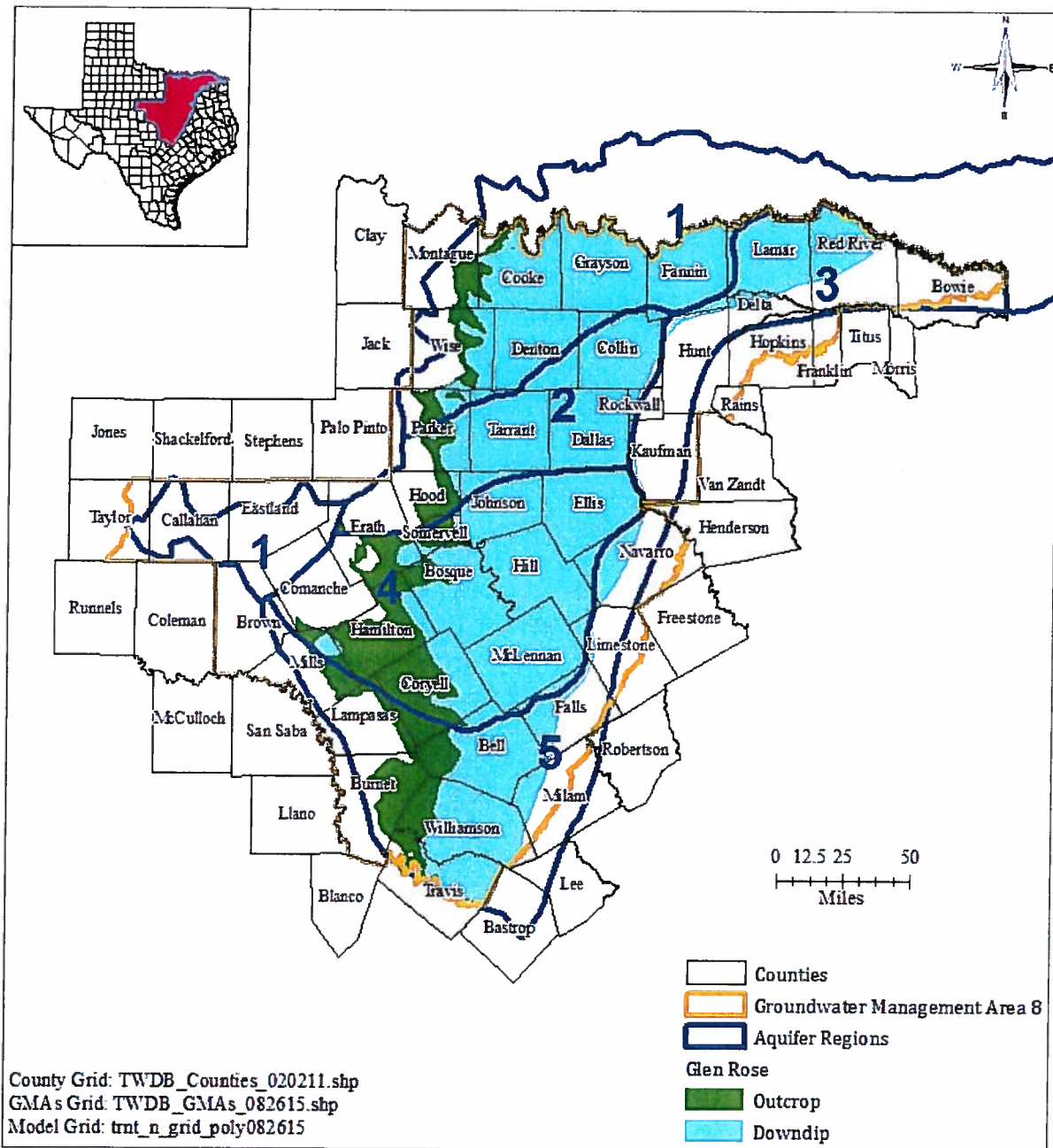
GAM Run 17-029 MAG: Modeled Available Groundwater for the Trinity, Woodbine, Edwards (Balcones Fault Zone), Marble Falls, Ellenburger-San Saba, and Hickory Aquifers in Groundwater Management Area 8

January 19, 2018

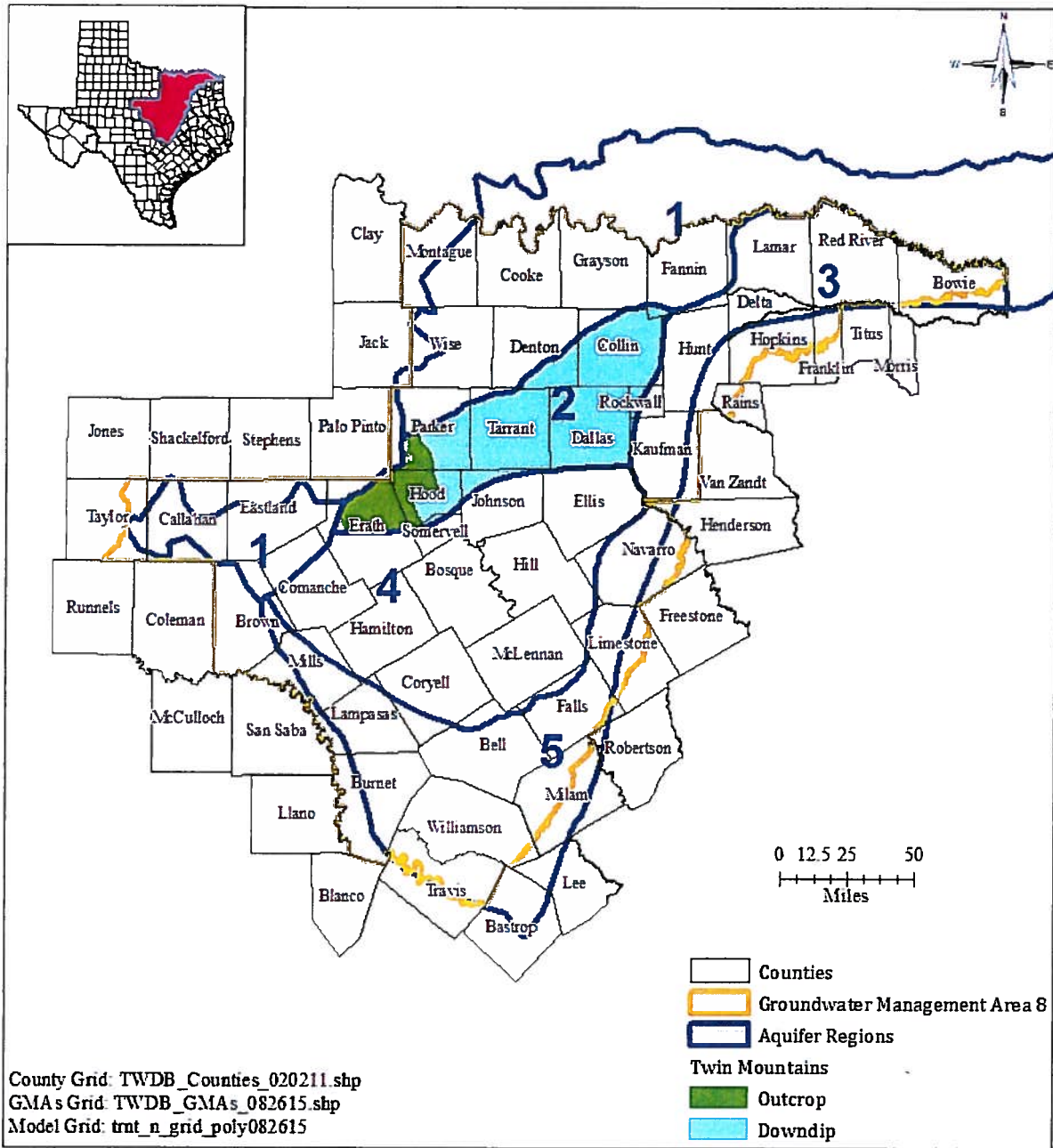
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**FIGURE 1. MAP SHOWING THE TRINITY AQUIFER (PALUXY) WITHIN GROUNDWATER MANAGEMENT AREA 8 FROM THE GROUNDWATER AVAILABILITY MODEL FOR THE NORTHERN PORTION OF THE TRINITY AND WOODBINE AQUIFERS.**



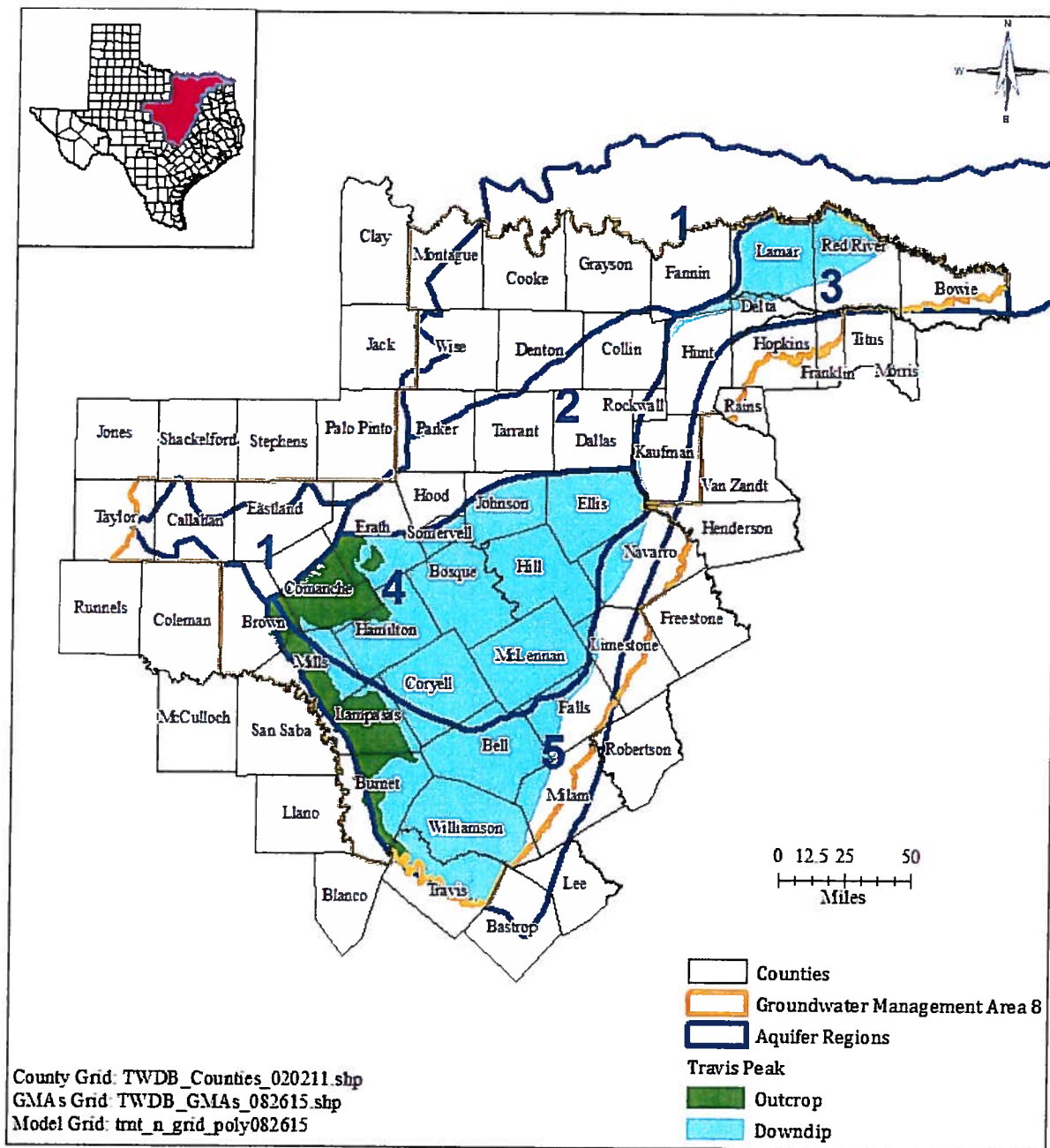
**FIGURE 2. MAP SHOWING THE TRINITY AQUIFER (GLEN ROSE) WITHIN GROUNDWATER MANAGEMENT AREA 8 FROM THE GROUNDWATER AVAILABILITY MODEL FOR THE NORTHERN PORTION OF THE TRINITY AND WOODBINE AQUIFERS.**



**FIGURE 3. MAP SHOWING THE TRINITY AQUIFER (TWIN MOUNTAINS) WITHIN GROUNDWATER MANAGEMENT AREA 8 FROM THE GROUNDWATER AVAILABILITY MODEL FOR THE NORTHERN PORTION OF THE TRINITY AND WOODBINE AQUIFERS.**

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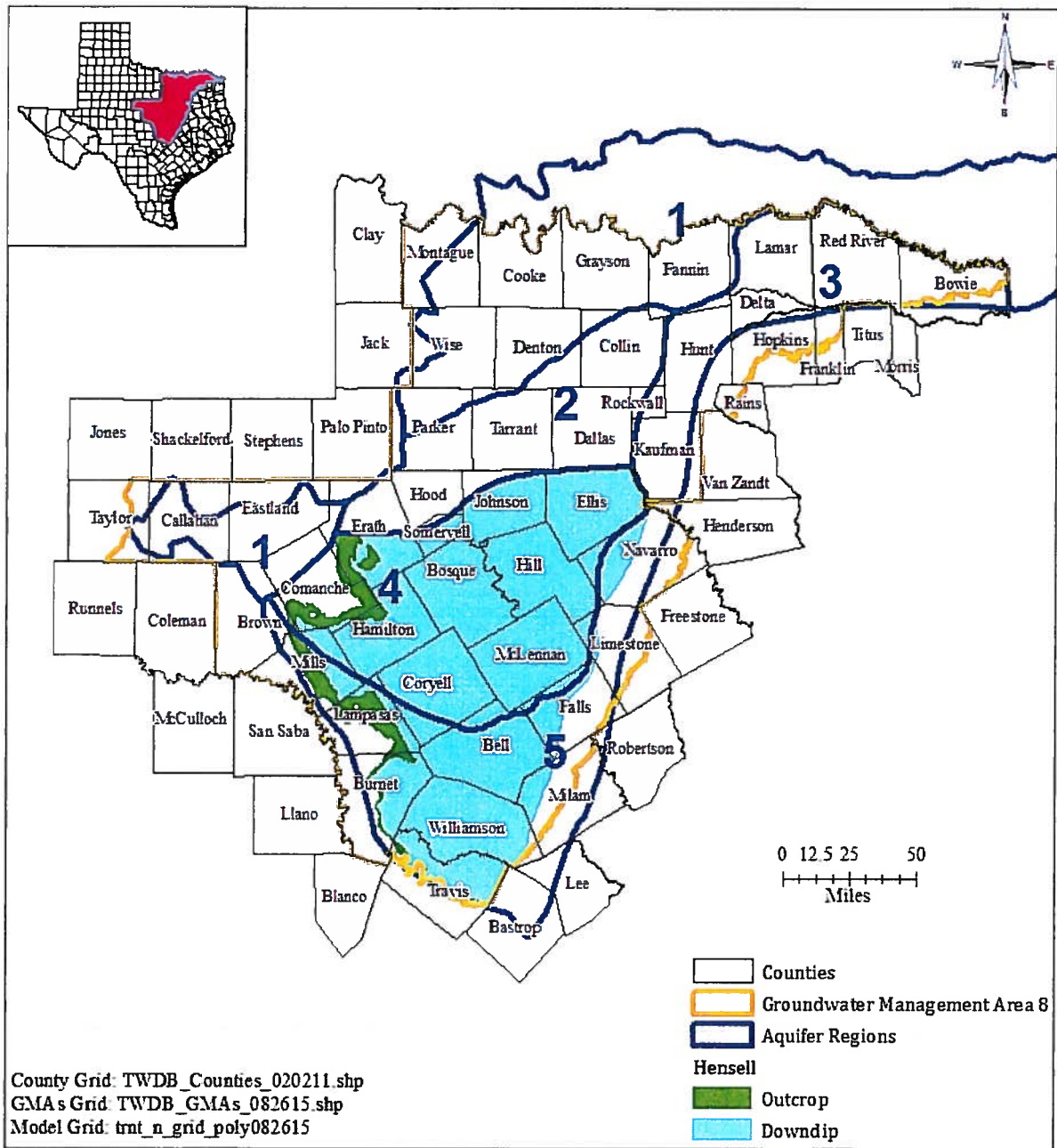


**FIGURE 4. MAP SHOWING THE TRINITY AQUIFER (TRAVIS PEAK) WITHIN GROUNDWATER MANAGEMENT AREA 8 FROM THE GROUNDWATER AVAILABILITY MODEL FOR THE NORTHERN PORTION OF THE TRINITY AND WOODBINE AQUIFERS.**

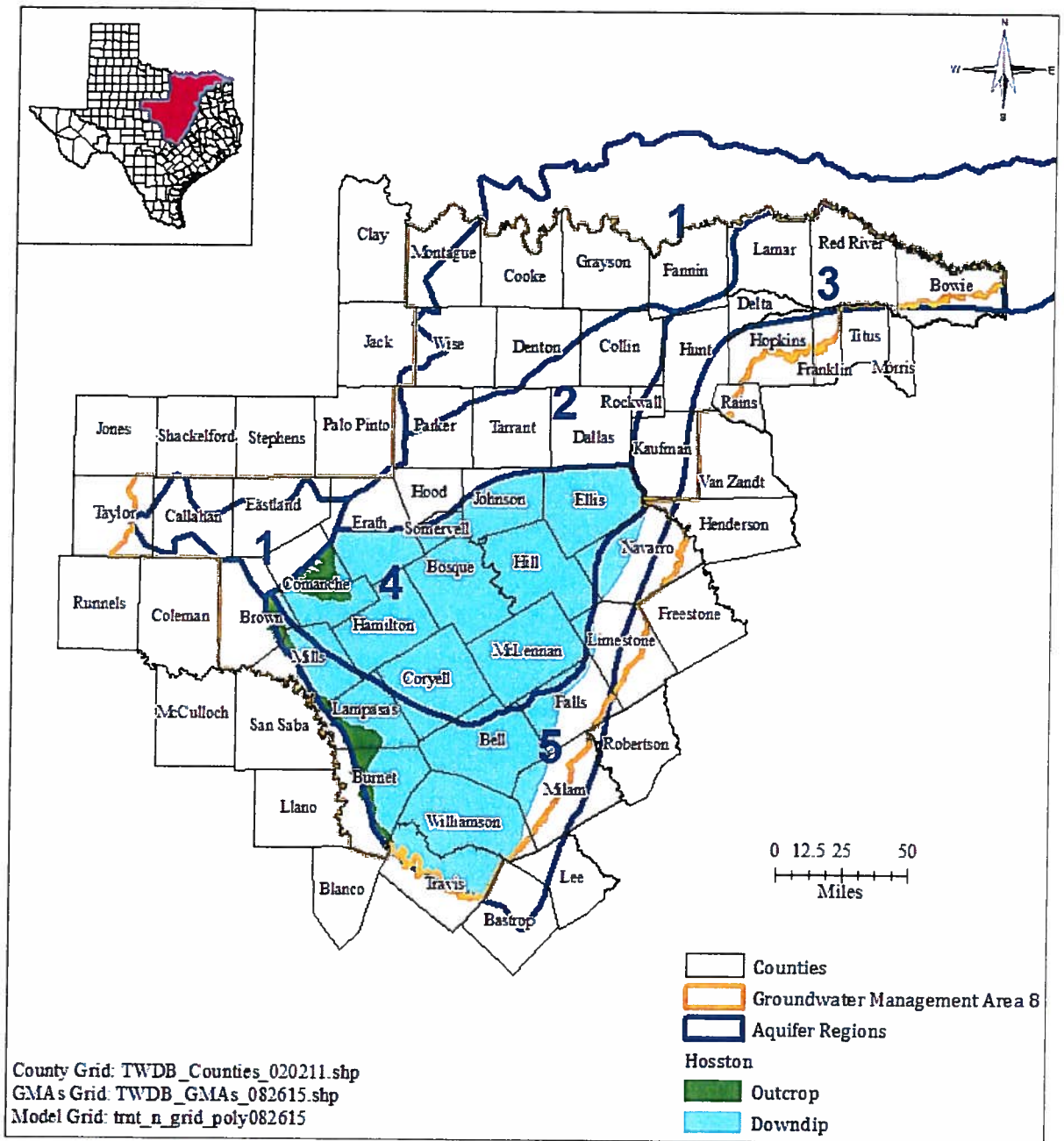


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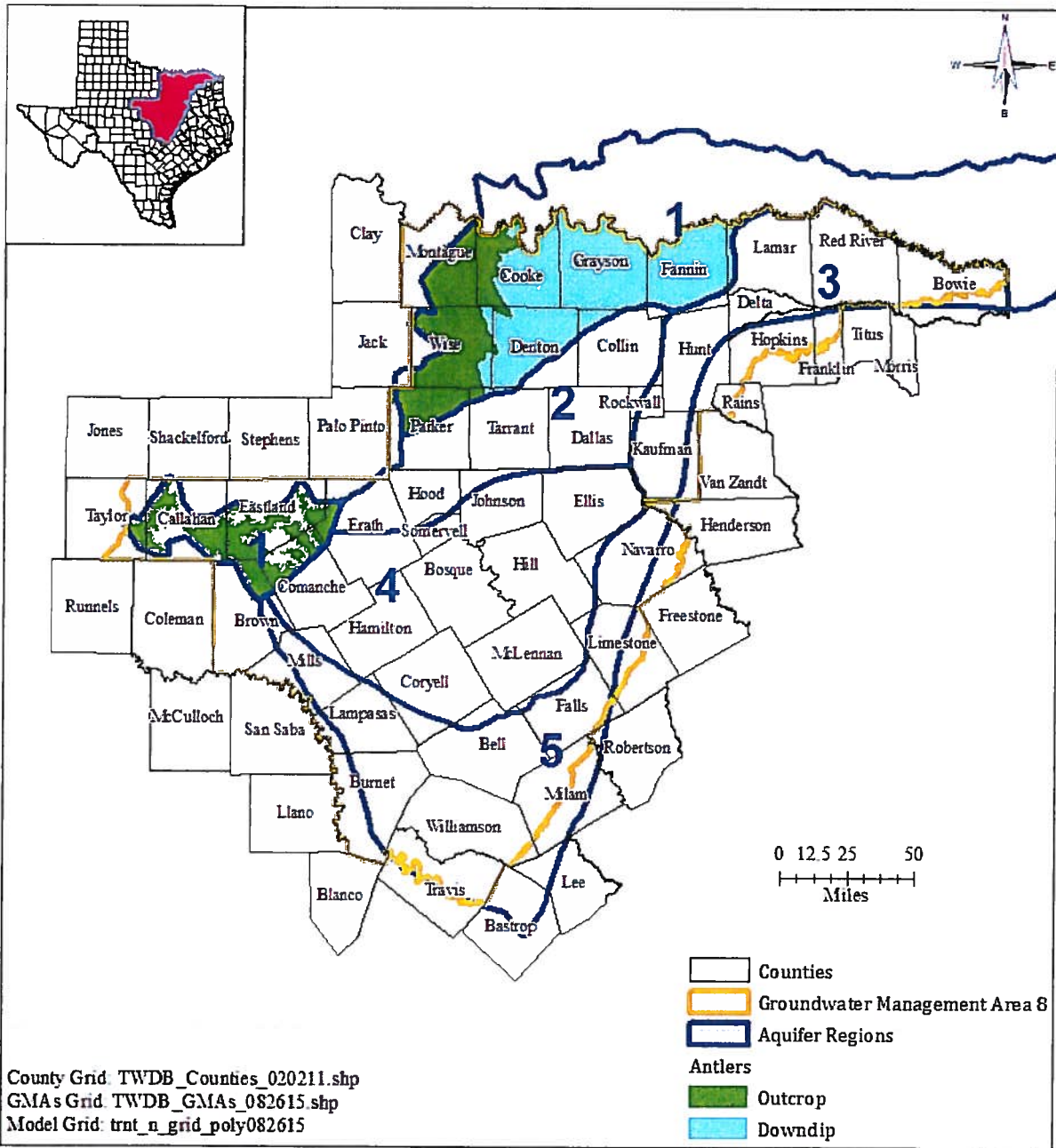
**FIGURE 5. MAP SHOWING THE TRINITY AQUIFER (HENSELL) WITHIN GROUNDWATER MANAGEMENT AREA 8 FROM THE GROUNDWATER AVAILABILITY MODEL FOR THE NORTHERN PORTION OF THE TRINITY AND WOODBINE AQUIFERS.**



**FIGURE 6. MAP SHOWING THE TRINITY AQUIFER (HOSSTON) WITHIN GROUNDWATER MANAGEMENT AREA 8 FROM THE GROUNDWATER AVAILABILITY MODEL FOR THE NORTHERN PORTION OF THE TRINITY AND WOODBINE AQUIFERS.**

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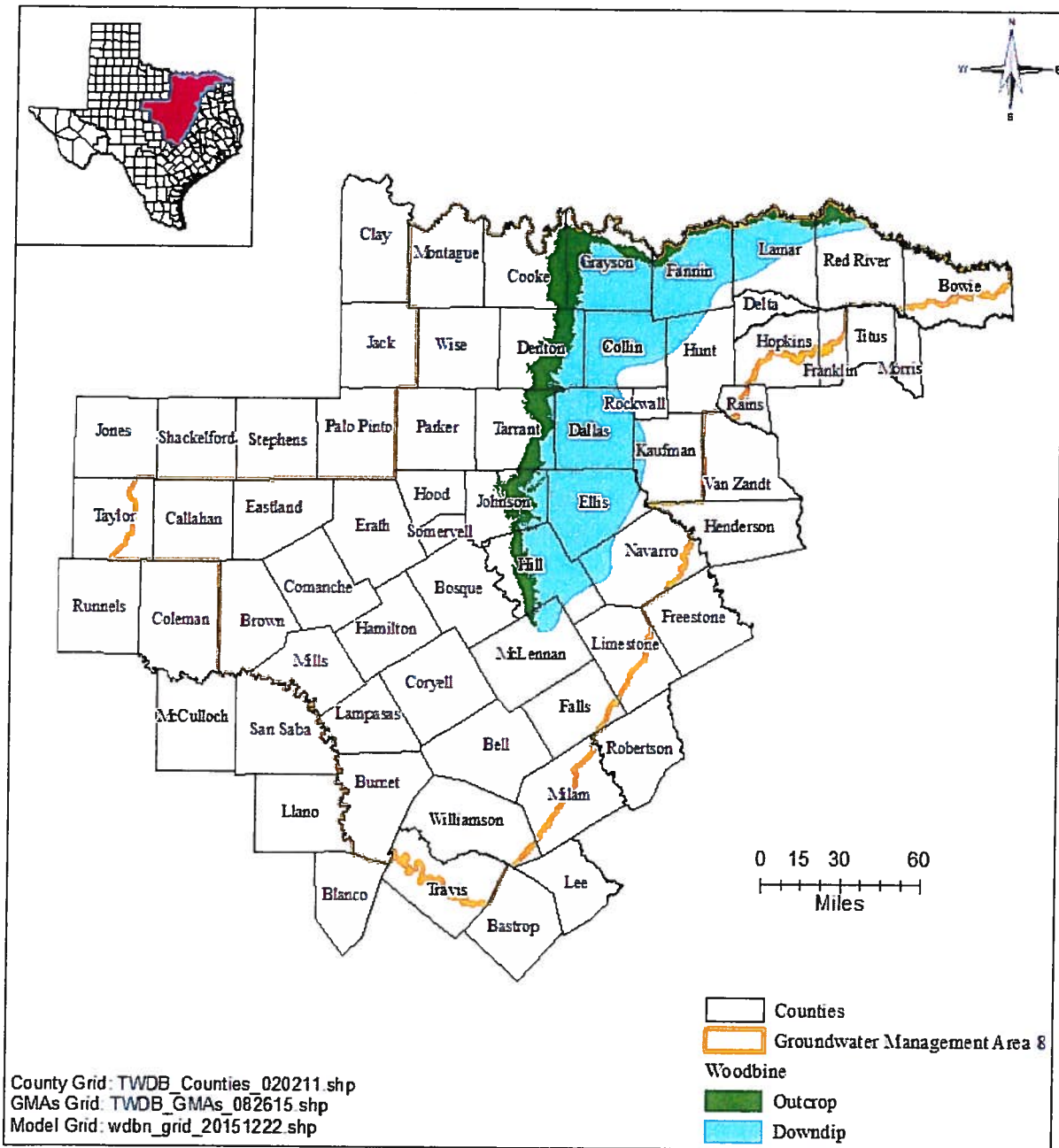


**FIGURE 7. MAP SHOWING THE TRINITY AQUIFER (ANTLERS) WITHIN GROUNDWATER MANAGEMENT AREA 8 FROM THE GROUNDWATER AVAILABILITY MODEL FOR THE NORTHERN PORTION OF THE TRINITY AND WOODBINE AQUIFERS.**

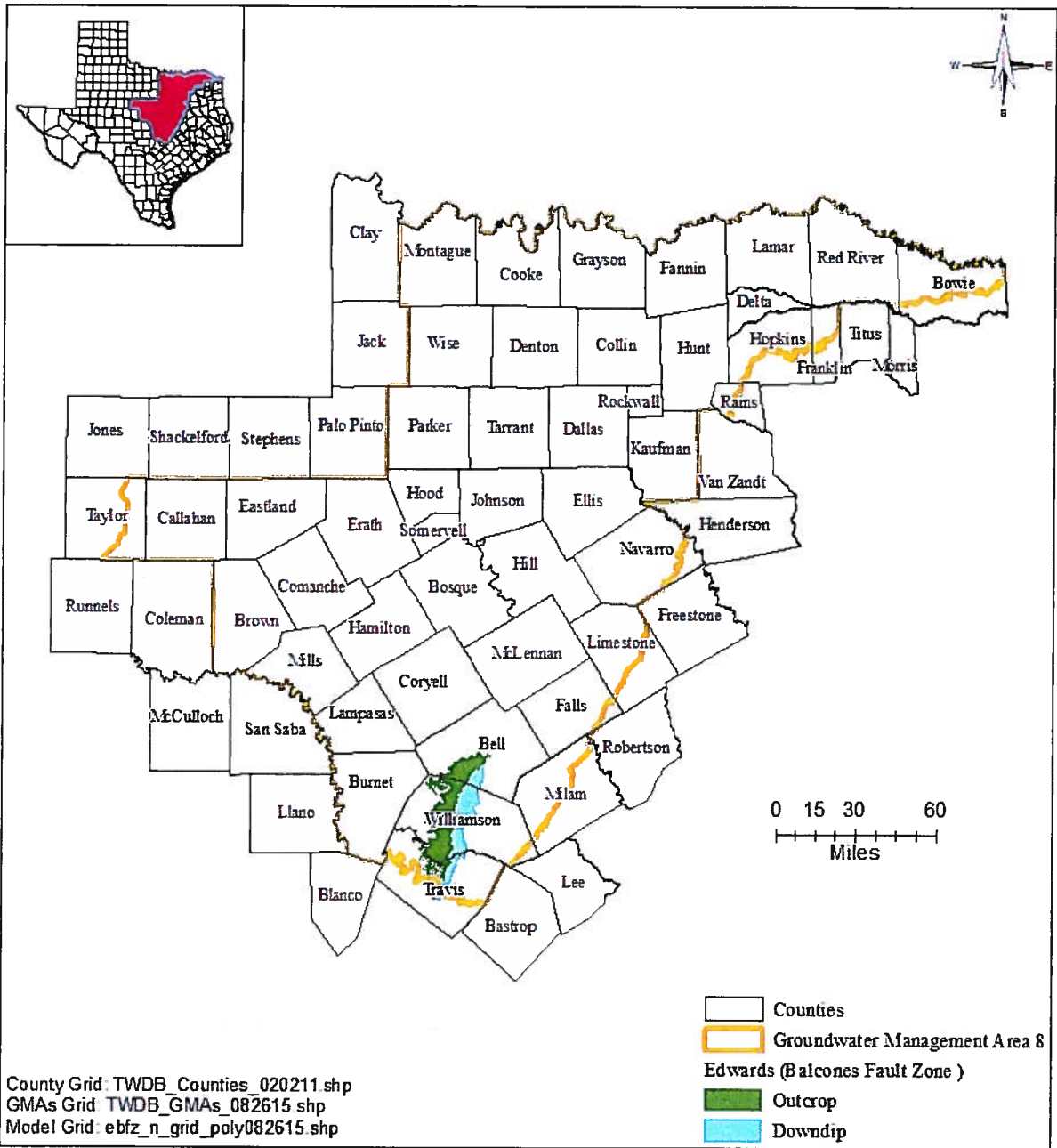


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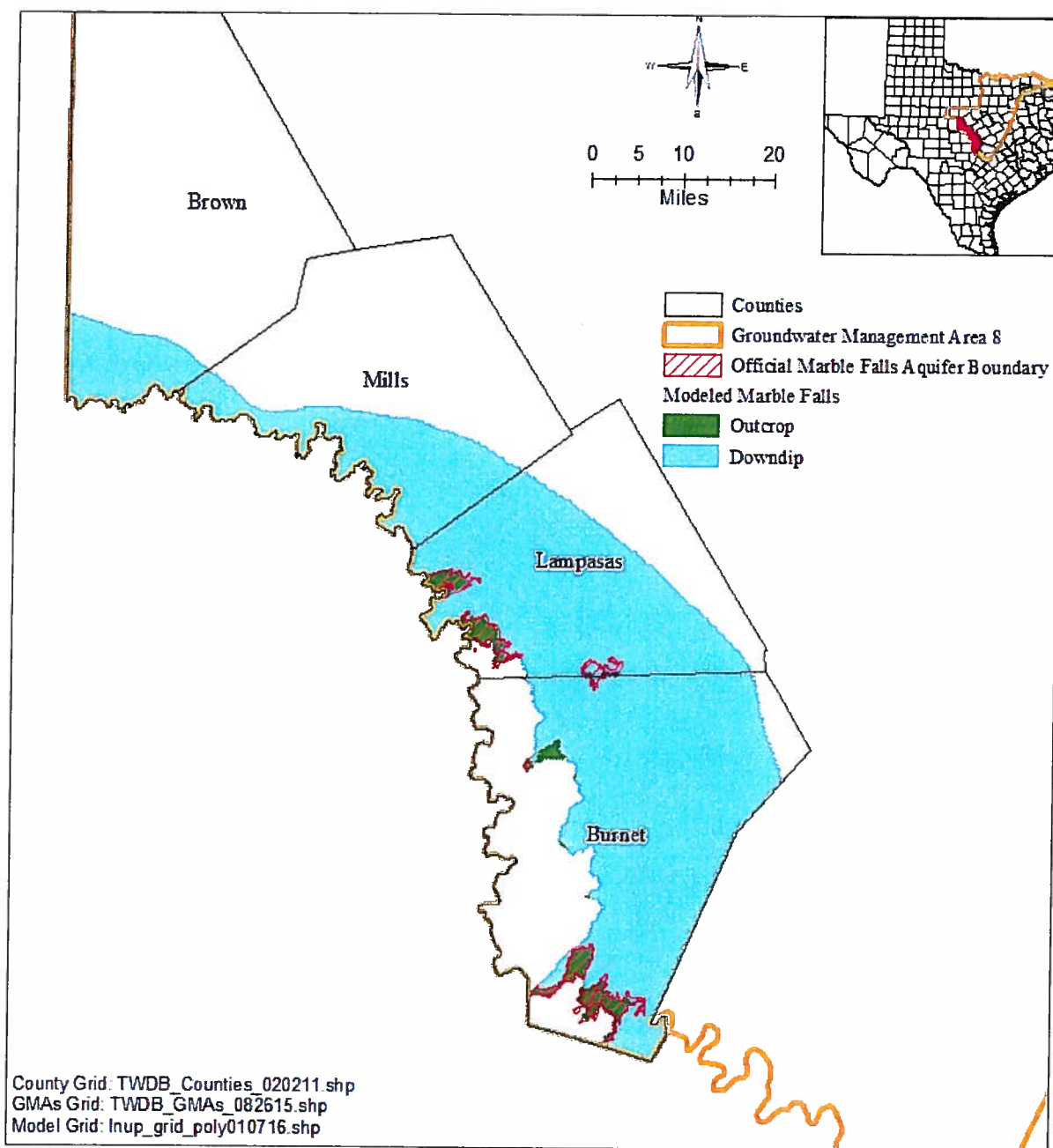
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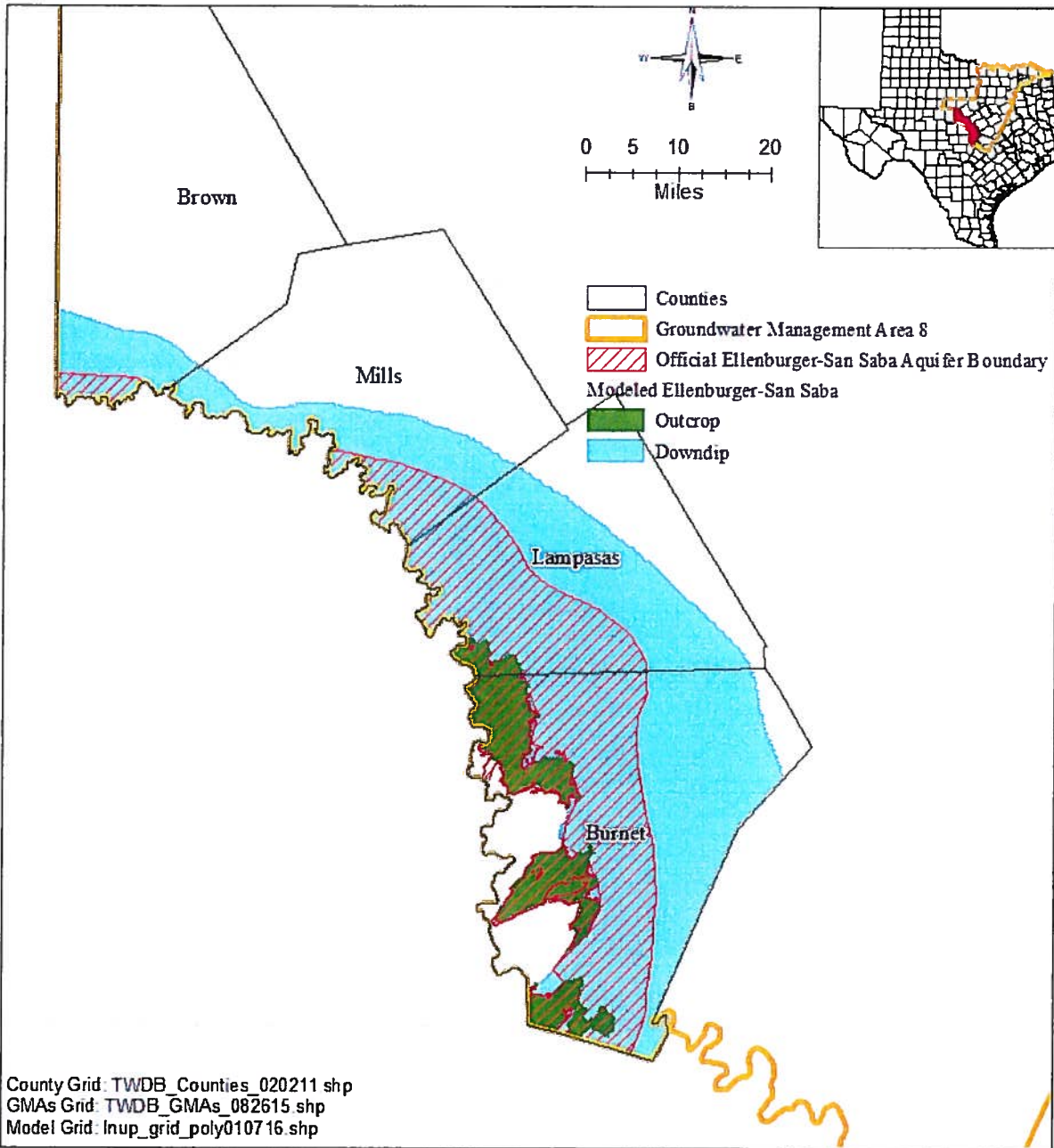
**FIGURE 8. MAP SHOWING THE WOODBINE AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 8 FROM THE GROUNDWATER AVAILABILITY MODEL FOR THE NORTHERN PORTION OF THE TRINITY AND WOODBINE AQUIFERS.**



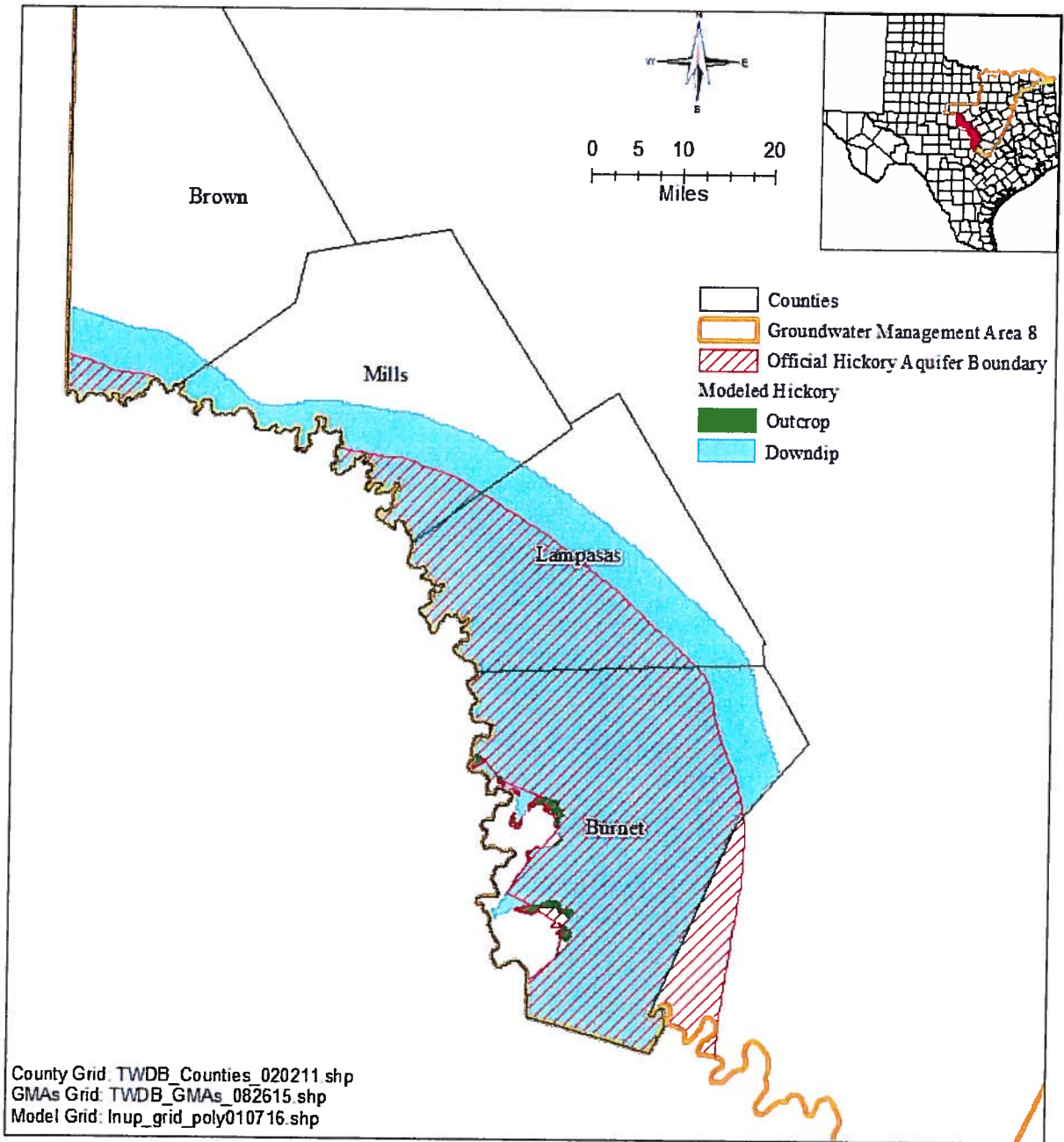
**FIGURE 9. MAP SHOWING THE EDWARDS (BALCONES FAULT ZONE) AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 8 FROM THE GROUNDWATER AVAILABILITY MODEL FOR THE NORTHERN SEGMENT OF THE EDWARDS (BALCONES FAULT ZONE) AQUIFER.**



**FIGURE 10. MAP SHOWING THE MARBLE FALLS AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 8 FROM THE GROUNDWATER AVAILABILITY MODEL FOR THE MINOR AQUIFERS IN LLANO UPLIFT REGION.**

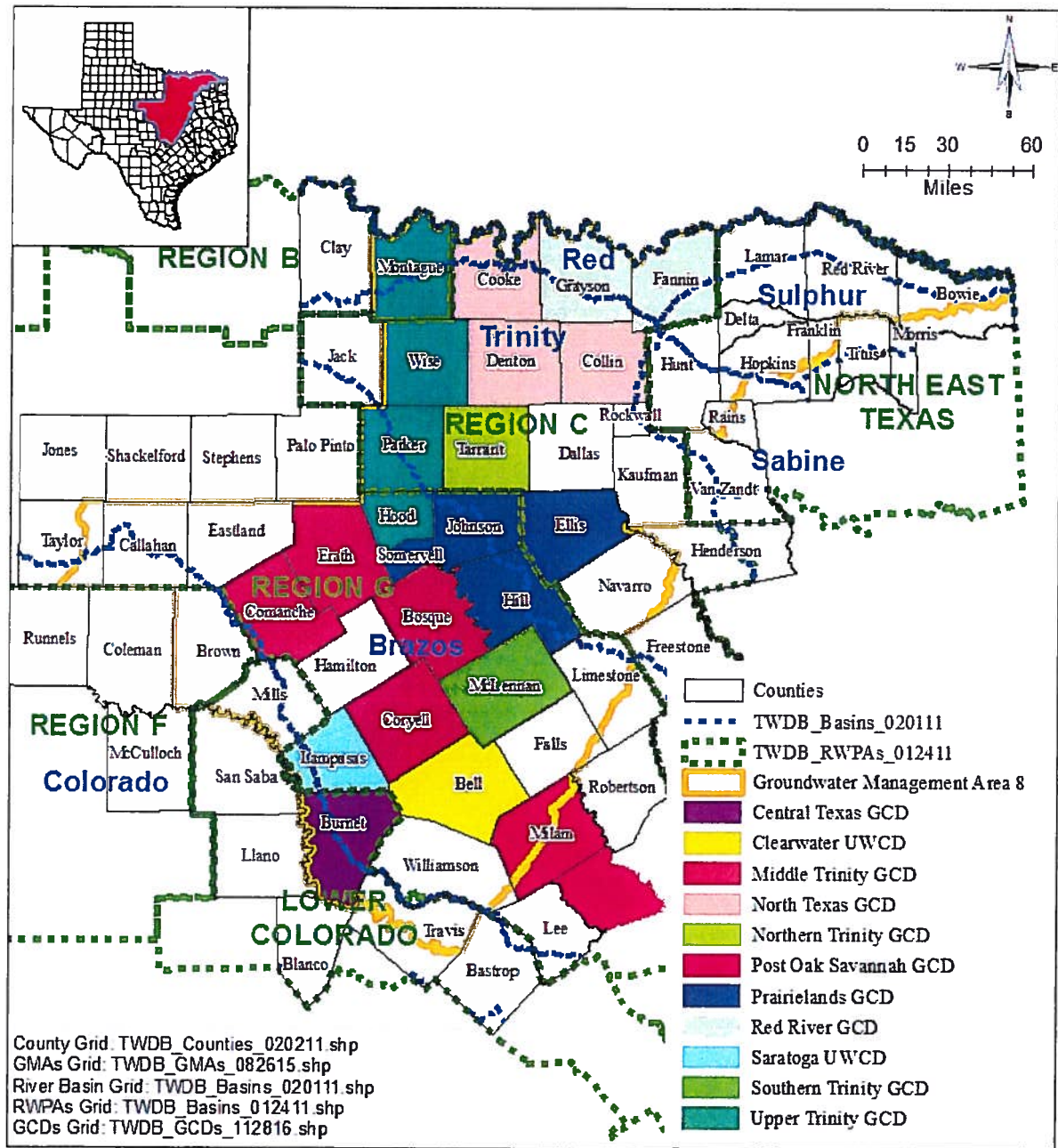


**FIGURE 11. MAP SHOWING THE ELLENBURGER-SAN SABA AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 8 FROM THE GROUNDWATER AVAILABILITY MODEL FOR THE MINOR AQUIFERS IN LLANO UPLIFT REGION.**



**FIGURE 12. MAP SHOWING THE HICKORY AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 8 FROM THE GROUNDWATER AVAILABILITY MODEL FOR THE MINOR AQUIFERS IN LLANO UPLIFT REGION.**





**FIGURE 13. MAP SHOWING REGIONAL WATER PLANNING AREAS (RWPAS), GROUNDWATER CONSERVATION DISTRICTS (GCDs), AND RIVER BASINS ASSOCIATED WITH GROUNDWATER MANAGEMENT AREA 8.**

GAM Run 17-029 MAG: Modeled Available Groundwater for the Trinity, Woodbine, Edwards (Balcones Fault Zone), Marble Falls, Ellenburger-San Saba, and Hickory Aquifers in Groundwater Management Area 8

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**TABLE 1. MODELED AVAILABLE GROUNDWATER FOR THE TRINITY AQUIFER (PALUXY) IN GROUNDWATER MANAGEMENT AREA 8 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2010 AND 2070 WITH BASELINE YEAR 2009. VALUES ARE IN ACRE-FEET PER YEAR.**

GCD	County	2009	2010	2020	2030	2040	2050	2060	2070
Clearwater UWCD	Bell	0	0	0	0	0	0	0	0
Middle Trinity GCD	Bosque	204	356	358	356	358	356	358	356
Middle Trinity GCD	Coryell	0	0	0	0	0	0	0	0
Middle Trinity GCD	Erath	38	61	61	61	61	61	61	61
<b>Middle Trinity GCD Total</b>		<b>242</b>	<b>417</b>	<b>419</b>	<b>417</b>	<b>419</b>	<b>417</b>	<b>419</b>	<b>417</b>
North Texas GCD	Collin	616	1,547	1,551	1,547	1,551	1,547	1,551	1,547
North Texas GCD	Denton	1,532	4,819	4,832	4,819	4,832	4,819	4,832	4,819
<b>North Texas GCD Total</b>		<b>2,148</b>	<b>6,366</b>	<b>6,383</b>	<b>6,366</b>	<b>6,383</b>	<b>6,366</b>	<b>6,383</b>	<b>6,366</b>
<b>Northern Trinity GCD</b>	Tarrant	<b>11,285</b>	<b>8,957</b>	<b>8,982</b>	<b>8,957</b>	<b>8,982</b>	<b>8,957</b>	<b>8,982</b>	<b>8,957</b>
Prairielands GCD	Ellis	510	442	443	442	443	442	443	442
Prairielands GCD	Hill	400	352	353	352	353	352	353	352
Prairielands GCD	Johnson	4,851	2,440	2,447	2,440	2,447	2,440	2,447	2,440
Prairielands GCD	Somervell	3	14	14	14	14	14	14	14
<b>Prairielands GCD Total</b>		<b>5,764</b>	<b>3,248</b>	<b>3,257</b>	<b>3,248</b>	<b>3,257</b>	<b>3,248</b>	<b>3,257</b>	<b>3,248</b>
Red River GCD	Fannin	389	2,087	2,092	2,087	2,092	2,087	2,092	2,087
Red River GCD	Grayson	0	0	0	0	0	0	0	0
<b>Red River GCD Total</b>		<b>389</b>	<b>2,087</b>	<b>2,092</b>	<b>2,087</b>	<b>2,092</b>	<b>2,087</b>	<b>2,092</b>	<b>2,087</b>
<b>Southern Trinity GCD</b>	McLennan	<b>319</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
Upper Trinity GCD	Hood (outcrop)	106	159	159	159	159	159	159	159
Upper Trinity GCD	Parker (outcrop)	2,100	2,607	2,614	2,607	2,614	2,607	2,614	2,607
Upper Trinity GCD	Parker (downdip)	221	50	50	50	50	50	50	50
<b>Upper Trinity GCD Total</b>		<b>2,427</b>	<b>2,816</b>	<b>2,823</b>	<b>2,816</b>	<b>2,823</b>	<b>2,816</b>	<b>2,823</b>	<b>2,816</b>
No District	Dallas	231	358	359	358	359	358	359	358
No District	Delta	56	56	56	56	56	56	56	56
No District	Falls	0	0	0	0	0	0	0	0
No District	Hamilton	0	0	0	0	0	0	0	0
No District	Hunt	3	3	3	3	3	3	3	3
No District	Kaufman	0	0	0	0	0	0	0	0
No District	Lamar	16	8	8	8	8	8	8	8

GAM Run 17-029 MAG: Modeled Available Groundwater for the Trinity, Woodbine, Edwards (Balcones Fault Zone), Marble Falls, Ellenburger-San Saba, and Hickory Aquifers in Groundwater Management Area 8

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<b>GCD</b>	<b>County</b>	<b>2009</b>	<b>2010</b>	<b>2020</b>	<b>2030</b>	<b>2040</b>	<b>2050</b>	<b>2060</b>	<b>2070</b>
No District	Limestone	0	0	0	0	0	0	0	0
No District	Mills	3	6	6	6	6	6	6	6
No District	Navarro	0	0	0	0	0	0	0	0
No District	Red River	190	177	177	177	177	177	177	177
No District	Rockwall	0	0	0	0	0	0	0	0
<b>No District Total</b>		<b>499</b>	<b>608</b>	<b>609</b>	<b>608</b>	<b>609</b>	<b>608</b>	<b>609</b>	<b>608</b>
<b>Groundwater Management Area 8</b>		<b>23,073</b>	<b>24,499</b>	<b>24,565</b>	<b>24,499</b>	<b>24,565</b>	<b>24,499</b>	<b>24,565</b>	<b>24,499</b>

UWCD: Underground Water Conservation District.



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**TABLE 2. MODELED AVAILABLE GROUNDWATER FOR THE TRINITY AQUIFER (GLEN ROSE) IN GROUNDWATER MANAGEMENT AREA 8 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2010 AND 2070 WITH BASELINE YEAR 2009. VALUES ARE IN ACRE-FEET PER YEAR.**

GCD	County	2009	2010	2020	2030	2040	2050	2060	2070
Central Texas GCD	Burnet	35	423	425	423	425	423	425	423
Clearwater UWCD	Bell	775	971	974	971	974	971	974	971
Middle Trinity GCD	Bosque	576	728	731	728	731	728	731	728
Middle Trinity GCD	Comanche	3	41	41	41	41	41	41	41
Middle Trinity GCD	Coryell	0	120	120	120	120	120	120	120
Middle Trinity GCD	Erath	263	1,078	1,081	1,078	1,081	1,078	1,081	1,078
<b>Middle Trinity GCD Total</b>		<b>842</b>	<b>1,967</b>	<b>1,973</b>	<b>1,967</b>	<b>1,973</b>	<b>1,967</b>	<b>1,973</b>	<b>1,967</b>
North Texas GCD	Collin	84	83	83	83	83	83	83	83
North Texas GCD	Denton	121	338	339	338	339	338	339	338
<b>North Texas GCD Total</b>		<b>205</b>	<b>421</b>	<b>422</b>	<b>421</b>	<b>422</b>	<b>421</b>	<b>422</b>	<b>421</b>
Northern Trinity GCD	Tarrant	1,070	793	795	793	795	793	795	793
Post Oak Savannah GCD	Milam	0	0	0	0	0	0	0	0
Prairielands GCD	Ellis	58	50	50	50	50	50	50	50
Prairielands GCD	Hill	116	115	115	115	115	115	115	115
Prairielands GCD	Johnson	1,780	1,632	1,636	1,632	1,636	1,632	1,636	1,632
Prairielands GCD	Somervell	81	146	146	146	146	146	146	146
<b>Prairielands GCD Total</b>		<b>2,035</b>	<b>1,943</b>	<b>1,947</b>	<b>1,943</b>	<b>1,947</b>	<b>1,943</b>	<b>1,947</b>	<b>1,943</b>
Red River GCD	Fannin	0	0	0	0	0	0	0	0
Red River GCD	Grayson	0	0	0	0	0	0	0	0
<b>Red River GCD Total</b>		<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
Saratoga UWCD	Lampasas	65	68	68	68	68	68	68	68
Southern Trinity GCD	McLennan	845	0	0	0	0	0	0	0
Upper Trinity GCD	Hood (outcrop)	483	653	655	653	655	653	655	653
Upper Trinity GCD	Hood (downdip)	81	103	103	103	103	103	103	103
Upper Trinity GCD	Parker (outcrop)	2,593	2,289	2,295	2,289	2,295	2,289	2,295	2,289
Upper Trinity GCD	Parker (downdip)	1,063	873	876	873	876	873	876	873
<b>Upper Trinity GCD Total</b>		<b>4,220</b>	<b>3,918</b>	<b>3,929</b>	<b>3,918</b>	<b>3,929</b>	<b>3,918</b>	<b>3,929</b>	<b>3,918</b>

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<b>GCD</b>	<b>County</b>	<b>2009</b>	<b>2010</b>	<b>2020</b>	<b>2030</b>	<b>2040</b>	<b>2050</b>	<b>2060</b>	<b>2070</b>
No District	Brown	0	0	0	0	0	0	0	0
No District	Dallas	135	131	132	131	132	131	132	131
No District	Delta	0	0	0	0	0	0	0	0
No District	Falls	0	0	0	0	0	0	0	0
No District	Hamilton	168	218	218	218	218	218	218	218
No District	Hunt	0	0	0	0	0	0	0	0
No District	Kaufman	0	0	0	0	0	0	0	0
No District	Lamar	0	0	0	0	0	0	0	0
No District	Limestone	0	0	0	0	0	0	0	0
No District	Mills	12	189	189	189	189	189	189	189
No District	Navarro	0	0	0	0	0	0	0	0
No District	Red River	0	0	0	0	0	0	0	0
No District	Rockwall	0	0	0	0	0	0	0	0
No District	Travis	898	971	974	971	974	971	974	971
No District	Williamson	695	688	690	688	690	688	690	688
<b>No District Total</b>		<b>1,908</b>	<b>2,197</b>	<b>2,203</b>	<b>2,197</b>	<b>2,203</b>	<b>2,197</b>	<b>2,203</b>	<b>2,197</b>
<b>Groundwater Management Area 8</b>		<b>12,000</b>	<b>12,701</b>	<b>12,736</b>	<b>12,701</b>	<b>12,736</b>	<b>12,701</b>	<b>12,736</b>	<b>12,701</b>

UWCD: Underground Water Conservation District.

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**TABLE 3. MODELED AVAILABLE GROUNDWATER FOR THE TRINITY AQUIFER (TWIN MOUNTAINS) IN GROUNDWATER MANAGEMENT AREA 8 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2010 AND 2070 WITH BASELINE YEAR 2009. VALUES ARE IN ACRE-FEET PER YEAR.**

GCD	County	2009	2010	2020	2030	2040	2050	2060	2070
<b>Middle Trinity GCD</b>	Erath	<b>3,443</b>	<b>5,017</b>	<b>5,031</b>	<b>5,017</b>	<b>5,031</b>	<b>5,017</b>	<b>5,031</b>	<b>5,017</b>
North Texas GCD	Collin	163	2,201	2,207	2,201	2,207	2,201	2,207	2,201
North Texas GCD	Denton	997	8,366	8,389	8,366	8,389	8,366	8,389	8,366
<b>North Texas GCD Total</b>		<b>1,160</b>	<b>10,567</b>	<b>10,596</b>	<b>10,567</b>	<b>10,596</b>	<b>10,567</b>	<b>10,596</b>	<b>10,567</b>
<b>Northern Trinity GCD</b>	Tarrant	<b>7,329</b>	<b>6,917</b>	<b>6,936</b>	<b>6,917</b>	<b>6,936</b>	<b>6,917</b>	<b>6,936</b>	<b>6,917</b>
Prairielands GCD	Ellis	0	0	0	0	0	0	0	0
Prairielands GCD	Johnson	539	384	385	384	385	384	385	384
Prairielands GCD	Somervell	150	174	174	174	174	174	174	174
<b>Prairielands GCD Total</b>		<b>689</b>	<b>558</b>	<b>559</b>	<b>558</b>	<b>559</b>	<b>558</b>	<b>559</b>	<b>558</b>
Red River GCD	Fannin	0	0	0	0	0	0	0	0
Red River GCD	Grayson	0	0	0	0	0	0	0	0
<b>Red River GCD Total</b>		<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
Upper Trinity GCD	Hood (outcrop)	3,379	3,662	3,672	3,662	3,672	3,662	3,672	3,662
Upper Trinity GCD	Hood (downdip)	7,143	7,759	7,780	7,759	7,780	7,759	7,780	7,759
Upper Trinity GCD	Parker (outcrop)	1,600	1,066	1,069	1,066	1,069	1,066	1,069	1,066
Upper Trinity GCD	Parker (downdip)	3,459	2,082	2,088	2,082	2,088	2,082	2,088	2,082
<b>Upper Trinity GCD Total</b>		<b>15,581</b>	<b>14,569</b>	<b>14,609</b>	<b>14,569</b>	<b>14,609</b>	<b>14,569</b>	<b>14,609</b>	<b>14,569</b>
No District	Dallas	2,282	3,199	3,208	3,199	3,208	3,199	3,208	3,199
No District	Hunt	0	0	0	0	0	0	0	0
No District	Kaufman	0	0	0	0	0	0	0	0
No District	Rockwall	0	0	0	0	0	0	0	0
<b>No District Total</b>		<b>2,282</b>	<b>3,199</b>	<b>3,208</b>	<b>3,199</b>	<b>3,208</b>	<b>3,199</b>	<b>3,208</b>	<b>3,199</b>
<b>Groundwater Management Area 8</b>		<b>30,484</b>	<b>40,827</b>	<b>40,939</b>	<b>40,827</b>	<b>40,939</b>	<b>40,827</b>	<b>40,939</b>	<b>40,827</b>

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**TABLE 4. MODELED AVAILABLE GROUNDWATER FOR THE TRINITY AQUIFER (TRAVIS PEAK) IN GROUNDWATER MANAGEMENT AREA 8 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2010 AND 2070 WITH BASELINE YEAR 2009. VALUES ARE IN ACRE-FEET PER YEAR.**

GCD	County	2009	2010	2020	2030	2040	2050	2060	2070
Central Texas GCD	Burnet	1,906	3,464	3,474	3,464	3,474	3,464	3,474	3,464
Clearwater UWCD	Bell	1,957	8,270	8,293	8,270	8,293	8,270	8,293	8,270
Middle Trinity GCD	Bosque	5,255	7,678	7,699	7,678	7,699	7,678	7,699	7,678
Middle Trinity GCD	Comanche	9,793	6,160	6,177	6,160	6,177	6,160	6,177	6,160
Middle Trinity GCD	Coryell	3,350	4,371	4,383	4,371	4,383	4,371	4,383	4,371
Middle Trinity GCD	Erath	8,263	11,815	11,849	11,815	11,849	11,815	11,849	11,815
<b>Middle Trinity GCD Total</b>		<b>26,661</b>	<b>30,024</b>	<b>30,108</b>	<b>30,024</b>	<b>30,108</b>	<b>30,024</b>	<b>30,108</b>	<b>30,024</b>
Post Oak Savannah GCD	Milam	0	0	0	0	0	0	0	0
Prairielands GCD	Ellis	5,583	5,032	5,046	5,032	5,046	5,032	5,046	5,032
Prairielands GCD	Hill	3,700	3,550	3,559	3,550	3,559	3,550	3,559	3,550
Prairielands GCD	Johnson	5,602	4,941	4,955	4,941	4,955	4,941	4,955	4,941
Prairielands GCD	Somervell	2,560	2,847	2,854	2,847	2,854	2,847	2,854	2,847
<b>Prairielands GCD Total</b>		<b>17,445</b>	<b>16,370</b>	<b>16,414</b>	<b>16,370</b>	<b>16,414</b>	<b>16,370</b>	<b>16,414</b>	<b>16,370</b>
Red River GCD	Fannin	0	0	0	0	0	0	0	0
Saratoga UWCD	Lampasas	1,669	1,599	1,603	1,599	1,603	1,599	1,603	1,599
Southern Trinity GCD	McLennan	13,252	20,635	20,691	20,635	20,691	20,635	20,691	20,635
Upper Trinity GCD	Hood (down dip)	70	89	89	89	89	89	89	89
No District	Brown	680	394	395	394	395	394	395	394
No District	Dallas	0	0	0	0	0	0	0	0
No District	Delta	0	0	0	0	0	0	0	0
No District	Falls	1,158	1,434	1,438	1,434	1,438	1,434	1,438	1,434
No District	Hamilton	1,685	2,207	2,213	2,207	2,213	2,207	2,213	2,207
No District	Hunt	0	0	0	0	0	0	0	0
No District	Kaufman	0	0	0	0	0	0	0	0
No District	Lamar	0	0	0	0	0	0	0	0
No District	Limestone	0	0	0	0	0	0	0	0
No District	Mills	1,011	2,275	2,282	2,275	2,282	2,275	2,282	2,275
No District	Navarro	0	0	0	0	0	0	0	0
No District	Red River	0	0	0	0	0	0	0	0
No District	Travis	3,442	4,113	4,125	4,113	4,125	4,113	4,125	4,113
No District	Williamson	3,026	2,883	2,891	2,883	2,891	2,883	2,891	2,883

GAM Run 17-029 MAG: Modeled Available Groundwater for the Trinity, Woodbine, Edwards (Balcones Fault Zone), Marble Falls, Ellenburger-San Saba, and Hickory Aquifers in Groundwater Management Area 8

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<b>GCD</b>	<b>County</b>	<b>2009</b>	<b>2010</b>	<b>2020</b>	<b>2030</b>	<b>2040</b>	<b>2050</b>	<b>2060</b>	<b>2070</b>
<b>No District Total</b>		<b>11,002</b>	<b>13,306</b>	<b>13,344</b>	<b>13,306</b>	<b>13,344</b>	<b>13,306</b>	<b>13,344</b>	<b>13,306</b>
<b>Groundwater Management Area 8</b>		<b>73,962</b>	<b>93,757</b>	<b>94,016</b>	<b>93,757</b>	<b>94,016</b>	<b>93,757</b>	<b>94,016</b>	<b>93,757</b>

UWCD: Underground Water Conservation District.

**TABLE 5. MODELED AVAILABLE GROUNDWATER FOR THE TRINITY AQUIFER (HENSELL) IN GROUNDWATER MANAGEMENT AREA 8 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2010 AND 2070 WITH BASELINE YEAR 2009. VALUES ARE IN ACRE-FEET PER YEAR.**

GCD	County	2009	2010	2020	2030	2040	2050	2060	2070
Central Texas GCD	Burnet	51	1,888	1,894	1,888	1,894	1,888	1,894	1,888
Clearwater UWCD	Bell	355	1,096	1,099	1,096	1,099	1,096	1,099	1,096
Middle Trinity GCD	Bosque	2,909	3,835	3,845	3,835	3,845	3,835	3,845	3,835
Middle Trinity GCD	Comanche	188	204	204	204	204	204	204	204
Middle Trinity GCD	Coryell	1,679	2,196	2,202	2,196	2,202	2,196	2,202	2,196
Middle Trinity GCD	Erath	3,446	5,137	5,151	5,137	5,151	5,137	5,151	5,137
<b>Middle Trinity GCD Total</b>		<b>8,222</b>	<b>11,372</b>	<b>11,402</b>	<b>11,372</b>	<b>11,402</b>	<b>11,372</b>	<b>11,402</b>	<b>11,372</b>
Post Oak Savannah GCD	Milam	0	0	0	0	0	0	0	0
Prairielands GCD	Ellis	0	0	0	0	0	0	0	0
Prairielands GCD	Hill	237	225	226	225	226	225	226	225
Prairielands GCD	Johnson	1,530	1,083	1,086	1,083	1,086	1,083	1,086	1,083
Prairielands GCD	Somervell	1,822	1,973	1,978	1,973	1,978	1,973	1,978	1,973
<b>Prairielands GCD Total</b>		<b>3,589</b>	<b>3,281</b>	<b>3,290</b>	<b>3,281</b>	<b>3,290</b>	<b>3,281</b>	<b>3,290</b>	<b>3,281</b>
Saratoga UWCD	Lampasas	730	712	715	712	715	712	715	712
Southern Trinity GCD	McLennan	3,018	4,698	4,711	4,698	4,711	4,698	4,711	4,698
Upper Trinity GCD	Hood (downdip)	45	36	36	36	36	36	36	36
No District	Brown	6	4	4	4	4	4	4	4
No District	Dallas	0	0	0	0	0	0	0	0
No District	Falls	0	0	0	0	0	0	0	0
No District	Hamilton	1,221	1,671	1,675	1,671	1,675	1,671	1,675	1,671
No District	Kaufman	0	0	0	0	0	0	0	0
No District	Limestone	0	0	0	0	0	0	0	0
No District	Mills	224	607	608	607	608	607	608	607
No District	Navarro	0	0	0	0	0	0	0	0
No District	Travis	919	1,141	1,144	1,141	1,144	1,141	1,144	1,141
No District	Williamson	772	751	753	751	753	751	753	751
<b>No District Total</b>		<b>3,142</b>	<b>4,174</b>	<b>4,184</b>	<b>4,174</b>	<b>4,184</b>	<b>4,174</b>	<b>4,184</b>	<b>4,174</b>
<b>Groundwater Management Area 8</b>		<b>19,152</b>	<b>27,257</b>	<b>27,331</b>	<b>27,257</b>	<b>27,331</b>	<b>27,257</b>	<b>27,331</b>	<b>27,257</b>

UWCD: Underground Water Conservation District.

**TABLE 6. MODELED AVAILABLE GROUNDWATER FOR THE TRINITY AQUIFER (HOSSTON) IN GROUNDWATER MANAGEMENT AREA 8 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2010 AND 2070 WITH BASELINE YEAR 2009. VALUES ARE IN ACRE-FEET PER YEAR.**

GCD	County	2009	2010	2020	2030	2040	2050	2060	2070
Central Texas GCD	Burnet	1,799	1,379	1,382	1,379	1,382	1,379	1,382	1,379
Clearwater UWCD	Bell	1,375	7,174	7,193	7,174	7,193	7,174	7,193	7,174
Middle Trinity GCD	Bosque	2,289	3,762	3,772	3,762	3,772	3,762	3,772	3,762
Middle Trinity GCD	Comanche	9,504	5,864	5,881	5,864	5,881	5,864	5,881	5,864
Middle Trinity GCD	Coryell	1,661	2,161	2,167	2,161	2,167	2,161	2,167	2,161
Middle Trinity GCD	Erath	4,637	6,383	6,400	6,383	6,400	6,383	6,400	6,383
<b>Middle Trinity GCD Total</b>		<b>18,091</b>	<b>18,170</b>	<b>18,220</b>	<b>18,170</b>	<b>18,220</b>	<b>18,170</b>	<b>18,220</b>	<b>18,170</b>
Post Oak Savannah GCD	Milam	0	0	0	0	0	0	0	0
Prairielands GCD	Ellis	5,575	5,026	5,040	5,026	5,040	5,026	5,040	5,026
Prairielands GCD	Hill	3,413	3,272	3,281	3,272	3,281	3,272	3,281	3,272
Prairielands GCD	Johnson	4,061	3,853	3,863	3,853	3,863	3,853	3,863	3,853
Prairielands GCD	Somervell	736	843	845	843	845	843	845	843
<b>Prairielands GCD Total</b>		<b>13,785</b>	<b>12,994</b>	<b>13,029</b>	<b>12,994</b>	<b>13,029</b>	<b>12,994</b>	<b>13,029</b>	<b>12,994</b>
Saratoga UWCD	Lampasas	907	857	859	857	859	857	859	857
Southern Trinity GCD	McLennan	10,212	15,937	15,980	15,937	15,980	15,937	15,980	15,937
Upper Trinity GCD	Hood (down dip)	25	53	53	53	53	53	53	53
No District	Brown	624	356	358	356	358	356	358	356
No District	Dallas	0	0	0	0	0	0	0	0
No District	Falls	1,157	1,434	1,438	1,434	1,438	1,434	1,438	1,434
No District	Hamilton	325	385	386	385	386	385	386	385
No District	Kaufman	0	0	0	0	0	0	0	0
No District	Limestone	0	0	0	0	0	0	0	0
No District	Mills	650	1,467	1,471	1,467	1,471	1,467	1,471	1,467
No District	Navarro	0	0	0	0	0	0	0	0
No District	Travis	2,357	2,783	2,791	2,783	2,791	2,783	2,791	2,783
No District	Williamson	2,050	1,933	1,938	1,933	1,938	1,933	1,938	1,933
<b>No District Total</b>		<b>7,163</b>	<b>8,358</b>	<b>8,382</b>	<b>8,358</b>	<b>8,382</b>	<b>8,358</b>	<b>8,382</b>	<b>8,358</b>
<b>Groundwater Management Area 8</b>		<b>53,357</b>	<b>64,922</b>	<b>65,098</b>	<b>64,922</b>	<b>65,098</b>	<b>64,922</b>	<b>65,098</b>	<b>64,922</b>

UWCD: Underground Water Conservation District.

**TABLE 7. MODELED AVAILABLE GROUNDWATER FOR THE TRINITY AQUIFER (ANTLERS) IN GROUNDWATER MANAGEMENT AREA 8 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2010 AND 2070 WITH BASELINE YEAR 2009. VALUES ARE IN ACRE-FEET PER YEAR.**

GCD	County	2009	2010	2020	2030	2040	2050	2060	2070
Middle Trinity GCD	Comanche	9,320	5,839	5,855	5,839	5,855	5,839	5,855	5,839
Middle Trinity GCD	Erath	1,663	2,628	2,636	2,628	2,636	2,628	2,636	2,628
<b>Middle Trinity GCD Total</b>		<b>10,983</b>	<b>8,467</b>	<b>8,491</b>	<b>8,467</b>	<b>8,491</b>	<b>8,467</b>	<b>8,491</b>	<b>8,467</b>
North Texas GCD	Collin	629	1,961	1,966	1,961	1,966	1,961	1,966	1,961
North Texas GCD	Cooke	4,117	10,514	10,544	10,514	10,544	10,514	10,544	10,514
North Texas GCD	Denton	11,427	16,545	16,591	16,545	16,591	16,545	16,591	16,545
<b>North Texas GCD Total</b>		<b>16,173</b>	<b>29,020</b>	<b>29,101</b>	<b>29,020</b>	<b>29,101</b>	<b>29,020</b>	<b>29,101</b>	<b>29,020</b>
<b>Northern Trinity GCD</b>	Tarrant	<b>1,908</b>	<b>1,248</b>	<b>1,251</b>	<b>1,248</b>	<b>1,251</b>	<b>1,248</b>	<b>1,251</b>	<b>1,248</b>
Red River GCD	Fannin	0	0	0	0	0	0	0	0
Red River GCD	Grayson	6,872	10,708	10,738	10,708	10,738	10,708	10,738	10,708
<b>Red River GCD Total</b>		<b>6,872</b>	<b>10,708</b>	<b>10,738</b>	<b>10,708</b>	<b>10,738</b>	<b>10,708</b>	<b>10,738</b>	<b>10,708</b>
Upper Trinity GCD	Montague (outcrop)	1,421	3,875	3,886	3,875	3,886	3,875	3,886	3,875
Upper Trinity GCD	Parker (outcrop)	3,321	2,897	2,905	2,897	2,905	2,897	2,905	2,897
Upper Trinity GCD	Wise (outcrop)	9,080	7,677	7,698	7,677	7,698	7,677	7,698	7,677
Upper Trinity GCD	Wise (downdip)	3,699	2,057	2,062	2,057	2,062	2,057	2,062	2,057
<b>Upper Trinity GCD Total</b>		<b>17,521</b>	<b>16,506</b>	<b>16,551</b>	<b>16,506</b>	<b>16,551</b>	<b>16,506</b>	<b>16,551</b>	<b>16,506</b>
No District	Brown	1,743	1,052	1,055	1,052	1,055	1,052	1,055	1,052
No District	Callahan	1,804	1,725	1,730	1,725	1,730	1,725	1,730	1,725
No District	Eastland	5,613	5,732	5,747	5,732	5,747	5,732	5,747	5,732
No District	Lamar	0	0	0	0	0	0	0	0
No District	Red River	0	0	0	0	0	0	0	0
No District	Taylor	17	13	13	13	13	13	13	13
<b>No District Total</b>		<b>9,177</b>	<b>8,522</b>	<b>8,545</b>	<b>8,522</b>	<b>8,545</b>	<b>8,522</b>	<b>8,545</b>	<b>8,522</b>
<b>Groundwater Management Area 8</b>		<b>62,634</b>	<b>74,471</b>	<b>74,677</b>	<b>74,471</b>	<b>74,677</b>	<b>74,471</b>	<b>74,677</b>	<b>74,471</b>



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**TABLE 8. MODELED AVAILABLE GROUNDWATER FOR THE WOODBINE AQUIFER IN GROUNDWATER MANAGEMENT AREA 8 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2010 AND 2070 WITH BASELINE YEAR 2009. VALUES ARE IN ACRE-FEET PER YEAR.**

GCD	County	2009	2010	2020	2030	2040	2050	2060	2070
North Texas GCD	Collin	2,427	4,251	4,263	4,251	4,263	4,251	4,263	4,251
North Texas GCD	Cooke	1,646	800	802	800	802	800	802	800
North Texas GCD	Denton	3,797	3,607	3,616	3,607	3,616	3,607	3,616	3,607
<b>North Texas GCD Total</b>		<b>7,870</b>	<b>8,658</b>	<b>8,681</b>	<b>8,658</b>	<b>8,681</b>	<b>8,658</b>	<b>8,681</b>	<b>8,658</b>
<b>Northern Trinity GCD</b>	Tarrant	<b>2,646</b>	<b>1,138</b>	<b>1,141</b>	<b>1,138</b>	<b>1,141</b>	<b>1,138</b>	<b>1,141</b>	<b>1,138</b>
Prairielands GCD	Ellis	2,471	2,073	2,078	2,073	2,078	2,073	2,078	2,073
Prairielands GCD	Hill	752	586	588	586	588	586	588	586
Prairielands GCD	Johnson	3,880	1,980	1,985	1,980	1,985	1,980	1,985	1,980
<b>Prairielands GCD Total</b>		<b>7,103</b>	<b>4,639</b>	<b>4,651</b>	<b>4,639</b>	<b>4,651</b>	<b>4,639</b>	<b>4,651</b>	<b>4,639</b>
Red River GCD	Fannin	5,495	4,920	4,934	4,920	4,934	4,920	4,934	4,920
Red River GCD	Grayson	5,056	7,521	7,541	7,521	7,541	7,521	7,541	7,521
<b>Red River GCD Total</b>		<b>10,551</b>	<b>12,441</b>	<b>12,475</b>	<b>12,441</b>	<b>12,475</b>	<b>12,441</b>	<b>12,475</b>	<b>12,441</b>
<b>Southern Trinity GCD</b>	McLennan	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
No District	Dallas	1,957	2,796	2,804	2,796	2,804	2,796	2,804	2,796
No District	Hunt	463	763	765	763	765	763	765	763
No District	Kaufman	0	0	0	0	0	0	0	0
No District	Lamar	61	49	49	49	49	49	49	49
No District	Navarro	65	68	68	68	68	68	68	68
No District	Red River	3	2	2	2	2	2	2	2
No District	Rockwall	0	0	0	0	0	0	0	0
<b>No District Total</b>		<b>2,549</b>	<b>3,678</b>	<b>3,688</b>	<b>3,678</b>	<b>3,688</b>	<b>3,678</b>	<b>3,688</b>	<b>3,678</b>
<b>Groundwater Management Area 8</b>		<b>30,719</b>	<b>30,554</b>	<b>30,636</b>	<b>30,554</b>	<b>30,636</b>	<b>30,554</b>	<b>30,636</b>	<b>30,554</b>

**TABLE 9. MODELED AVAILABLE GROUNDWATER FOR THE EDWARDS (BALCONES FAULT ZONE) AQUIFER IN GROUNDWATER MANAGEMENT AREA 8 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2010 AND 2070 WITH BASELINE YEAR 2009. VALUES ARE IN ACRE-FEET PER YEAR.**

GCD	County	2000	2010	2020	2030	2040	2050	2060	2070
Clearwater UWCD	Bell	949	6,469	6,469	6,469	6,469	6,469	6,469	6,469
No District	Travis	1,201	5,237	5,237	5,237	5,237	5,237	5,237	5,237
No District	Williamson	13,813	3,462	3,462	3,462	3,462	3,462	3,462	3,462
<b>Groundwater Management Area 8</b>		<b>15,981</b>	<b>15,168</b>	<b>15,168</b>	<b>15,168</b>	<b>15,168</b>	<b>15,168</b>	<b>15,168</b>	<b>15,168</b>

UWCD: Underground Water Conservation District.

**TABLE 10. MODELED AVAILABLE GROUNDWATER FOR THE MARBLE FALLS AQUIFER IN GROUNDWATER MANAGEMENT AREA 8 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2010 AND 2070 WITH BASELINE YEAR 2009. VALUES ARE IN ACRE-FEET PER YEAR.**

GCD	County	2009	2010	2020	2030	2040	2050	2060	2070
Central Texas GCD	Burnet	2,220	2,736	2,744	2,736	2,744	2,736	2,744	2,736
Saratoga UWCD	Lampasas	363	2,837	2,845	2,837	2,845	2,837	2,845	2,837
No District	Brown	0	25	25	25	25	25	25	25
No District	Mills	20	25	25	25	25	25	25	25
<b>No District Total</b>		<b>20</b>	<b>50</b>	<b>50</b>	<b>50</b>	<b>50</b>	<b>50</b>	<b>50</b>	<b>50</b>
<b>Groundwater Management Area 8</b>		<b>2,603</b>	<b>5,623</b>	<b>5,639</b>	<b>5,623</b>	<b>5,639</b>	<b>5,623</b>	<b>5,639</b>	<b>5,623</b>

UWCD: Underground Water Conservation District.

**TABLE 11. MODELED AVAILABLE GROUNDWATER FOR THE ELLENBURGER-SAN SABA AQUIFER IN GROUNDWATER MANAGEMENT AREA 8 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2010 AND 2070 WITH BASELINE YEAR 2009. VALUES ARE IN ACRE-FEET PER YEAR.**

GCD	County	2009	2010	2020	2030	2040	2050	2060	2070
Central Texas GCD	Burnet	5,256	10,827	10,857	10,827	10,857	10,827	10,857	10,827
Saratoga UWCD	Lampasas	351	2,593	2,601	2,593	2,601	2,593	2,601	2,593
No District	Brown	1	131	131	131	131	131	131	131
No District	Mills	0	499	500	499	500	499	500	499
<b>No District Total</b>		<b>1</b>	<b>630</b>	<b>631</b>	<b>630</b>	<b>631</b>	<b>630</b>	<b>631</b>	<b>630</b>
<b>Groundwater Management Area 8</b>		<b>5,608</b>	<b>14,050</b>	<b>14,089</b>	<b>14,050</b>	<b>14,089</b>	<b>14,050</b>	<b>14,089</b>	<b>14,050</b>

UWCD: Underground Water Conservation District.

**TABLE 12. MODELED AVAILABLE GROUNDWATER FOR THE HICKORY AQUIFER IN GROUNDWATER MANAGEMENT AREA 8 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2010 AND 2070 WITH BASELINE YEAR 2009. VALUES ARE IN ACRE-FEET PER YEAR.**

GCD	County	2009	2010	2020	2030	2040	2050	2060	2070
Central Texas GCD	Burnet	1,088	3,413	3,423	3,413	3,423	3,413	3,423	3,413
Saratoga UWCD	Lampasas	0	113	114	113	114	113	114	113
No District	Brown	0	12	12	12	12	12	12	12
No District	Mills	0	36	36	36	36	36	36	36
<b>No District Total</b>		<b>0</b>	<b>48</b>	<b>48</b>	<b>48</b>	<b>48</b>	<b>48</b>	<b>48</b>	<b>48</b>
<b>Groundwater Management Area 8</b>		<b>1,088</b>	<b>3,574</b>	<b>3,585</b>	<b>3,574</b>	<b>3,585</b>	<b>3,574</b>	<b>3,585</b>	<b>3,574</b>

UWCD: Underground Water Conservation District.

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**TABLE 13. MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE TRINITY AQUIFER (PALUXY) IN GROUNDWATER MANAGEMENT AREA 8. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN.**

County	RWPA	River Basin	2020	2030	2040	2050	2060	2070
<b>Counties Not in Upper Trinity GCD</b>								
Bell	Region G	Brazos	0	0	0	0	0	0
Bosque	Region G	Brazos	358	356	358	356	358	356
Collin	Region C	Sabine	0	0	0	0	0	0
Collin	Region C	Trinity	1,551	1,547	1,551	1,547	1,551	1,547
Coryell	Region G	Brazos	0	0	0	0	0	0
Dallas	Region C	Trinity	359	358	359	358	359	358
Delta	Northeast Texas	Sulphur	56	56	56	56	56	56
Denton	Region C	Trinity	4,832	4,819	4,832	4,819	4,832	4,819
Ellis	Region C	Trinity	443	442	443	442	443	442
Erath	Region G	Brazos	61	61	61	61	61	61
Falls	Region G	Brazos	0	0	0	0	0	0
Fannin	Region C	Sulphur	2,092	2,087	2,092	2,087	2,092	2,087
Fannin	Region C	Trinity	0	0	0	0	0	0
Grayson	Region C	Trinity	0	0	0	0	0	0
Hamilton	Region G	Brazos	0	0	0	0	0	0
Hill	Region G	Brazos	348	347	348	347	348	347
Hill	Region G	Trinity	5	5	5	5	5	5
Hunt	Northeast Texas	Sabine	0	0	0	0	0	0
Hunt	Northeast Texas	Sulphur	3	3	3	3	3	3
Hunt	Northeast Texas	Trinity	0	0	0	0	0	0
Johnson	Region G	Brazos	880	878	880	878	880	878
Johnson	Region G	Trinity	1,567	1,562	1,567	1,562	1,567	1,562
Kaufman	Region C	Trinity	0	0	0	0	0	0
Lamar	Northeast Texas	Red	0	0	0	0	0	0
Lamar	Northeast Texas	Sulphur	8	8	8	8	8	8
Limestone	Region G	Brazos	0	0	0	0	0	0
Limestone	Region G	Trinity	0	0	0	0	0	0
McLennan	Region G	Brazos	0	0	0	0	0	0
Mills	Lower Colorado	Brazos	6	6	6	6	6	6
Mills	Lower Colorado	Colorado	0	0	0	0	0	0
Navarro	Region C	Trinity	0	0	0	0	0	0
Red River	Northeast Texas	Red	52	52	52	52	52	52
Red River	Northeast Texas	Sulphur	125	125	125	125	125	125

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County	RWPA	River Basin	2020	2030	2040	2050	2060	2070
Rockwall	Region C	Trinity	0	0	0	0	0	0
Somervell	Region G	Brazos	14	14	14	14	14	14
Tarrant	Region C	Trinity	8,982	8,957	8,982	8,957	8,982	8,957
<b>Subtotal</b>			<b>21,742</b>	<b>21,683</b>	<b>21,742</b>	<b>21,683</b>	<b>21,742</b>	<b>21,683</b>
<b>Counties in Upper Trinity GCD</b>								
Hood (outcrop)	Region G	Brazos	159	158	159	158	159	158
Hood (outcrop)	Region G	Trinity	0	0	0	0	0	0
Parker (outcrop)	Region C	Brazos	34	34	34	34	34	34
Parker (outcrop)	Region C	Trinity	2,580	2,573	2,580	2,573	2,580	2,573
Parker (downdip)	Region C	Trinity	50	50	50	50	50	50
<b>Subtotal</b>			<b>2,823</b>	<b>2,815</b>	<b>2,823</b>	<b>2,815</b>	<b>2,823</b>	<b>2,815</b>
<b>Groundwater Management Area 8</b>			<b>24,565</b>	<b>24,498</b>	<b>24,565</b>	<b>24,498</b>	<b>24,565</b>	<b>24,498</b>

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**TABLE 14. MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE TRINITY AQUIFER (GLEN ROSE) IN GROUNDWATER MANAGEMENT AREA 8. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN.**

County	RWPA	River Basin	2020	2030	2040	2050	2060	2070
<b>Counties Not in Upper Trinity GCD</b>								
Bell	Region G	Brazos	974	971	974	971	974	971
Bosque	Region G	Brazos	731	728	731	728	731	728
Brown	Region F	Colorado	0	0	0	0	0	0
Burnet	Lower Colorado	Brazos	188	188	188	188	188	188
Burnet	Lower Colorado	Colorado	236	235	236	235	236	235
Collin	Region C	Sabine	0	0	0	0	0	0
Collin	Region C	Trinity	83	83	83	83	83	83
Comanche	Region G	Brazos	22	22	22	22	22	22
Comanche	Region G	Colorado	18	18	18	18	18	18
Coryell	Region G	Brazos	120	120	120	120	120	120
Dallas	Region C	Trinity	132	131	132	131	132	131
Delta	Northeast Texas	Sulphur	0	0	0	0	0	0
Denton	Region C	Trinity	339	338	339	338	339	338
Ellis	Region C	Trinity	50	50	50	50	50	50
Erath	Region G	Brazos	1,081	1,078	1,081	1,078	1,081	1,078
Falls	Region G	Brazos	0	0	0	0	0	0
Fannin	Region C	Sulphur	0	0	0	0	0	0
Fannin	Region C	Trinity	0	0	0	0	0	0
Grayson	Region C	Trinity	0	0	0	0	0	0
Hamilton	Region G	Brazos	218	218	218	218	218	218
Hill	Region G	Brazos	115	114	115	114	115	114
Hill	Region G	Trinity	1	1	1	1	1	1
Hunt	Northeast Texas	Sabine	0	0	0	0	0	0
Hunt	Northeast Texas	Sulphur	0	0	0	0	0	0
Hunt	Northeast Texas	Trinity	0	0	0	0	0	0
Johnson	Region G	Brazos	953	950	953	950	953	950
Johnson	Region G	Trinity	683	681	683	681	683	681
Kaufman	Region C	Trinity	0	0	0	0	0	0
Lamar	Northeast Texas	Red	0	0	0	0	0	0
Lamar	Northeast Texas	Sulphur	0	0	0	0	0	0
Lampasas	Region G	Brazos	68	68	68	68	68	68
Limestone	Region G	Brazos	0	0	0	0	0	0
Limestone	Region G	Trinity	0	0	0	0	0	0

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County	RWPA	River Basin	2020	2030	2040	2050	2060	2070
McLennan	Region G	Brazos	0	0	0	0	0	0
Milam	Region G	Brazos	0	0	0	0	0	0
Mills	Lower Colorado	Brazos	96	96	96	96	96	96
Mills	Lower Colorado	Colorado	93	93	93	93	93	93
Navarro	Region C	Trinity	0	0	0	0	0	0
Red River	Northeast Texas	Red	0	0	0	0	0	0
Red River	Northeast Texas	Sulphur	0	0	0	0	0	0
Rockwall	Region C	Trinity	0	0	0	0	0	0
Somervell	Region G	Brazos	146	146	146	146	146	146
Tarrant	Region C	Trinity	795	793	795	793	795	793
Travis	Lower Colorado	Brazos	0	0	0	0	0	0
Travis	Lower Colorado	Colorado	974	971	974	971	974	971
Williamson	Region G	Brazos	623	621	623	621	623	621
Williamson	Region G	Colorado	0	0	0	0	0	0
Williamson	Lower Colorado	Brazos	0	0	0	0	0	0
Williamson	Lower Colorado	Colorado	67	67	67	67	67	67
<b>Subtotal</b>			<b>8,806</b>	<b>8,781</b>	<b>8,806</b>	<b>8,781</b>	<b>8,806</b>	<b>8,781</b>
<b>Counties in Upper Trinity GCD</b>								
Hood (outcrop)	Region G	Brazos	655	653	655	653	655	653
Hood (downdip)	Region G	Brazos	83	83	83	83	83	83
Hood (downdip)	Region G	Trinity	20	20	20	20	20	20
Parker (outcrop)	Region C	Brazos	87	87	87	87	87	87
Parker (downdip)	Region C	Brazos	7	7	7	7	7	7
Parker (outcrop)	Region C	Trinity	2,208	2,202	2,208	2,202	2,208	2,202
Parker (downdip)	Region C	Trinity	869	866	869	866	869	866
<b>Subtotal</b>			<b>3,929</b>	<b>3,918</b>	<b>3,929</b>	<b>3,918</b>	<b>3,929</b>	<b>3,918</b>
<b>Groundwater Management Area 8</b>			<b>12,735</b>	<b>12,699</b>	<b>12,735</b>	<b>12,699</b>	<b>12,735</b>	<b>12,699</b>

**TABLE 15. MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE TRINITY AQUIFER (TWIN MOUNTAINS) IN GROUNDWATER MANAGEMENT AREA 8. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN.**

County	RWPA	River Basin	2020	2030	2040	2050	2060	2070
<b>Counties Not in Upper Trinity GCD</b>								
Collin	Region C	Sabine	0	0	0	0	0	0
Collin	Region C	Trinity	2,207	2,201	2,207	2,201	2,207	2,201
Dallas	Region C	Trinity	3,208	3,199	3,208	3,199	3,208	3,199
Denton	Region C	Trinity	8,389	8,366	8,389	8,366	8,389	8,366
Ellis	Region C	Trinity	0	0	0	0	0	0
Erath	Region G	Brazos	5,031	5,017	5,031	5,017	5,031	5,017
Fannin	Region C	Sulphur	0	0	0	0	0	0
Fannin	Region C	Trinity	0	0	0	0	0	0
Grayson	Region C	Trinity	0	0	0	0	0	0
Hunt	Northeast Texas	Sabine	0	0	0	0	0	0
Hunt	Northeast Texas	Trinity	0	0	0	0	0	0
Johnson	Region G	Brazos	133	133	133	133	133	133
Johnson	Region G	Trinity	252	251	252	251	252	251
Kaufman	Region C	Trinity	0	0	0	0	0	0
Rockwall	Region C	Trinity	0	0	0	0	0	0
Somervell	Region G	Brazos	174	174	174	174	174	174
Tarrant	Region C	Trinity	6,936	6,917	6,936	6,917	6,936	6,917
<b>Subtotal</b>			<b>26,330</b>	<b>26,258</b>	<b>26,330</b>	<b>26,258</b>	<b>26,330</b>	<b>26,258</b>
<b>Counties in Upper Trinity GCD</b>								
Hood (outcrop)	Region G	Brazos	3,672	3,662	3,672	3,662	3,672	3,662
Hood (downdip)	Region G	Brazos	7,761	7,740	7,761	7,740	7,761	7,740
Hood (downdip)	Region G	Trinity	19	19	19	19	19	19
Parker (outcrop)	Region C	Brazos	1,069	1,066	1,069	1,066	1,069	1,066
Parker (downdip)	Region C	Brazos	778	776	778	776	778	776
Parker (downdip)	Region C	Trinity	1,310	1,306	1,310	1,306	1,310	1,306
<b>Subtotal</b>			<b>14,609</b>	<b>14,569</b>	<b>14,609</b>	<b>14,569</b>	<b>14,609</b>	<b>14,569</b>
<b>Groundwater Management Area 8</b>			<b>40,939</b>	<b>40,827</b>	<b>40,939</b>	<b>40,827</b>	<b>40,939</b>	<b>40,827</b>



**TABLE 16. MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE TRINITY AQUIFER (TRAVIS PEAK) IN GROUNDWATER MANAGEMENT AREA 8. RESULTS ARE IN ACRE- FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN.**

County	RWPA	River Basin	2020	2030	2040	2050	2060	2070
<b>Counties Not in Upper Trinity GCD</b>								
Bell	Region G	Brazos	8,293	8,270	8,293	8,270	8,293	8,270
Bosque	Region G	Brazos	7,699	7,678	7,699	7,678	7,699	7,678
Brown	Region F	Brazos	3	3	3	3	3	3
Brown	Region F	Colorado	392	391	392	391	392	391
Burnet	Lower Colorado	Brazos	2,950	2,943	2,950	2,943	2,950	2,943
Burnet	Lower Colorado	Colorado	523	521	523	521	523	521
Comanche	Region G	Brazos	6,128	6,111	6,128	6,111	6,128	6,111
Comanche	Region G	Colorado	49	49	49	49	49	49
Coryell	Region G	Brazos	4,383	4,371	4,383	4,371	4,383	4,371
Dallas	Region C	Trinity	0	0	0	0	0	0
Delta	Northeast Texas	Sulphur	0	0	0	0	0	0
Ellis	Region C	Trinity	5,046	5,032	5,046	5,032	5,046	5,032
Erath	Region G	Brazos	11,849	11,815	11,849	11,815	11,849	11,815
Falls	Region G	Brazos	1,438	1,434	1,438	1,434	1,438	1,434
Fannin	Region C	Sulphur	0	0	0	0	0	0
Fannin	Region C	Trinity	0	0	0	0	0	0
Hamilton	Region G	Brazos	2,213	2,207	2,213	2,207	2,213	2,207
Hill	Region G	Brazos	3,304	3,295	3,304	3,295	3,304	3,295
Hill	Region G	Trinity	256	255	256	255	256	255
Hunt	Northeast Texas	Sabine	0	0	0	0	0	0
Hunt	Northeast Texas	Sulphur	0	0	0	0	0	0
Hunt	Northeast Texas	Trinity	0	0	0	0	0	0
Johnson	Region G	Brazos	1,932	1,927	1,932	1,927	1,932	1,927
Johnson	Region G	Trinity	3,022	3,014	3,022	3,014	3,022	3,014
Kaufman	Region C	Trinity	0	0	0	0	0	0
Lamar	Northeast Texas	Red	0	0	0	0	0	0
Lamar	Northeast Texas	Sulphur	0	0	0	0	0	0
Lampasas	Region G	Brazos	1,528	1,523	1,528	1,523	1,528	1,523
Lampasas	Region G	Colorado	76	75	76	75	76	75
Limestone	Region G	Brazos	0	0	0	0	0	0
Limestone	Region G	Trinity	0	0	0	0	0	0
McLennan	Region G	Brazos	20,691	20,635	20,691	20,635	20,691	20,635
Milam	Region G	Brazos	0	0	0	0	0	0

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County	RWPA	River Basin	2020	2030	2040	2050	2060	2070
Mills	Lower Colorado	Brazos	706	703	706	703	706	703
Mills	Lower Colorado	Colorado	1,576	1,572	1,576	1,572	1,576	1,572
Navarro	Region C	Trinity	0	0	0	0	0	0
Red River	Northeast Texas	Red	0	0	0	0	0	0
Red River	Northeast Texas	Sulphur	0	0	0	0	0	0
Somervell	Region G	Brazos	2,854	2,847	2,854	2,847	2,854	2,847
Travis	Lower Colorado	Brazos	1	1	1	1	1	1
Travis	Lower Colorado	Colorado	4,124	4,112	4,124	4,112	4,124	4,112
Williamson	Region G	Brazos	2,885	2,877	2,885	2,877	2,885	2,877
Williamson	Region G	Colorado	5	5	5	5	5	5
Williamson	Lower Colorado	Brazos	0	0	0	0	0	0
Williamson	Lower Colorado	Colorado	0	0	0	0	0	0
<b>Subtotal</b>			<b>93,926</b>	<b>93,666</b>	<b>93,926</b>	<b>93,666</b>	<b>93,926</b>	<b>93,666</b>
<b>Counties in Upper Trinity GCD</b>								
Hood (down dip)	Region G	Brazos	89	89	89	89	89	89
<b>Subtotal</b>			<b>89</b>	<b>89</b>	<b>89</b>	<b>89</b>	<b>89</b>	<b>89</b>
<b>Groundwater Management Area 8</b>			<b>94,015</b>	<b>93,755</b>	<b>94,015</b>	<b>93,755</b>	<b>94,015</b>	<b>93,755</b>

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**TABLE 17. MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE TRINITY AQUIFER (HENSELL) IN GROUNDWATER MANAGEMENT AREA 8. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN.**

County	RWPA	River Basin	2020	2030	2040	2050	2060	2070
<b>Counties Not in Upper Trinity GCD</b>								
Bell	Region G	Brazos	1,099	1,096	1,099	1,096	1,099	1,096
Bosque	Region G	Brazos	3,845	3,835	3,845	3,835	3,845	3,835
Brown	Region F	Colorado	4	4	4	4	4	4
Burnet	Lower Colorado	Brazos	1,761	1,757	1,761	1,757	1,761	1,757
Burnet	Lower Colorado	Colorado	133	132	133	132	133	132
Comanche	Region G	Brazos	181	180	181	180	181	180
Comanche	Region G	Colorado	24	24	24	24	24	24
Coryell	Region G	Brazos	2,202	2,196	2,202	2,196	2,202	2,196
Dallas	Region C	Trinity	0	0	0	0	0	0
Ellis	Region C	Trinity	0	0	0	0	0	0
Erath	Region G	Brazos	5,151	5,137	5,151	5,137	5,151	5,137
Falls	Region G	Brazos	0	0	0	0	0	0
Hamilton	Region G	Brazos	1,675	1,671	1,675	1,671	1,675	1,671
Hill	Region G	Brazos	225	224	225	224	225	224
Hill	Region G	Trinity	1	1	1	1	1	1
Johnson	Region G	Brazos	618	616	618	616	618	616
Johnson	Region G	Trinity	468	467	468	467	468	467
Kaufman	Region C	Trinity	0	0	0	0	0	0
Lampasas	Region G	Brazos	713	711	713	711	713	711
Lampasas	Region G	Colorado	1	1	1	1	1	1
Limestone	Region G	Brazos	0	0	0	0	0	0
Limestone	Region G	Trinity	0	0	0	0	0	0
McLennan	Region G	Brazos	4,711	4,698	4,711	4,698	4,711	4,698
Milam	Region G	Brazos	0	0	0	0	0	0
Mills	Lower Colorado	Brazos	172	172	172	172	172	172
Mills	Lower Colorado	Colorado	436	435	436	435	436	435
Navarro	Region C	Trinity	0	0	0	0	0	0
Somervell	Region G	Brazos	1,978	1,973	1,978	1,973	1,978	1,973
Travis	Lower Colorado	Brazos	1	1	1	1	1	1
Travis	Lower Colorado	Colorado	1,144	1,141	1,144	1,141	1,144	1,141
Williamson	Region G	Brazos	753	751	753	751	753	751
Williamson	Region G	Colorado	0	0	0	0	0	0
Williamson	Lower Colorado	Brazos	0	0	0	0	0	0

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County	RWPA	River Basin	2020	2030	2040	2050	2060	2070
Williamson	Lower Colorado	Colorado	0	0	0	0	0	0
<b>Subtotal</b>			<b>27,296</b>	<b>27,223</b>	<b>27,296</b>	<b>27,223</b>	<b>27,296</b>	<b>27,223</b>
<b>Counties in Upper Trinity GCD</b>								
Hood (downdip)	Region G	Brazos	36	36	36	36	36	36
<b>Subtotal</b>			<b>36</b>	<b>36</b>	<b>36</b>	<b>36</b>	<b>36</b>	<b>36</b>
<b>Groundwater Management Area 8</b>			<b>27,332</b>	<b>27,259</b>	<b>27,332</b>	<b>27,259</b>	<b>27,332</b>	<b>27,259</b>

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**TABLE 18. MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE TRINITY AQUIFER (HOSSTON) IN GROUNDWATER MANAGEMENT AREA 8. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN.**

County	RWPA	River Basin	2020	2030	2040	2050	2060	2070
<b>Counties Not in Upper Trinity GCD</b>								
Bell	Region G	Brazos	7,193	7,174	7,193	7,174	7,193	7,174
Bosque	Region G	Brazos	3,772	3,762	3,772	3,762	3,772	3,762
Brown	Region F	Brazos	3	3	3	3	3	3
Brown	Region F	Colorado	355	353	355	353	355	353
Burnet	Lower Colorado	Brazos	1,027	1,025	1,027	1,025	1,027	1,025
Burnet	Lower Colorado	Colorado	355	354	355	354	355	354
Comanche	Region G	Brazos	5,875	5,858	5,875	5,858	5,875	5,858
Comanche	Region G	Colorado	6	6	6	6	6	6
Coryell	Region G	Brazos	2,167	2,161	2,167	2,161	2,167	2,161
Dallas	Region C	Trinity	0	0	0	0	0	0
Ellis	Region C	Trinity	5,040	5,026	5,040	5,026	5,040	5,026
Erath	Region G	Brazos	6,400	6,383	6,400	6,383	6,400	6,383
Falls	Region G	Brazos	1,438	1,434	1,438	1,434	1,438	1,434
Hamilton	Region G	Brazos	386	385	386	385	386	385
Hill	Region G	Brazos	3,026	3,018	3,026	3,018	3,026	3,018
Hill	Region G	Trinity	255	254	255	254	255	254
Johnson	Region G	Brazos	1,311	1,307	1,311	1,307	1,311	1,307
Johnson	Region G	Trinity	2,553	2,546	2,553	2,546	2,553	2,546
Kaufman	Region C	Trinity	0	0	0	0	0	0
Lampasas	Region G	Brazos	786	783	786	783	786	783
Lampasas	Region G	Colorado	72	72	72	72	72	72
Limestone	Region G	Brazos	0	0	0	0	0	0
Limestone	Region G	Trinity	0	0	0	0	0	0
McLennan	Region G	Brazos	15,980	15,937	15,980	15,937	15,980	15,937
Milam	Region G	Brazos	0	0	0	0	0	0
Mills	Lower Colorado	Brazos	376	375	376	375	376	375
Mills	Lower Colorado	Colorado	1,096	1,093	1,096	1,093	1,096	1,093
Navarro	Region C	Trinity	0	0	0	0	0	0
Somervell	Region G	Brazos	845	843	845	843	845	843
Travis	Lower Colorado	Brazos	0	0	0	0	0	0
Travis	Lower Colorado	Colorado	2,791	2,783	2,791	2,783	2,791	2,783
Williamson	Region G	Brazos	1,933	1,928	1,933	1,928	1,933	1,928
Williamson	Region G	Colorado	5	5	5	5	5	5

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County	RWPA	River Basin	2020	2030	2040	2050	2060	2070
Williamson	Lower Colorado	Brazos	0	0	0	0	0	0
Williamson	Lower Colorado	Colorado	0	0	0	0	0	0
<b>Subtotal</b>			<b>65,046</b>	<b>64,868</b>	<b>65,046</b>	<b>64,868</b>	<b>65,046</b>	<b>64,868</b>
<b>Counties in Upper Trinity GCD</b>								
Hood (downdip)	Region G	Brazos	53	53	53	53	53	53
<b>Subtotal</b>			<b>53</b>	<b>53</b>	<b>53</b>	<b>53</b>	<b>53</b>	<b>53</b>
<b>Groundwater Management Area 8</b>			<b>65,099</b>	<b>64,921</b>	<b>65,099</b>	<b>64,921</b>	<b>65,099</b>	<b>64,921</b>

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**TABLE 19. MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE TRINITY AQUIFER (ANTLERS) IN GROUNDWATER MANAGEMENT AREA 8. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN.**

County	RWPA	River Basin	2020	2030	2040	2050	2060	2070
<b>Counties Not in Upper Trinity GCD</b>								
Brown	Region F	Brazos	48	48	48	48	48	48
Brown	Region F	Colorado	1,007	1,004	1,007	1,004	1,007	1,004
Callahan	Region G	Brazos	444	443	444	443	444	443
Callahan	Region G	Colorado	1,285	1,282	1,285	1,282	1,285	1,282
Collin	Region C	Trinity	1,966	1,961	1,966	1,961	1,966	1,961
Comanche	Region G	Brazos	5,855	5,839	5,855	5,839	5,855	5,839
Cooke	Region C	Red	2,191	2,184	2,191	2,184	2,191	2,184
Cooke	Region C	Trinity	8,353	8,330	8,353	8,330	8,353	8,330
Denton	Region C	Trinity	16,591	16,545	16,591	16,545	16,591	16,545
Eastland	Region G	Brazos	5,194	5,180	5,194	5,180	5,194	5,180
Eastland	Region G	Colorado	553	552	553	552	553	552
Erath	Region G	Brazos	2,636	2,628	2,636	2,628	2,636	2,628
Fannin	Region C	Red	0	0	0	0	0	0
Fannin	Region C	Sulphur	0	0	0	0	0	0
Fannin	Region C	Trinity	0	0	0	0	0	0
Grayson	Region C	Red	6,678	6,660	6,678	6,660	6,678	6,660
Grayson	Region C	Trinity	4,059	4,048	4,059	4,048	4,059	4,048
Lamar	Northeast Texas	Red	0	0	0	0	0	0
Lamar	Northeast Texas	Sulphur	0	0	0	0	0	0
Red River	Northeast Texas	Red	0	0	0	0	0	0
Tarrant	Region C	Trinity	1,251	1,248	1,251	1,248	1,251	1,248
Taylor	Region G	Brazos	5	5	5	5	5	5
Taylor	Region G	Colorado	9	9	9	9	9	9
<b>Subtotal</b>			<b>58,125</b>	<b>57,966</b>	<b>58,125</b>	<b>57,966</b>	<b>58,125</b>	<b>57,966</b>
<b>Counties in Upper Trinity GCD</b>								
Montague (outcrop)	Region B	Red	154	154	154	154	154	154
Montague (outcrop)	Region B	Trinity	3,732	3,721	3,732	3,721	3,732	3,721
Parker (outcrop)	Region C	Brazos	257	256	257	256	257	256
Parker (outcrop)	Region C	Trinity	2,648	2,640	2,648	2,640	2,648	2,640
Wise (outcrop)	Region C	Trinity	7,698	7,677	7,698	7,677	7,698	7,677

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<b>County</b>	<b>RWPA</b>	<b>River Basin</b>	<b>2020</b>	<b>2030</b>	<b>2040</b>	<b>2050</b>	<b>2060</b>	<b>2070</b>
Wise (downdip)	Region C	Trinity	2,062	2,057	2,062	2,057	2,062	2,057
<b>Subtotal</b>			<b>16,551</b>	<b>16,505</b>	<b>16,551</b>	<b>16,505</b>	<b>16,551</b>	<b>16,505</b>
<b>Groundwater Management Area 8</b>			<b>74,676</b>	<b>74,471</b>	<b>74,676</b>	<b>74,471</b>	<b>74,676</b>	<b>74,471</b>



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**TABLE 20. MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE WOODBINE AQUIFER IN GROUNDWATER MANAGEMENT AREA 8. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN.**

County	RWPA	River Basin	2020	2030	2040	2050	2060	2070
Collin	Region C	Sabine	0	0	0	0	0	0
Collin	Region C	Trinity	4,263	4,251	4,263	4,251	4,263	4,251
Cooke	Region C	Red	262	261	262	261	262	261
Cooke	Region C	Trinity	540	538	540	538	540	538
Dallas	Region C	Trinity	2,804	2,796	2,804	2,796	2,804	2,796
Denton	Region C	Trinity	3,616	3,607	3,616	3,607	3,616	3,607
Ellis	Region C	Trinity	2,078	2,073	2,078	2,073	2,078	2,073
Fannin	Region C	Red	3,553	3,544	3,553	3,544	3,553	3,544
Fannin	Region C	Sulphur	551	550	551	550	551	550
Fannin	Region C	Trinity	829	827	829	827	829	827
Grayson	Region C	Red	5,615	5,599	5,615	5,599	5,615	5,599
Grayson	Region C	Trinity	1,926	1,922	1,926	1,922	1,926	1,922
Hill	Region G	Brazos	285	284	285	284	285	284
Hill	Region G	Trinity	303	302	303	302	303	302
Hunt	Northeast Texas	Sabine	269	268	269	268	269	268
Hunt	Northeast Texas	Sulphur	165	165	165	165	165	165
Hunt	Northeast Texas	Trinity	330	329	330	329	330	329
Johnson	Region G	Brazos	24	24	24	24	24	24
Johnson	Region G	Trinity	1,961	1,956	1,961	1,956	1,961	1,956
Kaufman	Region C	Trinity	0	0	0	0	0	0
Lamar	Northeast Texas	Red	0	0	0	0	0	0
Lamar	Northeast Texas	Sulphur	49	49	49	49	49	49
McLennan	Region G	Brazos	0	0	0	0	0	0
Navarro	Region C	Trinity	68	68	68	68	68	68
Red River	Northeast Texas	Red	2	2	2	2	2	2
Rockwall	Region C	Trinity	0	0	0	0	0	0
Tarrant	Region C	Trinity	1,141	1,138	1,141	1,138	1,141	1,138
<b>Groundwater Management Area 8</b>			<b>30,634</b>	<b>30,553</b>	<b>30,634</b>	<b>30,553</b>	<b>30,634</b>	<b>30,553</b>

**TABLE 21. MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE EDWARDS (BALCONES FAULT ZONE) AQUIFER IN GROUNDWATER MANAGEMENT AREA 8. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN. MODELED AVAILABLE GROUNDWATER VALUES ARE FROM GAM RUN 08-010MAG BY ANAYA (2008).**

County	RWPA	River Basin	2020	2030	2040	2050	2060	2070
Bell	Region G	Brazos	6,469	6,469	6,469	6,469	6,469	6,469
Travis	Lower Colorado	Brazos	275	275	275	275	275	275
Travis	Lower Colorado	Colorado	4,962	4,962	4,962	4,962	4,962	4,962
Williamson	Region G	Brazos	3,351	3,351	3,351	3,351	3,351	3,351
Williamson	Region G	Colorado	101	101	101	101	101	101
Williamson	Lower Colorado	Brazos	6	6	6	6	6	6
Williamson	Lower Colorado	Colorado	4	4	4	4	4	4
<b>Groundwater Management Area 8</b>			<b>15,168</b>	<b>15,168</b>	<b>15,168</b>	<b>15,168</b>	<b>15,168</b>	<b>15,168</b>

**TABLE 22. MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE MARBLE FALLS AQUIFER IN GROUNDWATER MANAGEMENT AREA 8. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN.**

County	RWPA	River Basin	2020	2030	2040	2050	2060	2070
Brown	Region F	Colorado	25	25	25	25	25	25
Burnet	Lower Colorado	Brazos	1,387	1,383	1,387	1,383	1,387	1,383
Burnet	Lower Colorado	Colorado	1,357	1,353	1,357	1,353	1,357	1,353
Lampasas	Region G	Brazos	1,958	1,952	1,958	1,952	1,958	1,952
Lampasas	Region G	Colorado	887	885	887	885	887	885
Mills	Lower Colorado	Brazos	1	1	1	1	1	1
Mills	Lower Colorado	Colorado	24	24	24	24	24	24
<b>Groundwater Management Area 8</b>			<b>5,639</b>	<b>5,623</b>	<b>5,639</b>	<b>5,623</b>	<b>5,639</b>	<b>5,623</b>

**TABLE 23. MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE ELLENBURGER-SAN SABA AQUIFER IN GROUNDWATER MANAGEMENT AREA 8. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN.**

County	RWPA	River Basin	2020	2030	2040	2050	2060	2070
Brown	Region F	Colorado	131	131	131	131	131	131
Burnet	Lower Colorado	Brazos	3,833	3,822	3,833	3,822	3,833	3,822
Burnet	Lower Colorado	Colorado	7,024	7,005	7,024	7,005	7,024	7,005
Lampasas	Region G	Brazos	1,685	1,680	1,685	1,680	1,685	1,680
Lampasas	Region G	Colorado	916	913	916	913	916	913
Mills	Lower Colorado	Brazos	93	93	93	93	93	93
Mills	Lower Colorado	Colorado	407	406	407	406	407	406
<b>Groundwater Management Area 8</b>			<b>14,089</b>	<b>14,050</b>	<b>14,089</b>	<b>14,050</b>	<b>14,089</b>	<b>14,050</b>

**TABLE 24. MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE HICKORY AQUIFER IN GROUNDWATER MANAGEMENT AREA 8. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN.**

County	RWPA	River Basin	2020	2030	2040	2050	2060	2070
Brown	Region F	Colorado	12	12	12	12	12	12
Burnet	Lower Colorado	Brazos	1,240	1,236	1,240	1,236	1,240	1,236
Burnet	Lower Colorado	Colorado	2,183	2,177	2,183	2,177	2,183	2,177
Lampasas	Region G	Brazos	80	79	80	79	80	79
Lampasas	Region G	Colorado	34	34	34	34	34	34
Mills	Lower Colorado	Brazos	7	7	7	7	7	7
Mills	Lower Colorado	Colorado	29	29	29	29	29	29
<b>Groundwater Management Area 8</b>			<b>3,585</b>	<b>3,574</b>	<b>3,585</b>	<b>3,574</b>	<b>3,585</b>	<b>3,574</b>

### ***LIMITATIONS:***

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

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

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

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

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

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## *Appendix A*

### **Comparison between Desired Future Conditions and Simulated Drawdowns for the Trinity and Woodbine Aquifers**

Drawdown values for the Trinity and Woodbine aquifers between 2009 and 2070 were based on the simulated head values at individual model cells extracted from predictive simulation head file submitted by Groundwater Management Area 8.

The Paluxy, Glen Rose, Twin Mountains, Travis Peak, Hensell, Hosston, and Antlers are subunits of the Trinity Aquifer. These subunits and Woodbine Aquifer exist in both outcrop and downdip areas ([Figures 1 through 8](#)). Kelley and others (2014) further divided these aquifers into five (5) regions, each with unique aquifer combinations and properties (table below and [Figures 1 through 8](#)).

Model Layer	Region 1	Region 2	Region 3	Region 4	Region 5		
2	Woodbine			Woodbine (no sand)			
3	Washita/Fredericksburg						
4	Antlers	Paluxy			Paluxy (no sand)		
5		Glen Rose					
6		Twin Mountains	Travis Peak	Hensell		Hensell	
7				Pearsall/Sligo		Travis Peak	Pearsall/Sligo
8				Hosston		Travis Peak	Hosston

Vertically, the Trinity and Woodbine aquifers could contain multiple model layers and some of the model cells are pass-through cells with a thickness of one foot. To account for variable model cells from multiple model layers for the same aquifer, Beach and others (2016) adopted a method presented by Van Kelley of INTERA, Inc., which calculated a single composite head from multiple model cells with each adjusted by transmissivity. This composite head took both the head and hydraulic transmissivity at each cell into calculation, as shown in the following equation:

$$H_c = \frac{\sum_{i=UL}^{LL} T_i H_i}{\sum_{i=UL}^{LL} T_i}$$

Where:

$H_c$  = Composite Head (feet above mean sea level)

$T_i$  = Transmissivity of model layer  $i$  (square feet per day)

$H_i$  = Head of model layer  $i$  (feet above mean sea level)

*LL* = Lowest model layer representing the regional aquifer

*UL* = Uppermost model layer representing the regional aquifer.

The average head for the same aquifer in a county (*Hc\_County*) was then calculated using the following equation:

$$Hc\_County = \frac{\sum_{i=1}^n Hc_i}{n}$$

Where:

*Hc\_County* = Average composite head for a county  
(feet above mean sea level)

*Hc<sub>i</sub>* = Composite Head at a lateral location as defined in last step  
(feet above mean sea level)

*n* = Total lateral (row, column) locations of an aquifer in a county.

Drawdown of the aquifer in a county (*DD\_County*) was calculated using the following equation:

$$DD\_County = Hc\_County_{2009} - Hc\_County_{2070}$$

Where:

*Hc\_County<sub>2009</sub>* = Average head of an aquifer in a county in 2009  
as defined above (feet above mean sea level)

*Hc\_County<sub>2070</sub>* = Average head of an aquifer in a county in 2070  
as defined above (feet above mean sea level).

Model cells with head values below the cell bottom in 2009 were excluded from the calculation. Also, head was set at the cell bottom if it fell below the cell bottom at 2070.

In comparison with a simple average calculation based on total model cell count, use of composite head gives less weight to cells with lower transmissivity values (such as pass-through cells, cells with low saturation in outcrop area, or cells with lower hydraulic conductivity) in head and drawdown calculation.



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Per Groundwater Management Area 8, a desired future condition was met if the simulated drawdown from the desired future condition was within five percent or five feet. Using the head output file submitted by Groundwater Management Area 8 and the method described above, the TWDB calculated the drawdowns (Tables [A1](#) and [A2](#)) and performed the comparison against the corresponding desired future conditions by county (Tables [A3](#), [A4](#), [A5](#), and [A6](#)). The review by the TWDB indicates that the predictive simulation meets the desired future conditions (Tables [A7](#) and [A8](#)).

**TABLE A1. SIMULATED DRAWDOWN VALUES OF THE TRINITY AND WOODBINE AQUIFERS FOR COUNTIES NOT IN THE UPPER TRINITY GROUNDWATER CONSERVATION DISTRICT. DRAWDOWNS ARE IN FEET.**

County	Woodbine	Paluxy	Glen Rose	Twin Mountains	Travis Peak	Hensell	Hosston	Antlers
Bell	—	19	83	—	294	137	330	—
Bosque	—	6	49	—	167	129	201	—
Brown	—	—	2	—	1	1	1	2
Burnet	—	—	2	—	16	7	20	—
Callahan	—	—	—	—	—	—	—	1
Collin	459	705	339	526	—	—	—	570
Comanche	—	—	1	—	2	2	3	9
Cooke	2	—	—	—	—	—	—	179
Coryell	—	7	14	—	100	66	130	—
Dallas	123	324	263	463	350	332	351	—
Delta	—	264	181	—	186	—	—	—
Denton	19	552	349	716	—	—	—	398
Eastland	—	—	—	—	—	—	—	3
Ellis	61	107	194	333	305	263	310	—
Erath	—	1	5	6	19	11	31	11
Falls	—	144	215	—	460	271	465	—
Fannin	247	688	280	372	269	—	—	251
Grayson	157	922	337	417	—	—	—	348
Hamilton	—	2	4	—	24	13	35	—
Hill	16	38	133	—	299	186	337	—
Hunt	598	586	299	370	324	—	—	—
Johnson	3	-61	58	156	184	126	235	—
Kaufman	208	276	269	381	323	309	295	—
Lamar	38	93	97	—	114	—	—	122
Lampasas	—	—	1	—	6	1	11	—
Limestone	—	178	271	—	393	183	404	—
McLennan	6	35	133	—	468	220	542	—
Milam	—	—	212	—	344	229	345	—
Mills	—	1	1	—	7	2	13	—
Navarro	92	119	232	—	291	254	291	—
Red River	2	21	36	—	51	—	—	13
Rockwall	243	401	311	426	—	—	—	—
Somervell	—	1	4	31	52	26	83	—
Tarrant	6	101	148	315	—	—	—	149

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<b>County</b>	<b>Woodbine</b>	<b>Paluxy</b>	<b>Glen Rose</b>	<b>Twin Mountains</b>	<b>Travis Peak</b>	<b>Hensell</b>	<b>Hosston</b>	<b>Antlers</b>
Taylor	—	—	—	—	—	—	—	0
Travis	—	—	85	—	142	51	148	—
Williamson	—	—	76	—	172	73	176	—

—: Not available.

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**TABLE A2. SIMULATED DRAWDOWN VALUES OF THE TRINITY AQUIFER FOR COUNTIES IN THE UPPER TRINITY GROUNDWATER CONSERVATION DISTRICT. DRAWDOWNS ARE IN FEET.**

<b>County</b>	<b>Paluxy</b>	<b>Glen Rose</b>	<b>Twin Mountains</b>	<b>Antlers</b>
Hood (outcrop)	5	7	4	—
Hood (downdip)	—	27	46	—
Montague (outcrop)	—	—	—	18
Montague (downdip)	—	—	—	—
Parker (outcrop)	5	10	1	11
Parker (downdip)	1	28	46	—
Wise (outcrop)	—	—	—	35
Wise (downdip)	—	—	—	142

—: Not available.

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**TABLE A3. RELATIVE DIFFERENCE BETWEEN SIMULATED DRAWDOWNS AND DESIRED FUTURE CONDITIONS OF THE TRINITY AND WOODBINE AQUIFERS FOR COUNTIES NOT IN THE UPPER TRINITY GROUNDWATER CONSERVATION DISTRICT. VALUES GREATER THAN THE ERROR TOLERANCE OF FIVE PERCENT ARE HIGHLIGHTED.**

County	Woodbine	Paluxy	Glen Rose	Twin Mountains	Travis Peak	Hensell	Hosston	Antlers
Bell	—	0%	0%	—	-2%	0%	0%	—
Bosque	—	0%	0%	—	0%	0%	0%	—
Brown	—	—	0%	—	0%	0%	0%	0%
Burnet	—	—	0%	—	0%	0%	0%	—
Callahan	—	—	—	—	—	—	—	0%
Collin	0%	0%	0%	0%	—	—	—	0%
Comanche	—	—	0%	—	0%	0%	0%	0%
Cooke	0%	—	—	—	—	—	—	2%
Coryell	—	0%	0%	—	1%	0%	0%	—
Dallas	0%	0%	0%	0%	1%	0%	0%	—
Delta	—	0%	0%	—	0%	—	—	—
Denton	-16%	0%	0%	0%	—	—	—	1%
Eastland	—	—	—	—	—	—	—	0%
Ellis	0%	0%	0%	0%	1%	0%	0%	—
Erath	—	0%	0%	0%	0%	0%	0%	-9%
Falls	—	0%	0%	—	0%	0%	0%	—
Fannin	0%	0%	0%	0%	0%	—	—	0%
Grayson	-2%	0%	0%	0%	—	—	—	0%
Hamilton	—	0%	0%	—	0%	0%	0%	—
Hill	-25%	0%	0%	—	0%	0%	0%	—
Hunt	0%	0%	0%	0%	0%	—	—	—
Johnson	33%	0%	0%	0%	3%	0%	0%	—
Kaufman	0%	0%	0%	0%	0%	0%	0%	—
Lamar	0%	0%	0%	—	0%	—	—	0%
Lampasas	—	—	0%	—	0%	0%	0%	—
Limestone	—	0%	0%	—	0%	0%	0%	—
McLennan	0%	0%	0%	—	-1%	0%	0%	—
Milam	—	—	0%	—	0%	0%	0%	—
Mills	—	0%	0%	—	0%	0%	0%	—
—varro	0%	0%	0%	—	0%	0%	0%	—
Red River	0%	0%	0%	—	0%	—	—	0%
Rockwall	0%	0%	0%	0%	—	—	—	—

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County	Woodbine	Paluxy	Glen Rose	Twin Mountains	Travis Peak	Hensell	Hosston	Antlers
Somervell	—	0%	0%	0%	2%	0%	0%	—
Tarrant	-17%	0%	0%	0%	—	—	—	1%
Taylor	—	—	—	—	—	—	—	0%
Travis	—	—	0%	—	1%	2%	1%	—
Williamson	—	—	-1%	—	-1%	-1%	-1%	—

—: Not available.

**TABLE A4. RELATIVE DIFFERENCE BETWEEN SIMULATED DRAWDOWNS AND DESIRED FUTURE CONDITIONS OF THE TRINITY AQUIFER FOR COUNTIES IN THE UPPER TRINITY GROUNDWATER CONSERVATION DISTRICT. VALUES GREATER THAN THE ERROR TOLERANCE OF FIVE PERCENT ARE HIGHLIGHTED.**

<b>County</b>	<b>Paluxy</b>	<b>Glen Rose</b>	<b>Twin Mountains</b>	<b>Antlers</b>
Hood (outcrop)	0%	0%	0%	—
Hood (downdip)	—	-4%	0%	—
Montague (outcrop)	—	—	—	0%
Montague (downdip)	—	—	—	—
Parker (outcrop)	0%	0%	0%	0%
Parker (downdip)	0%	0%	0%	—
Wise (outcrop)	—	—	—	3%
Wise (downdip)	—	—	—	0%

—: Not available.

**TABLE A5. DIFFERENCE BETWEEN SIMULATED DRAWDOWNS AND DESIRED FUTURE CONDITIONS OF THE TRINITY AND WOODBINE AQUIFERS FOR COUNTIES NOT IN THE UPPER TRINITY GROUNDWATER CONSERVATION DISTRICT. VALUES GREATER THAN THE ERROR TOLERANCE OF FIVE FEET ARE HIGHLIGHTED.**

County	Woodbine	Paluxy	Glen Rose	Twin Mountains	Travis Peak	Hensell	Hosston	Antlers
Bell	—	0	0	—	-6	0	0	—
Bosque	—	0	0	—	0	0	0	—
Brown	—	—	0	—	0	0	0	0
Burnet	—	—	0	—	0	0	0	—
Callahan	—	—	—	—	—	—	—	0
Collin	0	0	0	0	—	—	—	0
Comanche	—	—	0	—	0	0	0	0
Cooke	0	—	—	—	—	—	—	3
Coryell	—	0	0	—	1	0	0	—
Dallas	0	0	0	0	2	0	0	—
Delta	—	0	0	—	0	—	—	—
Denton	-3	0	0	0	—	—	—	3
Eastland	—	—	—	—	—	—	—	0
Ellis	0	0	0	0	4	0	0	—
Erath	—	0	0	0	0	0	0	-1
Falls	—	0	0	—	-2	0	0	—
Fannin	0	0	0	0	0	—	—	0
Grayson	-3	0	0	0	—	—	—	0
Hamilton	—	0	0	—	0	0	0	—
Hill	-4	0	0	—	1	0	0	—
Hunt	0	0	0	0	0	—	—	—
Johnson	1	0	0	0	5	0	0	—
Kaufman	0	0	0	0	0	0	0	—
Lamar	0	0	0	—	0	—	—	0
Lampasas	—	—	0	—	0	0	0	—
Limestone	—	0	0	—	1	0	0	—
McLennan	0	0	0	—	-3	0	0	—
Milam	—	—	0	—	-1	0	0	—
Mills	—	0	0	—	0	0	0	—
Navarro	0	0	0	—	1	0	0	—
Red River	0	0	0	—	0	—	—	0
Rockwall	0	0	0	0	—	—	—	—



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County	Woodbine	Paluxy	Glen Rose	Twin Mountains	Travis Peak	Hensell	Hosston	Antlers
Somervell	—	0	0	0	1	0	0	—
Tarrant	-1	0	0	0	—	—	—	1
Taylor	—	—	—	—	—	—	—	0
Travis	—	—	0	—	1	1	2	—
Williamson	—	—	-1	—	-1	-1	-1	—

—: Not available.

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**TABLE A6. DIFFERENCE BETWEEN SIMULATED DRAWDOWNS AND DESIRED FUTURE CONDITIONS OF THE TRINITY AQUIFER FOR COUNTIES IN THE UPPER TRINITY GROUNDWATER CONSERVATION DISTRICT. NO VALUES ARE GREATER THAN THE ERROR TOLERANCE OF FIVE FEET.**

<b>County</b>	<b>Paluxy</b>	<b>Glen Rose</b>	<b>Twin Mountains</b>	<b>Antlers</b>
Hood (outcrop)	0	0	0	—
Hood (downdip)	—	-1	0	—
Montague (outcrop)	—	—	—	0
Montague (downdip)	—	—	—	—
Parker (outcrop)	0	0	0	0
Parker (downdip)	0	0	0	—
Wise (outcrop)	—	—	—	1
Wise (downdip)	—	—	—	0

—: Not available.

**TABLE A7. COMPARISON OF SIMULATED DRAWDOWNS WITH THE DESIRED FUTURE CONDITIONS OF THE TRINITY AND WOODBINE AQUIFERS FOR COUNTIES NOT IN THE UPPER TRINITY GROUNDWATER CONSERVATION DISTRICT. NO VALUES ARE GREATER THAN BOTH ERROR TOLLERRANCES OF FIVE PERCENT AND FIVE FEET AT THE SAME TIME. THUS, PREDICTIVE SIMULATION MEETS ALL DESIRED FUTURE CONDITIONS.**

County	Woodbine	Paluxy	Glen Rose	Twin Mountains	Travis Peak	Hensell	Hosston	Antlers
Bell	—	MEET	MEET	—	MEET	MEET	MEET	—
Bosque	—	MEET	MEET	—	MEET	MEET	MEET	—
Brown	—	—	MEET	—	MEET	MEET	MEET	MEET
Burnet	—	—	MEET	—	MEET	MEET	MEET	—
Callahan	—	—	—	—	—	—	—	MEET
Collin	MEET	MEET	MEET	MEET	—	—	—	MEET
Comanche	—	—	MEET	—	MEET	MEET	MEET	MEET
Cooke	MEET	—	—	—	—	—	—	MEET
Coryell	—	MEET	MEET	—	MEET	MEET	MEET	—
Dallas	MEET	MEET	MEET	MEET	MEET	MEET	MEET	—
Delta	—	MEET	MEET	—	MEET	—	—	—
Denton	MEET	MEET	MEET	MEET	—	—	—	MEET
Eastland	—	—	—	—	—	—	—	MEET
Ellis	MEET	MEET	MEET	MEET	MEET	MEET	MEET	—
Erath	—	MEET	MEET	MEET	MEET	MEET	MEET	MEET
Falls	—	MEET	MEET	—	MEET	MEET	MEET	—
Fannin	MEET	MEET	MEET	MEET	MEET	—	—	MEET
Grayson	MEET	MEET	MEET	MEET	—	—	—	MEET
Hamilton	—	MEET	MEET	—	MEET	MEET	MEET	—
Hill	MEET	MEET	MEET	—	MEET	MEET	MEET	—
Hunt	MEET	MEET	MEET	MEET	MEET	—	—	—
Johnson	MEET	MEET	MEET	MEET	MEET	MEET	MEET	—
Kaufman	MEET	MEET	MEET	MEET	MEET	MEET	MEET	—
Lamar	MEET	MEET	MEET	—	MEET	—	—	MEET
Lampasas	—	—	MEET	—	MEET	MEET	MEET	—
Limestone	—	MEET	MEET	—	MEET	MEET	MEET	—
McLennan	MEET	MEET	MEET	—	MEET	MEET	MEET	—
Milam	—	—	MEET	—	MEET	MEET	MEET	—
Mills	—	MEET	MEET	—	MEET	MEET	MEET	—
Navarro	MEET	MEET	MEET	—	MEET	MEET	MEET	—

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<b>County</b>	<b>Woodbine</b>	<b>Paluxy</b>	<b>Glen Rose</b>	<b>Twin Mountains</b>	<b>Travis Peak</b>	<b>Hensell</b>	<b>Hosston</b>	<b>Antlers</b>
Red River	MEET	MEET	MEET	—	MEET	—	—	MEET
Rockwall	MEET	MEET	MEET	MEET	—	—	—	—
Somervell	—	MEET	MEET	MEET	MEET	MEET	MEET	—
Tarrant	MEET	MEET	MEET	MEET	—	—	—	MEET
Taylor	—	—	—	—	—	—	—	MEET
Travis	—	—	MEET	—	MEET	MEET	MEET	—
Williamson	—	—	MEET	—	MEET	MEET	MEET	—

—: Not available.

**TABLE A8. COMPARISON OF SIMULATED DRAWDOWNS WITH THE DESIRED FUTURE CONDITIONS OF THE TRINITY AQUIFER FOR COUNTIES IN THE UPPER TRINITY GROUNDWATER CONSERVATION DISTRICT. NO VALUES ARE GREATER THAN BOTH ERROR TOLERANCES OF FIVE PERCENT AND FIVE FEET AT THE SAME TIME. THUS, PREDICTIVE SIMULATION MEETS ALL DESIRED FUTURE CONDITIONS.**

<b>County</b>	<b>Paluxy</b>	<b>Glen Rose</b>	<b>Twin Mountains</b>	<b>Antlers</b>
Hood (outcrop)	MEET	MEET	MEET	—
Hood (downdip)	—	MEET	MEET	—
Montague (outcrop)	—	—	—	MEET
Montague (downdip)	—	—	—	—
Parker (outcrop)	MEET	MEET	MEET	MEET
Parker (downdip)	MEET	MEET	MEET	—
Wise (outcrop)	—	—	—	MEET
Wise (downdip)	—	—	—	MEET

—: Not available.

## ***Appendix B***

### **Comparison between Desired Future Conditions and Simulated Saturated Thickness for the Marble Falls, Ellenburger-San Saba, and Hickory Aquifers in Brown, Burnet, Lampasas, and Mills Counties**

The predictive simulation used to evaluate the desired future conditions and the modeled available groundwater values for the Marble Falls, Ellenburger-San Saba, and Hickory aquifers in Brown, Burnet, Lampasas, and Mills counties within Groundwater Management Area 8 involves rewriting all relevant MODFLOW-USG packages to reflect the predictive simulation. The initial pumping for the predictive simulation was based on the last stress period of the groundwater availability model. In its clarification, Groundwater Management Area 8 also provided estimated pumping to use for the predictive simulation by TWDB ([Table B1](#)).

These pumping values from Groundwater Management Area 8 are more than the pumpage from the last stress period of the groundwater availability model. This surplus pumping for each aquifer was redistributed uniformly in each county according to its modeled extent.

The head file from the model output was used to calculate the remaining saturated thickness ( $ST$ ) within the modeled extent for each aquifer between 2009 and 2070 using the following equation:

$$ST = \frac{\sum_{i=1}^n (h_{2070_i} - e_i)}{\sum_{i=1}^n (h_{2009_i} - e_i)}$$

Where:

$n$  = Total model cells in a county

$h_{2009_i}$  = Head of 2009 at model cell  $i$  (feet)

$h_{2070_i}$  = Head of 2070 at model cell  $i$  (feet)

$e_i$  = Bottom elevation of model cell  $i$  (feet).

Model cells with head values below the cell bottom in 2009 were excluded from the calculation. Also, head was set at the cell bottom if it fell below the cell bottom at 2070.

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The comparison between the simulated remaining saturated thickness and the desired future conditions is presented in Table B2. Table B2 indicates that the predictive simulation meets the desired future conditions of the Marble Falls, Ellenburger-San Saba, and Hickory aquifers in Brown, Burnet, Lampasas, and Mills counties.

**TABLE B1. GROUNDWATER PUMPING RATES FOR THE MARBLE FALLS, ELLENBURGER-SAN SABA, AND HICKORY AQUIFERS IN BROWN, BURNET, LAMPASAS, AND MILLS COUNTIES PROVIDED BY GROUNDWATER MNAAGMENT AREA 8.**

<b>County</b>	<b>Aquifer</b>	<b>2010 to 2070 (acre-feet per year)</b>
Burnet	Marble Falls	2,736
Lampasas	Marble Falls	2,837
Brown	Marble Falls	25
Mills	Marble Falls	25
Burnet	Ellenburger-San Saba	10,827
Lampasas	Ellenburger-San Saba	2,593
Brown	Ellenburger-San Saba	131
Mills	Ellenburger-San Saba	499
Burnet	Hickory	3,413
Lampasas	Hickory	113
Brown	Hickory	12
Mills	Hickory	36



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**TABLE B2. COMPARISON BETWEEN SIMULATED REMAINING AQUIFER SATURATED THICKNESS AND DESIRED FUTURE CONDITIONS OF MARBLE FALLS, ELLENBURGER-SAN SABA, AND HICKORY AQUIFERS IN BROWN, BURNET, LAMPASAS, AND MILLS COUNTIES.**

<b>County</b>	<b>Aquifer</b>	<b>Remaining Aquifer Saturated Thickness Defined by Desired Future Condition</b>	<b>Simulated Remaining Aquifer Saturated Thickness</b>	<b>Is Desired Future Condition Met?</b>
Brown	Marble Falls	at least 90%	99.8%	Yes
Brown	Ellenburger-San Saba	at least 90%	99.9%	Yes
Brown	Hickory	at least 90%	99.9%	Yes
Burnet	Marble Falls	at least 90%	98.8%	Yes
Burnet	Ellenburger-San Saba	at least 90%	99.3%	Yes
Burnet	Hickory	at least 90%	99.5%	Yes
Lampasas	Marble Falls	at least 90%	98.2%	Yes
Lampasas	Ellenburger-San Saba	at least 90%	99.0%	Yes
Lampasas	Hickory	at least 90%	99.5%	Yes
Mills	Marble Falls	at least 90%	99.5%	Yes
Mills	Ellenburger-San Saba	at least 90%	99.7%	Yes
Mills	Hickory	at least 90%	99.8%	Yes

***Appendix C***

**Summary of Dry Model Cell Count for the Trinity and Woodbine Aquifers**

**TABLE C1. SUMMARY OF DRY MODEL CELLS FOR THE TRINITY AQUIFER (PALUXY) FROM THE REVISED PREDICTIVE SIMULATION.**

<b>Year</b>	<b>Collin</b>	<b>Dallas</b>	<b>Denton</b>	<b>Johnson</b>	<b>Tarrant</b>
Total Active Official Aquifer Model Cells	12,062	14,532	3,520	11,627	15,389
2009 (baseline)	0	0	0	17	3
2010	0	0	9	0	3
2011	1	0	49	0	3
2012	4	0	83	0	17
2013	8	0	140	0	47
2014	35	0	196	0	91
2015	49	0	264	0	146
2016	64	0	306	0	209
2017	72	0	349	0	291
2018	83	0	385	0	373
2019	93	0	428	0	460
2020	99	0	482	0	555
2021	109	0	550	0	620
2022	115	0	622	0	684
2023	125	0	695	0	746
2024	129	0	780	0	802
2025	138	0	879	0	862
2026	147	0	957	0	919
2027	151	0	1,018	0	964
2028	159	0	1,087	0	995
2029	166	0	1,171	0	1,038
2030	173	0	1,262	0	1,072
2031	176	0	1,326	0	1,101
2032	180	0	1,379	0	1,137
2033	187	0	1,420	0	1,156
2034	193	0	1,461	0	1,194
2035	201	0	1,492	0	1,224
2036	204	0	1,520	0	1,240
2037	209	0	1,554	0	1,274
2038	212	0	1,584	0	1,292
2039	215	0	1,607	0	1,317
2040	217	0	1,627	0	1,347
2041	224	0	1,659	0	1,362
2042	228	0	1,682	0	1,377

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<b>Year</b>	<b>Collin</b>	<b>Dallas</b>	<b>Denton</b>	<b>Johnson</b>	<b>Tarrant</b>
2043	235	0	1,710	0	1,409
2044	239	0	1,735	0	1,425
2045	242	0	1,755	0	1,438
2046	247	0	1,777	0	1,455
2047	250	0	1,790	0	1,477
2048	251	0	1,807	0	1,497
2049	253	0	1,823	0	1,517
2050	254	0	1,834	0	1,530
2051	258	2	1,847	0	1,539
2052	264	2	1,860	0	1,562
2053	266	2	1,874	0	1,585
2054	270	3	1,883	0	1,594
2055	272	3	1,893	0	1,606
2056	275	3	1,902	0	1,621
2057	276	3	1,923	0	1,634
2058	280	4	1,929	0	1,650
2059	282	4	1,934	0	1,666
2060	286	4	1,943	0	1,679
2061	288	4	1,947	0	1,693
2062	288	4	1,961	0	1,701
2063	290	5	1,973	0	1,712
2064	291	5	1,977	0	1,726
2065	292	5	1,988	0	1,739
2066	295	5	1,996	0	1,752
2067	297	6	2,002	0	1,760
2068	300	7	2,009	0	1,769
2069	304	7	2,017	0	1,778
2070	305	7	2,024	0	1,784

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**TABLE C2. SUMMARY OF DRY MODEL CELLS FOR THE TRINITY AQUIFER (GLEN ROSE) FROM THE REVISED PREDICTIVE SIMULATION.**

Year	Bell	Burnet	Coryell	Erath	Hamilton	Hood	Johnson	Mills	Parker	Travis
Total Active Official Aquifer Model Cells	23,737	22,534	41,647	20,905	36,944	14,461	12,342	10,615	11,389	14,552
2009 (baseline)	0	0	11	0	0	0	15	0	8	25
2010	0	0	11	0	0	0	15	0	9	29
2011	0	0	11	0	0	0	15	0	12	29
2012	0	0	11	0	0	0	15	0	15	29
2013	0	0	11	1	0	0	15	1	19	29
2014	0	1	11	1	0	1	15	1	22	31
2015	0	1	11	1	0	1	15	1	23	32
2016	0	1	12	1	0	1	15	1	30	33
2017	0	1	12	2	0	2	15	1	37	34
2018	0	1	12	3	0	2	15	1	38	34
2019	0	1	14	3	0	2	16	1	44	34
2020	0	1	14	3	0	2	16	1	46	34
2021	0	1	14	3	0	3	16	1	48	35
2022	0	1	14	3	0	3	16	1	49	38
2023	0	1	14	3	0	3	17	1	54	41
2024	0	1	15	3	0	3	17	1	58	45
2025	0	1	15	3	0	3	17	1	65	47
2026	0	1	15	3	0	5	19	1	72	48
2027	0	1	15	4	0	5	21	1	78	50
2028	0	1	15	4	0	5	21	1	82	51
2029	0	1	15	4	0	6	22	1	84	51
2030	0	1	15	4	0	6	22	1	90	54
2031	0	1	15	8	0	6	22	1	99	54
2032	0	1	15	8	0	8	23	1	103	55
2033	0	1	15	8	0	8	23	1	105	56
2034	0	1	15	9	0	9	23	1	108	56
2035	0	1	15	9	0	10	23	1	109	57
2036	0	1	15	9	0	12	23	1	110	58
2037	0	1	15	9	0	13	23	1	110	58
2038	0	1	15	9	0	14	23	1	113	59

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Year	Bell	Burnet	Coryell	Erath	Hamilton	Hood	Johnson	Mills	Parker	Travis
2039	0	2	15	9	0	14	23	1	113	59
2040	0	2	15	9	0	14	23	1	116	60
2041	0	2	15	9	0	16	23	1	119	60
2042	0	2	15	10	1	16	23	1	122	61
2043	0	2	15	10	2	16	23	1	124	61
2044	0	2	15	10	2	18	24	1	125	62
2045	0	2	15	10	2	18	25	1	131	63
2046	0	2	15	10	2	18	25	1	131	63
2047	0	2	16	10	3	18	25	1	134	64
2048	0	2	16	10	4	18	26	1	137	64
2049	0	2	16	11	4	20	26	1	139	65
2050	0	2	16	11	4	22	26	1	143	65
2051	0	2	16	12	5	22	29	1	144	66
2052	1	2	16	12	5	22	31	1	147	66
2053	3	2	16	12	7	24	32	1	149	67
2054	4	2	17	12	7	27	32	1	151	67
2055	4	2	17	12	7	27	34	1	152	67
2056	4	2	17	12	7	30	34	1	152	68
2057	6	2	17	13	7	31	34	1	156	69
2058	7	2	17	13	7	31	34	1	159	69
2059	7	2	17	13	7	31	34	1	164	69
2060	7	2	17	13	8	34	34	1	166	69
2061	7	2	17	13	8	34	34	1	165	69
2062	7	2	17	13	9	35	34	1	168	69
2063	7	2	17	14	9	36	34	1	168	69
2064	7	2	17	16	9	36	34	1	172	69
2065	8	2	17	16	9	36	34	2	176	69
2066	8	2	17	16	10	36	34	2	180	69
2067	8	3	17	19	10	36	34	2	184	69
2068	8	3	17	19	11	38	34	2	188	69
2069	8	3	17	20	11	38	34	2	191	69
2070	8	4	17	20	11	41	34	2	194	69

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**TABLE C3. SUMMARY OF DRY MODEL CELLS FOR THE TRINITY AQUIFER (TWIN MOUNTAINS) FROM THE REVISED PREDICTIVE SIMULATION.**

Year	Denton	Erath	Hood	Johnson	Parker	Tarrant
Total Active Official Aquifer Model Cells	10,560	46,642	37,444	6,816	30,830	40,713
2009 (baseline)	0	20	0	0	0	0
2010	0	27	0	0	0	0
2011	0	33	0	0	0	0
2012	0	40	0	0	0	0
2013	0	44	0	0	0	0
2014	0	48	0	0	0	0
2015	0	53	0	0	0	0
2016	0	56	0	0	0	0
2017	0	61	0	0	0	0
2018	0	65	0	0	0	0
2019	0	68	1	0	0	0
2020	0	71	1	0	0	0
2021	0	76	1	0	1	0
2022	0	80	1	0	4	0
2023	0	81	1	0	8	2
2024	0	85	4	0	13	6
2025	0	88	7	0	16	10
2026	0	91	15	0	17	16
2027	0	94	18	0	18	25
2028	0	97	23	0	18	32
2029	0	101	28	0	23	36
2030	0	107	33	0	24	41
2031	1	108	41	0	25	48
2032	1	111	46	0	25	53
2033	1	119	56	0	26	56
2034	1	122	64	0	27	66
2035	1	123	68	0	27	74
2036	2	126	75	0	29	93
2037	2	131	82	0	29	127
2038	2	134	95	0	30	170
2039	2	136	100	0	31	231
2040	2	137	114	0	32	289
2041	2	143	129	0	32	354

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<b>Year</b>	<b>Denton</b>	<b>Erath</b>	<b>Hood</b>	<b>Johnson</b>	<b>Parker</b>	<b>Tarrant</b>
2042	2	146	137	0	32	426
2043	2	150	150	0	32	500
2044	2	154	165	0	32	587
2045	3	157	178	0	34	648
2046	4	161	194	0	35	711
2047	4	167	212	0	36	767
2048	4	171	228	0	38	832
2049	5	174	242	0	38	889
2050	7	176	251	0	38	930
2051	8	178	262	0	38	996
2052	8	181	272	2	38	1,057
2053	9	184	282	7	38	1,114
2054	9	186	297	13	39	1,169
2055	9	189	313	19	40	1,234
2056	10	194	320	26	40	1,303
2057	11	196	330	33	41	1,366
2058	14	207	336	41	42	1,435
2059	14	211	341	49	42	1,508
2060	15	221	351	57	42	1,595
2061	16	221	363	67	43	1,681
2062	17	223	368	75	43	1,783
2063	18	224	375	83	43	1,899
2064	20	228	385	94	45	1,988
2065	22	229	393	105	46	2,104
2066	23	231	401	115	47	2,188
2067	24	233	408	130	47	2,285
2068	27	236	416	139	47	2,364
2069	31	240	424	155	47	2,468
2070	35	242	429	168	47	2,553



**TABLE C4. SUMMARY OF DRY MODEL CELLS FOR THE TRINITY AQUIFER (TRAVIS PEAK) FROM THE REVISED PREDICTIVE SIMULATION.**

Year	Burnet	Comanche	Erath	Johnson	Lampasas	McLennan	Travis
Total Active Official Aquifer Model Cells	46,474	78,137	39,220	28,386	63,905	50,973	30,318
2009 (baseline)	217	0	0	0	1	0	57
2010	176	0	1	0	1	0	59
2011	186	0	1	0	1	0	60
2012	218	0	1	0	1	0	63
2013	249	0	1	0	1	0	65
2014	271	0	1	0	1	0	68
2015	291	0	1	0	1	0	68
2016	314	0	3	0	1	0	70
2017	331	0	4	0	1	0	70
2018	345	0	5	0	1	0	71
2019	363	0	6	0	1	0	72
2020	378	0	11	0	1	0	72
2021	394	0	17	0	1	0	74
2022	400	0	29	0	1	0	74
2023	414	0	59	0	1	0	76
2024	424	0	93	0	1	0	77
2025	438	1	114	0	1	0	77
2026	450	9	130	0	1	0	79
2027	463	14	160	0	1	0	80
2028	474	14	183	0	1	0	80
2029	483	18	205	0	1	0	82
2030	494	30	238	0	1	0	82
2031	505	34	266	0	1	0	83
2032	512	35	299	0	1	0	83
2033	520	41	328	0	1	0	84
2034	527	54	343	0	1	0	85
2035	533	67	351	0	1	0	85
2036	543	72	370	0	1	0	87
2037	545	77	398	0	1	0	88
2038	554	85	414	0	1	0	88
2039	564	94	421	0	1	0	90
2040	571	103	435	0	1	1	90
2041	579	111	453	0	1	1	91
2042	588	116	481	0	1	1	92

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Year	Burnet	Comanche	Erath	Johnson	Lampasas	McLennan	Travis
2043	599	116	497	0	1	1	93
2044	604	121	507	0	1	1	93
2045	609	128	520	0	1	1	94
2046	618	138	538	0	1	1	95
2047	623	146	557	0	1	2	97
2048	629	152	590	0	1	2	97
2049	634	160	606	0	1	2	98
2050	640	166	620	0	1	2	99
2051	644	172	638	1	1	2	100
2052	648	180	651	1	1	2	100
2053	654	186	665	1	1	2	101
2054	658	190	678	1	1	2	102
2055	670	194	690	1	1	2	103
2056	675	196	699	1	1	2	103
2057	678	199	711	1	1	2	104
2058	692	206	723	1	1	2	105
2059	702	216	746	1	1	2	106
2060	717	222	774	1	1	2	106
2061	714	225	776	1	1	2	106
2062	719	227	790	1	1	2	107
2063	723	231	799	1	1	3	107
2064	728	235	813	2	1	3	109
2065	730	238	822	3	1	3	109
2066	730	245	832	3	1	3	109
2067	734	252	841	3	1	3	110
2068	741	258	850	3	1	3	110
2069	745	264	861	6	1	3	111
2070	748	269	871	7	1	3	112

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**TABLE C5. SUMMARY OF DRY MODEL CELLS FOR THE TRINITY AQUIFER (HENSELL) FROM THE REVISED PREDICTIVE SIMULATION.**

<b>Year</b>	<b>Erath</b>	<b>Lampasas</b>
Total Active Official Aquifer Model Cells	21,880	25,364
2009 (baseline)	0	1
2010	0	1
2011	0	1
2012	0	1
2013	0	1
2014	0	1
2015	0	1
2016	0	1
2017	0	1
2018	0	1
2019	0	1
2020	0	1
2021	0	1
2022	0	1
2023	0	1
2024	0	1
2025	0	1
2026	0	1
2027	0	1
2028	0	1
2029	0	1
2030	0	1
2031	0	1
2032	0	1
2033	0	1
2034	0	1
2035	0	1
2036	0	1
2037	0	1
2038	0	1
2039	0	1
2040	1	1
2041	1	1
2042	3	1
2043	3	1

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<b>Year</b>	<b>Erath</b>	<b>Lampasas</b>
2044	3	1
2045	6	1
2046	7	1
2047	7	1
2048	12	1
2049	14	1
2050	14	1
2051	18	1
2052	20	1
2053	22	1
2054	24	1
2055	25	1
2056	25	1
2057	30	1
2058	31	1
2059	35	1
2060	37	1
2061	37	1
2062	40	1
2063	42	1
2064	42	1
2065	44	1
2066	46	1
2067	46	1
2068	48	1
2069	50	1
2070	52	1

GAM Run 17-029 MAG: Modeled Available Groundwater for the Trinity, Woodbine, Edwards (Balcones Fault Zone), Marble Falls, Ellenburger-San Saba, and Hickory Aquifers in Groundwater Management Area 8

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**TABLE C6. SUMMARY OF DRY MODEL CELLS FOR THE TRINITY AQUIFER (HOSSTON) FROM THE REVISED PREDICTIVE SIMULATION.**

Year	Burnet	Comanche	Erath	Johnson	McLennan	Travis
Total Active Official Aquifer Model Cells	24,354	41,062	8,464	9,462	16,991	9,480
2009 (baseline)	217	0	0	0	0	57
2010	176	0	1	0	0	59
2011	186	0	1	0	0	60
2012	218	0	1	0	0	63
2013	247	0	1	0	0	65
2014	269	0	1	0	0	68
2015	288	0	1	0	0	68
2016	310	0	1	0	0	70
2017	325	0	1	0	0	70
2018	338	0	1	0	0	71
2019	353	0	1	0	0	72
2020	368	0	1	0	0	72
2021	382	0	2	0	0	74
2022	387	0	9	0	0	74
2023	400	0	25	0	0	76
2024	409	0	51	0	0	77
2025	423	1	66	0	0	77
2026	433	9	75	0	0	79
2027	444	14	93	0	0	80
2028	455	14	99	0	0	80
2029	463	18	105	0	0	82
2030	473	30	111	0	0	82
2031	484	34	118	0	0	83
2032	491	35	127	0	0	83
2033	498	41	132	0	0	84
2034	505	54	138	0	0	85
2035	511	67	143	0	0	85
2036	520	72	151	0	0	87
2037	522	77	158	0	0	88
2038	531	85	162	0	0	88
2039	541	94	162	0	0	90
2040	547	103	166	0	1	90
2041	555	111	174	0	1	91
2042	563	116	183	0	1	92
2043	570	116	187	0	1	93

GAM Run 17-029 MAG: Modeled Available Groundwater for the Trinity, Woodbine, Edwards (Balcones Fault Zone), Marble Falls, Ellenburger-San Saba, and Hickory Aquifers in Groundwater Management Area 8

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Year	Burnet	Comanche	Erath	Johnson	McLennan	Travis
2044	575	121	192	0	1	93
2045	579	128	198	0	1	94
2046	588	138	206	0	1	95
2047	591	146	211	0	2	97
2048	597	152	219	0	2	97
2049	602	160	222	0	2	98
2050	607	166	227	0	2	99
2051	609	172	229	1	2	100
2052	613	180	232	1	2	100
2053	619	186	239	1	2	101
2054	623	190	246	1	2	102
2055	633	194	253	1	2	103
2056	637	196	259	1	2	103
2057	640	199	263	1	2	104
2058	651	206	269	1	2	105
2059	659	216	283	1	2	106
2060	673	222	294	1	2	106
2061	671	225	295	1	2	106
2062	675	227	297	1	2	107
2063	679	231	299	1	3	107
2064	684	235	305	2	3	109
2065	686	238	307	3	3	109
2066	686	245	310	3	3	109
2067	689	252	315	3	3	110
2068	696	258	317	3	3	110
2069	700	264	320	6	3	111
2070	703	269	323	7	3	112

GAM Run 17-029 MAG: Modeled Available Groundwater for the Trinity, Woodbine, Edwards (Balcones Fault Zone), Marble Falls, Ellenburger-San Saba, and Hickory Aquifers in Groundwater Management Area 8

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**TABLE C7. SUMMARY OF DRY MODEL CELLS FOR THE TRINITY AQUIFER (ANTLERS) FROM THE REVISED PREDICTIVE SIMULATION.**

Year	Collin	Comanche	Cooke	Denton	Eastland	Erath	Grayson	Montague	Parker	Tarrant	Wise
Total Active Official Aquifer Model Cells	7,055	23,711	77,143	59,107	44,009	9,287	77,954	56,141	42,539	5,009	92,333
2009 (baseline)	0	123	0	0	74	0	0	0	0	0	0
2010	1	80	0	0	91	6	0	0	0	0	1
2011	3	85	0	5	94	13	0	0	0	0	5
2012	7	92	0	29	99	29	0	0	0	0	6
2013	11	99	0	95	108	34	0	0	0	1	6
2014	16	103	1	201	110	36	0	0	0	6	6
2015	22	111	2	341	111	36	0	0	0	15	8
2016	30	120	3	500	113	36	0	0	0	28	67
2017	37	130	4	616	115	36	2	0	0	40	221
2018	44	141	7	721	117	39	6	0	1	58	372
2019	47	156	10	806	120	44	10	0	1	78	484
2020	53	167	17	901	125	48	22	0	2	94	574
2021	57	176	27	1,017	127	51	29	0	2	111	654
2022	62	186	37	1,199	130	52	36	0	2	124	741
2023	67	202	49	1,375	130	60	48	0	6	140	810
2024	71	230	64	1,543	133	74	57	0	9	151	879
2025	77	270	76	1,692	137	81	72	0	19	158	947
2026	79	294	95	1,803	139	90	90	0	54	162	995
2027	83	327	111	1,903	149	102	101	0	84	167	1,053
2028	86	373	123	1,983	156	110	106	0	112	171	1,109
2029	90	422	140	2,056	162	128	117	0	141	179	1,180
2030	94	448	152	2,121	179	171	122	0	166	183	1,236

GAM Run 17-029 MAG: Modeled Available Groundwater for the Trinity, Woodbine, Edwards (Balcones Fault Zone), Marble Falls, Ellenburger-San Saba, and Hickory Aquifers in Groundwater Management Area 8

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Year	Collin	Comanche	Cooke	Denton	Eastland	Erath	Grayson	Montague	Parker	Tarrant	Wise
2031	96	478	164	2,180	204	185	134	0	184	190	1,294
2032	100	517	175	2,244	221	197	140	0	206	195	1,368
2033	103	554	185	2,299	233	208	148	0	218	202	1,479
2034	105	617	199	2,364	236	222	152	0	234	208	1,551
2035	110	669	216	2,436	242	225	161	0	244	215	1,628
2036	111	710	222	2,517	249	232	168	0	254	222	1,713
2037	113	771	234	2,623	259	246	175	0	262	229	1,809
2038	116	836	245	2,708	282	262	184	0	270	236	1,879
2039	121	865	256	2,788	304	283	191	0	278	244	1,952
2040	122	913	264	2,879	321	303	195	0	285	256	2,029
2041	123	957	276	2,951	331	313	201	0	292	291	2,085
2042	126	998	292	3,038	344	326	205	0	295	349	2,130
2043	128	1,032	300	3,119	363	334	210	0	303	383	2,174
2044	130	1,074	307	3,189	380	351	215	0	305	414	2,214
2045	131	1,129	314	3,251	397	359	221	0	309	446	2,253
2046	131	1,171	323	3,336	412	372	230	0	312	472	2,291
2047	136	1,221	333	3,405	442	390	233	0	318	501	2,349
2048	137	1,266	340	3,465	453	415	239	0	319	533	2,382
2049	139	1,320	353	3,524	474	440	240	0	325	558	2,413
2050	141	1,351	361	3,589	502	455	244	0	326	583	2,442
2051	141	1,389	367	3,633	525	468	247	0	327	608	2,458
2052	143	1,435	376	3,688	548	482	254	0	331	632	2,480
2053	146	1,469	379	3,745	590	493	257	0	332	652	2,496
2054	147	1,510	384	3,788	619	506	258	0	334	671	2,518
2055	148	1,548	392	3,849	645	526	264	0	335	697	2,533
2056	149	1,585	399	3,897	668	548	267	0	337	719	2,545



GAM Run 17-029 MAG: Modeled Available Groundwater for the Trinity, Woodbine, Edwards (Balcones Fault Zone), Marble Falls, Ellenburger-San Saba, and Hickory Aquifers in Groundwater Management Area 8

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<b>Year</b>	<b>Collin</b>	<b>Comanche</b>	<b>Cooke</b>	<b>Denton</b>	<b>Eastland</b>	<b>Erath</b>	<b>Grayson</b>	<b>Montague</b>	<b>Parker</b>	<b>Tarrant</b>	<b>Wise</b>
2057	150	1,626	402	3,948	681	564	270	0	340	754	2,558
2058	150	1,703	407	3,981	715	578	274	0	340	788	2,574
2059	152	1,750	411	4,028	733	606	280	1	346	817	2,586
2060	154	1,813	416	4,067	751	627	283	1	346	845	2,594
2061	155	1,846	424	4,115	756	637	283	1	350	872	2,607
2062	156	1,909	428	4,152	777	646	287	1	350	898	2,616
2063	158	1,944	434	4,193	793	673	288	1	350	930	2,629
2064	158	1,968	441	4,232	807	711	292	1	350	953	2,635
2065	158	2,001	448	4,260	821	744	294	1	350	966	2,642
2066	158	2,065	450	4,295	842	770	298	1	352	984	2,653
2067	160	2,117	454	4,335	854	792	301	1	354	1,005	2,665
2068	162	2,154	455	4,360	863	802	303	1	355	1,016	2,676
2069	162	2,198	459	4,395	876	825	303	1	359	1,017	2,684
2070	164	2,268	462	4,438	881	846	307	1	360	1,019	2,691

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**TABLE C8. SUMMARY OF DRY MODEL CELLS FOR THE WOODBINE AQUIFER FROM THE REVISED PREDICTIVE SIMULATION.**

Year	Collin	Cooke	Denton	Fannin	Grayson	Johnson	Tarrant
Total Active Model Cells in Official Aquifer Boundary	11,762	5,700	11,991	15,443	17,911	8,407	8,901
2009 (baseline)	0	0	3	3	2	14	2
2010	0	4	3	3	3	16	2
2011	0	4	3	4	3	16	2
2012	0	4	3	4	5	16	2
2013	0	4	3	4	5	19	2
2014	0	4	3	5	6	23	2
2015	0	4	3	6	7	23	2
2016	0	5	3	6	8	23	2
2017	0	5	3	8	9	24	2
2018	0	5	3	9	10	26	2
2019	0	5	3	10	11	26	2
2020	0	5	3	11	11	26	2
2021	0	5	3	12	13	27	2
2022	0	5	3	12	14	28	2
2023	0	5	3	12	14	28	2
2024	0	5	4	13	14	29	2
2025	0	5	5	14	15	29	2
2026	0	5	5	15	15	30	2
2027	0	5	5	15	15	31	2
2028	0	6	5	15	15	33	2
2029	0	6	5	15	15	34	2
2030	0	6	5	15	15	36	2
2031	0	6	5	16	15	37	2
2032	0	6	5	17	16	37	2
2033	0	6	5	18	17	38	2
2034	0	6	5	20	18	40	2
2035	0	6	5	21	19	40	2
2036	0	6	5	22	19	41	2
2037	0	6	5	24	19	41	2
2038	0	6	5	25	23	42	2
2039	0	6	5	26	25	42	2
2040	0	6	5	27	25	42	2
2041	0	6	5	27	25	42	2

GAM Run 17-029 MAG: Modeled Available Groundwater for the Trinity, Woodbine, Edwards (Balcones Fault Zone), Marble Falls, Ellenburger-San Saba, and Hickory Aquifers in Groundwater Management Area 8

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<b>Year</b>	<b>Collin</b>	<b>Cooke</b>	<b>Denton</b>	<b>Fannin</b>	<b>Grayson</b>	<b>Johnson</b>	<b>Tarrant</b>
2042	0	6	5	27	27	42	2
2043	0	6	5	27	27	42	2
2044	0	6	5	28	30	42	2
2045	0	6	5	29	31	43	2
2046	0	6	6	30	31	43	2
2047	0	6	6	30	31	43	2
2048	0	6	7	32	34	43	2
2049	0	6	8	35	34	43	2
2050	0	7	8	35	35	43	2
2051	0	8	8	35	35	43	2
2052	0	8	8	37	35	43	2
2053	0	8	8	38	35	44	2
2054	0	8	8	38	37	45	2
2055	0	9	8	38	38	45	2
2056	0	10	8	38	38	46	2
2057	0	10	9	39	38	46	2
2058	0	10	9	42	39	50	3
2059	0	10	9	44	40	52	3
2060	0	13	9	47	41	54	3
2061	0	14	9	47	41	53	3
2062	0	14	9	47	41	53	3
2063	0	17	9	47	42	55	3
2064	0	20	9	47	42	55	3
2065	0	21	9	47	42	56	3
2066	1	23	9	47	42	57	3
2067	1	23	9	48	45	58	3
2068	2	24	9	49	45	59	3
2069	2	24	9	50	45	59	3
2070	2	24	9	50	45	60	3

GAM Run 17-029 MAG: Modeled Available Groundwater for the Trinity, Woodbine, Edwards (Balcones Fault Zone), Marble Falls, Ellenburger-San Saba, and Hickory Aquifers in Groundwater Management Area 8

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## ***Appendix D***

### **Summary of Dry Model Cell Count for the Marble Falls, Ellenburger-San Saba, and Hickory Aquifers in Brown, Burnet, Lampasas, and Mills Counties**

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**TABLE D1. SUMMARY OF DRY MODEL CELLS FOR THE MARBLE FALLS, ELLENBURGER-SAN SABA, AND HICKORY AQUIFERS IN BROWN, BURNET, LAMPASAS, AND MILLS COUNTIES FROM THE PREDICTIVE SIMULATION.**

Year	Burnet	Lampasas	Burnet	Burnet
	Marble Falls		Ellenburger-San Saba	Hickory
Total Active Cells in modeled extent	10,810	7,614	13,618	14,334
2009 (baseline)	2298	611	709	111
2010	2353	631	724	112
2011	2363	638	735	112
2012	2376	641	744	113
2013	2386	642	758	113
2014	2391	646	769	113
2015	2395	650	776	113
2016	2397	653	781	115
2017	2405	654	787	117
2018	2406	657	795	117
2019	2409	659	801	118
2020	2413	661	804	118
2021	2419	661	809	118
2022	2419	661	810	118
2023	2421	661	811	118
2024	2422	662	813	119
2025	2423	662	817	120
2026	2425	664	821	120
2027	2426	665	821	120
2028	2428	666	823	120
2029	2433	667	824	122
2030	2433	669	824	123
2031	2435	670	825	123
2032	2436	671	828	123
2033	2438	671	830	123
2034	2440	672	832	124
2035	2441	673	832	124
2036	2441	675	833	124
2037	2442	676	833	124
2038	2442	677	834	125
2039	2443	678	837	126
2040	2443	678	837	126

GAM Run 17-029 MAG: Modeled Available Groundwater for the Trinity, Woodbine, Edwards (Balcones Fault Zone), Marble Falls, Ellenburger-San Saba, and Hickory Aquifers in Groundwater Management Area 8

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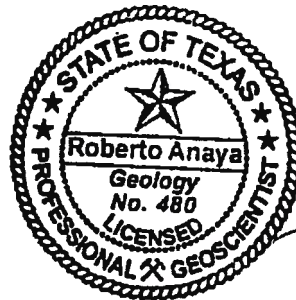
Year	Burnet	Lampasas	Burnet	Burnet
	Marble Falls		Ellenburger-San Saba	Hickory
2041	2443	680	839	126
2042	2443	680	840	126
2043	2443	680	842	127
2044	2444	680	842	127
2045	2445	680	842	128
2046	2446	680	843	128
2047	2446	680	843	128
2048	2446	680	843	128
2049	2446	680	844	128
2050	2446	680	845	128
2051	2446	681	846	128
2052	2446	681	846	128
2053	2446	681	846	130
2054	2446	681	846	130
2055	2447	681	846	130
2056	2447	681	847	130
2057	2447	681	848	130
2058	2447	682	848	130
2059	2448	682	849	130
2060	2448	682	849	130
2061	2448	682	849	130
2062	2448	682	849	130
2063	2448	682	849	130
2064	2449	682	849	130
2065	2449	683	849	130
2066	2449	683	849	130
2067	2449	683	850	130
2068	2449	683	850	130
2069	2450	683	850	130
2070	2450	683	850	130

**APPENDIX K**

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# GAM RUN 15-003: CLEARWATER UNDERGROUND WATER CONSERVATION DISTRICT MANAGEMENT PLAN

by Roberto Anaya, P.G.  
Texas Water Development Board  
Groundwater Resources Division  
Groundwater Availability Modeling Section  
(512) 463-6115  
November 24, 2015



*Roberto Anaya*



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# **GAM RUN 15-003: CLEARWATER UNDERGROUND WATER CONSERVATION DISTRICT MANAGEMENT PLAN**

by Roberto Anaya, P.G.  
Texas Water Development Board  
Groundwater Resources Division  
Groundwater Availability Modeling Section  
(512) 463-6115  
November 24, 2015

## ***EXECUTIVE SUMMARY:***

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

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

This report – Part 2 of a two-part package of information from the TWDB to Clearwater Underground Water Conservation District – fulfills the requirements noted above. Part 1 of the two-part package is the Estimated Historical Water Use/State Water Plan data report. The district will receive, or received, this data report from the TWDB Groundwater Technical Assistance Section. Questions about the data report can be directed to Mr. Stephen Allen, [Stephen.Allen@twdb.texas.gov](mailto:Stephen.Allen@twdb.texas.gov), (512) 463-7317.

The groundwater management plan for the Clearwater Underground Water Conservation District should be adopted by the district on or before January 14, 2016 and submitted to the executive administrator of the TWDB on or before February 13, 2016. The current management plan for the Clearwater Underground Water Conservation District expires on April 13, 2016.

This report discusses the methods, assumptions, and results from a model run using the most current groundwater availability models for the Trinity (northern portion) and Woodbine aquifers, version 2.01 (Kelley and others, 2014) and the northern segment of the Edwards (Balcones Fault Zone) Aquifer (Jones, 2003). This model run replaces the results of GAM Run 10-009 (Hassan, 2010) that used version 1.01 of the groundwater availability model for the Trinity (northern portion) and Woodbine aquifers (Bené and others, 2004). Tables 1 and 2 summarize the groundwater availability model data required by statute to be included in the district's groundwater conservation management plan, and Figures 1 and 2 show the areas of the model from which the values in the table were extracted. If after review of the figures, Clearwater Underground Water Conservation District determines that the district boundaries used in the assessment do not reflect current conditions, please notify the TWDB at your earliest convenience.

### ***METHODS:***

In accordance with the provisions of the Texas State Water Code, Section 36.1071, Subsection (h), the updated groundwater availability model for the northern portion of the Trinity and Woodbine aquifers (Kelley and others, 2014) and the original groundwater availability model for the northern segment of the Edwards (Balcones Fault Zone) Aquifer (Jones, 2003) was used for this analysis. Water budgets for the Clearwater Underground Water Conservation District were extracted for the historical model calibration periods of 1980-2012 for the Trinity Aquifer and 1980-2000 for the Edwards (Balcones Fault Zone) Aquifer using ZONEBUDGET Version 3.01 (Harbaugh, 2009). The average annual water budget values for recharge, surface water outflow, inflow to the district, outflow from the district, net inter-aquifer flow (upper), and net inter-aquifer flow (lower) for the portion of the aquifers located within the district are summarized in this report.

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

#### ***Northern portion of the Trinity Aquifer and Woodbine Aquifer***

- We used the updated groundwater availability model for the northern portion of the Trinity Aquifer and Woodbine Aquifer (Version 2.01). See

Kelley and others (2014) for assumptions and limitations of the updated groundwater availability model.

- The groundwater availability model includes eight layers, that generally correspond to:
  - the surficial outcrop area of the units in layers 2 through 8 and the younger formations overlying the downdip portions of the Woodbine Aquifer and Washita and Fredericksburg groups (Layer 1),
  - the Woodbine Aquifer (Layer 2),
  - the Washita and Fredericksburg groups (Layer 3),
  - the Paluxy Aquifer (Layer 4),
  - the Glen Rose Formation (Layer 5),
  - the Hensell Sand (Layer 6),
  - the Pearsall Formation (Layer 7), and
  - The Hosston Formation (Layer 8).
- The Trinity Aquifer is a major source of groundwater in the Clearwater Underground Water Conservation District. Most of the Trinity Aquifer occurs as subcrop within the district boundaries. A small amount of the aquifer outcrops in the western portion of the district. All of the eight numerical layers in the model are designated as active in the Clearwater Underground Water Conservation District. The Trinity Aquifer is represented by Model Layers 1 through 8 in the outcrop area and by Model Layers 4 through 8 in the subcrop area. These layers were combined to calculate water budget values for the Trinity Aquifer in the district.
- Groundwater in the Trinity Aquifer within the Clearwater Underground Water Conservation District is primarily fresh water, with total dissolved solids concentrations less than 1,000 milligrams per liter (see Figures 4.4.11 through 4.4.15 in Kelley and others (2014)).
- The Woodbine Aquifer does not exist within the Clearwater Underground Water Conservation District and thus water budgets for this aquifer were not calculated or included for this report.

- The model was run with MODFLOW-NWT (Niswonger and others, 2011).

### ***Northern Segment of the Edwards (Balcones Fault Zone) Aquifer***

- We used the original groundwater availability model for the northern segment of the Edwards (Balcones Fault Zone) Aquifer (Version 1.01). See Jones (2003) for assumptions and limitations of the groundwater availability model.
- The groundwater availability model includes one layer, that generally corresponds to:
  - The Edwards (Balcones Fault Zone) Aquifer.
- The Edwards (Balcones Fault Zone) Aquifer is a major source of groundwater in the Clearwater Underground Water Conservation District. Most of the Edwards (Balcones Fault Zone) Aquifer occurs as outcrop within the district boundaries (72 percent). The remainder of the aquifer subcrops to the southwest. The single numerical layer in the model is designated as active in the Clearwater Underground Water Conservation District. This layer was used to calculate water budget values for the Edwards (Balcones Fault Zone) Aquifer in the district.
- Groundwater in the Edwards (Balcones Fault Zone) Aquifer within the Clearwater Underground Water Conservation District is primarily fresh water, with total dissolved solids concentrations less than 1,000 milligrams per liter (see pages 37 through 39 in Jones (2003)).
- The model was run with MODFLOW-96 (Harbaugh and McDonald, 1996).

### **RESULTS:**

A groundwater budget summarizes the amount of water entering and leaving the aquifer according to the groundwater availability model. Selected groundwater budget components listed below were extracted from the model results for the Trinity Aquifer and Edwards (Balcones Fault Zone) Aquifer located within the district and averaged over the duration of the calibration and verification portion of the model run, as shown in Tables 1 and 2.

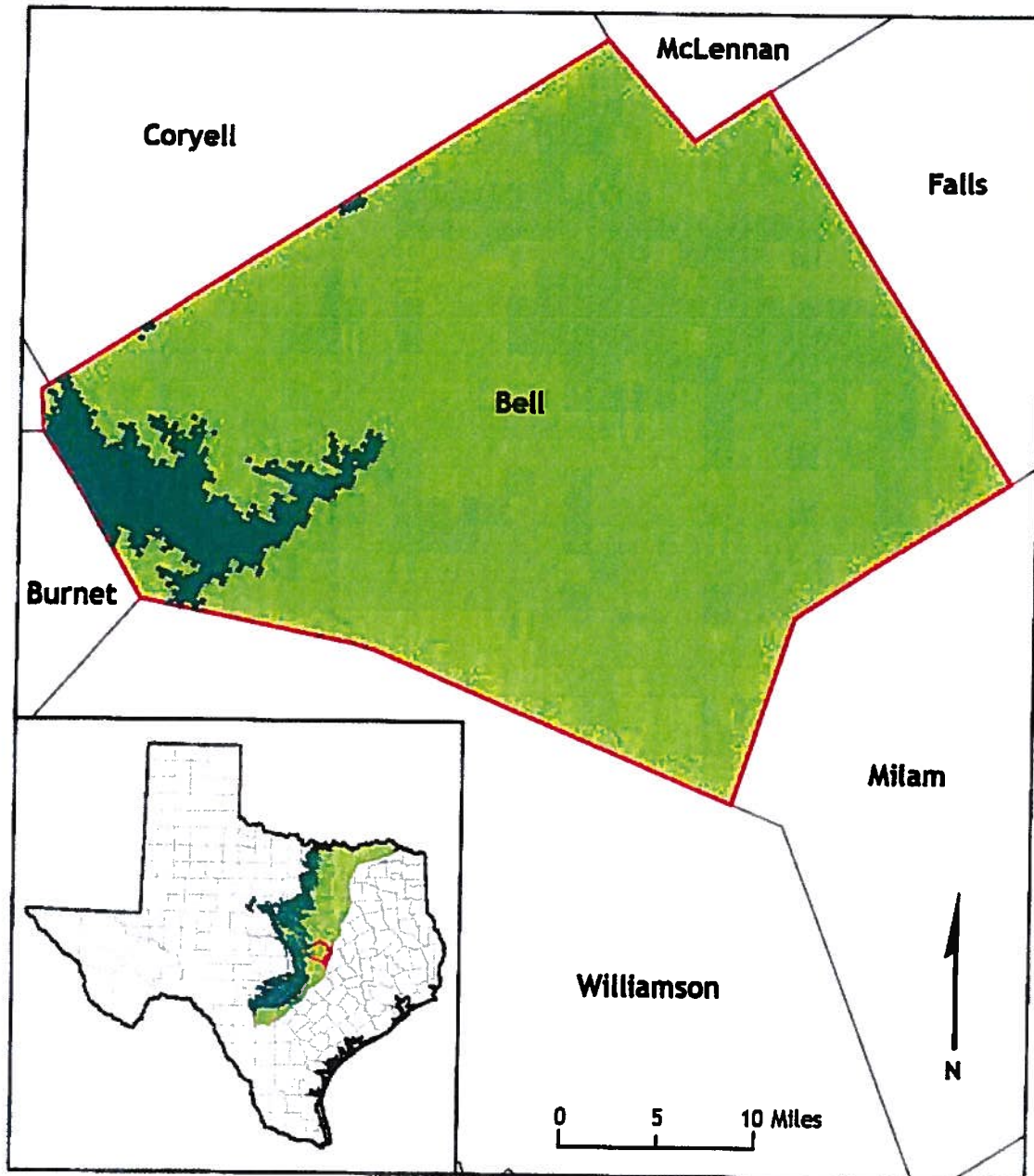
- Precipitation recharge—the areally-distributed recharge sourced from precipitation falling on the outcrop areas of the Trinity Aquifer or Edwards (Balcones Fault Zone) Aquifer (where the aquifers are exposed at land surface) within the district.

- **Surface water outflow**—the total volume of 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 aquifers 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 hydraulic properties of each aquifer or confining unit. In the Clearwater Underground Water Conservation District, this net vertical flow represents the net groundwater flow between the Trinity Aquifer and the immediate geologic unit overlying the aquifer in the subcrop area or the net groundwater flow between the Edwards (Balcones Fault Zone) Aquifer and the immediate geologic units overlying and underlying the aquifer in the subcrop area.





The information needed for the Clearwater Underground Water Conservation District's management plan is summarized in Tables 1 and 2. It is important to note that sub-regional water budgets are approximate. 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 and 2). Please note that the results of this model run are different from the results of the model run 10-009 that were obtained from the older groundwater availability model for the Trinity Aquifer. The changes can be attributed to several characteristics of the new model, such as differences in model layering, geologic boundaries, hydraulic properties distribution, and the use of different MODFLOW modeling packages.

**TABLE 1: SUMMARIZED INFORMATION FOR THE TRINITY AQUIFER THAT IS NEEDED FOR THE CLEARWATER UNDERGROUND WATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT.**

<i>Management Plan requirement</i>	<i>Aquifer or confining unit</i>	<i>Results</i>
Estimated annual amount of recharge from precipitation to the district	Trinity Aquifer	2,816
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Trinity Aquifer	11,131
Estimated annual volume of flow into the district within each aquifer in the district	Trinity Aquifer	7230
Estimated annual volume of flow out of the district within each aquifer in the district	Trinity Aquifer	5659
Estimated net annual volume of flow between each aquifer in the district	From younger overlying Washita and Fredericksburg Confining Units into the Trinity Aquifer	5,587



**Legend**

- |   |  |  |
|---|--|--|
|  | County Boundary                                      | <i>County Boundary Date = 02/02/2011</i> |
|  | Clearwater Underground Water Conservation District   | <i>GCD Boundary Date = 07/01/2015</i>    |
|  | Trinity Aquifer (North) Active Model Cells (outcrop) | <i>trnt_n Grid Date = 08/26/2015</i>     |
|  | Trinity Aquifer (North) Active Model Cells (subcrop) |  |

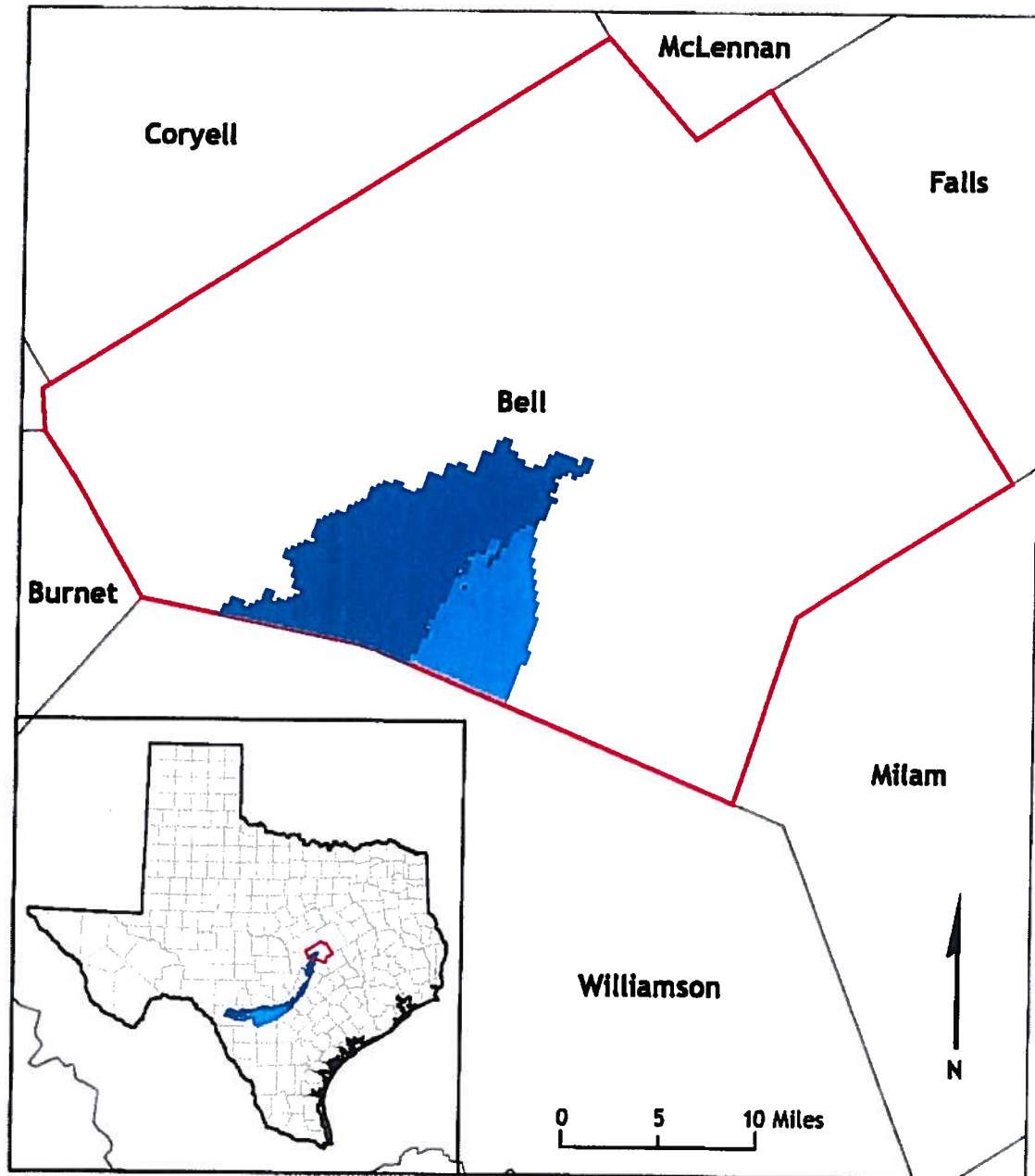
**FIGURE 1: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE NORTHERN PORTION OF THE TRINITY AQUIFER AND WOODBINE AQUIFER FROM WHICH THE INFORMATION IN TABLE 1 WAS EXTRACTED (THE TRINITY AQUIFER FOOTPRINT EXTENT WITHIN THE DISTRICT BOUNDARY).**







**TABLE 2: SUMMARIZED INFORMATION FOR THE EDWARDS (BALCONES FAULT ZONE) AQUIFER THAT IS NEEDED FOR THE CLEARWATER UNDERGROUND WATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT.**

<i>Management Plan requirement</i>	<i>Aquifer or confining unit</i>	<i>Results</i>
Estimated annual amount of recharge from precipitation to the district	Edwards (Balcones Fault Zone) Aquifer	27,565
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Edwards (Balcones Fault Zone) Aquifer	27,566
Estimated annual volume of flow into the district within each aquifer in the district	Edwards (Balcones Fault Zone) Aquifer	5,853
Estimated annual volume of flow out of the district within each aquifer in the district	Edwards (Balcones Fault Zone) Aquifer	1,090
Estimated net annual volume of flow between each aquifer in the district	From Edwards (Balcones Fault Zone) Aquifer to the overlying younger units	121
	From Edwards (Balcones Fault Zone) Aquifer to the downdip portion of the Edwards (Balcones Fault Zone) Aquifer	3,957*

\* The model extends beyond the TWDB official Edwards (Balcones Fault Zone) Aquifer boundary. This is the amount of saline groundwater (greater than 1,000 total dissolved solid) that exits in the downdip boundary limit of the aquifer within the district boundaries and into deeper portions of the Edwards Group formations.



**Legend**

- |   |  |  |
|---|--|--|
|  | County Boundary                                      | <i>County Boundary Date = 02/02/2011</i> |
|  | Clearwater Underground Water Conservation District   | <i>GCD Boundary Date = 07/01/2015</i>    |
|  | Edwards Aquifer (North) Active Model Cells (outcrop) | <i>ebfz_n Grid Date = 08/26/2015</i>     |
|  | Edwards Aquifer (North) Active Model Cells (subcrop) |  |

**FIGURE 2: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE NORTHERN SEGMENT OF THE EDWARDS (BALCONES FAULT ZONE) AQUIFER FROM WHICH THE INFORMATION IN TABLE 2 WAS EXTRACTED (THE EDWARDS (BALCONES FAULT ZONE) AQUIFER FOOTPRINT EXTENT WITHIN THE DISTRICT BOUNDARY).**

## **LIMITATIONS**

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

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

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

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

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

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**APPENDIX L**

**Table 3.1-1.  
Major Reservoirs<sup>1</sup> of the Brazos River Basin**

Reservoir	Water Right Owner	Authorized Storage (acft)	Authorized Diversion (acft)	Priority Date	County	Planning Region
Ablene	City of Abilene	11,868	1,675	1/23/18	Taylor	G
Alcoa Lake	Aluminum Co. of America	15,650	14,000	12/12/51	Milam	G
Alan Henry	Brazos River Authority	115,937	35,200	10/5/81	Garza	O
Allens Creek	Brazos River Authority City of Houston TWDB	145,553	99,650	9/1/99	Austin	H
Aquilla	Brazos River Authority	52,400	13,896	10/25/76	Hill	G
Belton	Brazos River Authority	457,600	100,257	12/16/63	Bell	G
Brazoria Reservoir-Off-Channel	Dow Chemical	21,700	0	4/7/52	Brazoria	H
Brushy Creek	City of Martin	6,580	0	6/16/86	Falls	G
Camp Creek	Camp Creek Water Co.	8,400	0	6/14/48	Robertson	G
Clasco	City of Clasco	45,000	1,971 56	4/16/20 9/5/78	Eastland	G
Daniel	City of Breckenridge	11,400	2,100	4/26/46	Stephens	G
Dansby Power Plant	City of Bryan	15,227	850	5/30/72	Brazos	G
Davis	League Ranch	4,477 918	2,000	6/13/58 5/15/72	Knox	G
Eagle Nest Lake	T L Smith Trust Et Al	18,000 11,315	4,000 1,800	1/15/48 9/9/93	Brazoria	H
Fort Phantom Hill	City of Abilene	73,960	30,690	3/25/37	Jones	G
GCWA	Gulf Coast Water Auth.	7,308	0	3/17/47	Fort Bend	H
Georgetown	Brazos River Authority	37,100	13,610	2/12/68	Williamson	G
Gibbons Creek Power	Texas Municipal Power	26,824 5,260	9,740	2/22/77 3/9/89	Grimes	G
Graham/Eddleman	City of Graham	4,503 39,000 8,883	5,000 15,000	11/21/27 11/15/54 9/16/57	Young	G
Granbury	Brazos River Authority	155,000	64,712	2/13/64	Hood	G
Granger	Brazos River Authority	65,500	19,640	2/12/68	Williamson	G
Harris Reservoir-Off-Channel	Dow Chemical	10,200	0	2/14/42	Brazoria	H
Hubbard Creek Lake	West Central Texas MWD	317,750	52,800 3,200	5/28/57 8/14/72	Stephens	G
Kirby	City of Abilene	8,500	3,880	10/10/27	Taylor	G
Lake Creek	Luminant Generation Co	8,500	10,000	3/6/1951	McLennan	G
Leon	Eastland Co WSD	28,000	1,285 2,438 2,598	5/17/31 3/21/52 3/25/86	Eastland	G
Limestone	Brazos River Authority	217,494 7,906	65,450	5/1/74 9/4/79	Robertson	G
Mexia	Bistone Municipal WSD	9,600	2,952	4/15/57	Limestone	G
Miller's Creek	North Central Texas MWA	30,696	5,000	10/1/58	Baylor	G / B
Mineral Wells	City of Mineral Wells	7,065	1,680 840	11/15/20 3/22/43	Parker	C
Palo Pinto	Palo Pinto Co. MWD 1	34,250 9,874	10,000 2,500 6,000	7/3/62 9/8/64 7/3/62	Palo Pinto	G
Pat Cleburne Reservoir	City of Cleburne	25,600	5,760 240	8/8/62 3/29/76	Johnson	G

Table 3.1-1 (Concluded)

Reservoir	Water Right Owner	Authorized Storage (acft)	Authorized Diversion (acft)	Priority Date	County	Planning Region
Post	White River MWD	57,420	10,600	1/20/70	Garza	O
Proctor	Brazos River Authority	59,400	19,658	12/16/63	Comanche	G
Somerville	Brazos River Authority	160,110	48,000	12/16/63	Washington	G
Squaw Creek Reservoir	Texas Utilities Electric Co.	151,500	23,180	4/25/73	Somervell	G
Stamford	City of Stamford	60,000	10,000	6/8/49	Haskell	G
Stillhouse Hollow	Brazos River Authority	235,700	67,766	12/16/63	Bell	G
Sweetwater	City of Sweetwater	10,000	3,740	10/17/27	Nolan	G
Tradinghouse Steam	Texas Utilities Electric Co.	37,800	12,000	8/21/26	McLennan	G
			15,000	9/16/66		
Twin Oak Steam Electric	Texas Utilities Electric Co.	30,319	13,200	7/1/74	Robertson	G
Waco	City of Waco	104,100	39,100	1/10/29	McLennan	G
			19,100	4/16/58		
			900	2/21/79		
	City of Waco	87,962	20,770	9/12/66		
Whitney	Brazos River Authority	50,000	18,336	8/30/82	Hill	G
White River Reservoir	White River MWD	33,160	6,000	9/22/58	Crosby	O
		5,072		11/21/60		
		6,665		8/16/71		

<sup>1</sup> A major reservoir is defined as one with an authorized capacity equal to or greater than 5,000 acft.

A number of interbasin transfer permits exist in the Brazos River Basin. These permits include both authorizations for diversions from the Brazos River Basin to adjacent river basins and from adjacent river basins to the Brazos River Basin. Most of the interbasin transfer permits are obviously located along the basin divide. Examples of interbasin transfers that authorize diversions from an adjacent river basin to the Brazos River Basin include: Lake Meredith (Canadian River Basin) to the Lubbock and Plainview areas in Lubbock and Hale County; Oak Creek Reservoir (Colorado River Basin) to the City of Sweetwater in Nolan County; and Lake Travis (Colorado River Basin) to the City of Cedar Park in Williamson County. Interbasin transfers authorized for diversion from the Brazos River Basin to other river basins include: Lake Mexia in Limestone County to part of the City of Mexia that lies in the Trinity River Basin; Teague City Lake in Freestone County to part of the City of Teague that lies in the Trinity River Basin; and Lake Granbury in Hood County to part of Johnson County that lies in the Trinity River Basin. A summary of interbasin transfers (excluding transfers authorized to adjacent coastal basins) associated with the Brazos River Basin is presented in Table 3.1-2.