Clearwater Underground Water Conservation District

District Groundwater 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)
February 8, 2011 (Approved by TWDB April 13, 2011)
January 13, 2016 (Approved by TWDB February 19, 2016)
Round 2 DFC/MAG Revisions Adopted
January 9, 2019 (Approved by TWDB March 12, 2019)
1st draft to TWDB Review (July 2020) (returned Sept 29, 2020)
2nd Preliminary Review to TWDB (October 1, 2020)
3rd Preliminary Review to TWDB (October 15, 2020)

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APPENDICES & EXHIBITS

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 GROUNDWATER MANAGEMENT PLAN

Senate Bill 1 (SB 1), enacted by the 75th Texas Legislature in 1997, and Senate Bill 2 (SB 2), enacted by the 77th 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 79th 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 modeled 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 modeled 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

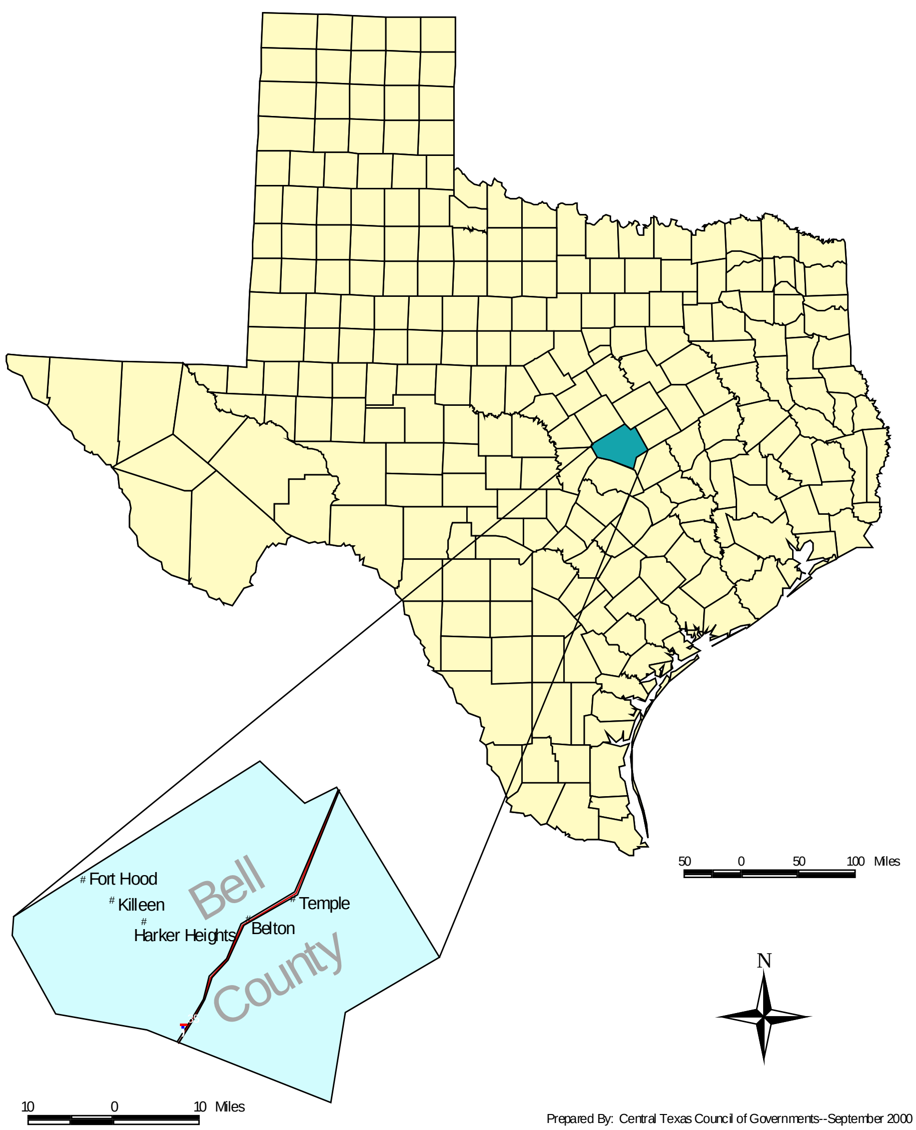
A. Creation

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, 71st Legislature, Regular Session, Chapter 524 (House Bill 3172), as amended by Act of April 25, 2001, 77th Legislature, Regular Session, Chapter 22 (Senate Bill 404), Act of May 7, 2009, 81st Legislature, Regular Session, Chapter 64 (Senate Bill 1755), and Act of May 27, 2015, 84th 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 groundwater management plan, and the District's 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 1,088 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.

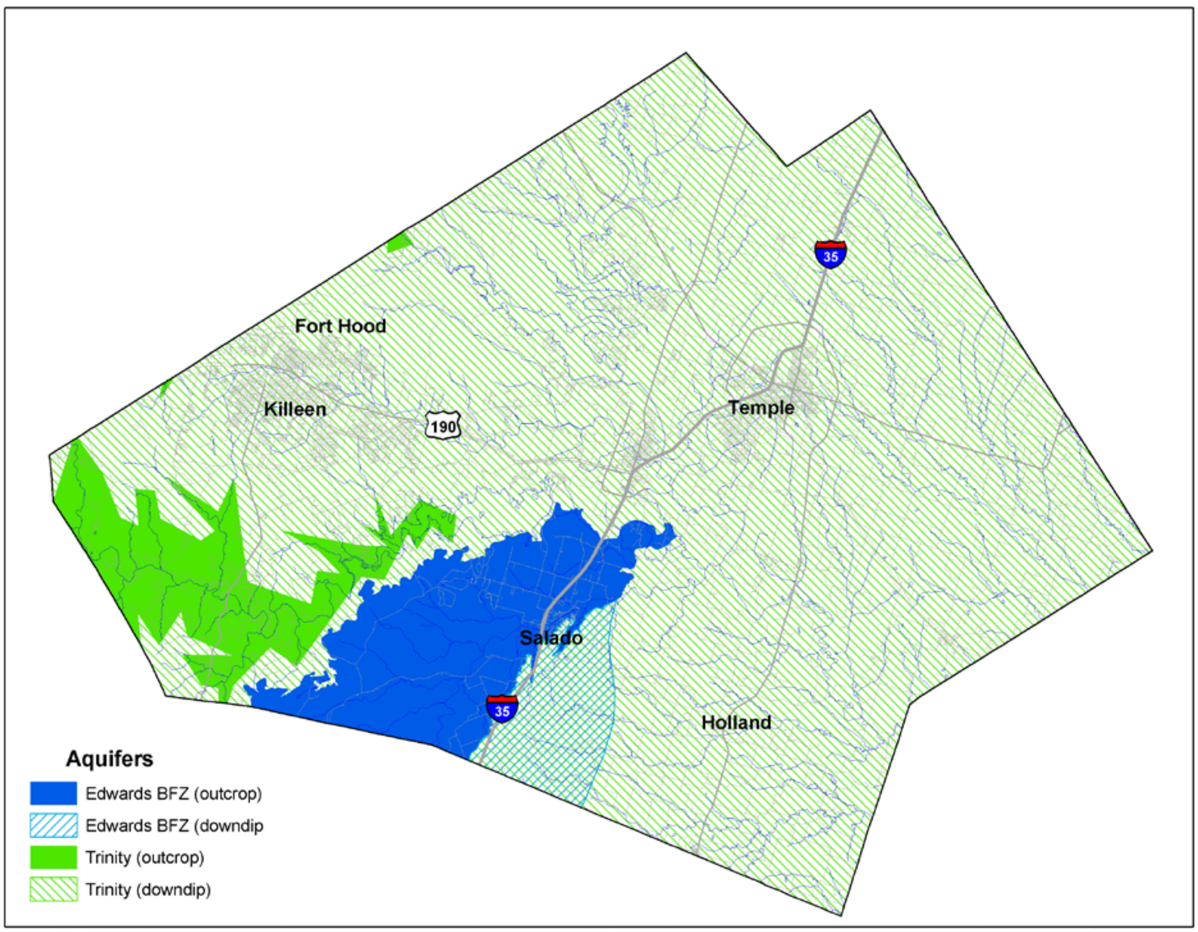
F. Groundwater Resources of Bell County

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 Formation, the Ozan Formation, the Pecan Gap Formation, the Austin Chalk, or the Buda Limestone. Additionally, there are wells which produce water from the Edwards Formation 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 oversite, 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 approved 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 previous plan was 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 of 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. S*ee 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 surface water management entities.

CUWCD reference letter documenting transmitting a copy of this plan to surface water management entities after adoption of the plan. S*ee Appendix G*: *Notice to 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 79th Legislature with the passage of HB 1763 into law. The District is 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 like those in 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 17-029 MAG for the current decade 2010-2020, 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 17-029 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 subdivides the water-bearing geologic units into the three Trinity Aquifer subdivisions as follows: the Upper Trinity (Glen Rose Limestone); the Middle Trinity (Hensell Sand); and the Lower Trinity (Hosston Conglomerate) aquifers.

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 for the current decade 2010-2020, is 9,266 acre-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. The subdivision allocation is currently at 400 acre feet for the Glen Rose Limestone, 650 acre feet for the Hensell Sand and 369 acre feet for the Hosston Conglomerate. This leaves approximately 7,847 acre-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 report TWDB GAM Run 17-029 MAG in Appendix I. CUWCD intends through its rules to regulate the Trinity Aquifer within the District by aquifer subdivision. While management is by subdivision the district reserves the right to implement management areas and management zones by geologic unit through the District's rules. The modeled available groundwater values for each Trinity Aquifer subdivision and management areas within the water-bearing unit that has a required separate allocation of water for exempt well use.
See Appendix I: TWDB GAM Run 17-029 MAG

3. <u>Other Water Bearing Formations</u>

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, Lake Waco, Ozan, and Pecan Gap formations. 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 2016 to 2020 is shown in the *Appendix B*. Data from 2002-2017 is provided by the Texas Water Development Board from their Water Use Survey database, *Appendix C*. The CUWCD data, A*ppendix 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 2016 through 2020 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 2019, approximately 5,794 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 (2015-2019)*

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

See Appendix J: 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 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 27,566 acre-feet per year
2. Trinity Aquifer 11,131 acre-feet per year

See Appendix J: 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

   Flow into the aquifer within the District: 5,853 acre-feet/year

   Flow out of the aquifer in the District: 1,090 acre-feet/year

   Net flow out of the aquifer to overlying units in the District: 121 acre-feet/year

   Net flow to downdip* Edwards (BFZ) Aquifer: 3,957 acre-feet/year

2. Trinity Aquifer

   Flow into the aquifer within the District: 7,230 acre-feet/year

   Flow out of the aquifer within the District: 5,659 acre-feet/year

   Net flow into the aquifer from the overlying Washita-Fredericksburg Confining Unit in the District: 5,587 acre-feet/year

Estimate source: TWDB GAM Run 15-003; November 24, 2015
**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 the downdip boundary limit of the [official] aquifer within the district boundaries and into deeper portions of the Edwards Group formations.*

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 2017 State Water Plan. The 2017 State Water Plan indicates a projected surface water supply for Bell County of 93,515 acre-feet/year for year 2070.

Two major water reservoirs located in Bell County are Lake Belton and Lake Stillhouse Hollow. The 2016 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 2017 State Water Plan Datasets for Bell County

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 2017 State Water Plan. The 2017 State Water Plan indicates a projected total water demand for Bell County of 134,411 acre-feet/year for year 2070. The projections are from year 2020 to 2070 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 2019 by the Water Utility Groups totaled 2,417 acre-feet or approximately 3.18% of the County's projected 2020 total demand for water in the 2017 State Water Plan.

Source Appendix C: TWDB 2017 State Water Plan Datasets for Bell County

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 2017 State Water Plan. In the 2017 State Water Plan, water needs were identified for sixteen 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 2017 State Water Plan twenty water management strategies (WMSs) were recommended for the sixteen Bell County WUGs with identified water needs. Seven of the WMSs involved conservation of existing water supplies. Four have recommended WMSs involve the redistribution and/or increase of surface water supplies of the respective WUGs. There is the 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 and is stated as the WTP expansion in the 2017State Water plan may 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 2017 State Water Plan.

Source Appendix C: TWDB 2017 State Water Plan Datasets for Bell County

A. Water Shortages

Of the 30 Bell County WUGs identified in the 2017 State Water Plan, sixteen were projected to have water shortages by the year 2070. The projected shortage of water for these sixteen users ranges from approximately 10,026 acre-feet/year in 2020 to approximately 43,762 acre-feet/year in 2070. Nine of these users use only surface water (439 WSC, City of Belton, Kempner WSC, City of Nolanville, City of Temple; , County-Other Bell, Steam Electric Power). Four of these WUGs use a mixture of groundwater and surface water (City of Little River-Academy, Chisholm Trail SUD, Elm Creek WSC, Salado WSC, Manufacturing), and three use only groundwater (City of Bartlett, Mining, Agriculture Irrigation). The source of groundwater for these users is identified as the Other Alluvial groundwater formation, Trinity Aquifer and the Edwards (BFZ) Aquifer. Some of the management strategies involve purchasing additional surface water, implementing conservation measures, Trinity ASR, direct reuse and groundwater from the Carrizo-Wilcox Aquifer in both Burleson and Milam Counties. Additional use of groundwater from the Trinity and Edwards BFZ Aquifers within CUWCD's jurisdiction been identified as strategies for the named as County-Other (identified as Edwards Aquifer Development, small Municipal Water Conservation, purchases from Central Texas WSC and Williamson County ASR).

Jarrell-Schwertner WSC's service area includes southern Bell County and northern Williamson County and is in the State Water Plan identified as a water user in Williamson County. Their primary water supply is both surface and groundwater in Bell County 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 2017 State Water Plan Datasets for Bell County

B. Water Surplus

Fourteen of the Water User Groups identified in the Brazos G Regional Water Plan are projected to have surplus water through the year 2070. Eight of these are identified as using both surface water and groundwater (Armstrong WSC, Bell-Milam-Falls WSC, City of Holland, East Bell WSC, Morgan's Point Resort, Pendleton WSC, City of Rogers Moffat WSC; City of Troy). The source of groundwater is identified as the Hosston Layer of the Trinity Aquifer. 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 2017 State Water Plan Datasets for Bell County

VIII. 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. The observation network has been expanded on an annual basis as opportunities for the District to fund new wells and include permitted wells on the network.

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 has been developed by CUWCD and adopted by the Board after notice and hearing. In developing the contingency plan, CUWCD considered 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 voluntary drought contingency plan is implemented. CUWCD evaluates the groundwater resources available within the District and determines 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 regard to achieving management goals and objectives in each fiscal year for consideration for adoption by the Board of Directors. The report is to 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 and on the District Website upon adoption.
Link to CUWCD-annual-reports

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 located or public viewing on the district's website http://www.cuwcd.org/ and maintained data base webpage https://clearwaterdistrict.halff.com/Map/Public.

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 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 repository and enhancements to the platform.
   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, Quarterly Webnews, and website.

   Performance Standard: The CUWCD annual report will include a copy of the District newsletter published each year, with select examples of the Quarterly Webnews on Mailchimp/Twitter/Facebook

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 presentations to civic organizations and invited opportunities to speak.

Performance Standard: The CUWCD annual report will include a summary of the District presentations 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))

1) Objective: Each year CUWCD will monitor water quality within the District by obtaining water samples from all newly constructed wells and testing the water quality of a minimum 90% of newly constructed wells.

   Performance Standard: Each year, CUWCD's Annual Report will provide a status report on the number of wells tested, by aquifers, aquifer subdivisions and the testing results. District will document the results and make them publicly available on the district web-maps for each well tested.

2) Objective: Each quarter of the year, CUWCD will monitor the water quality and spring-flow of the Salado Springs Complex and the Robertson springs of Salado in accordance with the necessary agreements under the Endanger Species Act (ESA) and a proposed, soon to be negotiated 4(d)rule with United States Fish and Wildlife Service (USFWS) and such, per Chapter 36.108 GMA8 Joint Planning, to manage to the Edwards BFZ Aquifer DFC.

   Performance Standard: Each year, CUWCD's Annual Report will provide a status summary report of the quarterly water quality assessments for nitrate, nitrite and dissolved oxygen of the both Salado Spring Complex and groundwater flow from all seven of the downtown springs collectively known as the Salado Spring Complex.

3) Objective: Each year CUWCD, in accordance with the an agreed upon five year reimbursable-task-order with Texas Fish and Wildlife Conservation Office (TXFWCO), will fund and support the efforts of the assigned research biologist, to assess the status the Threatened Salado Salamander by systematically monitoring under the federal permit TE676811-9 and state permit SPR-0111-03.

   Performance Standard: Each year, CUWCD's Annual Report will provide a summary of the formal findings of the assigned research biologist and accordingly maintain such findings and formal report from TXFWCO on the district website in a defined location assessable to all parties.

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

1. Objective: Each month, 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 monthly monitoring of drought conditions in the Edwards (BFZ) Aquifer and the implementation of any conservation measures will be provided in the annual report, on the District website http://cuwcd.org as well as the TWDB drought resources https://www.waterdatafortexas.org/drought . The Salado Salamander is protected by the District per the drought contingency plan in accordance with agreements with all non-exempt permit holders producing from the Edwards (BFZ) Aquifer and in accordance with elements of the pending 4(d)rule under the Endangered Species Act.

2. Objective: Each month, 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 monthly 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 and hosting educational events with AgriLife Extension Service and Texas 4-H2O Ambassadors on water conservation and by distributing conservation brochures and literature to the public at a minimum two educational events attended by district staff and directors (ex. Bell County Annual Water Symposium, Bell County Annual Grounds Conference and Bell County Annual Crops Conference)

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 month, 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, Robertson, Big Boiling, Little Bubbly, Side Spring, Critchfield, Benedict and Anderson Springs.

   Performance Standard – Each month, 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, and documented in the Annual Report to the Board of Directors.

2. Objective – Each month, CUWCD will collect at least 15 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 by each confining layer 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 stablished by GMA 8.

c. Every year, the CUWCD Annual Report to the Board of Directors will include a discussion of the trends and changes of 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.

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

This category of management goal is now applicable to the District even though the major water producing formations in the District are composed primarily of competent limestone are thought to be very low risk because the structural competency of the aquifer materials significantly limits the potential for the occurrence of land surface subsidence in the District. In 2016 the Texas Water Development Board (TWDB) Contract Number 1648302062) contracted with LRE Water, LLC to identify and characterize areas within Texas' major and minor aquifers that are susceptible to land subsidence related to groundwater pumping.

https://www.twdb.texas.gov/groundwater/models/research/subsidence/subsidence.asp

1) Objective – Each year the district will apply the subsidence prediction tool for the purpose of identifying and characterizing the areas of the district that might be experiencing land subsidence

Performance Standard – Each year the district with the assistance of TWDB and LRE will deploy the tool and results after calculating subsidence predictions based on the results generated from the subsidence prediction tool and report the findings in the annual report.

XII. MANAGEMENT GOALS DETERMINED NOT-APPLICABLE TO 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

Group	Formation	Member	Hydrologic Unit
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

<u>APPENDIX B</u>

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!

2016-2020
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
2020 YTD	1,336.21	0	72.33	0	348.38	363.61	729.00	1.16	2,850.69
2019	2,566.89	0	117.66	0	350.72	768.32	1,169.00	1.84	4,974.43
2018	2,795.91	0	294.90	0	809.90	575.03	1,133.00	1.83	5,610.57
2017	2,410.38	0	96.95	0	540.24	573.45	1,088.00	3.30	4,712.32
2016	2,197.31	18.19	52.52	0	448.61	571.94	1,612.00	3.13	4,903.70

2016-2020
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
2020 YTD	1,141.90	11.96	51.81	395.54	167.61	1,768.82
2019	1,994.46	48.25	91.20	1,008.17	256.72	3,398.80
2018	2,077.92	49.88	89.61	1,345.30	356.96	3,919.67
2017	1,969.76	58.00	91.99	858.76	102.27	3,080.78
2016	1,775.78	23.80	101.32	713.17	123.71	2,737.78

2016-2020
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
2020 YTD	256	145	202	32	448	1,083
2019	361	223	490	52	790	1,916
2018	484	223	258	48	676	1,689
2017	453	223	243	49	677	1,645
2016	455	327	392	70	926	2,107

2016-2020
Historical Groundwater Beneficial Use
By Exempt Well Owners
All Values in acre-feet/year

Table 4

Year	Domestic Use	Livestock & Poultry	Total GW USE
2020 YTD	729	353	1,082
2019	1,169	747	1,916
2018	1,133	556	1,689
2017	1,088	557	1,645
2016	1,612	558	2,170

Source: CUWCD annual estimates and CUWCD annual production reports
**represents production for small business, restaurants, funeral homes, auto repairs, churches*

APPENDIX C

Estimated Historical Water Use And 2017 State Water Plan Datasets:

Clearwater Underground Water Conservation District

by Stephen Allen
Texas Water Development Board
Groundwater Division
Groundwater Technical Assistance Section
stephen.allen@twdb.texas.gov
(512) 463-7317
June 29, 2020

GROUNDWATER MANAGEMENT PLAN DATA:

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

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

The five reports included in this part are:

1. Estimated Historical Water Use (checklist item 2)

   from the TWDB Historical Water Use Survey (WUS)

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

   from the 2017 Texas State Water Plan (SWP)

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

DISCLAIMER:

The data presented in this report represents the most up-to-date WUS and 2017 SWP data available as of 6/29/2020. Although it does not happen frequently, either of these datasets are subject to change pending the availability of more accurate WUS data or an amendment to the 2017 SWP. District personnel must review these datasets and correct any discrepancies in order to ensure approval of their groundwater management plan.

The WUS dataset can be verified at this web address:

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

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

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

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

Groundwater and surface water historical use estimates are currently unavailable for calendar year 2018. TWDB staff anticipates the calculation and posting of these estimates at a later date.

BELL COUNTY

All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2017	GW	2,663	13	11	0	817	218	3,722
	SW	50,719	604	0	0	2,653	509	54,485
2016	GW	2,490	2	11	0	585	271	3,359
	SW	48,391	618	0	0	2,210	632	51,851
2015	GW	2,411	2	10	0	839	259	3,521
	SW	48,857	769	0	565	1,002	604	51,797
2014	GW	2,497	2	9	0	693	250	3,451
	SW	52,531	639	0	0	1,762	583	55,515
2013	GW	3,616	2	6	0	1,259	233	5,116
	SW	50,974	608	0	0	1,500	544	53,626
2012	GW	4,046	0	6	0	897	242	5,191
	SW	58,035	601	0	0	1,618	564	60,818
2011	GW	4,619	0	0	0	1,474	524	6,617
	SW	63,159	559	0	0	1,658	1,222	66,598
2010	GW	3,568	0	1,155	0	1,560	510	6,793
	SW	51,877	521	1,383	0	1,300	1,190	56,271
2009	GW	3,110	0	1,106	0	583	311	5,110
	SW	58,056	652	1,562	0	1,836	727	62,833
2008	GW	2,592	0	1,056	0	63	293	4,004
	SW	49,832	664	1,515	0	1,769	684	54,464
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	43,973	490	305	0	2,103	715	47,586
2004	GW	2,305	0	0	0	173	92	2,570
	SW	41,056	542	193	0	749	828	43,368
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

Projected Surface Water Supplies
TWDB 2017 State Water Plan Data

BELL COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070
G	439 WSC	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	1,499	1,489	1,475	1,398	1,443	1,550
G	ARMSTRONG WSC	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	392	392	392	392	392	392
G	BELL-MILAM FALLS WSC	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	475	471	474	478	476	474
G	BELTON	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	7,349	7,305	7,235	6,864	6,771	6,625
G	CHISHOLM TRAIL SUD	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	259	238	216	197	180	165
G	COUNTY-OTHER, BELL	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	1,297	1,293	1,286	1,248	1,238	1,223
G	DOG RIDGE WSC	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	1,638	1,631	1,623	1,583	1,573	1,557
G	EAST BELL WSC	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	317	320	323	326	327	329
G	ELM CREEK WSC	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	334	337	339	336	335	331
G	FORT HOOD	BRAZOS	BRAZOS RUN-OF-RIVER	5,732	5,479	5,290	5,102	4,913	4,725

Projected Surface Water Supplies
TWDB 2017 State Water Plan Data

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070
G	HARKER HEIGHTS	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	7,155	7,103	7,103	7,565	8,112	7,935
G	HOLLAND	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	166	166	166	166	166	166
G	IRRIGATION, BELL	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	308	307	304	288	284	278
G	IRRIGATION, BELL	BRAZOS	BRAZOS RUN-OF-RIVER	355	355	356	356	357	357
G	JARRELL-SCHWERTNER WSC	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	457	466	485	444	412	381
G	KEMPNER WSC	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	277	283	293	302	311	319
G	KILLEEN	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	39,957	39,761	39,377	37,343	36,833	36,028
G	LITTLE RIVER-ACADEMY	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	323	323	323	323	323	323
G	LIVESTOCK, BELL	BRAZOS	BRAZOS LIVESTOCK LOCAL SUPPLY	1,009	1,009	1,009	1,009	1,009	1,009
G	MANUFACTURING, BELL	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	497	497	497	497	497	497
G	MINING, BELL	BRAZOS	BRAZOS RUN-OF-RIVER	0	0	0	0	0	0
G	MOFFAT WSC	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	1,112	1,107	1,095	1,059	1,044	1,021

Projected Surface Water Supplies
TWDB 2017 State Water Plan Data

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070
G	MORGAN'S POINT RESORT	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	1,935	1,935	1,935	1,935	1,935	1,935
G	NOLANVILLE	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	990	985	976	925	913	893
G	PENDLETON WSC	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	380	378	373	361	355	345
G	ROGERS	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	400	400	400	400	400	400
G	SALADO WSC	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	183	183	183	183	183	183
G	TEMPLE	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	19,952	18,494	19,018	18,384	18,158	19,586
G	TEMPLE	BRAZOS	BRAZOS RUN-OF-RIVER	1,706	1,739	1,771	1,804	1,836	1,869
G	TROY	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	959	959	959	959	959	959
G	WEST BELL COUNTY WSC	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	1,660	1,660	1,660	1,660	1,660	1,660
	Sum of Projected Surface Water Supplies (acre-feet)			**99,073**	**97,065**	**96,936**	**93,887**	**93,395**	**93,515**

Projected Water Demands
TWDB 2017 State Water Plan Data

Please note that the demand numbers presented here include the plumbing code savings found in the Regional and State Water Plans.

BELL COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
G	439 WSC	BRAZOS	1,044	1,134	1,233	1,351	1,489	1,644
G	ARMSTRONG WSC	BRAZOS	406	418	434	454	478	502
G	BARTLETT	BRAZOS	159	179	202	226	252	277
G	BELL-MILAM FALLS WSC	BRAZOS	344	356	371	390	411	432
G	BELTON	BRAZOS	3,807	4,306	4,872	5,480	6,099	6,715
G	CHISHOLM TRAIL SUD	BRAZOS	553	632	721	814	906	998
G	COUNTY-OTHER, BELL	BRAZOS	870	1,716	2,711	3,733	4,719	5,668
G	DOG RIDGE WSC	BRAZOS	438	488	547	613	682	751
G	EAST BELL WSC	BRAZOS	442	497	560	630	702	775
G	ELM CREEK WSC	BRAZOS	254	288	327	370	413	457
G	FORT HOOD	BRAZOS	3,954	3,870	3,815	3,810	3,804	3,804
G	HARKER HEIGHTS	BRAZOS	6,224	7,079	8,042	9,061	10,087	11,106
G	HOLLAND	BRAZOS	112	108	106	105	106	107
G	IRRIGATION, BELL	BRAZOS	2,205	2,174	2,147	2,117	2,086	2,058
G	JARRELL-SCHWERTNER WSC	BRAZOS	186	209	235	264	294	324
G	KEMPNER WSC	BRAZOS	350	398	451	507	565	622
G	KILLEEN	BRAZOS	19,467	21,902	24,713	27,748	30,864	33,969
G	LITTLE RIVER-ACADEMY	BRAZOS	377	409	447	490	534	578
G	LIVESTOCK, BELL	BRAZOS	1,009	1,009	1,009	1,009	1,009	1,009
G	MANUFACTURING, BELL	BRAZOS	1,370	1,490	1,607	1,711	1,847	1,994
G	MINING, BELL	BRAZOS	3,242	3,980	4,599	5,349	6,105	6,968
G	MOFFAT WSC	BRAZOS	479	481	487	500	517	536
G	MORGAN'S POINT RESORT	BRAZOS	595	684	787	897	1,009	1,121
G	NOLANVILLE	BRAZOS	1,382	1,749	2,154	2,575	2,991	3,401
G	PENDLETON WSC	BRAZOS	245	246	255	266	277	289
G	ROGERS	BRAZOS	172	177	183	192	202	213
G	SALADO WSC	BRAZOS	1,726	1,863	2,017	2,182	2,348	2,514
G	STEAM ELECTRIC POWER, BELL	BRAZOS	4,220	4,934	5,804	6,865	8,157	9,693
G	TEMPLE	BRAZOS	19,485	22,186	25,212	28,415	31,644	34,842
G	TROY	BRAZOS	169	180	193	209	228	247

Projected Water Demands
TWDB 2017 State Water Plan Data

Please note that the demand numbers presented here include the plumbing code savings found in the Regional and State Water Plans.

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
G	WEST BELL COUNTY WSC	BRAZOS	789	816	800	798	797	797
		Sum of Projected Water Demands (acre-feet)	**76,075**	**85,958**	**97,041**	**109,131**	**121,622**	**134,411**

Projected Water Supply Needs
TWDB 2017 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

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
G	439 WSC	BRAZOS	455	355	242	47	-46	-94
G	ARMSTRONG WSC	BRAZOS	865	853	837	817	793	769
G	BARTLETT	BRAZOS	-126	-145	-166	-189	-215	-240
G	BELL-MILAM FALLS WSC	BRAZOS	713	690	683	673	648	623
G	BELTON	BRAZOS	3,592	3,049	2,413	1,434	722	-40
G	CHISHOLM TRAIL SUD	BRAZOS	-263	-366	-478	-592	-703	-811
G	COUNTY-OTHER, BELL	BRAZOS	1,084	234	-768	-1,828	-2,824	-3,788
G	DOG RIDGE WSC	BRAZOS	1,200	1,143	1,076	970	891	806
G	EAST BELL WSC	BRAZOS	893	850	800	742	676	610
G	ELM CREEK WSC	BRAZOS	80	49	12	-34	-78	-126
G	FORT HOOD	BRAZOS	1,778	1,609	1,475	1,292	1,109	921
G	HARKER HEIGHTS	BRAZOS	931	24	-939	-1,496	-1,975	-3,171
G	HOLLAND	BRAZOS	377	381	383	384	383	382
G	IRRIGATION, BELL	BRAZOS	-1,157	-1,127	-1,102	-1,088	-1,060	-1,038
G	JARRELL-SCHWERTNER WSC	BRAZOS	288	270	259	185	119	57
G	KEMPNER WSC	BRAZOS	-73	-115	-158	-205	-254	-303
G	KILLEEN	BRAZOS	20,490	17,859	14,664	9,595	5,969	2,059
G	LITTLE RIVER-ACADEMY	BRAZOS	11	-21	-59	-102	-146	-190
G	LIVESTOCK, BELL	BRAZOS	0	0	0	0	0	0
G	MANUFACTURING, BELL	BRAZOS	-873	-993	-1,110	-1,214	-1,350	-1,497
G	MINING, BELL	BRAZOS	-3,242	-3,980	-4,599	-5,349	-6,105	-6,968
G	MOFFAT WSC	BRAZOS	839	832	814	765	733	691
G	MORGAN'S POINT RESORT	BRAZOS	1,340	1,251	1,148	1,038	926	814
G	NOLANVILLE	BRAZOS	-72	-444	-858	-1,330	-1,758	-2,188
G	PENDLETON WSC	BRAZOS	257	254	240	217	200	178
G	ROGERS	BRAZOS	435	430	424	415	405	394
G	SALADO WSC	BRAZOS	510	373	219	54	-112	-278
G	STEAM ELECTRIC POWER, BELL	BRAZOS	-4,220	-4,934	-5,804	-6,865	-8,157	-9,693
G	TEMPLE	BRAZOS	2,223	-1,903	-4,373	-8,177	-11,600	-13,337
G	TROY	BRAZOS	1,011	1,000	987	971	952	933
G	WEST BELL COUNTY WSC	BRAZOS	871	844	860	862	863	863
	Sum of Projected Water Supply Needs (acre-feet)		**-10,026**	**-14,028**	**-20,414**	**-28,469**	**-36,383**	**-43,762**

Projected Water Management Strategies
TWDB 2017 State Water Plan Data

BELL COUNTY

WUG, Basin (RWPG)

All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
439 WSC, BRAZOS (G)							
BRA SYSTEM OPERATIONS-LITTLE RIVER	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM [RESERVOIR]	0	4	11	49	59	74
REUSE- BCWCID #1 SOUTH	DIRECT REUSE [BELL]	0	0	0	0	0	20
		0	**4**	**11**	**49**	**59**	**94**
ARMSTRONG WSC, BRAZOS (G)							
MUNICIPAL WATER CONSERVATION (SUBURBAN) - ARMSTRONG WSC	DEMAND REDUCTION [BELL]	14	39	32	29	30	32
		14	**39**	**32**	**29**	**30**	**32**
BARTLETT, BRAZOS (G)							
ADDITIONAL ADVANCED CONSERVATION - BARTLETT	DEMAND REDUCTION [BELL]	0	0	0	3	18	34
MUNICIPAL WATER CONSERVATION (SUBURBAN) - BARTLETT	DEMAND REDUCTION [BELL]	5	19	29	31	34	37
TRINITY AQUIFER DEVELOPMENT	TRINITY AQUIFER [BELL]	144	151	156	159	323	327
		149	**170**	**185**	**193**	**375**	**398**
BELTON, BRAZOS (G)							
MUNICIPAL WATER CONSERVATION (SUBURBAN) - BELTON	DEMAND REDUCTION [BELL]	119	340	318	321	347	379
TRINITY - WILLIAMSON COUNTY ASR	TRINITY AQUIFER ASR [WILLIAMSON]	0	29	87	390	466	586
		119	**369**	**405**	**711**	**813**	**965**
CHISHOLM TRAIL SUD, BRAZOS (G)							
ADDITIONAL ADVANCED CONSERVATION - CHISHOLM TRAIL SUD	DEMAND REDUCTION [BELL]	0	0	1	45	96	153
CHISHOLM TRAIL SUD WTP EXPANSION	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM [RESERVOIR]	387	340	344	407	490	583
GEORGETOWN WTP EXPANSION	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM [RESERVOIR]	0	0	38	35	0	0
MUNICIPAL WATER CONSERVATION (SUBURBAN) - CHISHOLM TRAIL SUD	DEMAND REDUCTION [BELL]	23	76	100	110	122	134
		410	**416**	**483**	**597**	**708**	**870**

Projected Water Management Strategies
TWDB 2017 State Water Plan Data

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

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
COUNTY-OTHER, BELL, BRAZOS (G)							
EDWARDS AQUIFER DEVELOPMENT	EDWARDS-BFZ AQUIFER [BELL]	0	0	161	718	1,417	2,081
MUNICIPAL WATER CONSERVATION (RURAL) - COUNTY-OTHER, BELL	DEMAND REDUCTION [BELL]	14	62	73	94	117	138
PURCHASE FROM CENTRAL TEXAS WSC	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM [RESERVOIR]	0	0	500	500	500	500
TRINITY - WILLIAMSON COUNTY ASR	TRINITY AQUIFER ASR [WILLIAMSON]	0	4	34	516	790	1,069
		14	**66**	**768**	**1,828**	**2,824**	**3,788**
ELM CREEK WSC, BRAZOS (G)							
BRA SYSTEM OPERATIONS-LITTLE RIVER	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM [RESERVOIR]	0	0	0	34	78	126
		0	**0**	**0**	**34**	**78**	**126**
FORT HOOD, BRAZOS (G)							
MUNICIPAL WATER CONSERVATION (SUBURBAN) - FORT HOOD	DEMAND REDUCTION [BELL]	152	432	705	998	1,094	1,094
		152	**432**	**705**	**998**	**1,094**	**1,094**
HARKER HEIGHTS, BRAZOS (G)							
BRA SYSTEM OPERATIONS-LITTLE RIVER	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM [RESERVOIR]	1,645	1,697	1,697	1,235	688	865
KILLEEN REDUCTION TO HARKER HEIGHTS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM [RESERVOIR]	0	0	0	0	0	302
MUNICIPAL WATER CONSERVATION (SUBURBAN) - HARKER HEIGHTS	DEMAND REDUCTION [BELL]	262	836	1,367	1,499	1,656	1,819
REUSE- BCWCID #1 SOUTH	DIRECT REUSE [BELL]	185	185	185	185	185	185
		2,092	**2,718**	**3,249**	**2,919**	**2,529**	**3,171**
IRRIGATION, BELL, BRAZOS (G)							
EDWARDS AQUIFER DEVELOPMENT	EDWARDS-BFZ AQUIFER [BELL]	1,091	1,019	953	940	915	754
IRRIGATION WATER CONSERVATION	DEMAND REDUCTION [BELL]	66	109	150	148	146	144
TRINITY AQUIFER DEVELOPMENT	TRINITY AQUIFER [BELL]	0	0	0	0	0	140
		1,157	**1,128**	**1,103**	**1,088**	**1,061**	**1,038**

Projected Water Management Strategies
TWDB 2017 State Water Plan Data

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

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
KEMPNER WSC, BRAZOS (G)							
BRA SYSTEM OPERATIONS-LITTLE RIVER	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM [RESERVOIR]	554	570	589	636	653	673
MUNICIPAL WATER CONSERVATION (SUBURBAN) - KEMPNER WSC	DEMAND REDUCTION [BELL]	14	34	33	34	37	40
		568	**604**	**622**	**670**	**690**	**713**
KILLEEN, BRAZOS (G)							
REUSE- BCWCID #1 SOUTH	DIRECT REUSE [BELL]	563	563	563	563	563	543
REUSE-BCWCID #1 NORTH	DIRECT REUSE [BELL]	1,925	1,925	1,925	1,925	1,925	1,925
		2,488	**2,488**	**2,488**	**2,488**	**2,488**	**2,468**
LITTLE RIVER-ACADEMY, BRAZOS (G)							
BRA SYSTEM OPERATIONS-LITTLE RIVER	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM [RESERVOIR]	0	180	180	180	180	180
MUNICIPAL WATER CONSERVATION (SUBURBAN) - LITTLE RIVER-ACADEMY	DEMAND REDUCTION [BELL]	12	19	13	11	11	11
		12	**199**	**193**	**191**	**191**	**191**
MANUFACTURING, BELL, BRAZOS (G)							
EDWARDS AQUIFER DEVELOPMENT	EDWARDS-BFZ AQUIFER [BELL]	1,000	1,000	1,000	1,360	1,360	1,360
INDUSTRIAL WATER CONSERVATION	DEMAND REDUCTION [BELL]	41	75	112	120	129	140
		1,041	**1,075**	**1,112**	**1,480**	**1,489**	**1,500**
MINING, BELL, BRAZOS (G)							
EDWARDS AQUIFER DEVELOPMENT	EDWARDS-BFZ AQUIFER [BELL]	2,104	2,176	2,081	1,177	503	0
INDUSTRIAL WATER CONSERVATION	DEMAND REDUCTION [BELL]	97	199	322	374	427	488
TRINITY AQUIFER DEVELOPMENT	TRINITY AQUIFER [BELL]	582	582	582	582	260	120
		2,783	**2,957**	**2,985**	**2,133**	**1,190**	**608**
NOLANVILLE, BRAZOS (G)							
BRA SYSTEM OPERATIONS-LITTLE RIVER	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM [RESERVOIR]	0	5	14	65	77	97
MUNICIPAL WATER CONSERVATION (SUBURBAN) - NOLANVILLE	DEMAND REDUCTION [BELL]	67	224	444	721	884	1,003

Projected Water Management Strategies
TWDB 2017 State Water Plan Data

WUG, Basin (RWPG)

All values are in acre-feet

WUG, Basin (RWPG)	Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
	VOLUNTARY REDISTRIBUTION OF BELL COUNTY WCID#1 SUPPLY	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM [RESERVOIR]	5	215	401	544	798	1,088
			72	**444**	**859**	**1,330**	**1,759**	**2,188**
SALADO WSC, BRAZOS (G)								
	MUNICIPAL WATER CONSERVATION (SUBURBAN) - SALADO WSC	DEMAND REDUCTION [BELL]	97	255	431	624	830	1,044
			97	**255**	**431**	**624**	**830**	**1,044**
STEAM ELECTRIC POWER, BELL, BRAZOS (G)								
	REUSE- TEMPLE	DIRECT REUSE [BELL]	8,407	8,407	8,407	8,407	8,407	9,707
			8,407	**8,407**	**8,407**	**8,407**	**8,407**	**9,707**
TEMPLE, BRAZOS (G)								
	BRA SYSTEM OPERATIONS-LITTLE RIVER	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM [RESERVOIR]	3,080	4,262	3,994	314	2,447	2,245
	MUNICIPAL WATER CONSERVATION (URBAN) - TEMPLE	DEMAND REDUCTION [BELL]	914	2,740	5,015	7,724	10,771	11,850
	TRINITY - WILLIAMSON COUNTY ASR	TRINITY AQUIFER ASR [WILLIAMSON]	4,761	3,759	3,323	7,727	5,730	4,504
			8,755	**10,761**	**12,332**	**15,765**	**18,948**	**18,599**
	Sum of Projected Water Management Strategies (acre-feet)		**28,330**	**32,532**	**36,370**	**41,534**	**45,563**	**48,594**

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 November 11, 2020

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, 71st Legislature, Regular Session, Chapter 524 (House Bill 3172), as amended by Act of April 25, 2001, 77th Legislature, Regular Session, Chapter 22 (Senate Bill 404), Act of May 7, 2009, 81st Legislature, Regular Session, Chapter 64 (Senate Bill 1755), and Act of May 27, 2015, 84th 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 Groundwater 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, and revised and readopted by the Districts Board on January 9, 2019 and certified by TWDB on March 12, 2019.

WHEREAS, in conducting a the requisite five-year review of its existing Groundwater 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 notices and held two public hearings to receive public comments on the proposed amendments to the Groundwater Management Plan at the District's office located at 700 Kennedy Court, Belton, Texas, on October 14, 2020 and November 11, 2020;

WHEREAS, the District obtained comments from the TWDB through a preliminary review process the District's Groundwater 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 and all other Surface Water Management Entities during preparation of its Groundwater Management Plan;

WHEREAS, the Board of Directors finds that the Groundwater 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 amended Groundwater Management Plan pursuant to Texas Water Code § 36.1072(e).

NOW THEREFORE BE IT RESOLVED THAT:

The above recitals are true and correct;

The Groundwater Management Plan is hereby readopted with those changes reflected in the proposed, draft Groundwater 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 Groundwater 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 ______________, and seconded by Director ________, and upon discussion, the Board of Directors voted __ in favor and __opposed, __ abstained, and __ absent, and the motion thereby PASSED on this 11th day of November 2020.

CLEARWATER UNDERGROUND WATER CONSERVATION DISTRICT

By: ____________________________
Leland Gersbach, Board President

ATTEST:

____
C. Gary Young, Board Secretary

APPENDIX F

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., October 14, 2020 in the Clearwater Underground Water Conservation District (CUWCD) headquarters located at 700 Kennedy Court, Belton, Texas. Copies of the revised Management Plan are available for review at the CUWCD office and on the CUWCD website at www.cuwcd.org . Contact the CUWCD at 254/933-0120 for additional information.

Dated: October 2, 2020

CLEARWATER UNDERGROUND WATER CONSERVATION DISTRICT

By: ______________________

Dirk Aaron,
General Manager
Assistant Secretary to the Board of Directors

GUIDELINES FOR PUBLIC PARTICIPATION IN CLEARWATER UNDERGROUND WATER CONSERVATION DISTRICT BOARD MEETING, WORKSHOP AND PUBLIC HEARINGS

Clearwater UWCD, in order to maintain governmental transparency and continued government operation while reducing face-to-face contact for government open meetings, is implementing measures according to guidelines set forth by the Office of the Texas Governor, Greg Abbott. In accordance with section 418.016 of the Texas Government Code, Governor Abbott has suspended various open-meetings provisions that require government officials and members of the public to be physically present at a specified meeting location. CUWCD's adherence to the Governor's guidance temporary suspension procedure ensures public accessibility and opportunity to participate in CUWCD's open meeting, workshop and public hearings.

Members of the public wishing to make public comment during the meeting must register by emailing schapman@cuwcd.org prior to 11:30 a.m. on October 14, 2020. This meeting will be recorded and the audio will be available online http://www.cuwcd.org or by requesting a copy from daaron@cuwcd.org . A copy of the agenda packet is available on the CUWCD's website prior to the meeting.

You may join CUWCD's Board Public Hearing as follows:

- ✓ CUWCD Regular Board Workshop, Public Hearing and Business Meeting
- ✓ Wed, Oct 14, 2020 1:30 PM - 6:30 PM (CDT)
- ✓ Please join the meeting from your computer, tablet or smartphone.
  https://global.gotomeeting.com/join/478263293

You can also dial in using your phone.
United States (Toll Free): 1 866 899 4679 Access Code: 478-263-293
New to GoToMeeting? Get the app now: https://global.gotomeeting.com/install/478263293

Letter: Top deputies accuse Paxton of crimes

THE ASSOCIATED PRESS

DALLAS — Several top deputies of Texas' attorney general have reported to law enforcement that their boss engaged in crimes including bribery and abuse of office, according to an internal letter.

In a single-page letter to the director of human resources in the attorney general's office, the seven senior lawyers wrote that they reported Republican Ken Paxton to "the appropriate law enforcement authority" for potentially breaking the law "in his official capacity as the current Attorney General of Texas."

"We have a good faith belief that the attorney general is violating federal and/or state law including prohibitions related to improper influence, abuse of office, bribery and other potential criminal offenses," the Thursday letter states. It was first reported jointly by the Austin American-Statesman and KVUE-TV and subsequently obtained by The Associated Press.

The letter does not offer specifics but nonetheless stands as a remarkable accusation of criminal wrongdoing against the state's top law enforcement officer by his own staff, including some longtime supporters of his conservative Christian


Paxton

politics. It could deepen legal trouble for Paxton, who has spent nearly his entire five years in office under felony indictment for securities fraud, although the case has stalled for years over legal challenges.

Philip Hilder, Paxton's defense attorney in the securities case, declined to comment on the new allegations Sunday. Paxton pleaded not guilty in that case, but it is not clear whether the new accusations are related.

In a statement to the American-Statesman Paxton's office said: "The complaint filed against Attorney General Paxton was done to impede an ongoing investigation into criminal wrongdoing by public officials including employees of this office. Making false claims is a very serious matter and we plan to investigate this to the fullest extent of the law."

It's unclear what investigation is being referenced in the statement. A spokeswoman for the attorney general did not immediately respond to an email and phone call Sunday.

"These allegations raise serious concerns," Gov. Greg Abbott, also a Republican, said in a Sunday statement. He declined to comment further "until the results of any investigation are complete."

"Indicted Texas Republican Attorney General Ken Paxton is the top law enforcement official in the state," Texas Democratic Party Chairman Gilberto Hinojosa said in a statement. "Yet, he has proven for years that he cannot follow the law himself."

The letter was signed by the deputy attorneys general for policy, administration, civil litigation, criminal investigations and legal counsel, as well as Paxton's first assistant, Jeff Mateer, and Mateer's deputy. None of them responded to messages seeking comment Saturday or Sunday.

Mateer resigned from Paxton's office Friday to rejoin a prominent conservative nonprofit law firm in the Dallas-area, according to the Dallas Morning News. The First Liberty Institute did not immediately respond to an inquiry about him Sunday.

Bill Miller, a veteran Texas political consultant who's worked for Republicans and Democrats, said he couldn't think of any precedent for a current elected leader's staff accusing them of crimes.

"It's like, wow," he said.

TODAY IN HISTORY

Today is **Monday, Oct. 5,** the 279th day of 2020. There are 87 days left in the year.

Today's Highlight in History:

On **Oct. 5, 2005,** defying the White House, senators voted 90-9 to approve an amendment sponsored by Sen. John McCain, R-Ariz., that would prohibit the use of "cruel, inhuman or degrading treatment or punishment" against anyone in U.S. government custody. (A reluctant President George W. Bush later signed off on the amendment.)

On this date:

In **1892**, the Dalton Gang, notorious for its train robberies, was practically wiped out while attempting to rob a pair of banks in Coffeyville, Kansas.

In **1947**, President Harry S. Truman delivered the first televised White House address as he spoke on the world food crisis.

In **1953**, Earl Warren was sworn in as the 14th chief justice of the United States, succeeding Fred M. Vinson.

In **1958**, racially-desegregated Clinton High School in Clinton, Tennessee, was mostly leveled by an early morning bombing.

In **2001**, tabloid photo editor Robert Stevens died from inhaled anthrax, the first of a series of anthrax cases in Florida, New York, New Jersey and Washington.

In **2018**, a jury in Chicago convicted white police officer Jason Van Dyke of second-degree murder in the 2014 shooting of Black teenager Laquan McDonald.

Five years ago: The United States, Japan and 10 other nations in Asia and the Americas reached agreement on the landmark Trans-Pacific Partnership trade deal.

One year ago: A Taliban official said a delegation had met with a U.S. envoy in the Pakistani capital; it was the first such encounter since President Donald Trump announced a month earlier that a peace deal to end Afghanistan's 18-year war was dead.

The Associated Press

TEXAS LOTTERY

Pick 3

Oct. 3, morning: **0-0-7** Oct. 3, day: **4-3-7**
Oct. 3, evening: **2-3-8** Oct. 3, night: **1-4-1**

Daily 4

Oct. 3, morning: **8-5-6-0** Oct. 3, day: **5-6-6-1**
Oct. 3, evening: **6-1-0-1** Oct. 3, night: **4-7-2-0**

Cash 5

Oct. 3: **1-7-8-14-34**

Lotto Texas

Oct. 3: **6-13-18-26-48-54**

Texas Two Step

Oct. 1: **7-9-14-21** Bonus number: **1**

Mega Millions

Oct. 2: **9-38-47-49-68** Megaplier number (x2): **25**

Powerball

Oct. 3: **18-31-36-43-47** Powerball: **20**

Source: www.txlottery.org

NOAH BERGER | AP

A firefighter rubs his head while watching the LNU Lightning Complex fires spread through the Berryessa Estates neighborhood of unincorporated Napa County, Calif., in August. Deadly wildfires in California have burned more than 4 million acres this year — more than double the previous record for the most land burned in a single year in the state.

Wildfires burn a record 4M acres in Calif.

THE ASSOCIATED PRESS

SAN FRANCISCO — In a year that has already brought apocalyptic skies and smothering smoke to the West Coast, California set a grim new record Sunday when officials announced that the wildfires of 2020 have now scorched a record 4 million acres — in a fire season that is far from over.

The unprecedented figure — an area larger than the state of Connecticut — is more than double the previous record for the most land burned in a single year in California.

"The 4 million mark is unfathomable. It boggles the mind, and it takes your breath away," said Scott McLean, a spokesman for the California Department of Forestry and Fire Protection. "And that number will grow."

BRIEFS

Police officer killed in the line of duty in South Carolina

MYRTLE BEACH, S.C. — A police officer was killed in South Carolina during an exchange of gunfire after responding to a domestic call, authorities said Sunday.

The South Carolina Law Enforcement Division said in a statement that a second officer was injured during the shootout in Myrtle Beach. A suspect was later found dead. The second officer was taken to a hospital with injuries not considered life-threatening.

France, Italy search for missing victims after deadly floods

PARIS — French authorities deployed about 1,000 firefighters, four military helicopters and troops to search for at least eight people who were missing after devastating floods hit a mountainous border region with Italy, where at least four people were killed.

Emergency workers in Italy recovered two corpses Sunday in northern Liguria that they feared may have been washed away as a result of the storms that killed two other people on Saturday.

Floods washed away houses and destroyed roads and bridges surrounding the city of Nice on the French Riviera after almost a year's average rainfall fell in less than 12 hours. Nice Mayor Christian Estrosi said over 100 homes were destroyed or severely damaged.

U.S. push for Arab-Israel ties divides Sudanese leaders

CAIRO — Sudan's fragile interim government is sharply divided over normalizing relations with Israel, as it finds itself under intense pressure from the Trump administration to become the third Arab country to do so in short order — after the United Arab Emirates and Bahrain.

Washington's push for Sudan-Israel ties is part of a campaign to score foreign policy achievements ahead of the U.S. presidential election in November.

Herald wire reports

PEOPLE IN THE NEWS

'Saturday Night Live' recreates debate in 46th season opener

LOS ANGELES — "Saturday Night Live" went political with a parody of this week's presidential debate, Chris Rock's jab at President Donald Trump and Megan Thee Stallion's message supporting Black people during her performance.

The NBC late-night sketch series opened its 46th season, returning to the studio this week after the coronavirus pandemic halted production.

Alec Baldwin returned to play Trump before the president's COVID diagnosis, while Jim Carrey made his feature debut as Democratic Challenger Joe Biden.

Birthdays

Actor **Glynis Johns** is 97. College Football Hall of Fame coach **Barry Switzer** is 83. Rock musician **David Bryson** (Counting Crows) is 66. Astrophysicist-author **Neil deGrasse Tyson** is 62. Actor **Daniel Baldwin** is 60. Hockey Hall of Famer **Mario Lemieux** is 55. Actor **Guy Pearce** is 53. Actor **Josie Bissett** is 50. Actor **Kate Winslet** is 45. Actor **Jesse Eisenberg** is 37. Actor **Joshua Logan Moore** is 26. Actor **Jacob Tremblay** is 14.

Herald wire reports

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NOTICE OF PUBLIC HEARING

The Clearwater Underground Water Conservation District (CUWCD) will hold a public hearing and consider adopting proposed update with revisions to the District Management Plan at 1:30 p.m., October 14, 2020 in the District Headquarters Building located at 700 Kennedy Court, Belton, Texas. Copies of the revised Management Plan are available for review at the CUWCD Headquarters Building and on the CUWCD website at www.cuwcd.org. Contact the CUWCD at 254-933-0120 for additional information.

VIRUS OUTBREAK

Trump's doctor's comments on symptoms, care spark confusion

BY LAURAN NEERGAARD
AP MEDICAL WRITER

Jacquelyn Martin/Associated Press

Dr. Sean Conley, physician to President Donald Trump, and other doctors, arrive Sunday to brief reporters at Walter Reed National Military Medical Center in Bethesda, Md.

For the second day in a row, the Navy commander in charge of President Donald Trump's care left the world wondering: Just how sick is the president?

Dr. Sean Conley is trained in emergency medicine, not infectious disease, but he has a long list of specialists helping determine Trump's treatment at Walter Reed National Military Medical Center.

Conley said Sunday that Trump is doing well enough that he might be sent back to the White House in another day — even as he announced the president was given a steroid drug that's only recommended for the very sick.

Worse, steroids tamp down important immune cells, raising concern about whether the treatment choice might hamper the ability of the president's body to fight the virus.

Then there's the question of public trust: Conley acknowledged that that he had tried to present a rosy description of the president's condition in his first briefing of the weekend "and in doing so, came off like we're trying to hide something, which wasn't necessarily true."

In fact, Conley refused to directly answer on Saturday whether the president had been given any oxygen — only to admit the next day that he had ordered oxygen for Trump on Friday morning.

It's puzzling even for outside specialists.

"It's a little unusual to have to guess what's really going on because the clinical descriptions are so vague," said Dr. Steven Shapiro, the University of Pittsburgh Medical Center's chief medical and science officer. With the steroid news, "there's a little bit of a disconnect."

Conley has been Trump's physician since 2018 — and has experienced some criticism about his decisions. In May, Conley prescribed Trump a two-week course of the malaria drug hydroxychloroquine to protect against the coronavirus after two White House staffers had tested positive. Rigorous studies have made clear that hydroxychloroquine, which Trump long championed, does no good in either treating or preventing COVID-19.

This time around, Conley is being put to an even greater test, trying to balance informing a public that needs honesty about the condition of the president with a patient who dislikes appearing vulnerable.

Dr. Stephen Xenakis, a psychiatrist who retired from the Army medical corps as a brigadier general, said Conley would be obliged to follow Trump's wishes regarding what information about his condition is released publicly, as is true in any doctor-patient relationship.

But Conley as a military medical officer is bound to adhere to the Uniform Code of Military Justice, which prohibits lying, he said.

A number of current and former military officials declined to comment on the record. But several said they were concerned that Conley's efforts to spin a more upbeat characterization of the president's current health condition is raising flags within the Navy about his credibility and the reputation of the Navy's medical team.

Trump

Continued from 1A

showed any damage.

It was the second straight day of confusion and obfuscation from a White House already suffering from a credibility crisis. And it raised questions about whether the doctors treating the president were sharing accurate, timely information with the American public about the severity of him condition.

Pressed about conflicting information he and the White House released on Saturday, Navy Cmdr. Dr. Sean Conley acknowledged that he had tried to present a rosy description of the president's condition.

"I was trying to reflect the upbeat attitude of the team, that the president, that his course of illness has had. Didn't want to give any information that might steer the course of illness in another direction," Conley said. "And in doing so, came off like we're trying to hide something, which wasn't necessarily true. The fact of the matter is that he's doing really well."

The briefing outside the Walter Reed National Military Medical Center lasted just 10 minutes.

Medical experts said Conley's revelations raised new questions about how ill the president was and are hard to square with the doctor's upbeat assessment and talk of a discharge.

"There's a little bit of a disconnect," said Dr. Steven Shapiro, chief medical and scientific officer at the University of Pittsburgh Medical Center.

Blood oxygen saturation is a key health marker for COVID-19 patients. A normal reading is between 95 and 100. Conley said the president had a "high fever" and a blood oxygen level below 94% on Friday and during "another episode" on Saturday.

He was evasive about the timing of Trump oxygen drops. ("It was over the course of the day, yeah, yesterday morning," he said) and asked whether Trump's level had dropped below 90%, into concerning territory. ("We don't have any recordings here on that.") But he revealed that Trump was given a dose of the steroid dexamethasone in response.

At the time of the briefing, Trump's blood oxygen level was 98% — within normal rage, Trump's medical team said.

Signs of pneumonia or other lung damage could be detected in scans before a patient feels short of breath, but the president's doctors declined to say what those scans have revealed.

"There's some expected findings, but nothing of any major clinical concern," Conley said. He declined to outline those "expected findings."

Trump's Democratic challenger, Joe Biden, pulled his attack ads off the air during Trump's hospitalization, and on Sunday, he dispatched senior aides to deliver a largely friendly message.

"We are sincerely hoping that the president makes a very quick recovery, and we can see him back out on the campaign trail very soon," Biden adviser Symone Sanders said on CNN's "State of the Union."

She added, "This is a glaring reminder that the virus is real."

Paxton

Continued from 1A

done to impede an ongoing investigation into criminal wrongdoing by public officials including employees of this office. Making false claims is a very serious matter and we plan to investigate this to the fullest extent of the law."

She declined to comment further, citing an open investigation.

Ryan Bangert, the deputy first assistant attorney general and one of the seven aides who signed on to the letter, wrote to agency staff Sunday encouraging them "to ensure the agency continues its important work without interruption."

"I write to assure you that the executive team remains committed to serving you, this office, and the people of Texas. The work we do together makes a difference every day in the lives of our fellow citizens," Bangert wrote. "Your work, your sacrifice, and your dedication to this office inspire us all."

Meanwhile, top Texas Republicans reacted cautiously to the allegations against Paxton.

"These allegations raise serious concerns," Gov. Greg Abbott said Sunday in a prepared statement. "I will withhold further comment until the results of any investigation are complete."

Lt. Gov. Dan Patrick called the news "obviously concerning."

"I learned about this from media reports," Patrick said in a statement. "I will wait until the investigation is complete before making any additional comments."

The office of House Speaker Dennis Bonnen did not immediately return requests for comment.

An attorney with Paxton's defense team in the securities fraud case, Philip Hilder, declined to comment. Brian Wice, one of the special prosecutors on the case, said Sunday that "we're going to look into this," but declined to elaborate further. It's not clear whether the latest allegations are related to the pending securities fraud charges.

Jordan Berry, a political adviser to Paxton, confirmed Sunday that he had resigned in the wake of the allegations.

Michelle Lee, a public affairs officer for the FBI, declined to comment on the matter, citing internal policy within the FBI and the U.S. Department of Justice not to comment on the existence of pending or potential investigations. A spokesman for the U.S. Attorney for the region said "we have no comment." Travis County District Attorney Margaret Moore said Saturday evening "we do not have an investigation."

Paxton has faced numerous questions over his ethics over his more than a decade in public life. To help pay for his stacked team of defense attorneys, he has collected hundreds of thousands of dollars in gifts for his legal defense fund, claiming the contributions came from "family friends" and are exempt from a state bribery law that bars elected officials from receiving gifts from people who are subject to their authority.

In the securities fraud charges that are still pending, Paxton is accused of convincing investors to buy stock in a technology firm without disclosing that he would be compensated for it. He has maintained his innocence and criticized the prosecution as politically motivated. In 2014, the Texas State Securities Board fined Paxton $1,000 for soliciting investment clients without being registered, and he signed a disciplinary order without disputing its findings.

Last year, his wife, state Sen. Angela Paxton, filed a bill that would have expanded her husband's power as attorney general, giving him the power to exempt individuals from state regulations like the one he has been charged with violating.

In 2018, Paxton's office filed — and then abruptly recalled — a formal court brief in a lawsuit over Plano's zoning policies, in a move that his supporters attributed to political influence from conservatives in his home county.

Paxton, a conservative who has often elbowed for airtime as the state's top culture warrior, has kept up a busy and high-profile role during the coronavirus pandemic.

This spring, he declared that Gov. Greg Abbott's ban on elective medical procedures, an effort to conserve hospital resources for coronavirus patients, also barred abortions in the state, sparking a lawsuit that would drag on for weeks and force hundreds of women to cancel appointments to terminate their pregnancies. His office threatened to sue the state's biggest cities if they did not roll back coronavirus-related safety precautions, including mask mandates, and told local officials they could not keep landlords from evicting their tenants during the pandemic.

Paxton used the power of his office to lean on a Colorado county after it shut its doors to vacation home owners — including a top donor.

Paxton has led major multistate lawsuits to overturn laws like the Affordable Care Act and the Deferred Action for Childhood Arrivals program, often landing cases before the U.S. Supreme Court. He's made equally political choices in the cases he chooses not to take. His office refused to defend a state agency, as it typically would, when it was sued for disciplining a state judge who refused to perform marriage ceremonies for same-sex couples. And it declined to defend the Texas Ethics Commission in a lawsuit brought by the hardline conservative group Empower Texans, a political donor.

Last year, he was a major player in Texas' botched effort to review its voter rolls.

Paxton often boasts of his close relationship with the president, frequently greeting him on the tarmac when Air Force One touches down in Texas, and sharing stories during public appearances about their communication on major Texas-led litigation — the time Trump called while Paxton was in the shower is a favorite.

In 2018, Paxton narrowly bested his Democratic opponent, Justin Nelson, to win reelection in an unexpectedly tight race. Nelson had made Paxton's indictments the centerpiece of his campaign.

"Ken Paxton is the top law enforcement official in the state," Texas Democratic Party Chair Gilberto Hinojosa said in a statement Saturday. "Yet, he has proven for years that he cannot follow the law himself."

Horses

Continued from 1A

train horses together.

"I show clients' horses, and I have a few of my own that I train to sell," Sabine said.

"I love how they teach you to communicate," she said of horses. "You always have to be patient and put in the work to understand them."

Sabine is studying online at Sam Houston State University in Huntsville, with a major in communications.

"I'd like to do something along the line of teaching people how to communicate with each other," she said.

Julie Hill said she grew up in the CAQHA program and has won world champion and reserve world champion at the American Paint Horse Association World Show. She's a graduate student at Texas A&M University and hopes to go to medical school. She's been on the A&M equestrian team four years, and plans to stay involved with horse shows.

"I started riding when I was five years old," Hill said. "I got my first pony (Plaudits Handsome Lad). I started with him in these shows."

She was the first in her family to start riding, she said.

"My grandfather told me every Texan needed to learn how to ride a horse," she said. "He paid for my first five riding lessons and I was hooked."

lcausey@tdtnews.com

Register

Continued from 1A

application through the Texas Secretary of State's office.

Absentee ballots must be postmarked by Election Day.

Early voting will kick off next week. Registered voters may cast their ballot at any poll in the county.

There are six early voting locations in the county: the Belton's Bell County Courthouse Annex, 550 E. Second Ave.; the Temple Bell County Annex, 205 E. Central Ave.; Salado Church of Christ, 217 N. Stagecoach Road; the Harker Heights Parks & Recreation Center, 307 Millers Crossing; the Killeen Bell County Annex, 304 Priest Drive; and the Killeen Community Center, 2201 E. Veterans Memorial Blvd.

Polls will be open 8 a.m. to 5 p.m. Oct. 13 through Oct. 16; 7 a.m. to 7 p.m. Oct. 17; noon to 5 p.m. Oct. 18; 8 a.m. to 5 p.m. Oct. 19 through Oct. 23; 7 a.m. to 7 p.m. Oct. 24; noon to 5 p.m. Oct. 25; and 7 a.m. to 7 p.m. Oct. 26 through Oct. 30.

Finally, voters can cast their ballots 7 a.m. to 7 p.m. Nov. 3 at any of the 41 voting centers located throughout Bell County.

jsanchez@tdtnews.com

Notice of Public Hearing

The Clearwater Underground Water Conservation District (CUWCD) will hold a public hearing and consider adopting proposed update with revisions to the District Management Plan at 1:30 p.m., October 14, 2020 in the District Headquarters Building located at 700 Kennedy Court, Belton, Texas. Copies of the revised Management Plan are available for review at the CUWCD Headquarters Building and on the CUWCD website at www.cuwcd.org. Contact the CUWCD at 254/933-0120 for additional information.

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

October 15, 2020

David Collinsworth, General Manager 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). Standard revisions are proposed to update this plan. 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.*

The draft of the revised management plan is at located at GMP public-hearing & draft plan and notice that the District conducted an initial public hearing on the plan on October 14, 2020 at 1:30 p.m., and will hold a second public hearing on November 11, 2020 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.

The District will after conducting the final public hearing of the draft plan on November 11, 2020 will deliberate the same day for final adoption of all proposed and agreed upon revisions to the plan 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
Electronic copy to: Brad Brunett (bradb@brazos.org); Stephen Allen stephen.allen@twdb.texas.gov

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!

October 15, 2020

TO: Surface Water Management Entities (via email)

RE: Revised Management Plan

Dear Manager:

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). Standard revisions are proposed to update this plan. One major component of the plan is evidence of its coordination with surface water management entities pursuant to TWC 36.1071 (a):

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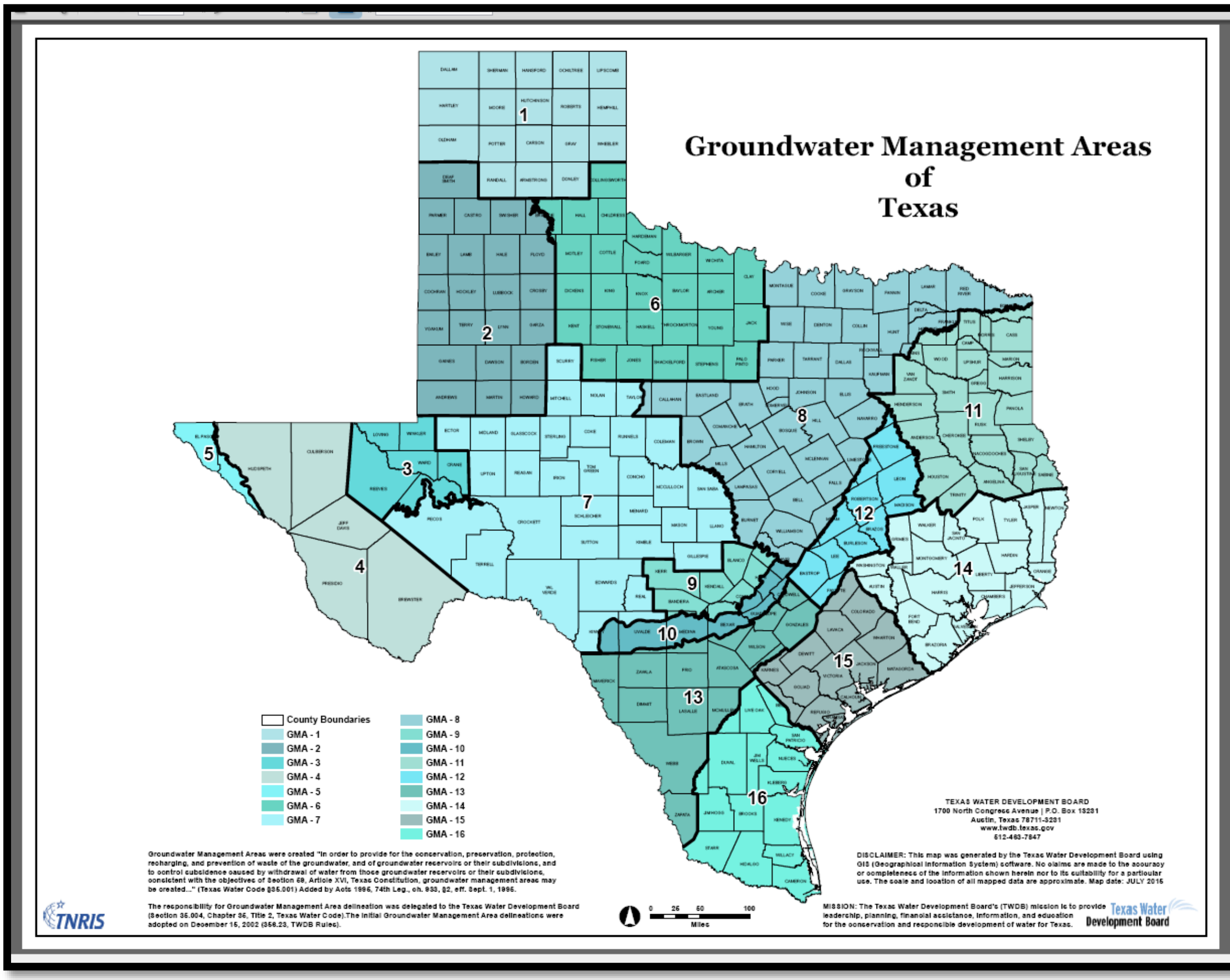
Sincerely,

Dirk Aaron
General Manager
Clearwater UWCD

Electronic copy to: Stephen Allen stephen.allen@twdb.texas.gov

APPENDIX H


Groundwater Management Areas
of
Texas
1
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14
15
16
County Boundaries
GMA - 1
GMA - 2
GMA - 3
GMA - 4
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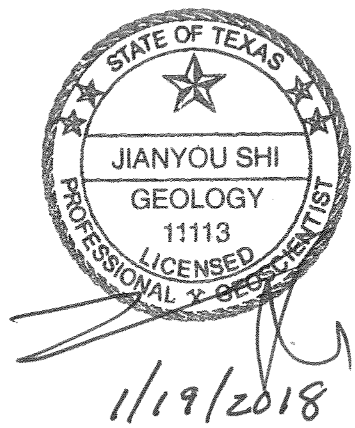
GMA - 16
Groundwater Management Areas were created "In order to provide for the conservation, preservation, protection, recharging, and prevention of waste of the groundwater, and of groundwater reservoirs or their subdivisions, and to control subsidence caused by withdrawal of water from those groundwater reservoirs or their subdivisions, consistent with the objectives of Section 59, Article XVI, Texas Constitution, groundwater management areas may be created..." (Texas Water Code §35.001) Added by Acts 1995, 74th Leg., ch. 933, §2, eff. Sept. 1, 1995.
The responsibility for Groundwater Management Area delineation was delegated to the Texas Water Development Board (Section 35.004, Chapter 35, Title 2, Texas Water Code).The initial Groundwater Management Area delineations were adopted on December 15, 2002 (356.23, TWDB Rules).
TEXAS WATER DEVELOPMENT BOARD
1700 North Congress Avenue | P.O. Box 13231
Austin, Texas 78711-3231
www.twdb.texas.gov
512-463-7847
DISCLAIMER: This map was generated by the Texas Water Development Board using GIS (Geographical Information System) software. No claims are made to the accuracy or completeness of the information shown herein nor to its suitability for a particular use. The scale and location of all mapped data are approximate. Map date: JULY 2015
MISSION: The Texas Water Development Board's (TWDB) mission is to provide leadership, planning, financial assistance, information, and education for the conservation and responsible development of water for Texas.
0 25 50 100
Miles
TNRIS
Texas Water Development Board

APPENDIX I

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 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.

- 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

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	—	—	—

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:

County	Adopted Desired Future Condition
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 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.

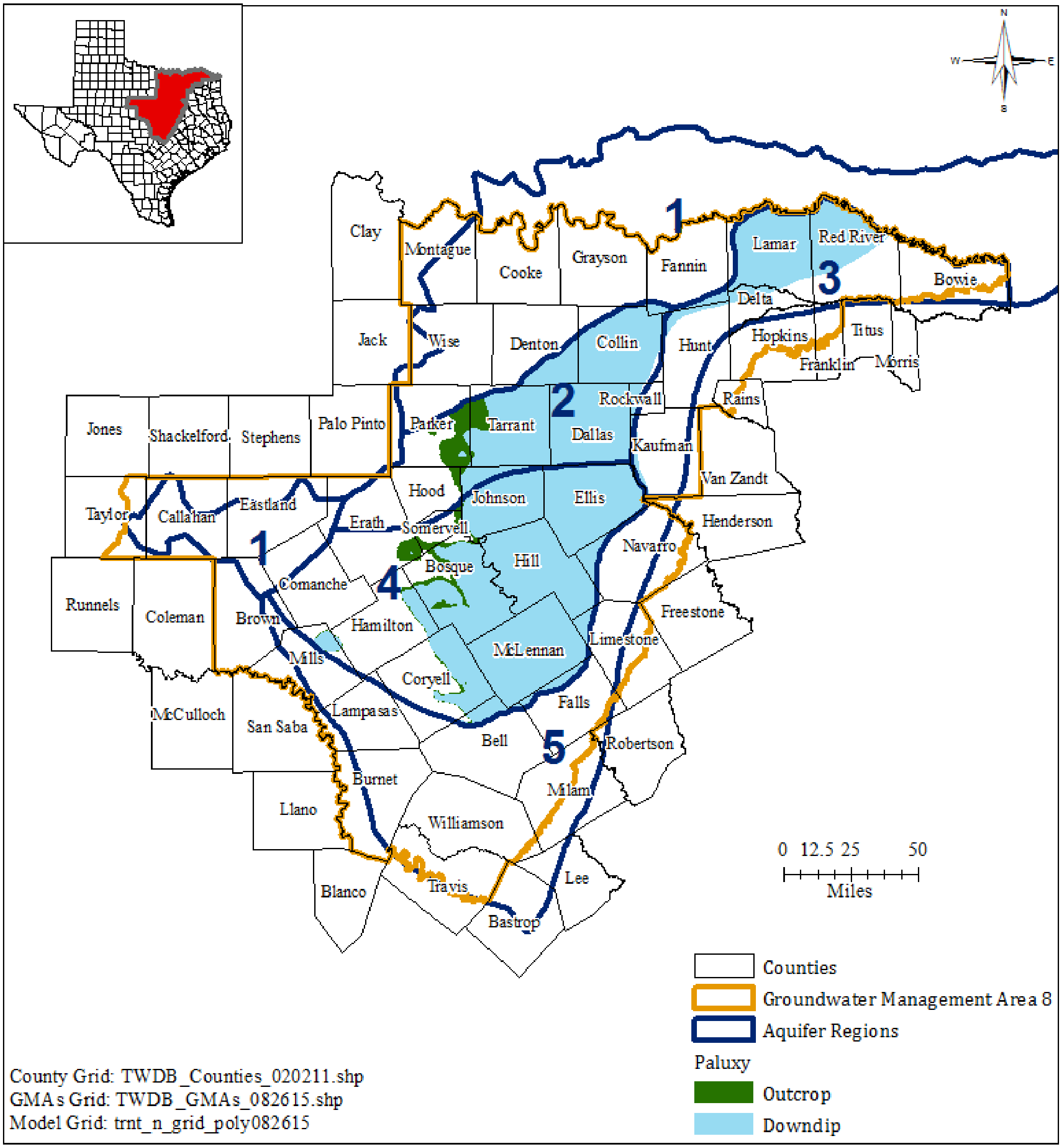


FIGURE 1. MAP SHOWING THE TRINITY AQUIFER (PALUXY) WITHIN GROUNDWATER MANAGEMENT AREA 8 FROM THE GROUNDWATER AVAILABILITY MODEL FOR THE NORTHERN PORTION OF THE TRINITY AND WOODBINE AQUIFERS.

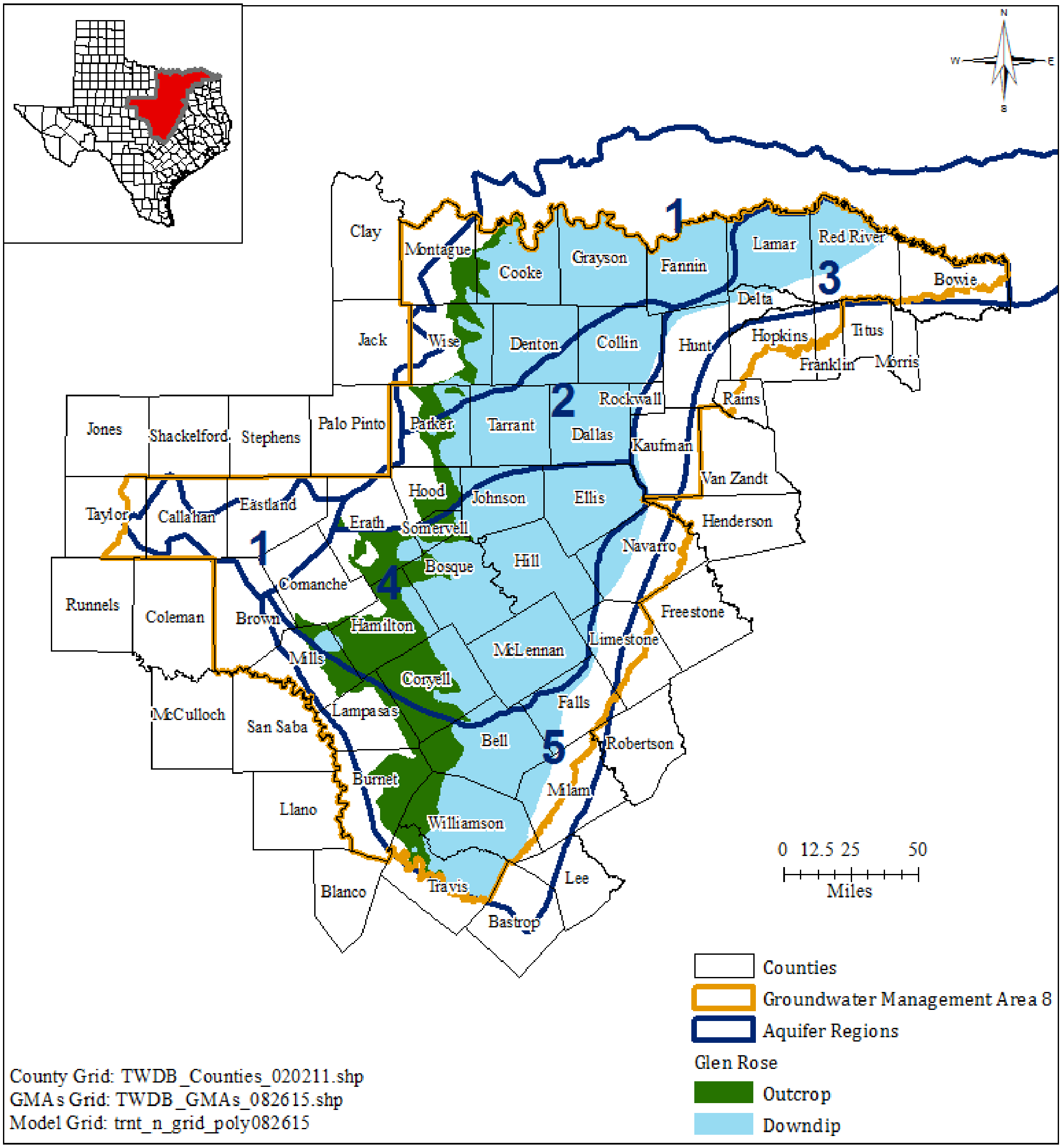


FIGURE 2. MAP SHOWING THE TRINITY AQUIFER (GLEN ROSE) WITHIN GROUNDWATER MANAGEMENT AREA 8 FROM THE GROUNDWATER AVAILABILITY MODEL FOR THE NORTHERN PORTION OF THE TRINITY AND WOODBINE AQUIFERS.

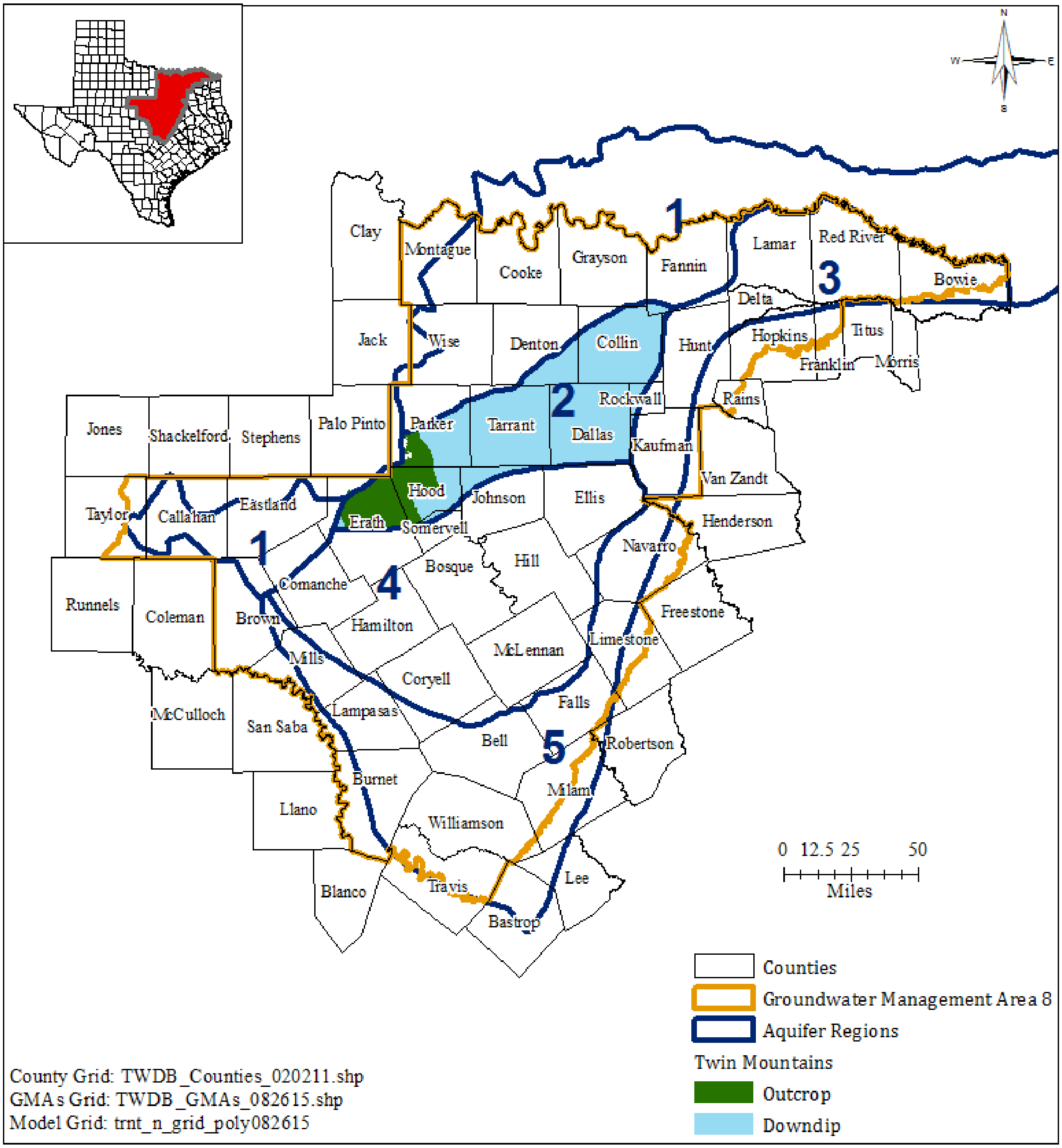


FIGURE 3. **MAP SHOWING THE TRINITY AQUIFER (TWIN MOUNTAINS) WITHIN GROUNDWATER MANAGEMENT AREA 8 FROM THE GROUNDWATER AVAILABILITY MODEL FOR THE NORTHERN PORTION OF THE TRINITY AND WOODBINE AQUIFERS.**

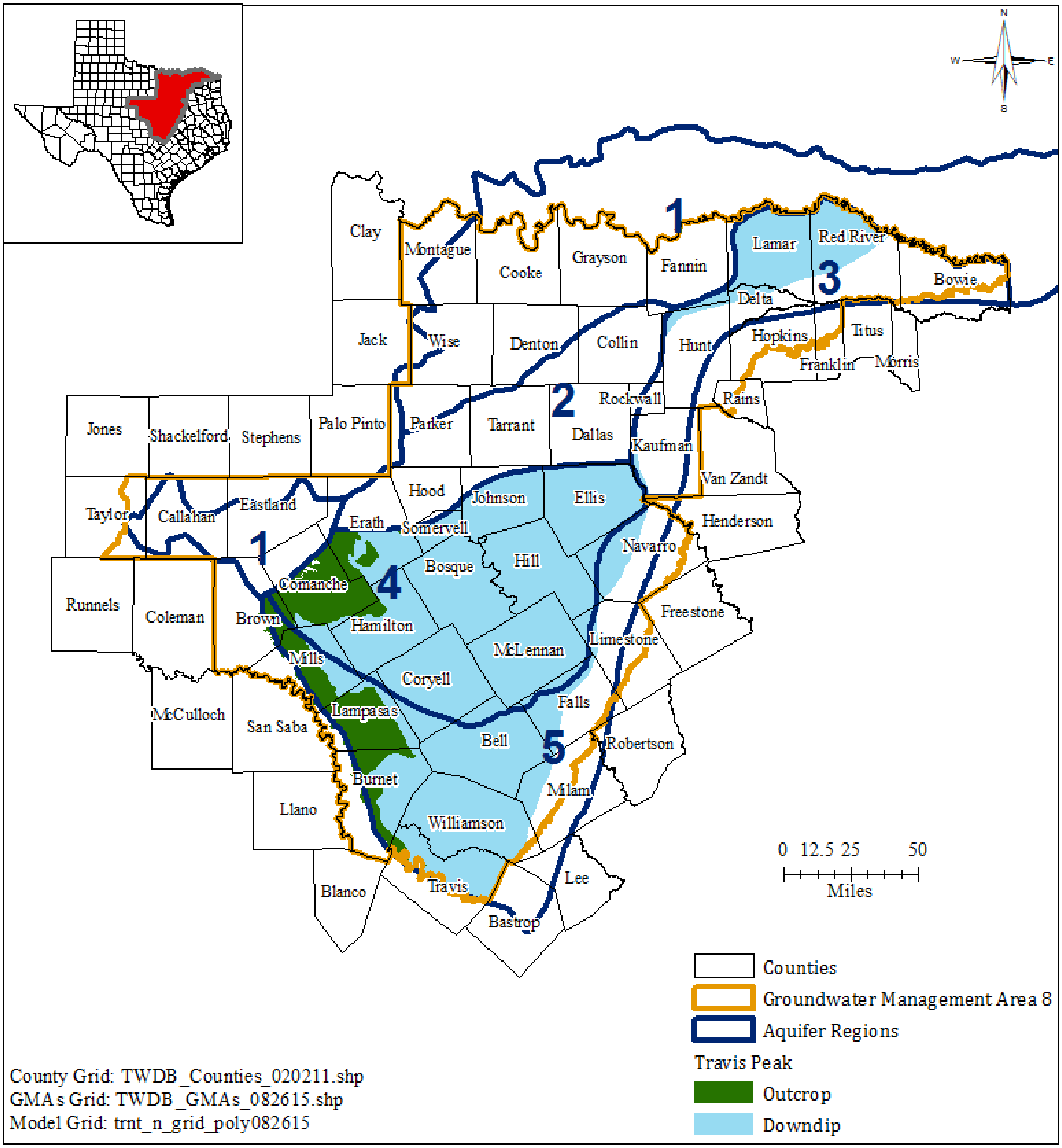


FIGURE 4. MAP SHOWING THE TRINITY AQUIFER (TRAVIS PEAK) WITHIN GROUNDWATER MANAGEMENT AREA 8 FROM THE GROUNDWATER AVAILABILITY MODEL FOR THE NORTHERN PORTION OF THE TRINITY AND WOODBINE AQUIFERS.

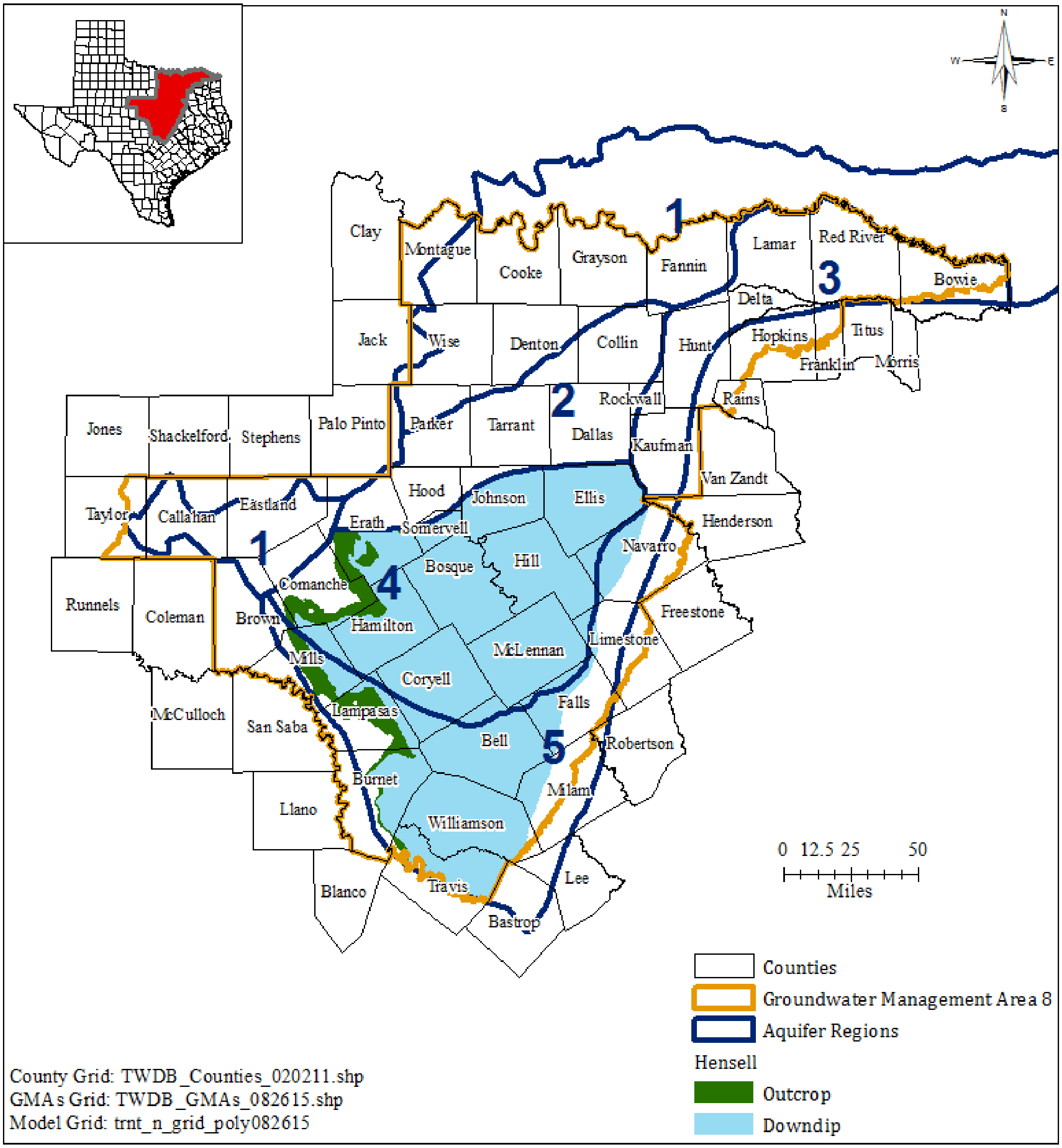


FIGURE 5. MAP SHOWING THE TRINITY AQUIFER (HENSELL) WITHIN GROUNDWATER MANAGEMENT AREA 8 FROM THE GROUNDWATER AVAILABILITY MODEL FOR THE NORTHERN PORTION OF THE TRINITY AND WOODBINE AQUIFERS.

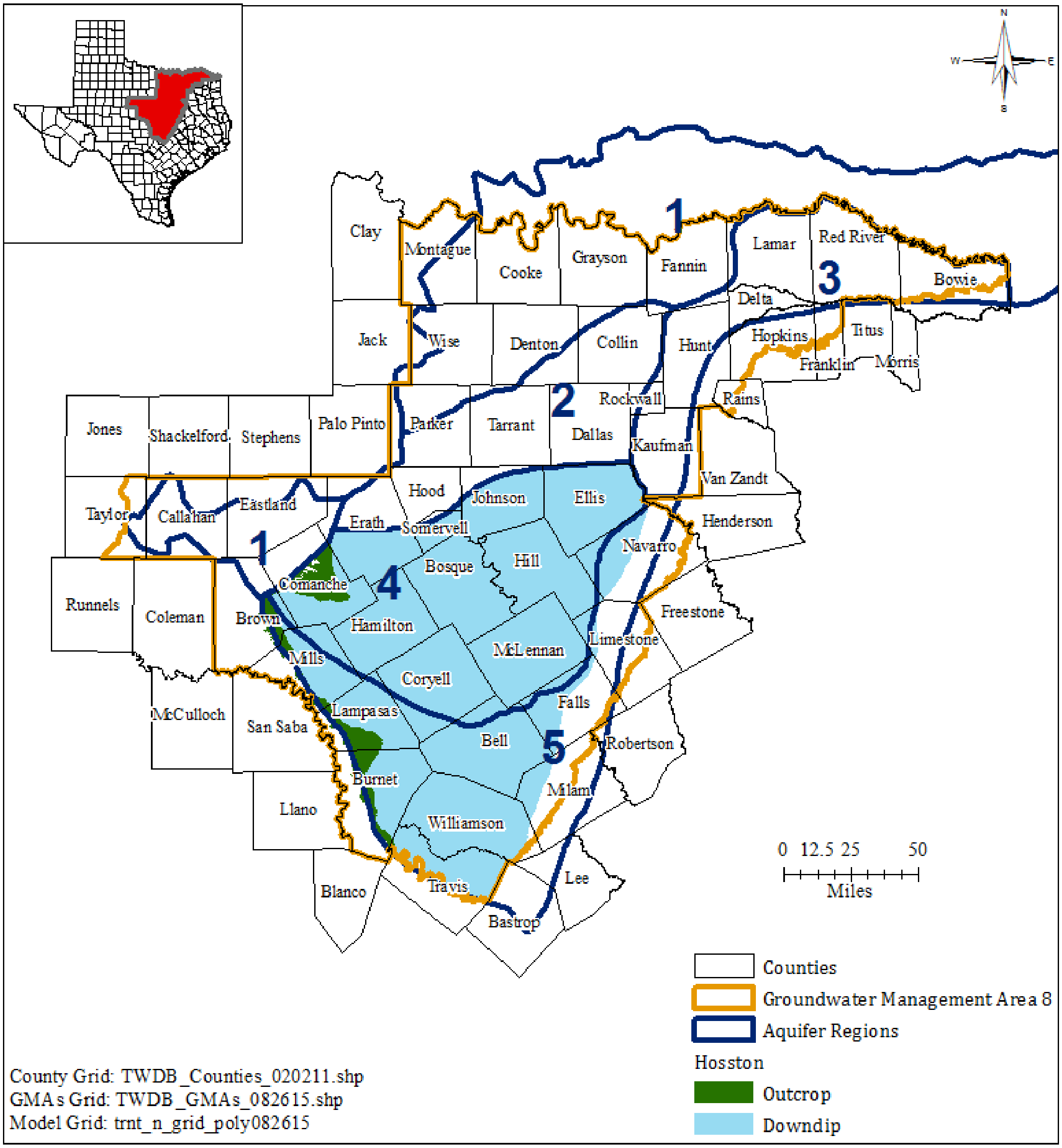


FIGURE 6. MAP SHOWING THE TRINITY AQUIFER (HOSSTON) WITHIN GROUNDWATER MANAGEMENT AREA 8 FROM THE GROUNDWATER AVAILABILITY MODEL FOR THE NORTHERN PORTION OF THE TRINITY AND WOODBINE AQUIFERS.

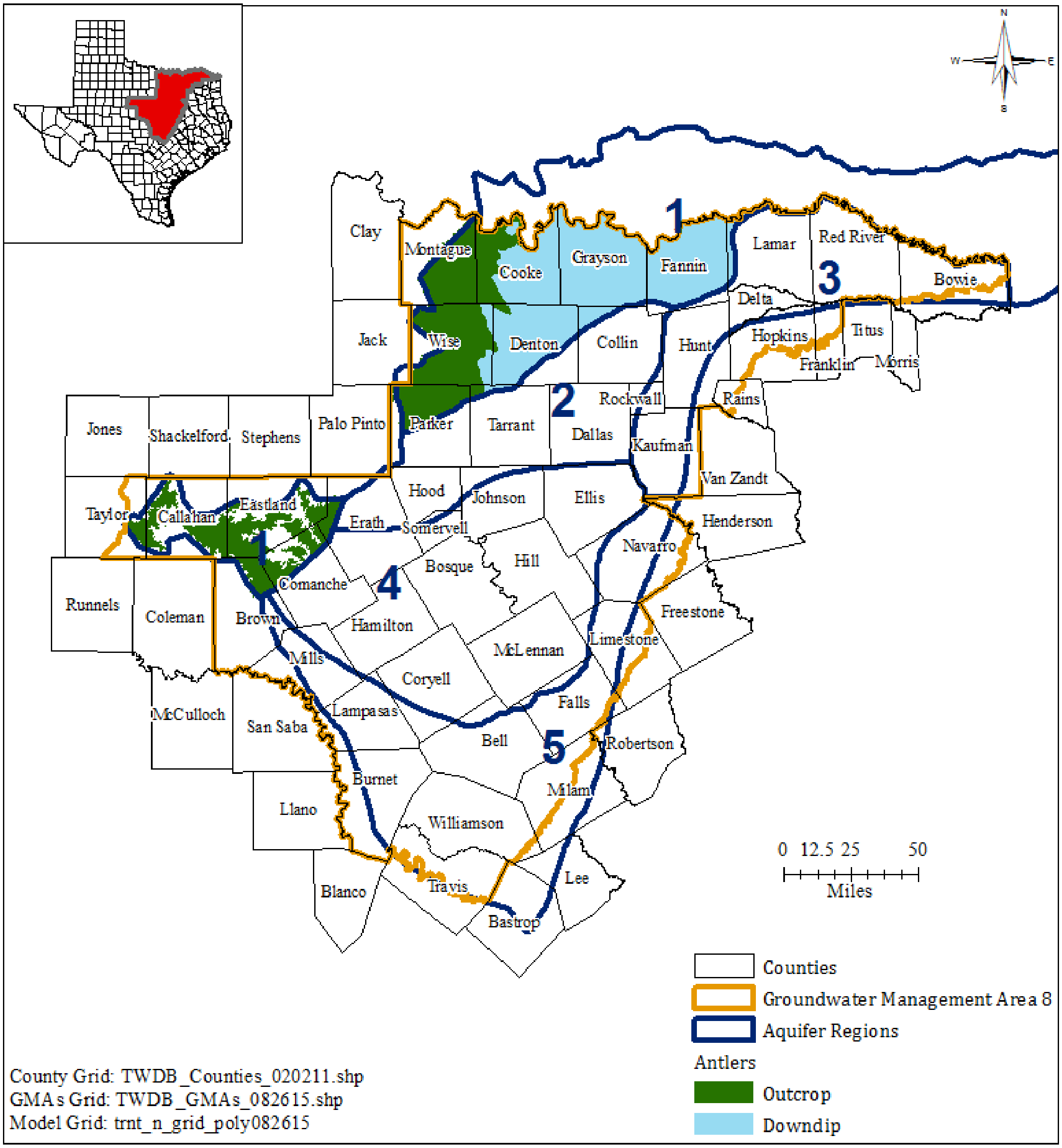


FIGURE 7. MAP SHOWING THE TRINITY AQUIFER (ANTLERS) WITHIN GROUNDWATER MANAGEMENT AREA 8 FROM THE GROUNDWATER AVAILABILITY MODEL FOR THE NORTHERN PORTION OF THE TRINITY AND WOODBINE AQUIFERS.

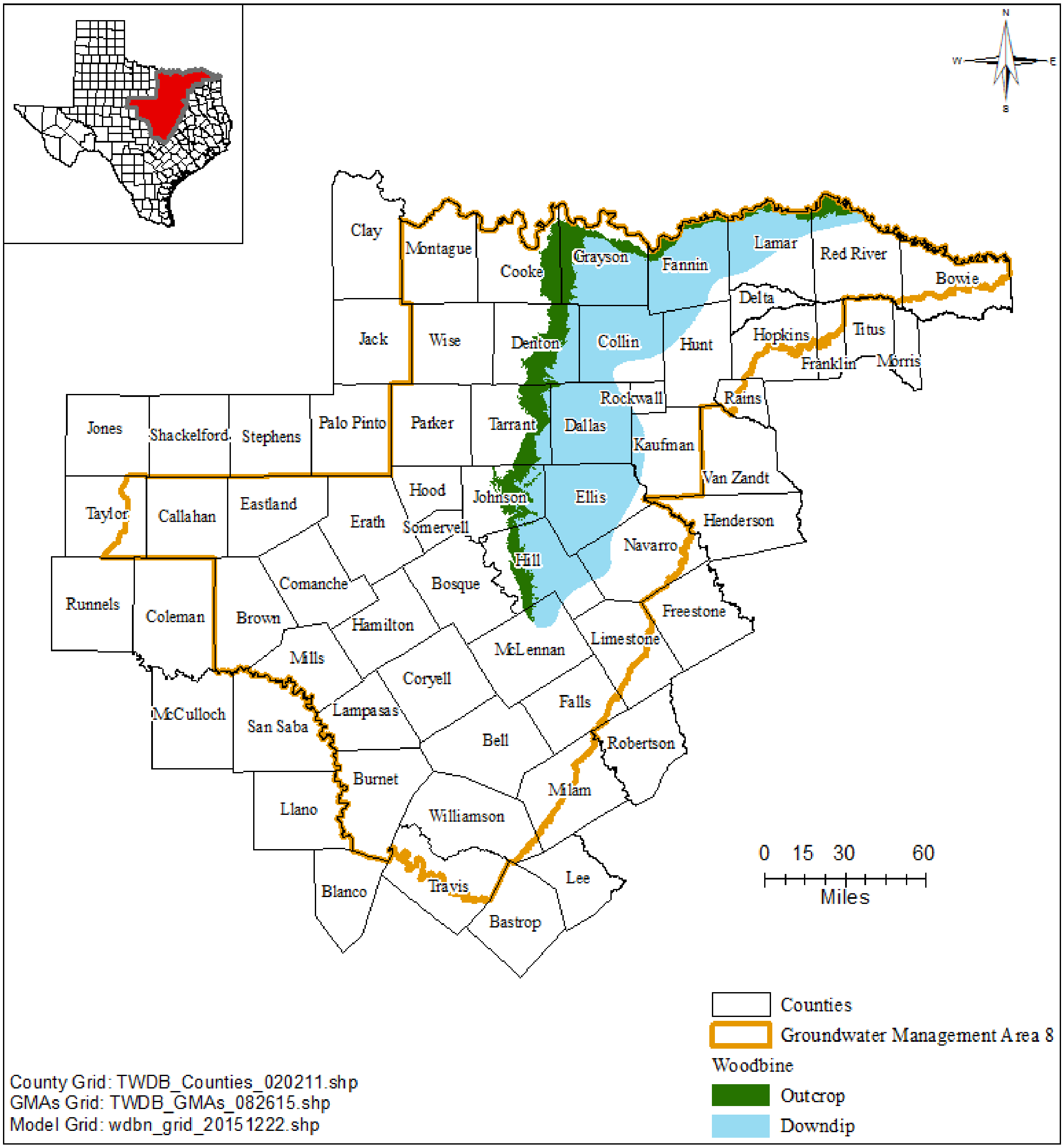


FIGURE 8. MAP SHOWING THE WOODBINE AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 8 FROM THE GROUNDWATER AVAILABILITY MODEL FOR THE NORTHERN PORTION OF THE TRINITY AND WOODBINE AQUIFERS.

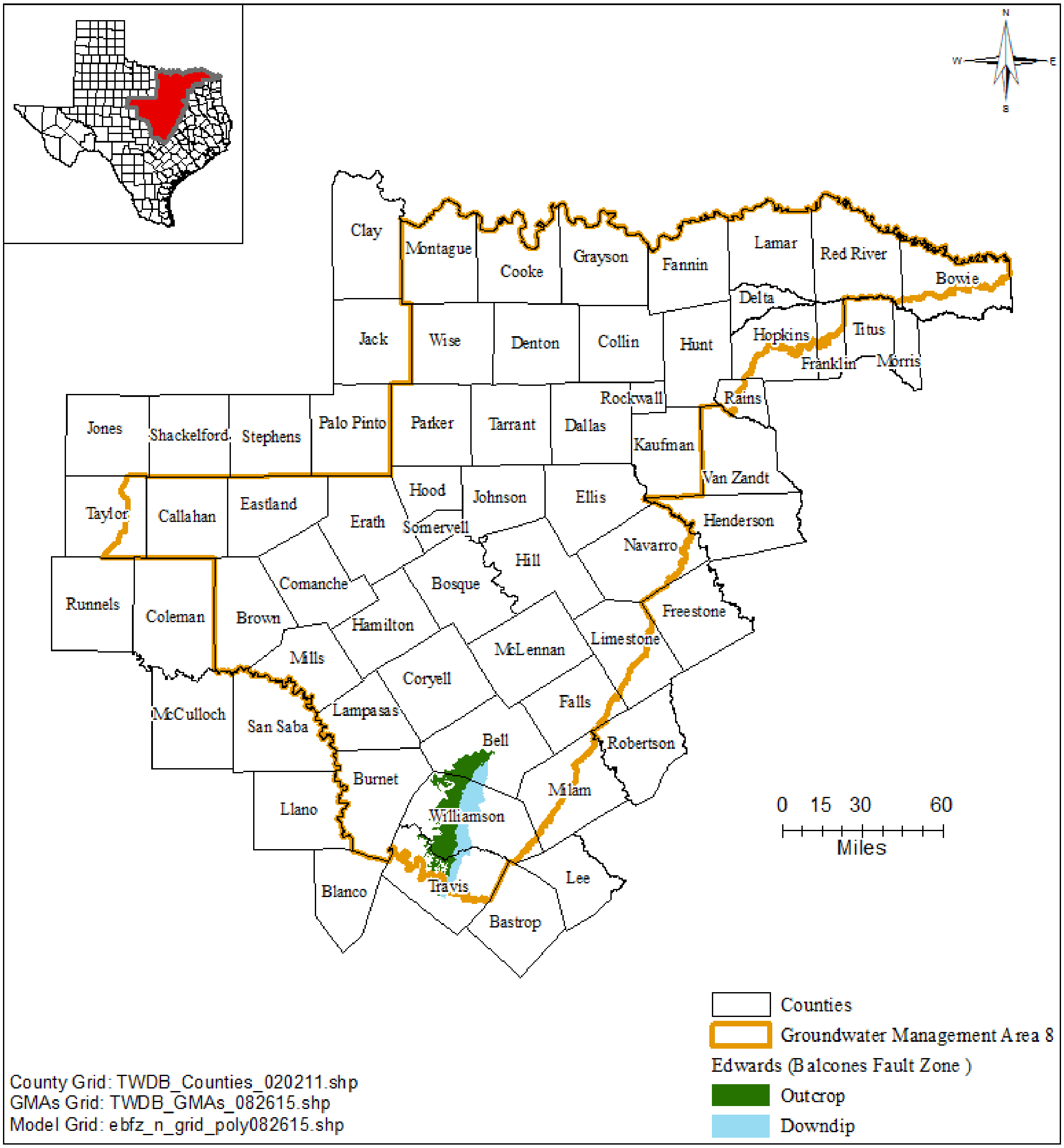


FIGURE 9. MAP SHOWING THE EDWARDS (BALCONES FAULT ZONE) AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 8 FROM THE GROUNDWATER AVAILABILITY MODEL FOR THE NORTHERN SEGMENT OF THE EDWARDS (BALCONES FAULT ZONE) AQUIFER.

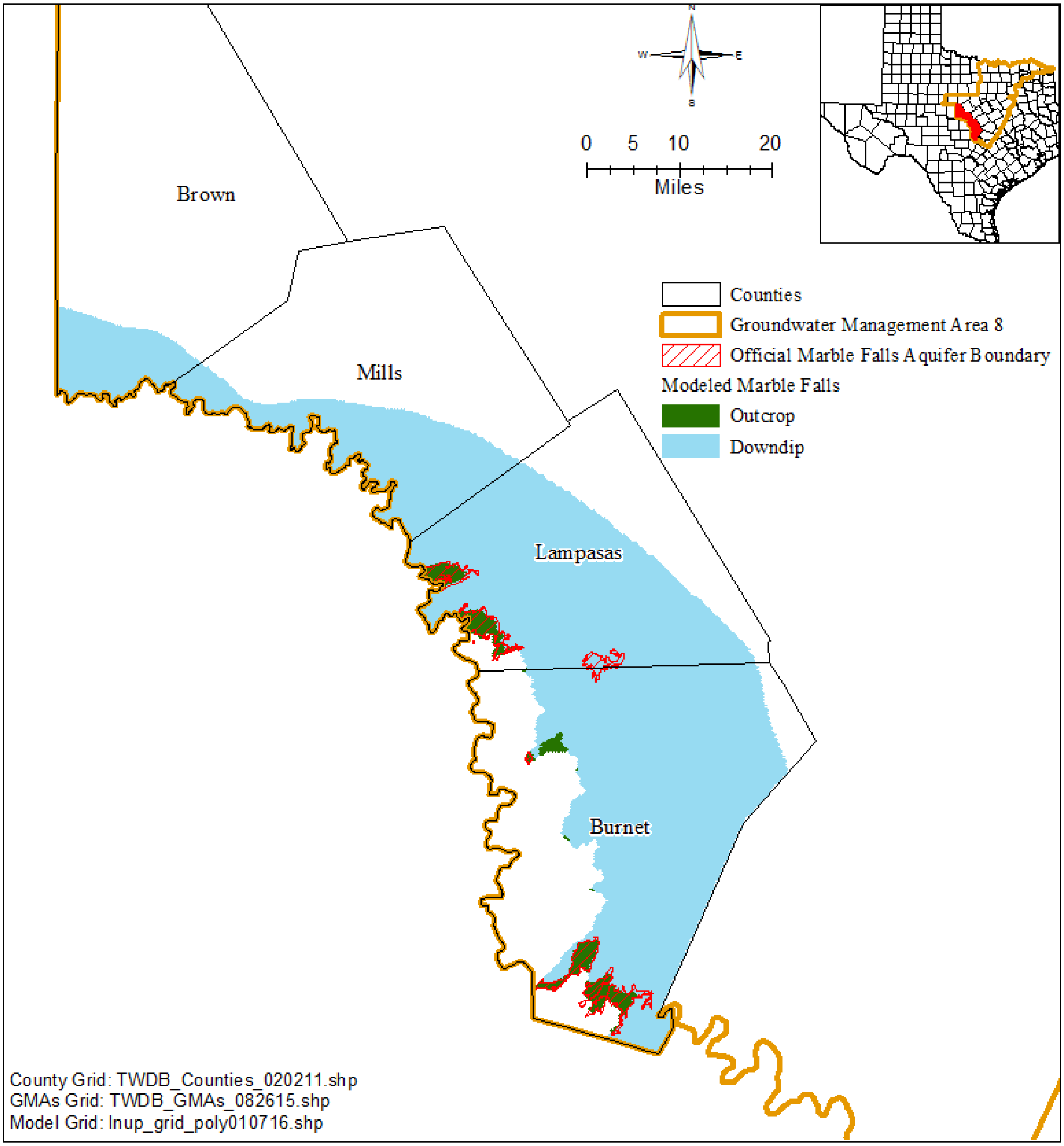


FIGURE 10. MAP SHOWING THE MARBLE FALLS AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 8 FROM THE GROUNDWATER AVAILABILITY MODEL FOR THE MINOR AQUIFERS IN LLANO UPLIFT REGION.

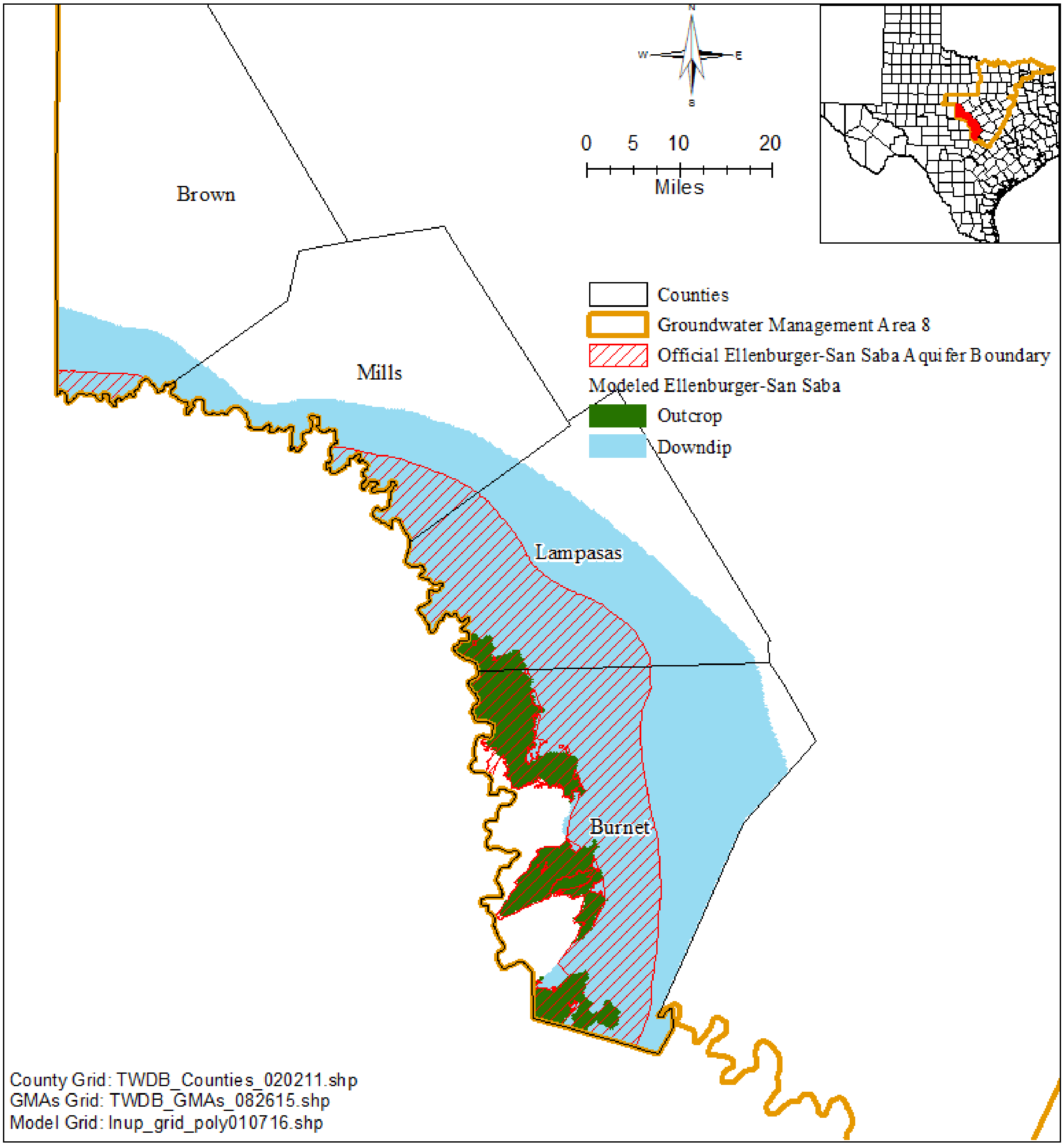


FIGURE 11. MAP SHOWING THE ELLENBURGER-SAN SABA AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 8 FROM THE GROUNDWATER AVAILABILITY MODEL FOR THE MINOR AQUIFERS IN LLANO UPLIFT REGION.

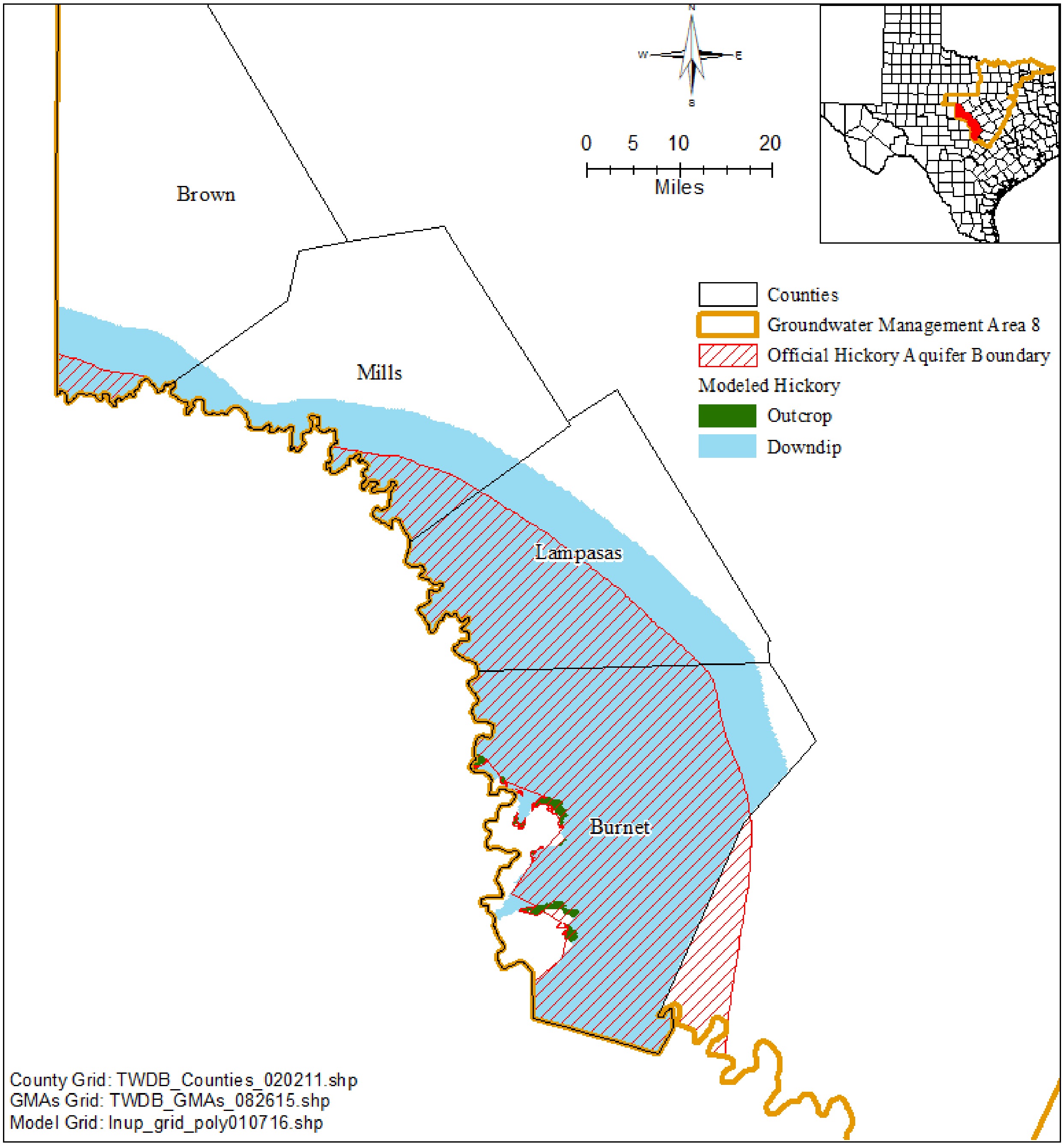


FIGURE 12. MAP SHOWING THE HICKORY AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 8 FROM THE GROUNDWATER AVAILABILITY MODEL FOR THE MINOR AQUIFERS IN LLANO UPLIFT REGION.

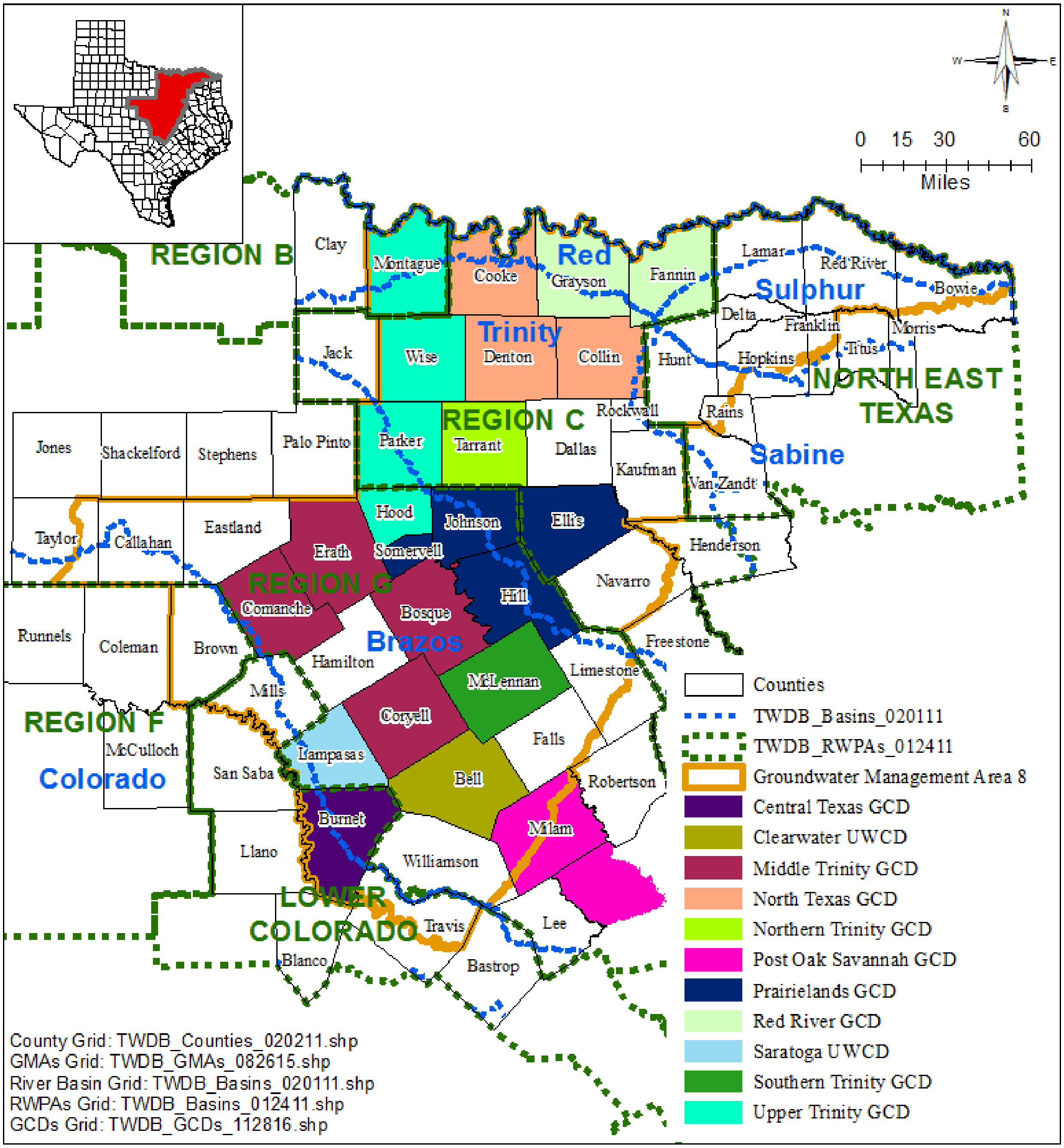


FIGURE 13. **MAP SHOWING REGIONAL WATER PLANNING AREAS (RWPAS), GROUNDWATER CONSERVATION DISTRICTS (GCDS), AND RIVER BASINS ASSOCIATED WITH GROUNDWATER MANAGEMENT AREA 8.**

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
Middle Trinity GCD Total		**242**	**417**	**419**	**417**	**419**	**417**	**419**	**417**
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
North Texas GCD Total		**2,148**	**6,366**	**6,383**	**6,366**	**6,383**	**6,366**	**6,383**	**6,366**
Northern Trinity GCD	Tarrant	**11,285**	**8,957**	**8,982**	**8,957**	**8,982**	**8,957**	**8,982**	**8,957**
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
Prairielands GCD Total		**5,764**	**3,248**	**3,257**	**3,248**	**3,257**	**3,248**	**3,257**	**3,248**
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
Red River GCD Total		**389**	**2,087**	**2,092**	**2,087**	**2,092**	**2,087**	**2,092**	**2,087**
Southern Trinity GCD	McLennan	**319**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
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
Upper Trinity GCD Total		**2,427**	**2,816**	**2,823**	**2,816**	**2,823**	**2,816**	**2,823**	**2,816**
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

GCD	County	2009	2010	2020	2030	2040	2050	2060	2070
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
No District Total		**499**	**608**	**609**	**608**	**609**	**608**	**609**	**608**
Groundwater Management Area 8		**23,073**	**24,499**	**24,565**	**24,499**	**24,565**	**24,499**	**24,565**	**24,499**

UWCD: Underground Water Conservation District.

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
Middle Trinity GCD Total		**842**	**1,967**	**1,973**	**1,967**	**1,973**	**1,967**	**1,973**	**1,967**
North Texas GCD	Collin	84	83	83	83	83	83	83	83
North Texas GCD	Denton	121	338	339	338	339	338	339	338
North Texas GCD Total		**205**	**421**	**422**	**421**	**422**	**421**	**422**	**421**
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
Prairielands GCD Total		**2,035**	**1,943**	**1,947**	**1,943**	**1,947**	**1,943**	**1,947**	**1,943**
Red River GCD	Fannin	0	0	0	0	0	0	0	0
Red River GCD	Grayson	0	0	0	0	0	0	0	0
Red River GCD Total		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
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
Upper Trinity GCD Total		**4,220**	**3,918**	**3,929**	**3,918**	**3,929**	**3,918**	**3,929**	**3,918**

GCD	County	2009	2010	2020	2030	2040	2050	2060	2070
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
No District Total		**1,908**	**2,197**	**2,203**	**2,197**	**2,203**	**2,197**	**2,203**	**2,197**
Groundwater Management Area 8		**12,000**	**12,701**	**12,736**	**12,701**	**12,736**	**12,701**	**12,736**	**12,701**

UWCD: Underground Water Conservation District.

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
Middle Trinity GCD	Erath	**3,443**	**5,017**	**5,031**	**5,017**	**5,031**	**5,017**	**5,031**	**5,017**
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
North Texas GCD Total		**1,160**	**10,567**	**10,596**	**10,567**	**10,596**	**10,567**	**10,596**	**10,567**
Northern Trinity GCD	Tarrant	**7,329**	**6,917**	**6,936**	**6,917**	**6,936**	**6,917**	**6,936**	**6,917**
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
Prairielands GCD Total		**689**	**558**	**559**	**558**	**559**	**558**	**559**	**558**
Red River GCD	Fannin	0	0	0	0	0	0	0	0
Red River GCD	Grayson	0	0	0	0	0	0	0	0
Red River GCD Total		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
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
Upper Trinity GCD Total		**15,581**	**14,569**	**14,609**	**14,569**	**14,609**	**14,569**	**14,609**	**14,569**
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
No District Total		**2,282**	**3,199**	**3,208**	**3,199**	**3,208**	**3,199**	**3,208**	**3,199**
Groundwater Management Area 8		**30,484**	**40,827**	**40,939**	**40,827**	**40,939**	**40,827**	**40,939**	**40,827**

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
Middle Trinity GCD Total		**26,661**	**30,024**	**30,108**	**30,024**	**30,108**	**30,024**	**30,108**	**30,024**
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
Prairielands GCD Total		**17,445**	**16,370**	**16,414**	**16,370**	**16,414**	**16,370**	**16,414**	**16,370**
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 (downdip)	**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

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

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
Middle Trinity GCD Total		**8,222**	**11,372**	**11,402**	**11,372**	**11,402**	**11,372**	**11,402**	**11,372**
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
Prairielands GCD Total		**3,589**	**3,281**	**3,290**	**3,281**	**3,290**	**3,281**	**3,290**	**3,281**
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
No District Total		**3,142**	**4,174**	**4,184**	**4,174**	**4,184**	**4,174**	**4,184**	**4,174**
Groundwater Management Area 8		**19,152**	**27,257**	**27,331**	**27,257**	**27,331**	**27,257**	**27,331**	**27,257**

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
Middle Trinity GCD Total		**18,091**	**18,170**	**18,220**	**18,170**	**18,220**	**18,170**	**18,220**	**18,170**
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
Prairielands GCD Total		**13,785**	**12,994**	**13,029**	**12,994**	**13,029**	**12,994**	**13,029**	**12,994**
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 (downdip)	**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
No District Total		**7,163**	**8,358**	**8,382**	**8,358**	**8,382**	**8,358**	**8,382**	**8,358**
Groundwater Management Area 8		**53,357**	**64,922**	**65,098**	**64,922**	**65,098**	**64,922**	**65,098**	**64,922**

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
Middle Trinity GCD Total		**10,983**	**8,467**	**8,491**	**8,467**	**8,491**	**8,467**	**8,491**	**8,467**
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
North Texas GCD Total		**16,173**	**29,020**	**29,101**	**29,020**	**29,101**	**29,020**	**29,101**	**29,020**
Northern Trinity GCD	Tarrant	**1,908**	**1,248**	**1,251**	**1,248**	**1,251**	**1,248**	**1,251**	**1,248**
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
Red River GCD Total		**6,872**	**10,708**	**10,738**	**10,708**	**10,738**	**10,708**	**10,738**	**10,708**
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
Upper Trinity GCD Total		**17,521**	**16,506**	**16,551**	**16,506**	**16,551**	**16,506**	**16,551**	**16,506**
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
No District Total		**9,177**	**8,522**	**8,545**	**8,522**	**8,545**	**8,522**	**8,545**	**8,522**
Groundwater Management Area 8		**62,634**	**74,471**	**74,677**	**74,471**	**74,677**	**74,471**	**74,677**	**74,471**

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
North Texas GCD Total		**7,870**	**8,658**	**8,681**	**8,658**	**8,681**	**8,658**	**8,681**	**8,658**
Northern Trinity GCD	Tarrant	**2,646**	**1,138**	**1,141**	**1,138**	**1,141**	**1,138**	**1,141**	**1,138**
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
Prairielands GCD Total		**7,103**	**4,639**	**4,651**	**4,639**	**4,651**	**4,639**	**4,651**	**4,639**
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
Red River GCD Total		**10,551**	**12,441**	**12,475**	**12,441**	**12,475**	**12,441**	**12,475**	**12,441**
Southern Trinity GCD	McLennan	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
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
No District Total		**2,549**	**3,678**	**3,688**	**3,678**	**3,688**	**3,678**	**3,688**	**3,678**
Groundwater Management Area 8		**30,719**	**30,554**	**30,636**	**30,554**	**30,636**	**30,554**	**30,636**	**30,554**

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
Groundwater Management Area 8		**15,981**	**15,168**	**15,168**	**15,168**	**15,168**	**15,168**	**15,168**	**15,168**

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
No District Total		**20**	**50**	**50**	**50**	**50**	**50**	**50**	**50**
Groundwater Management Area 8		**2,603**	**5,623**	**5,639**	**5,623**	**5,639**	**5,623**	**5,639**	**5,623**

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
No District Total		**1**	**630**	**631**	**630**	**631**	**630**	**631**	**630**
Groundwater Management Area 8		**5,608**	**14,050**	**14,089**	**14,050**	**14,089**	**14,050**	**14,089**	**14,050**

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
No District Total		**0**	**48**	**48**	**48**	**48**	**48**	**48**	**48**
Groundwater Management Area 8		**1,088**	**3,574**	**3,585**	**3,574**	**3,585**	**3,574**	**3,585**	**3,574**

UWCD: Underground Water Conservation District.

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
Counties Not in Upper Trinity GCD								
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

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
Subtotal			**21,742**	**21,683**	**21,742**	**21,683**	**21,742**	**21,683**
Counties in Upper Trinity GCD								
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
Subtotal			**2,823**	**2,815**	**2,823**	**2,815**	**2,823**	**2,815**
Groundwater Management Area 8			**24,565**	**24,498**	**24,565**	**24,498**	**24,565**	**24,498**

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
Counties Not in Upper Trinity GCD								
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

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
Subtotal			**8,806**	**8,781**	**8,806**	**8,781**	**8,806**	**8,781**
Counties in Upper Trinity GCD								
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
Subtotal			**3,929**	**3,918**	**3,929**	**3,918**	**3,929**	**3,918**
Groundwater Management Area 8			**12,735**	**12,699**	**12,735**	**12,699**	**12,735**	**12,699**

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
Counties Not in Upper Trinity GCD								
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
Subtotal			**26,330**	**26,258**	**26,330**	**26,258**	**26,330**	**26,258**
Counties in Upper Trinity GCD								
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
Subtotal			**14,609**	**14,569**	**14,609**	**14,569**	**14,609**	**14,569**
Groundwater Management Area 8			**40,939**	**40,827**	**40,939**	**40,827**	**40,939**	**40,827**

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
Counties Not in Upper Trinity GCD								
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

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
Subtotal			**93,926**	**93,666**	**93,926**	**93,666**	**93,926**	**93,666**
Counties in Upper Trinity GCD								
Hood (downdip)	Region G	Brazos	89	89	89	89	89	89
Subtotal			**89**	**89**	**89**	**89**	**89**	**89**
Groundwater Management Area 8			**94,015**	**93,755**	**94,015**	**93,755**	**94,015**	**93,755**

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
Counties Not in Upper Trinity GCD								
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

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

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
Counties Not in Upper Trinity GCD								
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

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
Subtotal			**65,046**	**64,868**	**65,046**	**64,868**	**65,046**	**64,868**
Counties in Upper Trinity GCD								
Hood (downdip)	Region G	Brazos	53	53	53	53	53	53
Subtotal			**53**	**53**	**53**	**53**	**53**	**53**
Groundwater Management Area 8			**65,099**	**64,921**	**65,099**	**64,921**	**65,099**	**64,921**

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
Counties Not in Upper Trinity GCD								
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
Subtotal			**58,125**	**57,966**	**58,125**	**57,966**	**58,125**	**57,966**
Counties in Upper Trinity GCD								
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

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

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
Groundwater Management Area 8			**30,634**	**30,553**	**30,634**	**30,553**	**30,634**	**30,553**

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
Groundwater Management Area 8			**15,168**	**15,168**	**15,168**	**15,168**	**15,168**	**15,168**

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
Groundwater Management Area 8			**5,639**	**5,623**	**5,639**	**5,623**	**5,639**	**5,623**

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
Groundwater Management Area 8			**14,089**	**14,050**	**14,089**	**14,050**	**14,089**	**14,050**

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
Groundwater Management Area 8			**3,585**	**3,574**	**3,585**	**3,574**	**3,585**	**3,574**

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.

REFERENCES:

Anaya, R., 2008, Gam Run 08-010mag: Managed available groundwater for the Edwards (Balcones Fault Zone) Aquifer in Bell, Travis, and Williamson counties, 7 p., http://www.twdb.texas.gov/groundwater/docs/GAMruns/GR08-10mag_final.pdf?d=16598.495

Beach, J., Keester, M., and Konetchy, B, 2016, LBG-Guyton Associates Technical Memorandum: Results of Predictive Simulation in Support of GMA 8 Joint Planning – NTGCD GMA 8 Run 10 (January 14, 2016).

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

Jones, I., 2003, Groundwater Availability Modeling: Northern Segment of the Edwards Aquifer, Texas (December 2003), 75 p., http://www.twdb.texas.gov/publications/reports/numbered_reports/doc/R358/Report%20358%20Northern%20Edwards.pdf?d=1503601352574.

Kelley, V.A., Ewing, J., Jones, T.L., Young, S.C., Deeds, N., and Hamlin, S., 2014, Updated Groundwater Availability Model of the Northern Trinity and Woodbine Aquifers – Draft Final Model Report (August 2014), 990 p., http://www.twdb.texas.gov/groundwater/models/gam/trnt_n/Final_NTGAM_Vol%20I%20Aug%202014_Report.pdf?d=1503601407956.

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

Niswonger, R.G., Panday, S., and Ibaraki, M., 2011, MODFLOW-NWT, a Newton formulation for MODFLOW-2005: United States Geological Survey, Techniques and Methods 6-A37, 44 p.

Panday, S., Langevin, C.D., Niswonger, R.G., Ibaraki, M., and Hughes, J.D., 2013, MODFLOW–USG version 1: An unstructured grid version of MODFLOW for simulating groundwater flow and tightly coupled processes using a control volume finite-difference formulation: U.S. Geological Survey Techniques and Methods, book 6, chap. A45, 66 p.

Shi, J., Boghici, R., Kohlrenken, W., and Hutchison, W.R., 2016, Numerical Model Report: Minor Aquifers of the Llano Uplift Region of Texas (Marble Falls, Ellenburger-San Saba, and Hickory). Texas Water Development Board, November 2016, 435p.

http://www.twdb.texas.gov/groundwater/models/gam/llano/Llano_Uplift_Numerical_Model_Report_Final.pdf?d=1503601525245.

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

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).

<table>
<tr><th>Model Layer</th><th>Region 1</th><th>Region 2</th><th>Region 3</th><th>Region 4</th><th colspan="2">Region 5</th></tr>
<tr><td>2</td><td colspan="3">Woodbine</td><td colspan="3">Woodbine (no sand)</td></tr>
<tr><td>3</td><td colspan="6">Washita/Fredericksburg</td></tr>
<tr><td>4</td><td rowspan="5">Antlers</td><td colspan="3">Paluxy</td><td colspan="2">Paluxy (no sand)</td></tr>
<tr><td>5</td><td colspan="5">Glen Rose</td></tr>
<tr><td>6</td><td rowspan="3">Twin Mountains</td><td rowspan="3">Travis Peak</td><td>Hensell</td><td rowspan="3">Travis Peak</td><td>Hensell</td></tr>
<tr><td>7</td><td>Pearsall/Sligo</td><td>Pearsall/Sligo</td></tr>
<tr><td>8</td><td>Hosston</td><td>Hosston</td></tr>
</table>

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:

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

Where:

Hc = 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_i = 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_{2009} = Average head of an aquifer in a county in 2009 as defined above (feet above mean sea level)

Hc_County_{2070} = 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.

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

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

—: Not available.

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

County	Paluxy	Glen Rose	Twin Mountains	Antlers
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.

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%	—
McLen—n	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%	—	—	—	—

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.

County	Paluxy	Glen Rose	Twin Mountains	Antlers
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	—	—	—	—

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.

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.

County	Paluxy	Glen Rose	Twin Mountains	Antlers
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 TOLERRANCES 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	—

County	Woodbine	Paluxy	Glen Rose	Twin Mountains	Travis Peak	Hensell	Hosston	Antlers
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 TOLERRANCES OF FIVE PERCENT AND FIVE FEET AT THE SAME TIME. THUS, PREDICTIVE SIMULATION MEETS ALL DESIRED FUTURE CONDITIONS.

County	Paluxy	Glen Rose	Twin Mountains	Antlers
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:

$$ST = \frac{\sum_{i=1}^{n}\left(h2070_i - e_i\right)}{\sum_{i=1}^{n}\left(h2009_i - e_i\right)}$$

Where:

n = Total model cells in a county

$h2009_i$ = Head of 2009 at model cell i (feet)

$h2070_i$ = 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.

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.

County	Aquifer	2010 to 2070 (acre-feet per year)
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

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

County	Aquifer	Remaining Aquifer Saturated Thickness Defined by Desired Future Condition	Simulated Remaining Aquifer Saturated Thickness	Is Desired Future Condition Met?
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.

Year	Collin	Dallas	Denton	Johnson	Tarrant
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

Year	Collin	Dallas	Denton	Johnson	Tarrant
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

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

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

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

Year	Denton	Erath	Hood	Johnson	Parker	Tarrant
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

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

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

Year	Erath	Lampasas
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

Year	Erath	Lampasas
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

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

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

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

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

Year	Collin	Comanche	Cooke	Denton	Eastland	Erath	Grayson	Montague	Parker	Tarrant	Wise
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

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

Year	Collin	Cooke	Denton	Fannin	Grayson	Johnson	Tarrant
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

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

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.

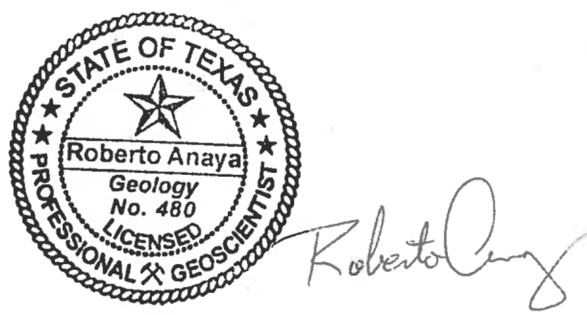
Year	Burnet	Lampasas	Burnet	Burnet
	Marble Falls		Ellenburger-San Saba	Hickory
Total Active Cells in modeled extent	10,810	7,614	13,618	14,334
2009 (baseline)	2298	611	709	111
2010	2353	631	724	112
2011	2363	638	735	112
2012	2376	641	744	113
2013	2386	642	758	113
2014	2391	646	769	113
2015	2395	650	776	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

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 J

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



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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, (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.

Management Plan requirement	*Aquifer or confining unit*	*Results*
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

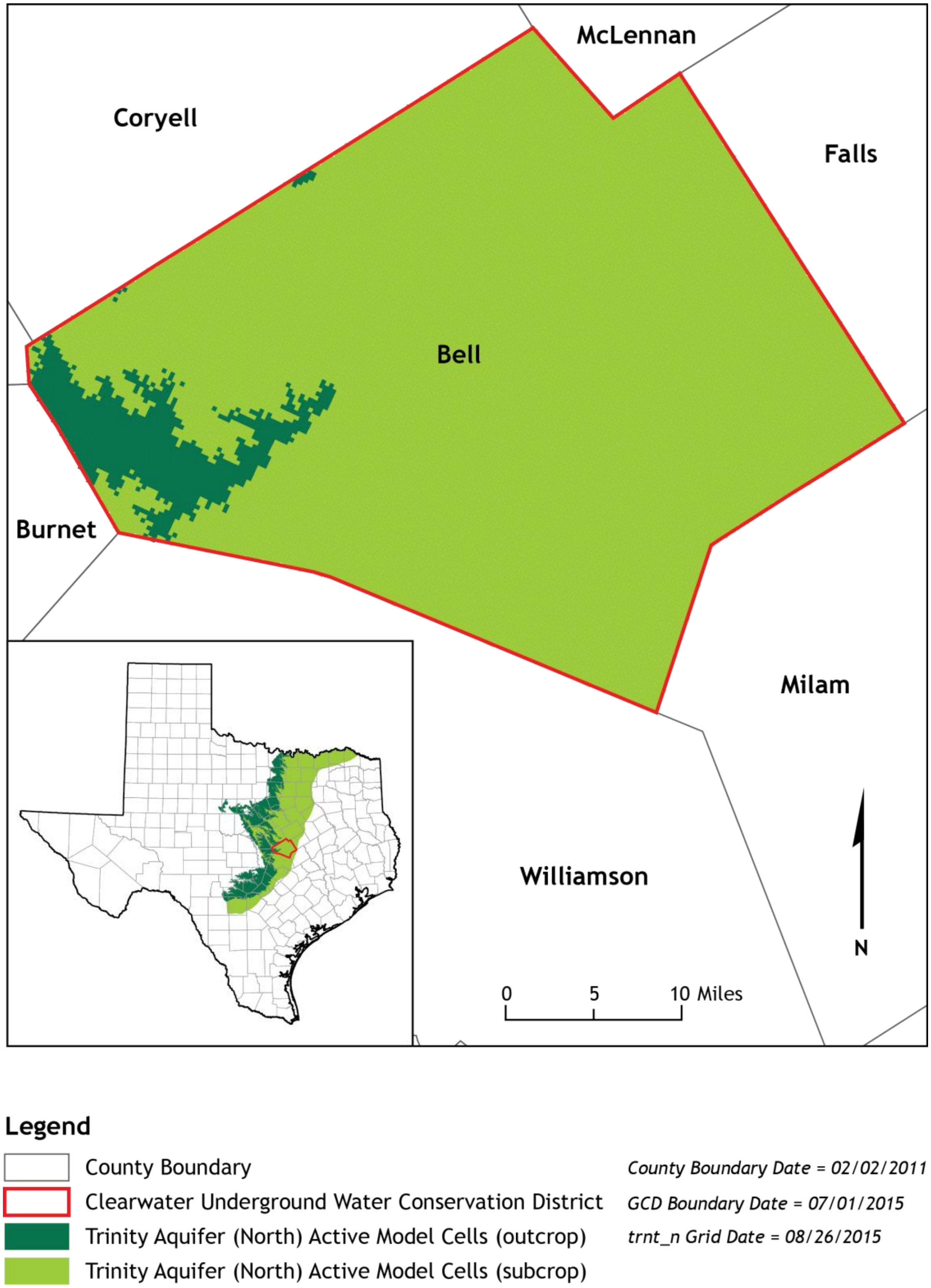
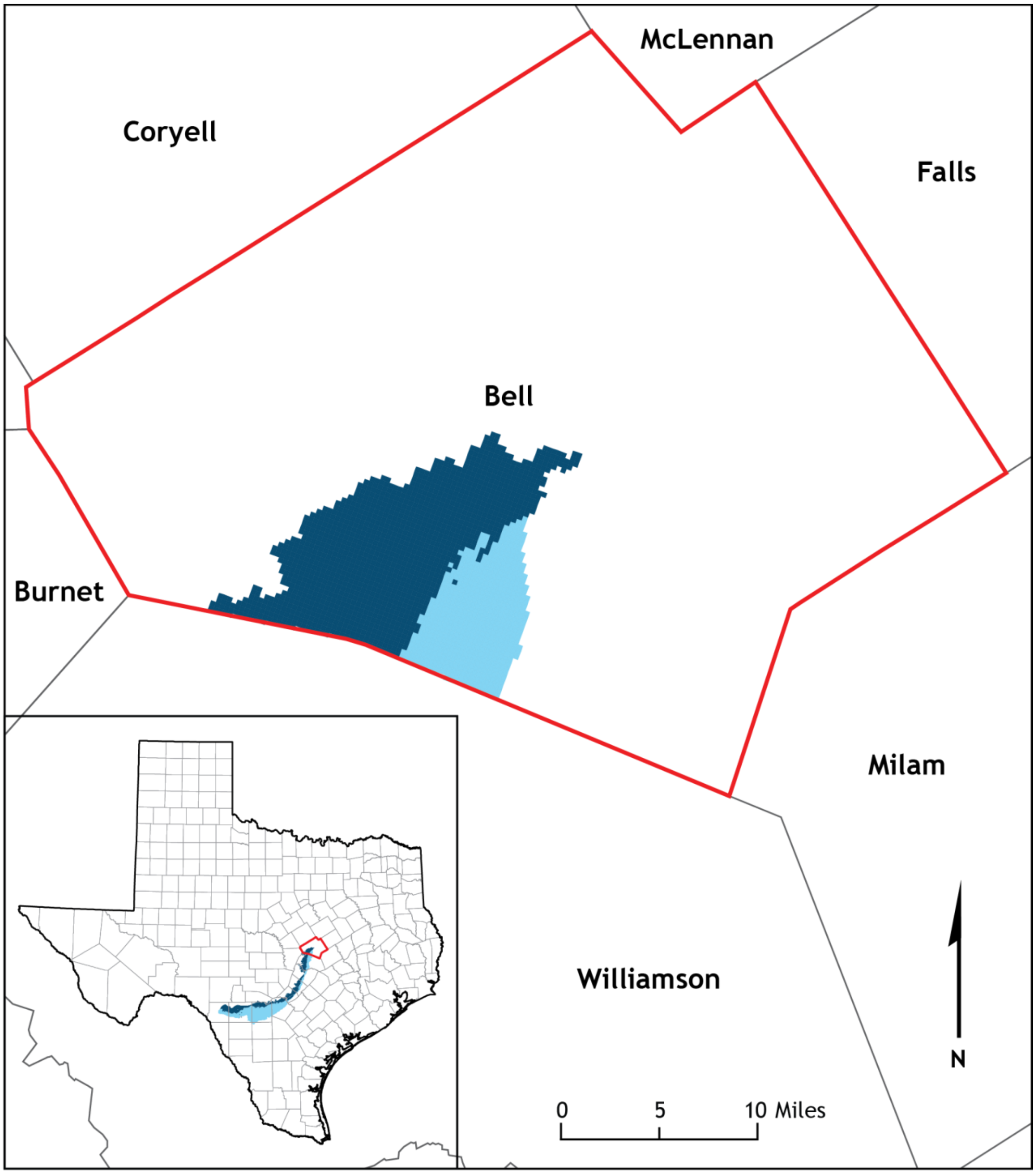


FIGURE 1: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE NORTHERN PORTION OF THE TRINITY AQUIFER AND WOODBINE AQUIFER FROM WHICH THE INFORMATION IN TABLE 1 WAS EXTRACTED (THE TRINITY AQUIFER FOOTPRINT EXTENT WITHIN THE DISTRICT BOUNDARY).

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.

Management Plan requirement	*Aquifer or confining unit*	*Results*
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	*County Boundary Date = 02/02/2011*
Clearwater Underground Water Conservation District	*GCD Boundary Date = 07/01/2015*
Edwards Aquifer (North) Active Model Cells (outcrop)	*ebfz_n Grid Date = 08/26/2015*
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.

REFERENCES:

Bené, J., Harden, B., O'Rourke, D., Donnelly, A., and Yelderman, J., 2004, Northern Trinity/Woodbine Groundwater Availability Model: contract report to the Texas Water Development Board by R.W. Harden and Associates, 391 p., http://www.twdb.texas.gov/groundwater/models/gam/trnt_n/TRNT_N_Model_Report.pdf.

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

Harbaugh, A. W., 2009, Zonebudget Version 3.01, A computer program for computing subregional water budgets for MODFLOW ground-water flow models, U.S. Geological Survey Groundwater Software.

Hassan, W., 2010, GAM Run 10-009: Texas Water Development Board, GAM Run 10-009 Management plan data for Clearwater Underground Water Conservation District Report, 7 p., http://www.twdb.texas.gov/groundwater/docs/GAMruns/GR10-09.pdf.

Jones, Ian. C., 2003, Groundwater Availability Modeling: Northern Segment of the Edwards (Balcones Fault Zone) Aquifer, Texas: Numerical Simulations through 1999- Model Report, 196 p., http://www.twdb.texas.gov/publications/reports/numbered_reports/doc/R358/Report%20358%20Northern%20Edwards.pdf.

Kelley, V.A., Ewing. J., Jones, T.L., Young, S.C., Deeds, N., and Hamlin, S., 2014, Updated Groundwater Availability Model of the Northern Trinity and Woodbine Aquifers: contract report prepared for North Texas GCD, Northern Trinity GCD, Prairielands GCD, and Upper Trinity GCD by INTERA Incorporated, Bureau of Economic Geology, and LBG-Guyton Associates, 990 p., http://www.twdb.texas.gov/groundwater/models/gam/trnt_n/Final_NTGAM_Vol%20I%20Aug%202014_Report.pdf.

Niswonger, R.G., Panday, S., and Ibaraki, M., 2011, MODFLOW-NWT, a Newton formulation for MODFLOW-2005: USGS, Techniques and Methods 6-A37, 44 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., http://www.nap.edu/catalog.php?record_id=11972.

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

APPENDIX K

Table 3.1-1. Major Reservoirs[1] of the Brazos River Basin

Reservoir	Water Right Owner	Authorized Storage (acft)	Authorized Diversion (acft)	Priority Date	County	Planning Region
Alan Henry	City of Lubbock	115,937	35,200	10/5/1981	Garza	O
Allens Creek	Brazos River Authority/City of Houston	145,553	202,000	9/1/1999	Austin	H
Aquilla	Brazos River Authority	52,400	13,896	10/25/1976	Hill	G
Belton	Brazos River Authority	457,600	100,257	12/16/1963	Bell	G
Belton	U.S. Dept. of the Army[2]	12,000	10,000 2,000	8/24/1953 8/23/1954	Bell	G
Dow - Brazoria Reservoir	Dow Chemical[3]	21,973	--	4/7/1952	Brazoria	H
Dow - Harris Reservoir	Dow Chemical[3]	10,200	--	2/14/1942	Brazoria	H
Cisco	City of Cisco	45,110	1,971 1,000	4/16/1920 11/8/1954	Eastland	G
Daniel	City of Breckenridge	11,400	2,100	4/26/1946	Stephens	G
Dansby Power Plant	City of Bryan	15,227	850	5/30/1972	Brazos	G
Eagle Nest Lake	U.S. Dept. of the Interior	11,315	1,800	1/15/1948	Brazoria	H
Fort Phantom Hill	City of Abilene	73,960	30,690	3/25/1937	Jones	G
Georgetown	Brazos River Authority	37,100	13,610	2/12/1968	Williamson	G
Gibbons Creek Power	Texas Municipal Power Agency	26,824 5,260	9,740	2/22/1977 3/9/1989	Grimes	G
Graham/Eddleman	City of Graham	4,503 39,000 8,883	5,000 15,000	11/21/1927 11/15/1954 9/16/1957	Young	G
Granbury	Brazos River Authority	155,000	64,712	2/13/1964	Hood	G
Granger	Brazos River Authority	65,500	19,840	2/12/1968	Williamson	G
Hubbard Creek Lake	West Central Texas MWD	317,750	52,800 3,200	5/28/1957 8/14/1972	Stephens	G
Leon	Eastland Co WSD	28,000	1,265 2,438 2,597	5/17/1931 3/21/1952 3/25/1986		

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Reservoir	Water Right Owner	Authorized Storage (acft)	Authorized Diversion (acft)	Priority Date	County	Planning Region
Limestone	Brazos River Authority	225,400	65,074	5/6/1974	Robertson	G
Miller's Creek	North Central Texas MWA	30,696	5,000	10/1/1958	Baylor	B
Palo Pinto	Palo Pinto County MWD No. 1	44,100 24	16,000 2,500	7/3/1962 9/8/1964	Palo Pinto	G
Pat Cleburne Reservoir	City of Cleburne	25,600	5,760 240	8/6/1962 3/29/1976	Johnson	G
Possum Kingdom	Brazos River Authority	724,739	230,750	4/6/1938	Palo Pinto	G
Proctor	Brazos River Authority	59,400	19,658	12/16/1963	Comanche	G
Smithers Lake	Houston L&P	18,750	28,711	12/16/1955	Fort Bend	H
Somerville	Brazos River Authority	160,110	48,000	12/16/1963	Washington	G
Squaw Creek Reservoir	Luminant	151,500	23,180	4/25/1973	Somervell	G
Stamford	City of Stamford	60,000	10,000	6/8/1949	Haskell	G
Stillhouse Hollow	Brazos River Authority	235,700	67,768	12/16/1963	Bell	G
Sweetwater	City of Sweetwater	10,000	3,740	10/17/1927	Nolan	G
Tradinghouse Steam	Luminant	37,800	12,000 15,000	8/21/1926 9/16/1966	McLennan	G
Twin Oak Steam Electric	Luminant	30,319	13,200	7/1/1974	Robertson	G
Waco	City of Waco	104,100 87,962	39,100 19,100 900 20,770	1/10/1929 4/16/1985 2/21/1979 9/12/1986	McLennan	G
Whitney	Brazos River Authority	50,000	18,336	8/30/1982	Hill	G
White River Reservoir	White River MWD	33,160 5,072 6,665	6,000	9/22/1958 11/21/1960 8/16/1971	Crosby	O

1 – A major reservoir is defined as one with an authorized capacity equal to or greater than 5,000 acft

2 – The Dept. of the Army (Fort Hood) owns water rights in Lake Belton alongside the BRA.

3 – The Dow Chemical Company holds diversion rights from the Brazos River totaling 238,156 acft/yr with priority dates ranging from 1929 to 1976, which are used in conjunction with the two off-channel reservoirs.