CROCKETT COUNTY GROUNDWATER CONSERVATION DISTRICT

MANAGEMENT PLAN

2018-2023

Adopted: September 10th, 2018

Approved by the Texas Water Development Board
______________________, 2018.

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DISTRICT MISSION

The Crockett County Groundwater Conservation District is dedicated to the implementation of sound management strategies that will preserve and protect its groundwater resources within the District. The District strives to promote conservation, as well as preserve the quality and quantity of its water resources within the District for the benefit of all the citizens and economy of the area.

TIME PERIOD FOR THIS PLAN

This plan becomes effective upon adoption by the Board of Directors of the Crockett County Groundwater Conservation District and approval by the Texas Water Development Board executive administrator. This plan remains in effect until September 1, 2023, or until such time as a revised or amended plan is approved.

STATEMENT OF GUIDING PRINCIPLES

The Crockett County Groundwater Conservation District recognizes the vital importance of groundwater to the economy of Crockett County as well as the entire GMA 7 area. Being the predominate water resource, the District is dedicated to conserving and protecting the quantity and quality of this valuable natural resource through prudent and cost effective management. Management planning should be based on awareness of the hydrologic properties of the specific aquifers within the District as well as quantification of existing and future resource data. The goals set forth within the plan are intended to provide for the conservation, preservation, protection, recharge, prevention of waste and pollution, as well as the efficient and prudent use of groundwater resources within the District. The goals of this plan can best be achieved through guidance from the locally elected board members who have an understanding of local conditions as well as technical support from the Texas Water Development Board and qualified consulting agencies. This management plan is intended only as a reference tool to provide guidance in the execution of district activities, but should allow flexibility in achieving goals.

GENERAL DESCRIPTION OF THE DISTRICT

History

The Crockett County Groundwater Conservation District, formerly Emerald Underground Water Conservation District, was created by Acts of the 71st Legislature (1989). The district was confirmed by the citizens of Crockett County on January 26, 1991. In 2007, by Acts of the 80th Legislature, H.B. 4009, the District's name was changed to Crockett County Groundwater Conservation District. Members of the current Board of Directors are:President, Paul C. Perner, III -Vice President, James W. Owens - Secretary, Carlon A. Stapper, George Bunger, Jr. and Will M. Black. The District General Manager is Slate Williams. The Crockett County Groundwater Conservation District encompasses all of Crockett County with the exception of the metes and bounds of the Crockett County Water Control & Improvement District No. 1. Historically, Crockett County's economy has been centered around agriculture, but in the last several years, oil and gas has become the dominate industry. The agricultural income is derived from sheep and goats as well as some beef cattle production. Due to the topography and climate of the area, there is very little farming. Recreational hunting has also become a major supplemental income to the county.

Location and Extent

Crockett County, having an areal extent of 2,795.60 square miles or approximately 1,789,182.62 acres of land, is located in southwest Texas on the western edge of the Edwards Plateau. Crockett County is the eighth largest county in Texas with the Pecos River forming its western boundary. On the west lie Pecos and Terrell counties. Crane, Upton, Reagan and Irion counties border Crockett County on the north. On the east lie Schleicher and Sutton counties with Val Verde County on the south. Ozona, being the only town in the county, is centrally located in the eastern part of Crockett County. 1

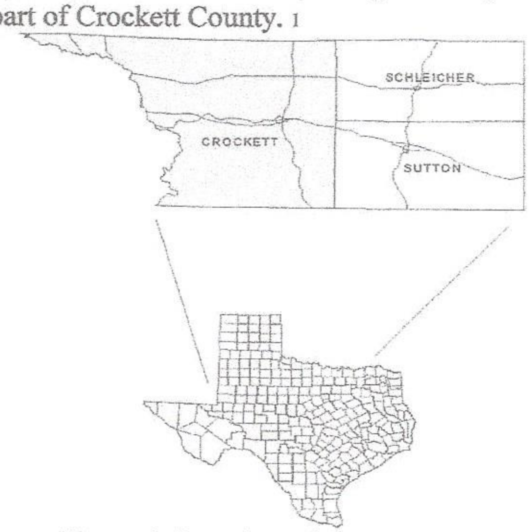


Figure 1. Location of the Crockett County

Topography and Drainage

Crockett County's topography is characterized by deep, narrow, steep walled canyons and flat mesas in the southern and western portions. Broad valleys and flat divides make up the northern part of the county; the northeastern area is a large flat divide. The altitude ranges from about 1,800 feet in the southwest to over 3,000 feet in the northwest. Karst topography, characterized by numerous sinkholes having underground drainage, occurs in the northeastern quarter of the county on the upper flat divide between the Colorado River and Rio Grande drainage basins.

Drainage of Crockett County is by means of intermittent, dendritic streams. On the east side of the county a dry tributary of Devils River drains southeastward into Sutton County. Johnsons Run and Howards Creek bisect central Crockett County and drain southward, joining Devils River and the Pecos River, respectively, in Val Verde County. In the Northwestern part of Crockett County, Live Oak Creek drains southward into the Pecos River at Lancaster Hill. The dry bed of Spring Creek originates in the northeastern corner of the county and runs northeastward. Generally, the county can be said to lie in the Rio Grande drainage basin. Only the extreme northeastern corner of the county lies in the Colorado River drainage basin.[1]

REGIONAL COOPERATION AND COORDINATION

West Texas Regional Groundwater Alliance

The District is a member of the West Texas Regional Groundwater Alliance (WTGRA). This regional alliance consists of seventeen (17) locally created and locally funded districts that encompass approximately eighteen (18.2) million acres or twenty eight thousand three hundred sixty eight (28,368) square miles of West Texas. To put this in perspective, this area is larger than many individual states including Rhode Island (1,045 sq mi), Delaware (1,954 sq mi), Puerto Rico (3,425 sq mi), Hawaii (6,423 sq mi), New Jersey (7,417 sq mi), Massachusetts (7,840 sq mi), New Hampshire (8,968 sq mi), Vermont (9,250 sq mi), Maryland (9,774 sq mi), and West Virginia (24,230 sq mi). This west Texas Region is as diverse as the State of Texas.

Due to the diversity of this region, each member district provides it's own unique programs to best serve its constituents.

In May of 1988 four (4) groundwater districts; Coke County UWCD, Glasscock County UWCD, Irion County WCD, and Sterling County UWCD adopted the original Cooperative Agreement. As new districts were created, they too adopted the Cooperative Agreement. In the fall of 1996, the original Cooperative Agreement was redrafted and the West Texas Regional Groundwater Alliance was created. The current member districts and the year they joined the Alliance are:

Coke County UWCD	(1988)	Crockett County GCD	(1992)	Glasscock GCD	(1988)
Hickory UWCD #1	(1997)	Hill County UWCD	(2005)	Irion County WCD	(1988)
Kimble GCD	(2004)	Lipan-Kickapoo WCD	(1989)	Lone Wolf GCD	(2002)
Menard County UWD	(2000)	Middle Pecos GCD	(2005)	Permian Basin UWCD	(2006)
Plateau UWC&SD	(1991)	Santa Rita UWCD	(1990)	Sterling County UWCD	(1988)
Sutton County UWCD	(1991)	Wes-Tex GCD	(2005)		

This Alliance was created for local districts to coordinate and implement common objectives to facilitate the conservation, preservation and beneficial use of water and related resources in this region of the State, to exchange information among the districts, and to educate the public about water issues. Local districts monitor the water-related activities that include but are not limited to farming, ranching, oil & gas production, and municipal water use. The Alliance coordinates management activities of the member districts primarily through exchange of information and policy discussions.

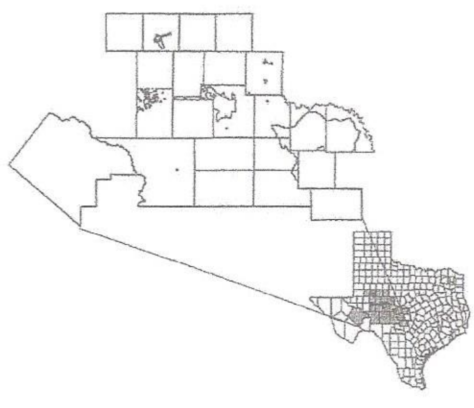


Figure 2. Territory in the West Texas Regional Alliance.

GROUNDWATER RESOURCES OF THE CROCKETT COUNTY GCD

The primary resources of groundwater in Crockett County are derived from the Edwards-Georgetown aquifer of Cretaceous age, sands of the Trinity Group or Trinity aquifer and unconsolidated alluvium of Quaternary age which overlies the older Cretaceous rocks principally along the Pecos River, Live Oak Creek, Howard Creek and Johnson Draw.

Most of the water wells in Crockett County produce water from the Edwards-Georgetown and the Trinity aquifers for domestic and livestock purposes. Generally, the wells yield only small quantities of water, 1 to 20 gallons per minute, although yields of up to 2,000 gallons per minute have been reported in both aquifers. Groundwater is encountered at varying depths depending primarily upon topography. Water levels in the alluvium along the Pecos River may be only a few feet below surface, while on the high divides, the water level may occur as much as 600 feet below land surface.

The quality of water from wells in Crockett County varies within wide limits, but is generally good quality. The water is typically very hard and generally high in fluoride content. Samples from a few wells indicate that the water is undesirable for domestic use, but only a very few are considered unusable.

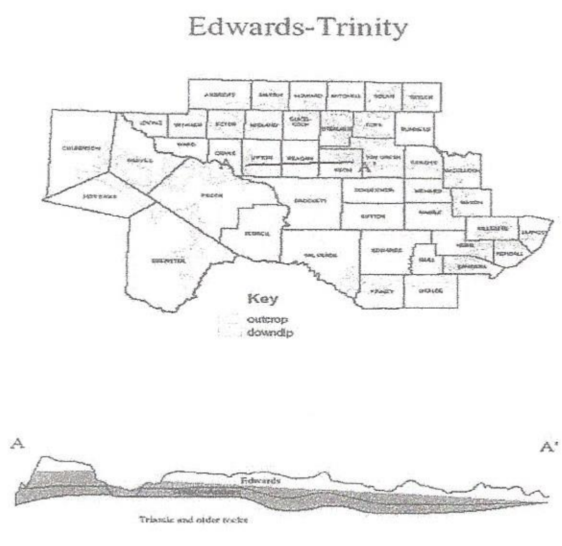


Figure3. Location of Edwards-Trinity (Plateau) Aquifer

SURFACE WATER RESOURCES OF CROCKETT COUNTY GCD

There are no surface water management entities in Crockett County and little to no available surface water within the District with the exception of the Pecos River which forms the western boundary of the district. Although there are a few small surface impoundments used as an efficient means of storage.

TECHNICAL DISTRICT INFORMATION REQUIRED BY TEXAS ADMINISTRATIVE CODE

MODELED AVAILABLE GROUNDWATER

An estimate of the modeled available groundwater for the Crockett County Groundwater Conservation District based on desired future conditions.

Texas Water Code § 36.001 defines modeled available groundwater as "the amount of water that the executive administrator determines may be produced on an average annual basis to achieve a desired future condition established under Section 36.108".

The joint planning process set forth in Texas Water Code § 36.001 must be collectively conducted by all groundwater conservation districts within the same GMA. The District is a member of GMA 7. The adopted DFC's were then forwarded to the TWDB for development for the MAG calculations. The submittal package for the DFC's can be found here:

http://www.twdb.state.tx.us/groundwater/management_areas/DFC.asp

Modeled Available Groundwater

Please refer to Appendix A

Amount of Groundwater being used within the district on an Annual Basis

Please refer to Appendix B *

Annual Amount of Recharge from Precipitation to the Groundwater Resources within the District

Please refer to Appendix C

Annual Volume of Water that Discharges from the Aquifer to springs and surface water bodies

Please refer to Appendix C

Estimate of the Annual Volume of Flow into the District, out of the District, and Between Aquifers in the District

Please refer to Appendix C

Projected Surface Water Supply within the District

Please refer to Appendix B *

Projected Total Demand for Water within the District

Please refer to Appendix B *

Water Supply Needs

Please refer to Appendix B *

***Since the District does not cover all of Crockett County, it is recommended that all estimates presented in the management plan be based on a proportional area percentage. This percentage can be derived by dividing the amount of acres or square miles covered by the District by the total number of acres or square miles contained within Crockett County. The percentage derived by the TWDB is 99.94% (i.e. 0.9995; see the 'Area' tab), but any estimates that the District provides is preferable. It is recommended that the generic county-wide data (e.g. county other, manufacturing, steam electric power, irrigation, livestock) be converted to a percentage of the total county-wide data. These generic county-wide data have been converted to a proportional value (relative to the size of the District) by multiplying each value from the 'County Water Demands' worksheet by 0.9994.**

WATER SUPPLY NEEDS

Based on current supply and demand calculations and projections, there are no projected water needs for Crockett County through 2070 according to the 2017 Water Plan.

WATER MANAGEMENT STRATEGIES

Presently, there are no water management strategies listed in the 2017 State Water Plan because there are no water needs projected for the county through 2070, except for oil and gas production which is exempt from district regulation. Preservation and protection of groundwater quantity and quality has been the guiding principle of the District since its creation. The goals and objectives of this plan will provide guidance in the performance of existing District activities and practices. District Rules adopted in 2017 address groundwater withdrawals by means of spacing and/or production limits, waste, and well drilling completion as well as capping and plugging of unused or abandoned wells. The rules are meant to provide equitable conservation and preservation of groundwater resources, protect vested property rights and prevent confiscation of property.

In pursuit of the District's mission to provide for conserving, preserving, protecting, recharging and preventing waste of water resources, the District may exercise the powers, rights and privileges to enforce its rules by injunction, mandatory injunction, or other appropriate remedies in a court of competent jurisdiction as provided for in the Texas Water Code §36.102.

ACTIONS, PROCEDURES, PERFORMANCE AND AVOIDANCE FOR PLAN IMPLEMENTATION

All District activities will be carried out in accordance with this plan and will utilize the provisions of this plan as a guide in prioritizing all District operations.

District rules adopted in 2017 shall be amended and enforced, as necessary, to implement this plan. All rules adopted or amended by the District shall be pursuant to Texas Water Code Chapter 36 and the provisions of this plan.

The District shall treat all citizens with equity. Citizens may apply to the District for discretion in enforcement of the rules on grounds of adverse economic effect or unique local characteristics. In granting discretion to any rule, the Board shall consider the potential for adverse effect on adjacent owners and aquifer conditions. The exercise of said discretion by the Board shall not be constructed as limiting the power of the Board.

METHODOLOGY

The methodology that the District will use to trace its progress on an annual basis in achieving all of its management goals will be as follows:

- The District Manager will prepare and present an annual report to the Board of Directors on District performance in regards to achieving management goals and objectives for the previous fiscal year, during the first meeting of each new fiscal year. The reports will include the number of instances each activity was engaged in during the year.
- The annual report will be maintained on file at the District office.

GOALS, MANAGEMENT OBJECTIVES AND PERFORMANCE STANDARDS

Goal 1.0 Provide for the efficient use of groundwater within the District (36.1071(a)(1))

Management Objective
1.1 Provide public information programs on water conservation

Performance Standard
1.1a – Annually report to the Board of Directors on the number of programs conducted during the year.

Management Objective
1.2 Each year the District will publish one article or newsletter on water conservation.

Performance Standard
1.2a – Annually report to the Board of Directors on the number of articles or newsletters published each year.

Goal 2.0 Control and prevent the waste of groundwater (36.1071(a)(2))

Management Objective
2.1 Each year, register all new wells drilled in the District.

Performance Standard
2.1a – District will maintain files including information on the drilling and completion of all new wells in the District.

2.1b - Annually report to the Board of Directors on the number of new wells registered during the year.

Goal 3.0 **Natural Resources Issues. Gather and maintain groundwater data to improve the understanding of the aquifers and their hydrogeological properties. This data will help in determining groundwater availability and future planning. (36.1071(a)(5))**

Management Objective
3.1 Annually measure 90 percent of wells in the water level monitoring network within the District

Performance Standards
3.1a – Annually report to the Board of Directors the number of wells monitored annually in the Districts water level monitoring network.

Management Objective
3.2 Maintain a district-wide rainfall event network using voluntary monitors and automatic digital rainfall collectors to help evaluate recharge.

Performance Standards
3.2a – Annually report to the Board of Directors the total number of rain gauges in the rainfall monitoring network.

3.2b – Annually report to the Board of Directors the annual rainfall within the District.

Management Objective
3.3 Annually sample 45 percent of the wells in the water quality monitoring network within the District.

Performance Standards
3.3a – Annually report to the Board of Directors the number of wells sampled annually in the Districts water quality monitoring network.

3.3b – Annually report to the Board of Directors any substantial water quality changes that were observed.

Goal 4.0 **Implement management strategies that address drought conditions. (36.1071(a)(6)).**

Management Objective

4.1 Each year the District will monitor the Palmer Drought Severity Index, Standardized Precipitation Index and the Crop Moisture Index to help develop strategies that would offset adverse climactic conditions.

Performance Standards

4.1a – Provide a report quarterly to the Board of Directors on climactic conditions and proposed management strategies. It will be difficult to meet the water needs of the future without reporting amount of use by the oil field which the District is unable to regulate. The District will encourage conservation from these users and also ask that they report usage to the district voluntarily and will be aware of conditions that could keep the district from meeting their DFC. 1

Goal 5.0 **Conservation and Precipitation Enhancement (36.1071(a)(7))**

Management Objective: Conservation

5.1 Provide and distribute literature on water conservation to area residents.

Performance Standards

5.1a – The district staff will proved information to area residents about water conservation by publishing at least one newsletter or newspaper article annually.

5.1b – Annual report to the Board of Directors listing the number of times newsletters or newspaper articles were published.

Management Objective: Precipitation Enhancement

5.2 The District will participate in the West Texas Weather Modification Association rainfall enhancement program.

Performance Standards

5.2a – Report monthly to the Board of Directors on West Texas Weather Modification Association activities.

5.2b – Annually provide to the Board of Directors the West Texas Weather Modification Association Annual Report.

5.2c – Annually provide to the Board of Directors the number of meetings attended by at least one District employee.

Goal 6.0 **Desired Future Condition (36.1071(a)(8))**

The District is actively participating in the joint planning process and the development of a desired future condition for the portion of the aquifer(s) within the District. Although the District does not feel that the "One Size Fits All" Desired Future Conditions process is the most efficient way to evaluate future needs of the Edwards-Trinity aquifer due to the extreme differences in the aquifers throughout the state.

Management Objective
6.1 Annually measure 90 percent of wells in the water level monitoring network within the District.

Performance Standards
6.1a – Annually report to the Board of Directors the number of wells monitored annually in the Districts water level monitoring network. The measurements collected will also be compared to the Desired Future Conditions.

MANAGEMENT GOALS DETERMINED NOT-APPLICABLE

Goal 7.0 **Control and Prevention Subsidence. (36.1071(a)(3))**

The rigid geologic framework of the region precludes significant subsidence from occurring.

Goal 8.0 **Conjunctive Surface Water Management Issues (36.1071(a)(4))**

There exists only one permitted surface water use in Crockett County – this being treated waste water expelled from Crockett County Water Control and Improvement District No. 1's waste water treatment facility located south of the town of Ozona. The Crockett County GCD has no jurisdiction over surface water or permitted water users.

Goal 9.0 **Recharge Enhancement (36.1071(a)(7))**

The size of the District, the diverse topography, and the limited knowledge of any specific recharge sites makes any type of recharge enhancement project economically unfeasible. This management goal is not applicable to the operation of the District.

Goal 10.0 **Rainwater Harvesting (36.1071(a)(7))**

The arid nature of the area within the District, with annual rainfall averaging 15 inches or less, makes the cost of rainwater harvesting projects economically unfeasible. This management goal is not applicable to the operations of this District.

Goal 11.0 **Brush Control (36.1071(a)(7))**

The District recognizes the benefits of brush control through increased spring flows and the enhancement of native turf which limits runoff. However, most brush control projects within the District are carried out and funded through the NRCS and ample educational material and programs on brush control are provided by the Texas Agrilife Extension Service. This management goal is not applicable to the operations of the District.

Goal 12.0 **Addressing Natural Resource Issues which impact the use and availability of groundwater which are impacted by the use of groundwater in the District (356.5(a)(1)(E))**

The District has no documented occurrences of endangered or threatened species dependent upon groundwater. Other issues related to resources-air, water, soil, etc. supplies by nature that are useful to life are likewise documented. The natural resources of the oil and gas industry are regulated by the Railroad Commission of Texas, are exempt by Chapter 36.117(e), unless the spacing requirements of the District can be met when space is available. Therefore, this management goal is not applicable to the operations of the District.

SUMMARY DEFINITIONS

"Board of Directors" – the Board of Directors of the Crockett County Groundwater Conservation District.

"District" – the Crockett County Groundwater Conservation District.

"Waste" – as defined by Chapter 36 of the Texas Water Code means any one or more of the following:

(1) withdrawal of groundwater from a groundwater reservoir at a rate and in an amount that causes or threatens to cause intrusion into the reservoir of water unsuitable for agricultural, gardening, domestic, or stock purposes;
(2) the flowing or producing of wells from a groundwater reservoir if the water produced is not used for a beneficial purpose;
(3) escape of groundwater from a groundwater reservoir to any other reservoir or geologic strata that does not contain groundwater;
(4) pollution or harmful alteration of groundwater in a groundwater reservoir by saltwater or by other deleterious matter admitted from another stratum or from the surface of the ground;
(5) willfully or negligently causing, suffering, or allowing groundwater to escape into any river, creek, natural watercourse, depression, lake, reservoir, drain, sewer, street, highway, road, or road ditch, or onto any land other than that of

the owner of the well unless such discharge is authorized by permit, rule, or order issued by the commission under Chapter 26;

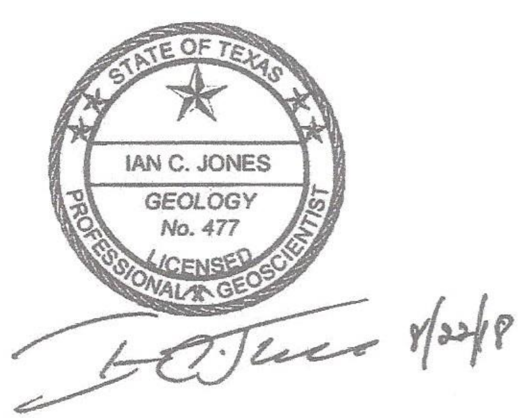
(6) groundwater pumped for irrigation that escapes as irrigation tailwater onto land other than that of the owner of the well unless permission has been granted by the occupant of the land receiving the discharge.

(7) for water produced from an artesian well "waste" has the meaning assigned by Section 11.205.

APPENDIX
A

GAM Run 16-026 MAG: Modeled Available Groundwater for the Aquifers in Groundwater Management Area 7

Ian C. Jones, Ph.D., P.G.
Texas Water Development Board
Groundwater Division
Groundwater Availability Modeling Department
(512) 463-6641
August 22, 2018



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GAM RUN 16-026 MAG: MODELED AVAILABLE GROUNDWATER FOR THE AQUIFERS IN GROUNDWATER MANAGEMENT AREA 7

Ian C. Jones, Ph.D., P.G.
Texas Water Development Board
Groundwater Division
Groundwater Availability Modeling Department
(512) 463-6641
August 22, 2018

EXECUTIVE SUMMARY:

We have prepared estimates of the modeled available groundwater for the relevant aquifers of Groundwater Management Area 7—the Capitan Reef Complex, Dockum, Edwards-Trinity (Plateau), Ellenburger-San Saba, Hickory, Ogallala, Pecos Valley, Rustler, and Trinity aquifers. The estimates are based on the desired future conditions for these aquifers adopted by the groundwater conservation districts in Groundwater Management Area 7 on September 22, 2016 and March 22, 2018. The explanatory reports and other materials submitted to the Texas Water Development Board (TWDB) were determined to be administratively complete on June 22, 2018.

The modeled available groundwater values are summarized by decade for the groundwater conservation districts (Tables 1, 3, 5, 7, 9, 11, 13) and for use in the regional water planning process (Tables 2, 4, 6, 8, 10, 12, 14). The modeled available groundwater estimates are 26,164 acre-feet per year in the Capitan Reef Complex Aquifer; 2,324 acre-feet per year in the Dockum Aquifer; 479,063 acre-feet per year in the undifferentiated Edwards-Trinity (Plateau), Pecos Valley, and Trinity aquifers; 22,616 acre-feet per year in the Ellenburger-San Saba Aquifer; 49,936 acre-feet per year in the Hickory Aquifer; 6,570 to 8,019 acre-feet per year in the Ogallala Aquifer; and 7,040 acre-feet per year in the Rustler Aquifer. The modeled available groundwater estimates were extracted from results of model runs using the groundwater availability models for the Capitan Reef Complex Aquifer (Jones, 2016); the High Plains Aquifer System (Deeds and Jigmond, 2015); the minor aquifers of the Llano Uplift Area (Shi and others, 2016), and the Rustler Aquifer (Ewing and others, 2012). In addition, the alternative 1-layer model for the Edwards-Trinity (Plateau), Pecos Valley, and Trinity aquifers (Hutchison and others, 2011) was used for the Edwards-Trinity (Plateau), Pecos Valley, and Trinity aquifers, except for Kinney and Val Verde counties. In these two counties, the alternative Kinney County model

(Hutchison and others, 2011) and the model associated with a hydrogeological study for Val Verde County and the City of Del Rio (EcoKai Environmental, Inc. and Hutchison, 2014), respectively, were used to estimate modeled available groundwater. The Val Verde County/Del Rio model covers Val Verde County. This model was used to simulate multiple pumping scenarios indicating the effects of a proposed wellfield. The model indicated the effects of varied pumping rates and wellfield locations. These model runs were used by Groundwater Management Area 7 as the basis for the desired future conditions for Val Verde County.

REQUESTOR:

Mr. Joel Pigg, chair of Groundwater Management Area 7 districts.

DESCRIPTION OF REQUEST:

In letters dated November 22, 2016 and March 26, 2018, Dr. William Hutchison on behalf of Groundwater Management Area 7 provided the TWDB with the desired future conditions for the Capitan, Dockum, Edwards-Trinity (Plateau), Ellenburger-San Saba, Hickory, Ogallala, Pecos Valley, Rustler, and Trinity aquifers in Groundwater Management Area 7. Groundwater Management Area 7 provided additional clarifications through emails to the TWDB on March 23, 2018 and June 12, 2018 for the use of model extents (Dockum, Ellenburger-San Saba, Hickory, Ogallala, Rustler aquifers), the use of aquifer extents (Capitan Reef Complex, Edwards-Trinity [Plateau], Pecos Valley, and Trinity aquifers), and desired future conditions for the Edwards-Trinity (Plateau) Aquifer of Kinney and Val Verde counties.

The final adopted desired future conditions as stated in signed resolutions for the aquifers in Groundwater Management Area 7 are reproduced below:

Capitan Reef [Complex] Aquifer

Total net drawdown of the Capitan Reef [Complex] Aquifer not to exceed 56 feet in Pecos County (Middle Pecos [Groundwater Conservation District]) in 2070 as compared with 2006 aquifer levels (Reference: Scenario 4, GMA 7 Technical Memorandum 15-06, 4-8-2015).

Dockum Aquifer

Total net drawdown of the Dockum Aquifer not to exceed 14 feet in Reagan County (Santa Rita [Groundwater Conservation District]) in 2070, as compared with 2012 aquifer levels.

Total net drawdown of the Dockum Aquifer not to exceed 52 feet in Pecos County (Middle Pecos [Groundwater Conservation District]) in 2070, as compared with 2012 aquifer levels.

Edwards-Trinity (Plateau), Pecos Valley, and Trinity aquifers

Average drawdown for [the Edwards-Trinity (Plateau), Pecos Valley, and Trinity aquifers] in the following [Groundwater Management Area] 7 counties not to exceed drawdowns from 2010 to 2070 [...].

County	[...] Average Drawdowns from 2010 to 2070 [feet]
Coke	0
Crockett	10
Ector	4
Edwards	2
Gillespie	5
Glasscock	42
Irion	10
Kimble	1
Menard	1
Midland	12
Pecos	14
Reagan	42
Real	4
Schleicher	8
Sterling	7
Sutton	6
Taylor	0
Terrell	2
Upton	20
Uvalde	2

Total net drawdown *[of the Edwards-Trinity (Plateau), Pecos Valley, and Trinity aquifers]* in Kinney County in 2070, as compared with 2010 aquifer levels, shall be consistent with maintenance of an annual average flow of 23.9 [cubic feet per second] and an annual median flow of 23.9 [cubic feet per second] at Las Moras Springs [...].

Total net drawdown [of the Edwards-Trinity (Plateau), Pecos Valley, and Trinity aquifers] in Val Verde County in 2070, as compared with 2010 aquifer levels, shall be consistent with maintenance of an average annual flow of 73-75 [million gallons per day] at San Felipe Springs.

Minor Aquifers of the Llano Uplift Area

Total net drawdowns of [Ellenburger-San Saba Aquifer] levels in 2070, as compared with 2010 aquifer levels, shall not exceed the number of feet set forth below, respectively, for the following counties and districts:

County	[Groundwater Conservation District]	Drawdown in 2070 (feet)
Gillespie	Hill Country [Underground Water Conservation District]	8
Mason	Hickory [Underground Water Conservation District] no. 1	14
McCulloch	Hickory [Underground Water Conservation District] no. 1	29
Menard	Menard County [Underground Water District] and Hickory [Underground Water Conservation District] no. 1	46
Kimble	Kimble County [Groundwater Conservation District] and Hickory [Underground Water Conservation District] no. 1	18
San Saba	Hickory [Underground Water Conservation District] no. 1	5

Total net drawdown of [Hickory Aquifer] levels in 2070, as compared with 2010 aquifer levels, shall not exceed the number of feet set forth below, respectively, for the following counties and districts:

County	[Groundwater Conservation District]	Drawdown in 2070 (feet)
Concho	Hickory [Underground Water Conservation District No. 1]	53
Gillespie	Hill Country UWCD	9
Mason	Hickory [Underground Water Conservation District No. 1]	17
McCulloch	Hickory [Underground Water Conservation District No. 1]	29
Menard	Menard UWD and Hickory [Underground Water Conservation District No. 1]	46
Kimble	Kimble County [Groundwater Conservation District] and Hickory [Underground Water Conservation District No. 1]	18
San Saba	Hickory [Underground Water Conservation District No. 1]	6

Ogallala Aquifer

Total net [drawdown] of the Ogallala Aquifer in Glasscock County (Glasscock [Groundwater Conservation District]) in 2070, as compared with 2012 aquifer levels, not to exceed 6 feet [...].

Rustler Aquifer

Total net drawdown of the Rustler Aquifer in Pecos County (Middle Pecos GCD) in 2070 not to exceed 94 feet as compared with 2009 aquifer levels.

Additionally, districts in Groundwater Management Area 7 voted to declare that the following aquifers or parts of aquifers are non-relevant for the purposes of joint planning:

- The Blaine, Igneous, Lipan, Marble Falls, and Seymour aquifers.
- The Edwards-Trinity (Plateau) Aquifer in Hickory Underground Water Conservation District No. 1, the Lipan-Kickapoo Water Conservation District, Lone Wolf Groundwater Conservation District, and Wes-Tex Groundwater Conservation District.
- The Ellenburger-San Saba Aquifer in Llano County.
- The Hickory Aquifer in Llano County.
- The Dockum Aquifer outside of Santa Rita Groundwater Conservation District and Middle Pecos Groundwater Conservation District.
- The Ogallala Aquifer outside of Glasscock County.

In response to a several requests for clarifications from the TWDB in 2017 and 2018, the Groundwater Management Area 7 Chair, Mr. Joel Pigg, and Groundwater Management Area 7 consultant, Dr. William R. Hutchison, indicated the following preferences for verifying the desired future condition of the aquifers and calculating modeled available groundwater volumes in Groundwater Management Area 7:

Capitan Reef Complex Aquifer

Calculate modeled available groundwater values based on the official aquifer boundaries.

Assume that modeled drawdown verifications within 1 foot achieve the desired future conditions.

Edwards-Trinity (Plateau), Pecos Valley, and Trinity aquifers

Calculate modeled available groundwater values based on the official aquifer boundaries.

Assume that modeled drawdown verifications within 1 foot achieve the desired future conditions.

Kinney County

Use the modeled available groundwater values and model assumptions from GAM Run 10-043 MAG Version 2 (Shi, 2012) to maintain annual average springflow of 23.9 cubic feet per second and a median flow of 24.4 cubic feet per second at Las Moras Springs from 2010 to 2060.

Val Verde County

There is no associated drawdown as a desired future condition. The desired future condition is based solely on simulated springflow conditions at San Felipe Spring of 73 to 75 million gallons per day. Pumping scenarios—50,000 acre-feet per year—in three well field locations, and monthly hydrologic conditions for the historic period 1969 to 2012 meet the desired future conditions set by Groundwater Management Area 7 (EcoKai and Hutchison, 2014; Hutchison 2018b).

Minor Aquifers of the Llano Uplift Area

Calculate modeled available groundwater values based on the spatial extent of the Ellenburger-San Saba and Hickory aquifers in the groundwater availability model for the aquifers of the Llano Uplift Area and use the same model assumptions used in Groundwater Management Area 7 Technical Memorandum 16-02 (Hutchison 2016g).

Drawdown calculations do not take into consideration the occurrence of dry cells where water levels are below the base of the aquifer.

Assume that modeled drawdown verifications within 1 foot achieve the desired future conditions.

Dockum Aquifer

Calculate modeled available groundwater values based on the spatial extent of the groundwater availability model for the Dockum Aquifer.

Modeled available groundwater analysis excludes pass-through cells.

Assume that modeled drawdown verifications within 1 foot achieve the desired future conditions.

Ogallala Aquifer

Calculate modeled available groundwater values based on the official aquifer boundary and use the same model assumptions used in Groundwater Management Area Technical Memorandum 16-01 (Hutchison, 2016f).

Modeled available groundwater analysis excludes pass-through cells.

Well pumpage decreases as the saturated thickness of the aquifer decreases below a 30-foot threshold.

Assume that modeled drawdown verifications within 1 foot achieve the desired future conditions.

Rustler Aquifer

Use 2008 as the baseline year and run the model from 2009 through 2070 (end of 2008/beginning of 2009 as initial conditions), as used in the submitted predictive model run.

Use 2008 recharge conditions throughout the predictive period.

Calculate modeled available groundwater values based on the spatial extent of the groundwater availability model for the Rustler Aquifer.

General-head boundary heads decline at a rate of 1.5 feet per year.

Use the same model assumptions used in Groundwater Management Area 7 Technical Memorandum 15-05 (Hutchison, 2016d).

Assume that modeled drawdown verifications within 1 foot achieve the desired future conditions.

METHODS:

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

For relevant aquifers with desired future conditions based on water-level drawdown, water levels simulated at the end of the predictive simulations were compared to specified baseline water levels. In the case of the High Plains Aquifer System (Dockum and Ogallala aquifers) and the minor aquifers of the Llano Uplift area (Ellenburger-San Saba and Hickory aquifers), baseline water levels represent water levels at the end of the calibrated transient model are the initial water level conditions in the predictive simulation—water levels at the end of the preceding year. In the case of the Capitan Reef Complex, Edwards-Trinity (Plateau), Pecos Valley, and Trinity, and Rustler aquifers, the baseline water levels may occur in a specified year, early in the predictive simulation. These baseline years are 2006 in the groundwater availability model for the Capitan Reef Complex Aquifer, 2010 in the alternative model for the Edwards-Trinity (Plateau), Pecos Valley, and Trinity aquifers, 2012 in the groundwater availability model for the High Plains Aquifer System, 2010 in the groundwater availability model for the minor aquifers of the Llano Uplift area, and 2009 in the groundwater availability model for the Rustler Aquifer. The predictive model runs used average pumping rates from the historical period for the respective model except in the aquifer or area of interest. In those areas, pumping rates are varied until they produce drawdowns consistent with the adopted desired future conditions. Pumping rates or modeled available groundwater are reported in 10-year intervals.

Water-level drawdown averages were calculated for the relevant portions of each aquifer. Drawdown for model cells that became dry during the simulation—when the water level dropped below the base of the cell—were excluded from the averaging. In Groundwater Management Area 7, dry cells only occur during the predictive period in the Ogallala Aquifer of Glasscock County. Consequently, estimates of modeled available groundwater decrease over time as continued simulated pumping predicts the development of increasing numbers of dry model cells in areas of the Ogallala Aquifer in Glasscock County. The calculated water-level drawdown averages were compared with the desired future conditions to verify that the pumping scenario achieved the desired future conditions.

In Kinney and Val Verde counties, the desired future conditions are based on discharge from selected springs. In these cases, spring discharge is estimated based on simulated average spring discharge over a historical period maintaining all historical hydrologic conditions—such as recharge and river stage—except pumping. In other words, we assume that past average hydrologic conditions—the range of fluctuation—will continue in the future. In the cases of Kinney and Val Verde counties, simulated spring discharge is based on hydrologic variations that took place over the periods 1950 through 2005 and 1968 through 2013, respectively. The desired future condition for the Edwards-Trinity (Plateau) Aquifer in Kinney County is similar to the one adopted in 2010 and the associated modeled available groundwater is based on a specific model run—GAM Run 10-043 (Shi, 2012).

Modeled available groundwater values for the Ellenburger-San Saba and Hickory aquifers were determined by extracting pumping rates by decade from the model results using ZONBUDUSG Version 1.01 (Panday and others, 2013). For the remaining relevant aquifers in Groundwater Management Area 7 modeled available groundwater values were determined by extracting pumping rates by decade from the model results using ZONEBUDGET Version 3.01 (Harbaugh, 2009). Decadal modeled available groundwater for the relevant aquifers are reported by groundwater conservation district and county (Figure 1; Tables 1, 3, 5, 7, 9, 11, 13), and by county, regional water planning area, and river basin (Figures 2 and 3; Tables 2, 4, 6, 8, 10, 12, 14).

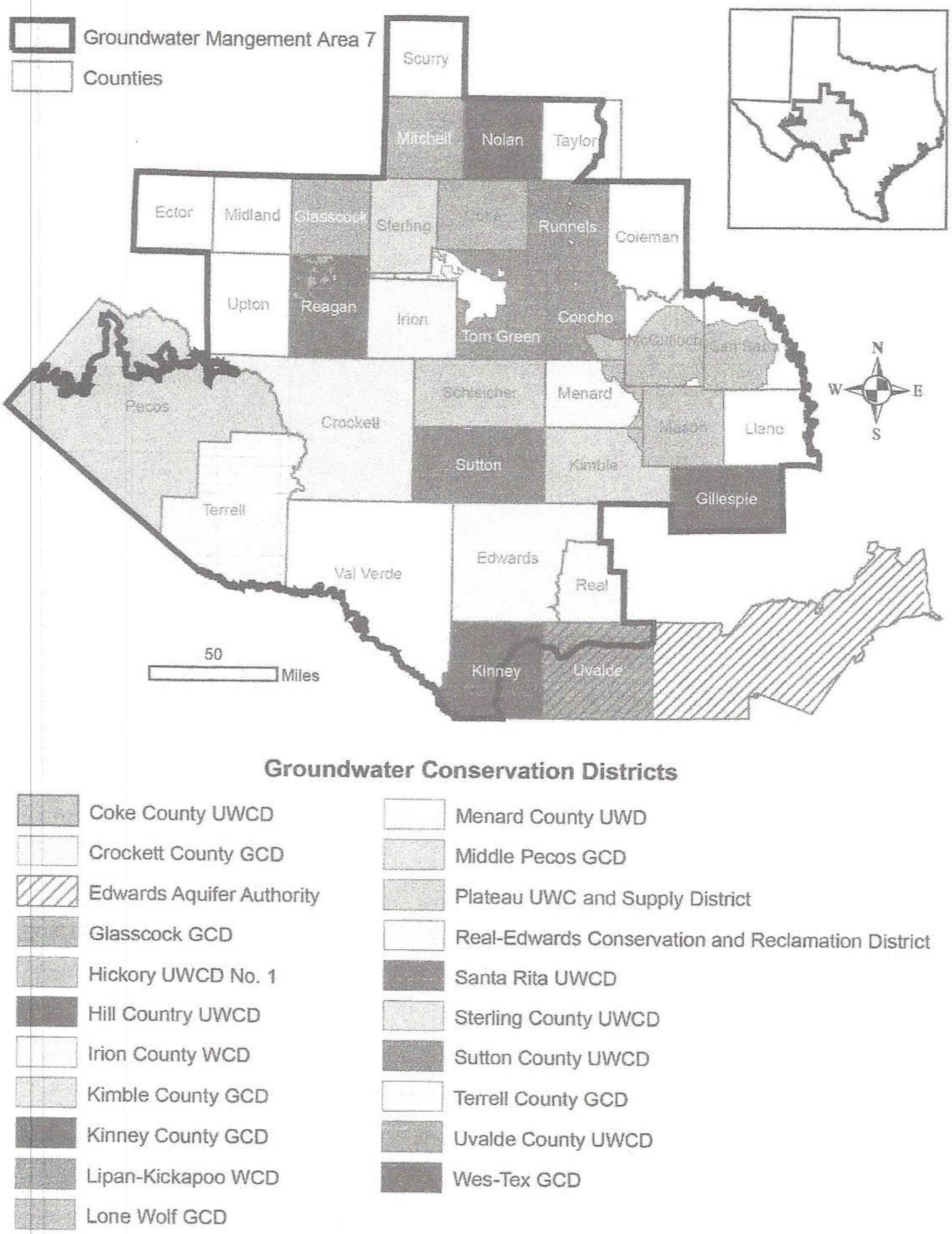

FIGURE 1. **MAP SHOWING THE GROUNDWATER CONSERVATION DISTRICTS (GCD) IN GROUNDWATER MANAGEMENT AREA 7. NOTE: THE BOUNDARIES OF THE EDWARDS AQUIFER AUTHORITY OVERLAP WITH THE UVALDE COUNTY UNDERGROUND WATER CONSERVATION DISTRICT (UWCD).**

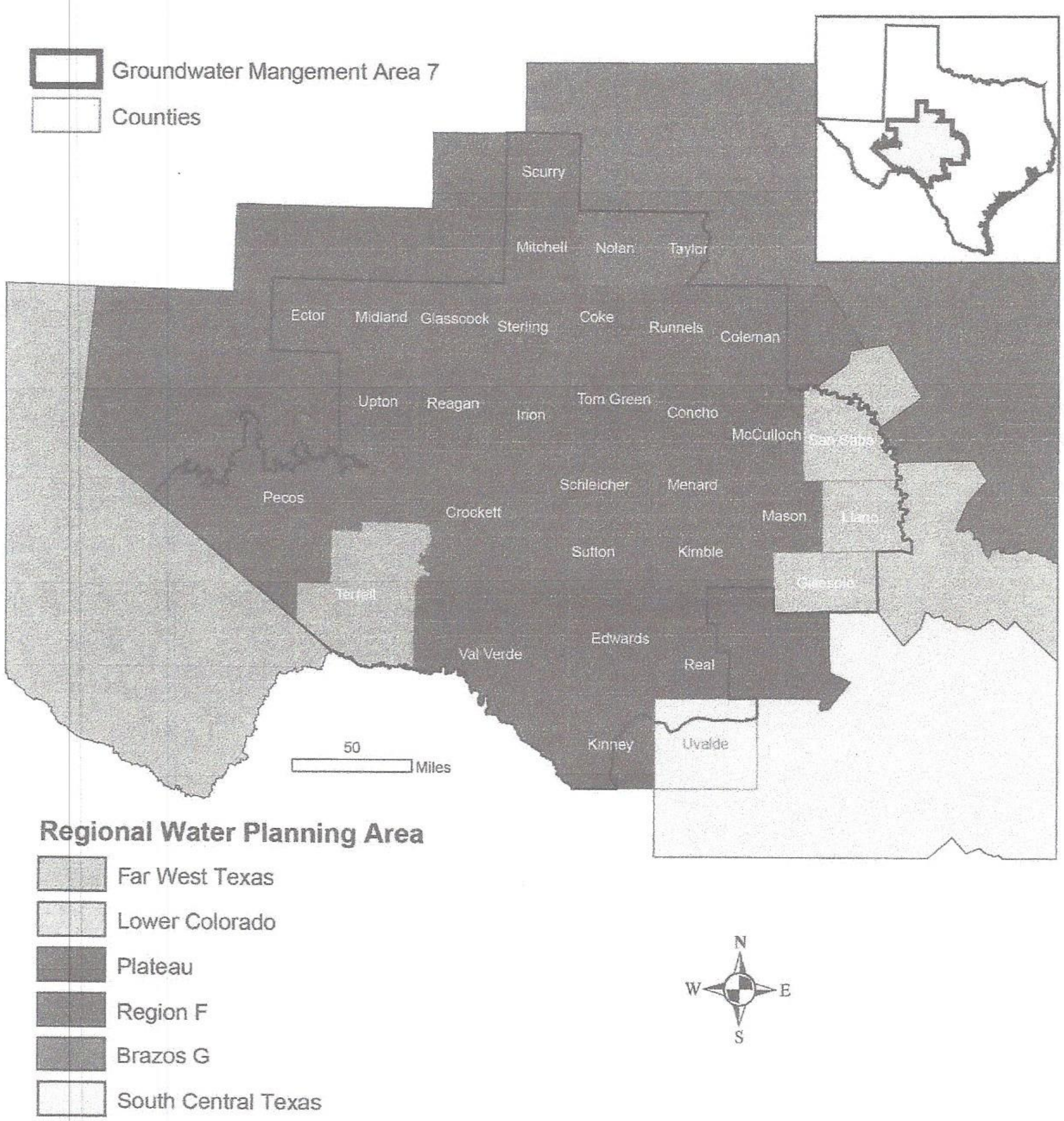

FIGURE 2. MAP SHOWING REGIONAL WATER PLANNING AREAS IN GROUNDWATER MANAGEMENT AREA 7.

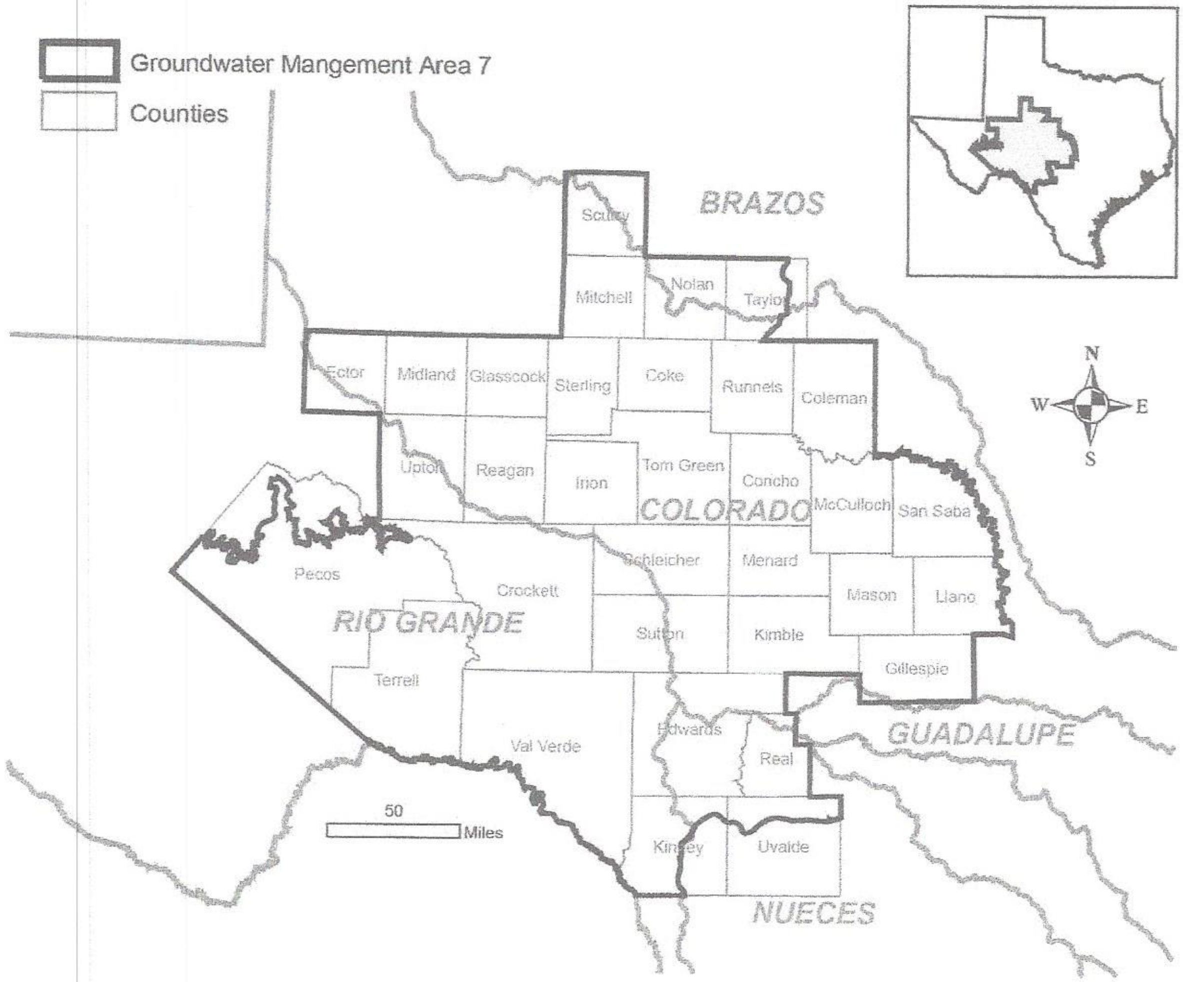

FIGURE 3. MAP SHOWING RIVER BASINS IN GROUNDWATER MANAGEMENT AREA 7. THESE INCLUDE PARTS OF THE BRAZOS, COLORADO, GUADALUPE, NUECES, AND RIO GRANDE RIVER BASINS.

PARAMETERS AND ASSUMPTIONS:

Capitan Reef Complex Aquifer

- Version 1.01 of the groundwater availability model of the eastern arm of the Capitan Reef Complex Aquifer was used. See Jones (2016) for assumptions and limitations of the groundwater availability model. See Hutchison (2016h) for details on the assumptions used for predictive simulations.
- The model has five layers: Layer 1, the Edwards-Trinity (Plateau) and Pecos Valley aquifers; Layer 2, the Dockum Aquifer and the Dewey Lake Formation; Layer 3, the Rustler Aquifer; Layer 4, a confining unit made up of the Salado and Castile formations, and the overlying portion of the Artesia Group; and Layer 5, the Capitan Reef Complex Aquifer, part of the Artesia Group, and the Delaware Mountain Group. Layers 1 through 4 are intended to act solely as boundary conditions facilitating groundwater inflow and outflow relative to the Capitan Reef Complex Aquifer (Layer 5).
- The model was run with MODFLOW-2000 (Harbaugh and others, 2000).
- The model was run for the interval 2006 through 2070 for a 64-year predictive simulation. Drawdowns were calculated by subtracting 2006 simulated water levels from 2070 simulated water levels, which were then averaged over the portion of the aquifer in Groundwater Management Area 7.
- During predictive simulations, there were no cells where water levels were below the base elevation of the cell ("dry" cells). Therefore, all drawdowns were included in the averaging.
- Drawdown averages and modeled available groundwater volumes are based on the official aquifer boundary within Groundwater Management Area 7.

Dockum and Ogallala Aquifers

- Version 1.01 of the groundwater availability model for the High Plains Aquifer System by Deeds and Jigmond (2015) was used to construct the predictive model simulation for this analysis. See Hutchison (2016f) for details of the initial assumptions.
- The model has four layers which represent the Ogallala and Pecos Valley Alluvium aquifers (Layer 1), the Edwards-Trinity (High Plains) and Edwards-Trinity (Plateau) aquifers (Layer 2), the Upper Dockum Aquifer (Layer 3), and the Lower Dockum Aquifer (Layer 4). Pass-through cells exist in layers 2 and 3 where the Dockum Aquifer was absent but provided pathway for flow between the Lower Dockum and the Ogallala or Edwards-Trinity (High Plains) aquifers vertically. These pass-through cells were excluded from the calculations of drawdowns and modeled available groundwater.

The model was run with MODFLOW-NWT (Niswonger and others, 2011). The model uses the Newton formulation and the upstream weighting package, which automatically reduces pumping as heads drop in a particular cell, as defined by the user. This feature may simulate the declining production of a well as saturated thickness decreases. Deeds and Jigmond (2015) modified the MODFLOW-NWT code to use a saturated thickness of 30 feet as the threshold—instead of percent of the saturated thickness—when pumping reductions occur during a simulation. It is important for groundwater management areas 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.

The model was run for the interval 2013 through 2070 for a 58-year predictive simulation. Drawdowns were calculated by subtracting 2012 simulated water levels from 2070 simulated water levels, which were then averaged over the portion of the aquifer in Groundwater Management Area 7.

During predictive simulations, there were no cells where water levels were below the base elevation of the cell ("dry" cells). Therefore, all drawdowns were included in the averaging. Modeled available groundwater analysis excludes pass-through cells.

Drawdown averages and modeled available groundwater volumes are based on the model boundaries within Groundwater Management Area 7 for the Dockum Aquifer and official aquifer boundaries for the Ogallala Aquifer.

Pecos Valley, Edwards-Trinity (Plateau) and Trinity Aquifers

The single-layer alternative groundwater flow model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers used for this analysis. This model is an update to the previously developed groundwater availability model documented in Anaya and Jones (2009). See Hutchison and others (2011a) and Anaya and Jones (2009) for assumptions and limitations of the model. See Hutchison (2016e; 2018c) for details on the assumptions used for predictive simulations.

The groundwater model has one layer representing the Pecos Valley Aquifer and the Edwards-Trinity (Plateau) Aquifer. In the relatively narrow area where both aquifers are present, the model is a lumped representation of both aquifers.

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

The model was run for the interval 2006 through 2070 for a 65-year predictive simulation. Drawdowns were calculated by subtracting 2010 simulated water levels from 2070 simulated water levels, which were then averaged over the portion of the aquifer in Groundwater Management Area 7. Comparison of 2010 simulated and measured water levels indicate a root mean squared error of 84 feet or 3 percent of the range in water-level elevations.

Drawdowns for cells with water levels below the base elevation of the cell ("dry" cells) were included in the averaging.

Drawdown averages and modeled available groundwater volumes are based on the official aquifer boundaries within Groundwater Management Area 7.

Edwards-Trinity (Plateau) Aquifer of Kinney County

All parameters and assumptions for the Edwards-Trinity (Plateau) Aquifer of Kinney County in Groundwater Management Area 7 are described in GAM Run 10-043 MAG Version 2 (Shi, 2012). This report assumes a planning period from 2010 to 2070.

The Kinney County Groundwater Conservation District model developed by Hutchison and others (2011b) was used for this analysis. The model was calibrated to water level and spring flux collected from 1950 to 2005.

The model has four layers representing the following hydrogeologic units (from top to bottom): Carrizo-Wilcox Aquifer (layer 1), Upper Cretaceous Unit (layer 2), Edwards (Balcones Fault Zone) Aquifer/Edwards portion of the Edwards-Trinity (Plateau) Aquifer (layer 3), and Trinity portion of the Edwards-Trinity (Plateau) Aquifer (layer 4).

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

The model was run for the interval 2006 through 2070 for a 65-year predictive simulation. Drawdowns were calculated by subtracting 2010 simulated water levels from 2070 simulated water levels, which were then averaged over the portion of the aquifer in Groundwater Management Area 7.

Modeled available groundwater volumes are based on the official aquifer boundaries within Groundwater Management Area 7 in Kinney County.

Edwards-Trinity (Plateau) Aquifer of Val Verde County

The single-layer numerical groundwater flow model for the Edwards-Trinity (Plateau) Aquifer of Val Verde County was used for this analysis. This model is based on the previously developed alternative groundwater model of the Kinney County area documented in Hutchison and others (2011b). See EcoKai (2014) for assumptions and limitations of the model. See Hutchison (2016e; 2018b) for details on the assumptions used for predictive simulations, including recharge and pumping assumptions.

The groundwater model has one layer representing the Edwards-Trinity (Plateau) Aquifer of Val Verde County.

The model was run with MODFLOW-2005 (Harbaugh, 2005).

The model was run for a 45-year predictive simulation representing hydrologic conditions of the interval 1968 through 2013. Simulated spring discharge from San Felipe Springs was then averaged over duration of the simulation. The resultant pumping rate that met the desired future conditions was applied to the predictive period—2010 through 2070—based on the assumption that average conditions over the predictive period are the same as those over the historic period represented by the model run.

Modeled available groundwater volumes are based on the official aquifer boundaries within Groundwater Management Area 7 in Val Verde County.

Rustler Aquifer

Version 1.01 of the groundwater availability model for the Rustler Aquifer by Ewing and others (2012) was used to construct the predictive model simulation for this analysis. See Hutchison (2016d) for details of the initial assumptions, including recharge conditions.

The model has two layers, the top one representing the Rustler Aquifer, and the other representing the Dewey Lake Formation and the Dockum Aquifer.

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

The model was run for the interval 2009 through 2070 for a 61-year predictive simulation. Drawdowns were calculated by subtracting 2009 simulated water levels from 2070 simulated water levels, which were then averaged over the portion of the aquifer in Groundwater Management Area 7. During predictive simulations, there were no cells where water levels were below the base elevation of the cell ("dry" cells). Therefore, all drawdowns were included in the averaging.

Drawdown averages and modeled available groundwater volumes are based on the model boundaries within Groundwater Management Area 7.

Minor aquifers of the Llano Uplift Area

We used version 1.01 of the groundwater availability model for the minor aquifers in the Llano Uplift Area. See Shi and others (2016) for assumptions and limitations of the model. See Hutchison (2016g) for details of the initial assumptions.

The model contains eight layers: Trinity Aquifer, Edwards-Trinity (Plateau) Aquifer, and younger alluvium deposits (Layer 1), confining units (Layer 2), Marble Falls Aquifer and equivalent units (Layer 3), confining units (Layer 4), Ellenburger-San Saba Aquifer and equivalent units (Layer 5), confining units (Layer 6), Hickory Aquifer and equivalent units (Layer 7), and Precambrian units (Layer 8).

The model was run with MODFLOW-USG beta (development) version (Panday and others, 2013). Perennial rivers and reservoirs were simulated using the MODFLOW-USG river package. Springs were simulated using the MODFLOW-USG drain package.

Drawdown averages and modeled available groundwater volumes are based on the model boundaries within Groundwater Management Area 7.

The model was run for the interval 2011 through 2070 for a 60-year predictive simulation. Drawdowns were calculated by subtracting 2010 simulated water levels from 2070 simulated water levels, which were then averaged over the portion of the aquifer in Groundwater Management Area 7. During predictive simulations, there were no cells where water levels were below the base elevation of the cell ("dry" cells). Therefore, all drawdowns were included in the averaging.

RESULTS:

The modeled available groundwater estimates are 26,164 acre-feet per year in the Capitan Reef Complex Aquifer, 479,063 acre-feet per year in the undifferentiated Edwards-Trinity (Plateau), Pecos Valley, and Trinity aquifers, 22,616 acre-feet per year in the Ellenburger-San Saba Aquifer, 49,936 acre-feet per year in the Hickory Aquifer, 6,570 to 7,925 acre-feet per year in the Ogallala Aquifer, 2,324 acre-feet per year in the Dockum Aquifer, and 7,040 acre-feet per year in the Rustler Aquifer.

The modeled available groundwater for the respective aquifers has been summarized by aquifer, county, and groundwater conservation district (Tables 1, 3, 5, 7, 9, 11, and 13). The modeled available groundwater is also summarized by county, regional water planning area, river basin, and aquifer for use in the regional water planning process (Tables 2, 4, 6, 8, 10, 12, and 14). The modeled available groundwater for the Ogallala Aquifer that achieves the desired future conditions adopted by districts in Groundwater Management Area 7 decreases from 7,925 to 6,570 acre-feet per year between 2020 and 2070 (Tables 9 and 10). This decline is attributable to the occurrence of increasing numbers of cells where water levels were below the base elevation of the cell ("dry" cells) in parts of Glasscock County. Please note that MODFLOW-NWT automatically reduces pumping as water levels decline.

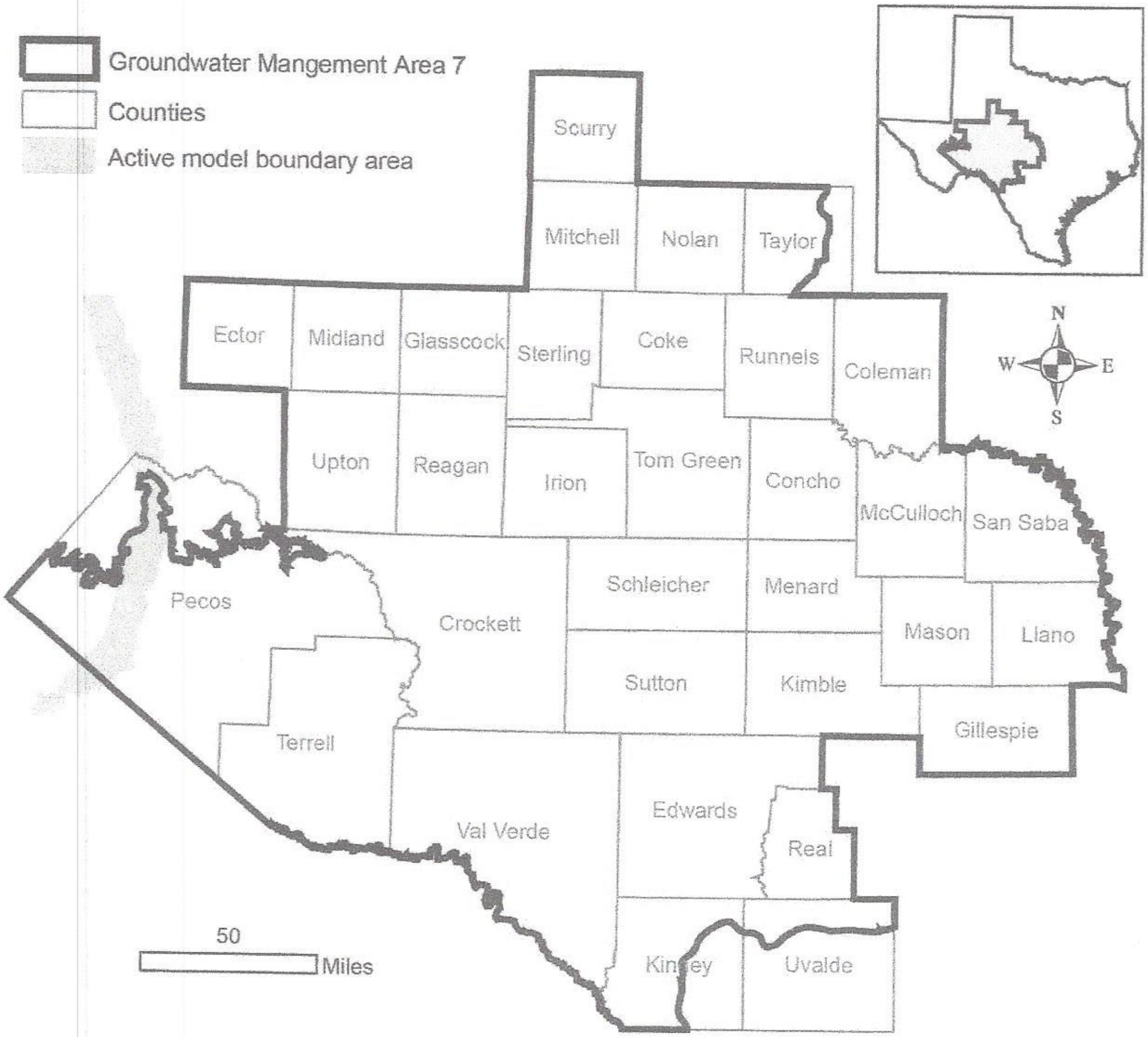

FIGURE 4. **MAP SHOWING THE AREAS COVERED BY THE CAPITAN REEF COMPLEX AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL FOR THE EASTERN ARM OF THE CAPITAN REEF COMPLEX AQUIFER IN GROUNDWATER MANAGEMENT AREA 7.**

TABLE 1. MODELED AVAILABLE GROUNDWATER FOR THE CAPITAN REEF COMPLEX AQUIFER IN GROUNDWATER MANAGEMENT AREA 7 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT AND COUNTY FOR EACH DECADE BETWEEN 2006 AND 2070. RESULTS ARE IN ACRE-FEET PER YEAR. GCD IS THE ABBREVIATION FOR GROUNDWATER CONSERVATION DISTRICT.

District	County	Year							
		2006	2010	2020	2030	2040	2050	2060	2070
Middle Pecos GCD	Pecos	26,164	26,164	26,164	26,164	26,164	26,164	26,164	26,164
	Total	**26,164**	**26,164**	**26,164**	**26,164**	**26,164**	**26,164**	**26,164**	**26,164**
GMA 7		**26,164**	**26,164**	**26,164**	**26,164**	**26,164**	**26,164**	**26,164**	**26,164**

TABLE 2. MODELED AVAILABLE GROUNDWATER FOR THE CAPITAN REEF COMPLEX AQUIFER IN GROUNDWATER MANAGEMENT AREA 7 SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN FOR EACH DECADE BETWEEN 2020 AND 2070. RESULTS ARE IN ACRE-FEET PER YEAR.

County	RWPA	River Basin	Year					
			2020	2030	2040	2050	2060	2070
Pecos	F	Rio Grande	26,164	26,164	26,164	26,164	26,164	26,164
		Total	**26,164**	**26,164**	**26,164**	**26,164**	**26,164**	**26,164**
GMA 7			**26,164**	**26,164**	**26,164**	**26,164**	**26,164**	**26,164**

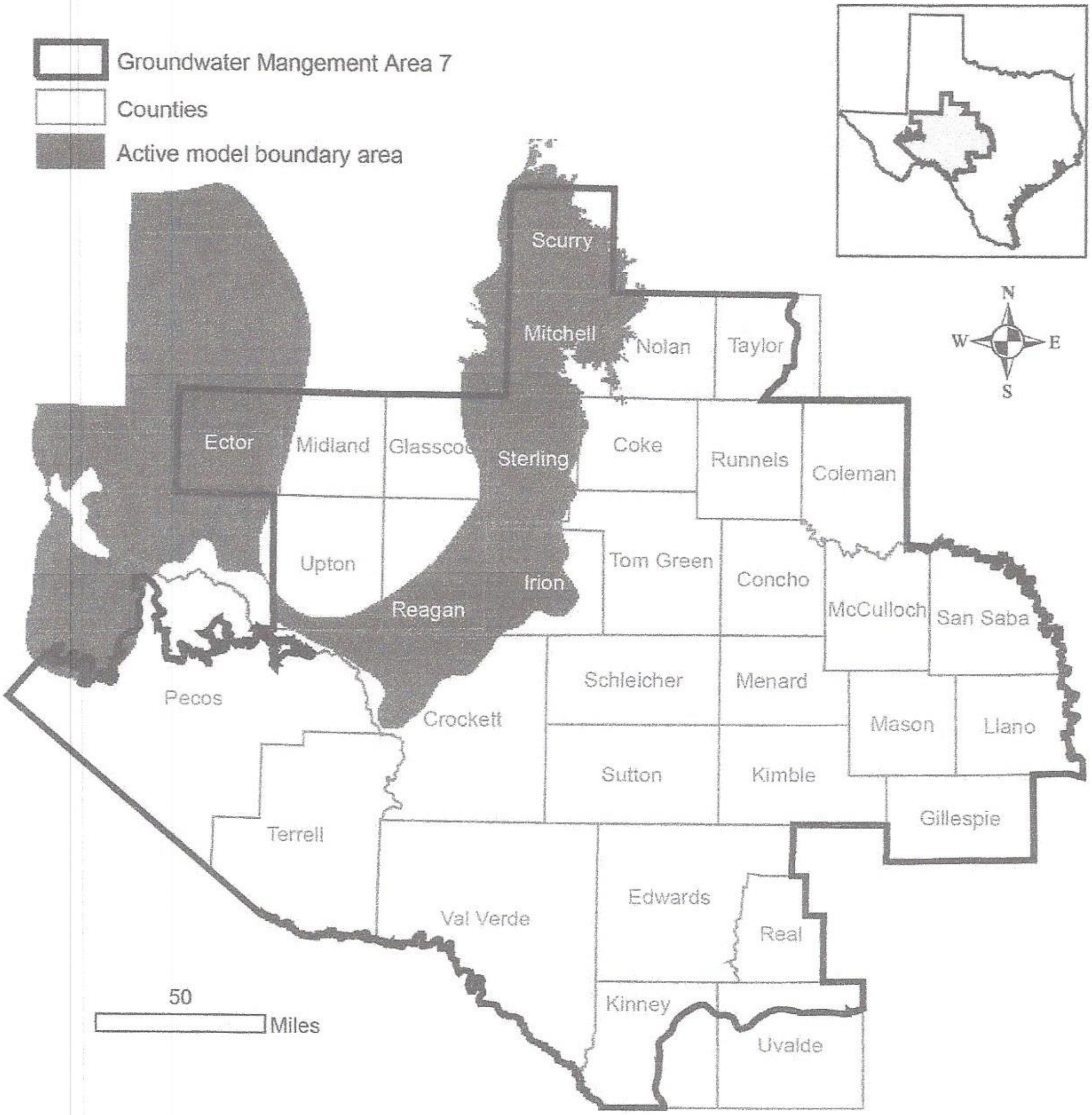

FIGURE 5. **MAP SHOWING AREAS COVERED BY THE DOCKUM AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL FOR THE HIGH PLAINS AQUIFER SYSTEM IN GROUNDWATER MANAGEMENT AREA 7.**

TABLE 3. MODELED AVAILABLE GROUNDWATER FOR THE DOCKUM AQUIFER IN GROUNDWATER MANAGEMENT AREA 7 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT AND COUNTY FOR EACH DECADE BETWEEN 2013 AND 2070. RESULTS ARE IN ACRE-FEET PER YEAR. GCD AND UWCD ARE THE ABBREVIATIONS FOR GROUNDWATER CONSERVATION DISTRICT AND UNDERGROUND WATER CONSERVATION DISTRICT, RESPECTIVELY.

District	County	Year						
		2013	2020	2030	2040	2050	2060	2070
Middle Pecos GCD	Pecos	2,022	2,022	2,022	2,022	2,022	2,022	2,022
	Total	2,022	2,022	2,022	2,022	2,022	2,022	2,022
Santa Rita UWCD	Reagan	302	302	302	302	302	302	302
	Total	302	302	302	302	302	302	302
GMA 7		2324	2,324	2,324	2,324	2,324	2,324	2,324

Note: The modeled available groundwater for Santa Rita Underground Water Conservation District excludes parts of Reagan County that fall within Glasscock Groundwater Conservation District. The year 2013 is used because the 2012 desired future condition baseline year for the Dockum Aquifer is an initial condition in the predictive model run.

TABLE 4. MODELED AVAILABLE GROUNDWATER FOR THE DOCKUM AQUIFER IN GROUNDWATER MANAGEMENT AREA 7 SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN FOR EACH DECADE BETWEEN 2020 AND 2070. RESULTS ARE IN ACRE-FEET PER YEAR.

County	RWPA	River Basin	Year					
			2020	2030	2040	2050	2060	2070
Pecos	F	Rio Grande	2,022	2,022	2,022	2,022	2,022	2,022
		Total	**2,022**	**2,022**	**2,022**	**2,022**	**2,022**	**2,022**
Reagan	F	Colorado	302	302	302	302	302	302
		Rio Grande	0	0	0	0	0	0
		Total	**962**	**962**	**962**	**962**	**962**	**962**
GMA 7			2,324	2,324	2,324	2,324	2,324	2,324

Note: The modeled available groundwater for Reagan County excludes parts of Reagan County that fall outside of Santa Rita Underground Water Conservation District.

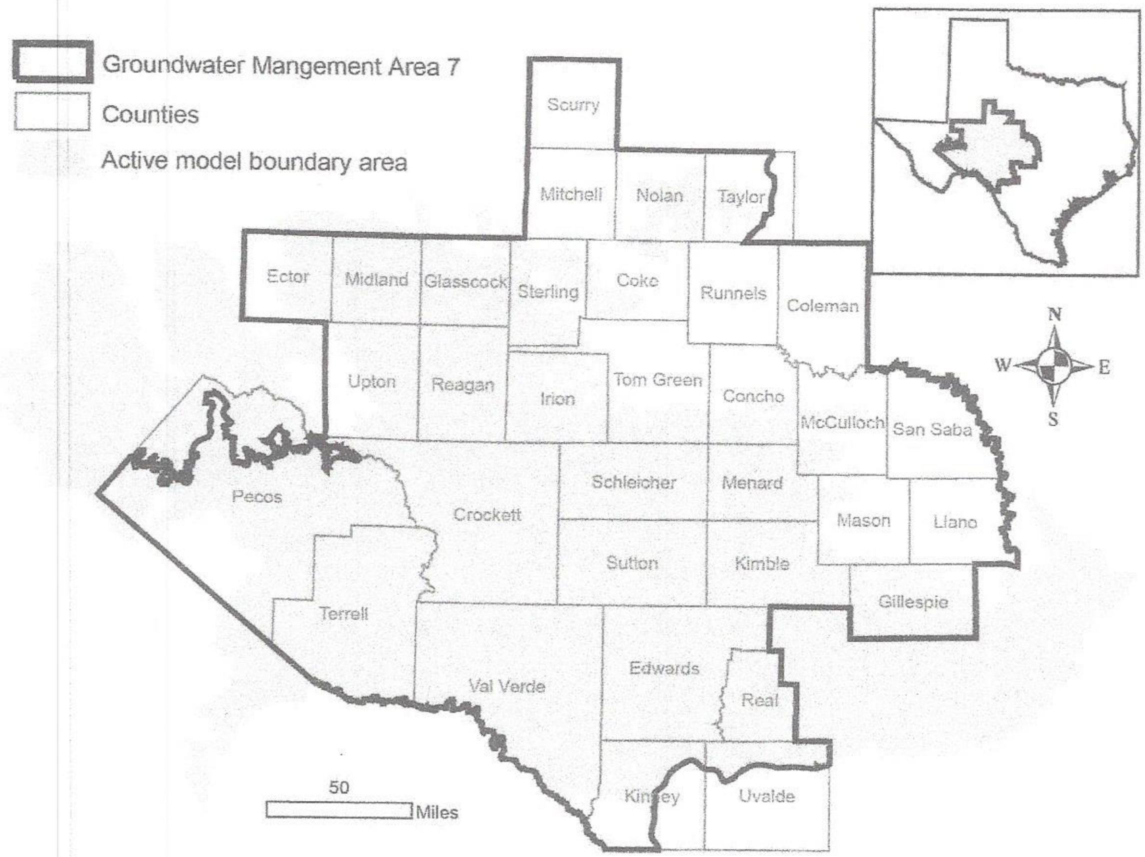

FIGURE 6. **MAP SHOWING THE AREAS COVERED BY THE UNDIFFERENTIATED EDWARDS-TRINITY (PLATEAU), PECOS VALLEY, AND TRINITY AQUIFERS IN THE GROUNDWATER AVAILABILITY MODEL FOR THE EDWARDS-TRINITY (PLATEAU) AND PECOS VALLEY AQUIFERS IN GROUNDWATER MANAGEMENT AREA 7.**

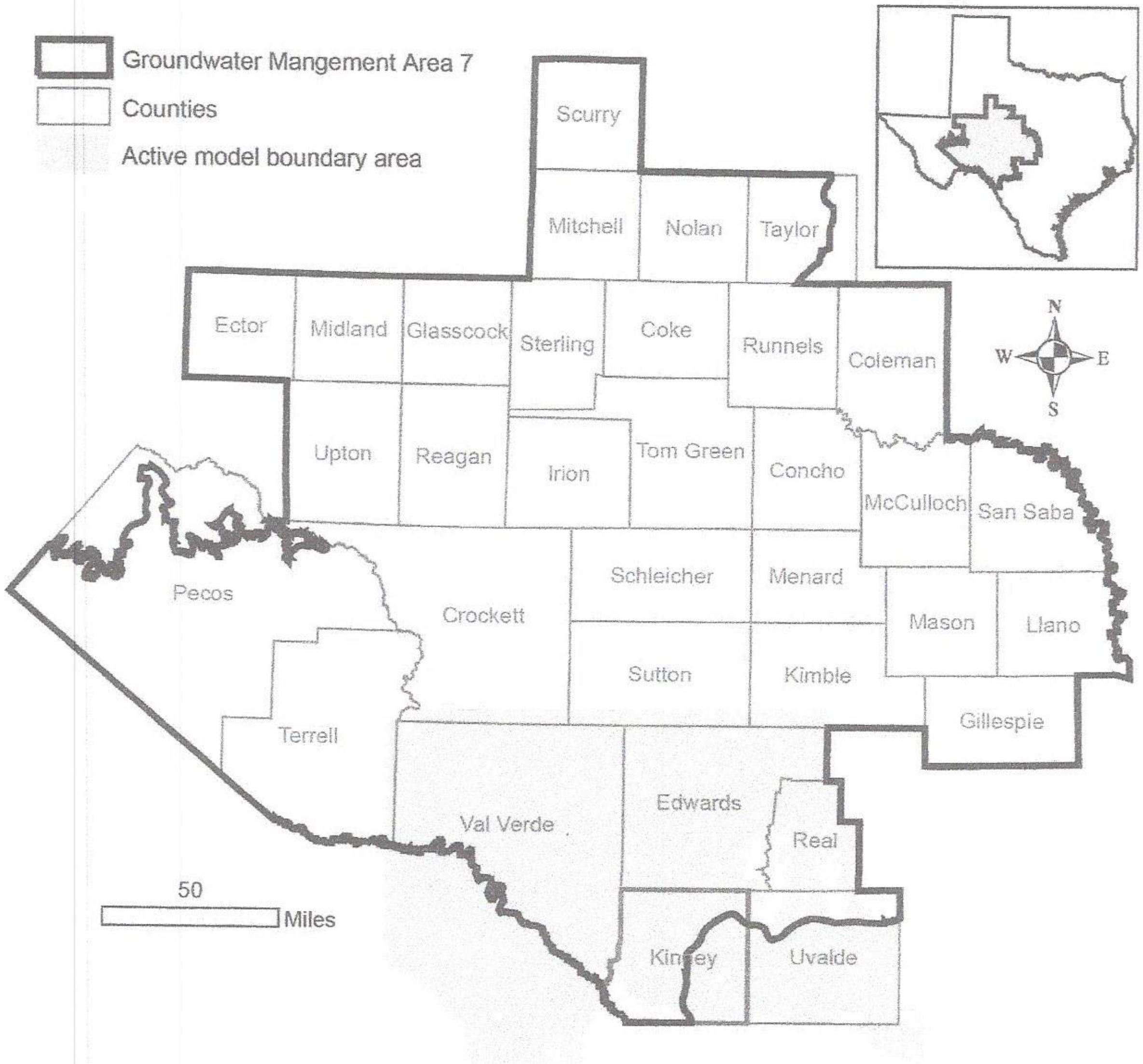

FIGURE 7. MAP SHOWING THE AREAS COVERED BY THE EDWARDS-TRINITY (PLATEAU) AQUIFER IN THE ALTERNATIVE MODEL FOR THE EDWARDS-TRINITY (PLATEAU) AQUIFER IN KINNEY COUNTY.

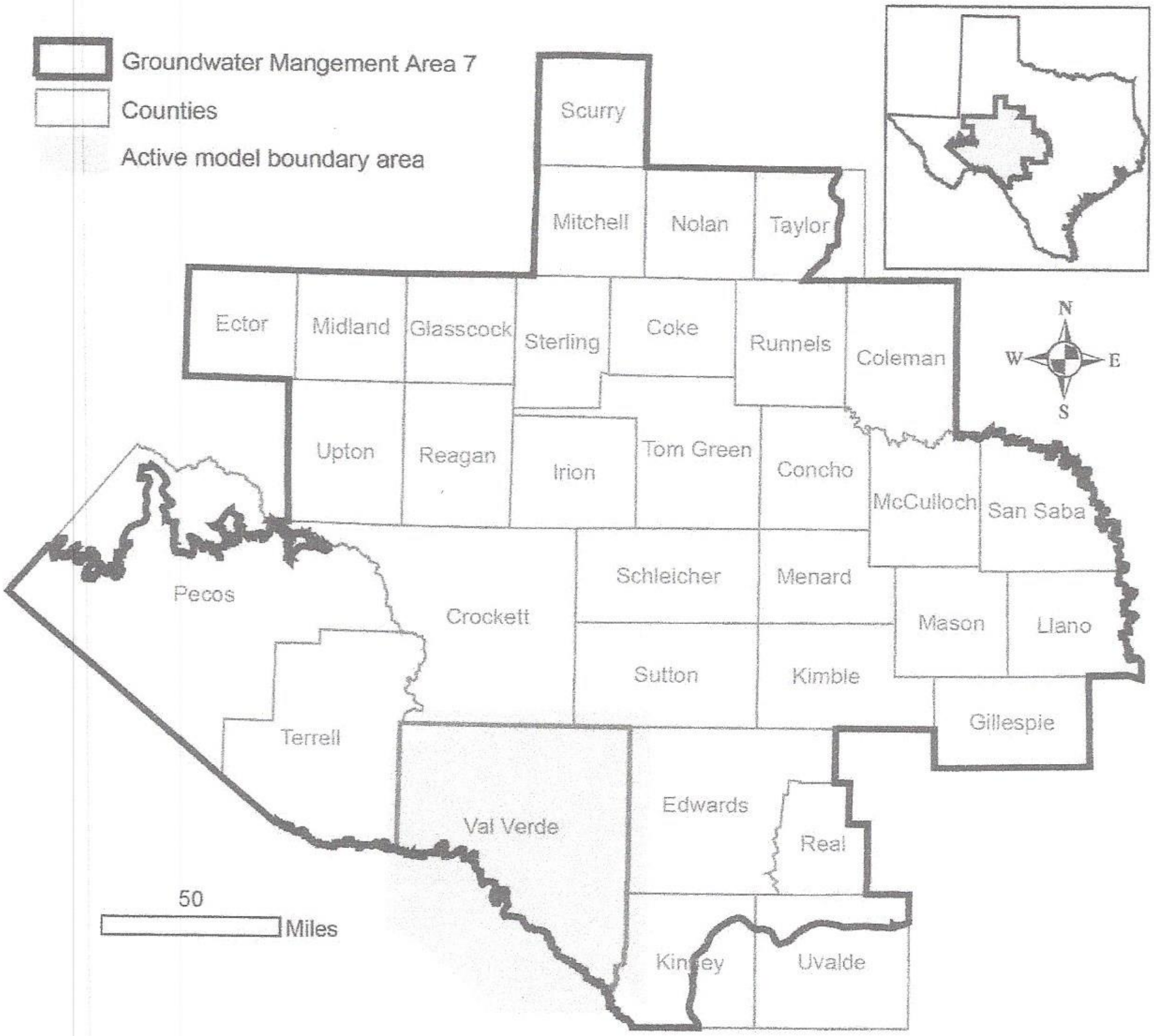

FIGURE 8. **MAP SHOWING THE AREAS COVERED BY THE EDWARDS-TRINITY (PLATEAU) AQUIFER IN THE GROUNDWATER FLOW MODEL FOR THE EDWARDS-TRINITY (PLATEAU) AQUIFER IN VAL VERDE COUNTY.**

TABLE 5. MODELED AVAILABLE GROUNDWATER FOR THE UNDIFFERENTIATED EDWARDS-TRINITY (PLATEAU), PECOS VALLEY, AND TRINITY AQUIFERS IN GROUNDWATER MANAGEMENT AREA 7 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY, FOR EACH DECADE BETWEEN 2006 AND 2070. RESULTS ARE IN ACRE-FEET PER YEAR. UWCD IS ABBREVIATION FOR UNDERGROUND WATER CONSERVATION DISTRICT, WCD IS WATER CONSERVATION DISTRICT, UWD IS UNDERGROUND WATER DISTRICT, UWC IS UNDERGROUND WATER CONSERVATION, AND C AND R DISTRICT IS CONSERVATION AND RECLAMATION DISTRICT.

District	County	Year						
		2010	2020	2030	2040	2050	2060	2070
Coke County UWCD	Coke	997	997	997	997	997	997	997
	Total	**997**	**997**	**997**	**997**	**997**	**997**	**997**
Crockett County GCD	Crockett	4,675	4,675	4,675	4,675	4,675	4,675	4,675
	Total	**4,675**	**4,675**	**4,675**	**4,675**	**4,675**	**4,675**	**4,675**
Glasscock GCD	Glasscock	65,186	65,186	65,186	65,186	65,186	65,186	65,186
	Reagan	40,835	40,835	40,835	40,835	40,835	40,835	40,835
	Total	**106,021**	**106,021**	**106,021**	**106,021**	**106,021**	**106,021**	**106,021**

TABLE 5. (CONTINUED).

District	County	Year						
		2010	2020	2030	2040	2050	2060	2070
Hickory UWCD No. 1	Concho	170	170	170	170	170	170	170
	Kimble	104	104	104	104	104	104	104
	Mason	18	18	18	18	18	18	18
	McCulloch	144	144	144	144	144	144	144
	Menard	380	380	380	380	380	380	380
	Total	**816**	**816**	**816**	**816**	**816**	**816**	**816**
Hill Country UWCD	Gillespie	4,979	4,979	4,979	4,979	4,979	4,979	4,979
	Total	**4,979**	**4,979**	**4,979**	**4,979**	**4,979**	**4,979**	**4,979**
Irion County WCD	Irion	3,289	3,289	3,289	3,289	3,289	3,289	3,289
	Tom Green	142	142	142	142	142	142	142
	Total	**3,431**	**3,431**	**3,431**	**3,431**	**3,431**	**3,431**	**3,431**
Kimble County GCD	Kimble	1,282	1,282	1,282	1,282	1,282	1,282	1,282
	Total	**1,282**	**1,282**	**1,282**	**1,282**	**1,282**	**1,282**	**1,282**

TABLE 5. (CONTINUED).

District	County	Year						
		2010	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Kinney County GCD	Kinney	70,341	70,341	70,341	70,341	70,341	70,341	70,341
	Total	**70,341**	**70,341**	**70,341**	**70,341**	**70,341**	**70,341**	**70,341**
Lipan-Kickapoo WCD	Concho	289	289	289	289	289	289	289
	Tom Green	2,371	2,371	2,371	2,371	2,371	2,371	2,371
	Total	**2,660**	**2,660**	**2,660**	**2,660**	**2,660**	**2,660**	**2,660**
Menard County UWD	Menard	2,217	2,217	2,217	2,217	2,217	2,217	2,217
	Total	**2,217**	**2,217**	**2,217**	**2,217**	**2,217**	**2,217**	**2,217**
Middle Pecos GCD	Pecos	117,309	117,309	117,309	117,309	117,309	117,309	117,309
	Total	**117,309**	**117,309**	**117,309**	**117,309**	**117,309**	**117,309**	**117,309**
Plateau UWC and Supply District	Schleicher	8,034	8,034	8,034	8,034	8,034	8,034	8,034
	Total	**8,034**	**8,034**	**8,034**	**8,034**	**8,034**	**8,034**	**8,034**
Real-Edwards C and R District	Edwards	5,676	5,676	5,676	5,676	5,676	5,676	5,676
	Real	7,523	7,523	7,523	7,523	7,523	7,523	7,523
	Total	**13,199**	**13,199**	**13,199**	**13,199**	**13,199**	**13,199**	**13,199**

TABLE 5. (CONTINUED).

District	County	Year						
		2010	2020	2030	2040	2050	2060	2070
Santa Rita UWCD	Reagan	27,398	27,398	27,398	27,398	27,398	27,398	27,398
	Total	**27,398**	**27,398**	**27,398**	**27,398**	**27,398**	**27,398**	**27,398**
Sterling County UWCD	Sterling	2,495	2,495	2,495	2,495	2,495	2,495	2,495
	Total	**2,495**	**2,495**	**2,495**	**2,495**	**2,495**	**2,495**	**2,495**
Sutton County UWCD	Sutton	6,400	6,400	6,400	6,400	6,400	6,400	6,400
	Total	**6,400**	**6,400**	**6,400**	**6,400**	**6,400**	**6,400**	**6,400**
Terrell County GCD	Terrell	1,420	1,420	1,420	1,420	1,420	1,420	1,420
	Total	**1,420**	**1,420**	**1,420**	**1,420**	**1,420**	**1,420**	**1,420**
Uvalde County UWCD	Uvalde	1,993	1,993	1,993	1,993	1,993	1,993	1,993
	Total	**1,993**	**1,993**	**1,993**	**1,993**	**1,993**	**1,993**	**1,993**
Wes-Tex GCD	Nolan	693	693	693	693	693	693	693
	Total	**693**	**693**	**693**	**693**	**693**	**693**	**693**

TABLE 5. (CONTINUED).

District	County	Year						
		2010	2020	2030	2040	2050	2060	2070
No district		102,703	102,703	102,703	102,703	102,703	102,703	102,703
GMA 7		**479,063**	**479,063**	**479,063**	**479,063**	**479,063**	**479,063**	**479,063**

TABLE 6. MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE UNDIFFERENTIATED EDWARDS-TRINITY (PLATEAU), PECOS VALLEY, AND TRINITY AQUIFERS IN GROUNDWATER MANAGEMENT AREA 7 SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN FOR EACH DECADE BETWEEN 2020 AND 2070. RESULTS ARE IN ACRE-FEET PER YEAR.

County	RWPA	River Basin	Year					
			2020	2030	2040	2050	2060	2070
Coke	F	Colorado	997	997	997	997	997	997
		Total	**997**	**997**	**997**	**997**	**997**	**997**
Concho	F	Colorado	459	459	459	459	459	459
		Total	**459**	**459**	**459**	**459**	**459**	**459**
Crockett	F	Colorado	20	20	20	20	20	20
		Rio Grande	5,427	5,427	5,427	5,427	5,427	5,427
		Total	**5,447**	**5,447**	**5,447**	**5,447**	**5,447**	**5,447**
Ector	F	Colorado	4,925	4,925	4,925	4,925	4,925	4,925
		Rio Grande	617	617	617	617	617	617
		Total	**5,542**	**5,542**	**5,542**	**5,542**	**5,542**	**5,542**
Edwards	J	Colorado	2,305	2,305	2,305	2,305	2,305	2,305
		Nueces	1,631	1,631	1,631	1,631	1,631	1,631
		Rio Grande	1,740	1,740	1,740	1,740	1,740	1,740
		Total	**5,676**	**5,676**	**5,676**	**5,676**	**5,676**	**5,676**
Gillespie	K	Colorado	4,843	4,843	4,843	4,843	4,843	4,843
		Guadalupe	136	136	136	136	136	136
		Total	**4,979**	**4,979**	**4,979**	**4,979**	**4,979**	**4,979**
Glasscock	F	Colorado	65,186	65,186	65,186	65,186	65,186	65,186
		Total	**65,186**	**65,186**	**65,186**	**65,186**	**65,186**	**65,186**

TABLE 6. (CONTINUED).

County	RWPA	River Basin	Year					
			2020	2030	2040	2050	2060	2070
Irion	F	Colorado	3,289	3,289	3,289	3,289	3,289	3,289
		Total	**3,289**	**3,289**	**3,289**	**3,289**	**3,289**	**3,289**
Kimble	F	Colorado	1,386	1,386	1,386	1,386	1,386	1,386
		Total	**1,386**	**1,386**	**1,386**	**1,386**	**1,386**	**1,386**
Kinney	J	Nueces	12	12	12	12	12	12
		Rio Grande	70,329	70,329	70,329	70,329	70,329	70,329
		Total	**70,341**	**70,341**	**70,341**	**70,341**	**70,341**	**70,341**
Mason	F	Colorado	18	18	18	18	18	18
		Total	**18**	**18**	**18**	**18**	**18**	**18**
McCulloch	F	Colorado	148	148	148	148	148	148
		Total	**148**	**148**	**148**	**148**	**148**	**148**
Menard	F	Colorado	2,597	2,597	2,597	2,597	2,597	2,597
		Total	**2,597**	**2,597**	**2,597**	**2,597**	**2,597**	**2,597**
Midland	F	Colorado	23,233	23,233	23,233	23,233	23,233	23,233
		Total	**23,233**	**23,233**	**23,233**	**23,233**	**23,233**	**23,233**
Nolan	G	Brazos	302	302	302	302	302	302
		Colorado	391	391	391	391	391	391
		Total	**693**	**693**	**693**	**693**	**693**	**693**
Pecos	F	Rio Grande	117,309	117,309	117,309	117,309	117,309	117,309
		Total	**117,309**	**117,309**	**117,309**	**117,309**	**117,309**	**117,309**

TABLE 6. (CONTINUED).

County	RWPA	River Basin	Year					
			2020	2030	2040	2050	2060	2070
Reagan	F	Colorado	68,205	68,205	68,205	68,205	68,205	68,205
		Rio Grande	28	28	28	28	28	28
		Total	**68,233**	**68,233**	**68,233**	**68,233**	**68,233**	**68,233**
Real	J	Colorado	277	277	277	277	277	277
		Guadalupe	3	3	3	3	3	3
		Nueces	7,243	7,243	7,243	7,243	7,243	7,243
		Total	**7,523**	**7,523**	**7,523**	**7,523**	**7,523**	**7,523**
Schleicher	F	Colorado	6,403	6,403	6,403	6,403	6,403	6,403
		Rio Grande	1,631	1,631	1,631	1,631	1,631	1,631
		Total	**8,034**	**8,034**	**8,034**	**8,034**	**8,034**	**8,034**
Sterling	F	Colorado	2,495	2,495	2,495	2,495	2,495	2,495
		Total	**2,495**	**2,495**	**2,495**	**2,495**	**2,495**	**2,495**
Sutton	F	Colorado	388	388	388	388	388	388
		Rio Grande	6,022	6,022	6,022	6,022	6,022	6,022
		Total	**6,410**	**6,410**	**6,410**	**6,410**	**6,410**	**6,410**
Taylor	G	Brazos	331	331	331	331	331	331
		Colorado	158	158	158	158	158	158
		Total	**489**	**489**	**489**	**489**	**489**	**489**
Terrell	E	Rio Grande	1,420	1,420	1,420	1,420	1,420	1,420
		Total	**1,420**	**1,420**	**1,420**	**1,420**	**1,420**	**1,420**
Tom Green	F	Colorado	2,797	2,797	2,797	2,797	2,797	2,797
		Total	**2,797**	**2,797**	**2,797**	**2,797**	**2,797**	**2,797**

TABLE 6. (CONTINUED).

County	RWPA	River Basin	Year					
			2020	2030	2040	2050	2060	2070
Upton	F	Colorado	21,243	21,243	21,243	21,243	21,243	21,243
		Rio Grande	1,126	1,126	1,126	1,126	1,126	1,126
		Total	**22,369**	**22,369**	**22,369**	**22,369**	**22,369**	**22,369**
Uvalde	L	Nueces	1,993	1,993	1,993	1,993	1,993	1,993
		Total	**1,993**	**1,993**	**1,993**	**1,993**	**1,993**	**1,993**
Val Verde	J	Rio Grande	50,000	50,000	50,000	50,000	50,000	50,000
		Total	**50,000**	**50,000**	**50,000**	**50,000**	**50,000**	**50,000**
GMA 7			479,063	479,063	479,063	479,063	479,063	479,063

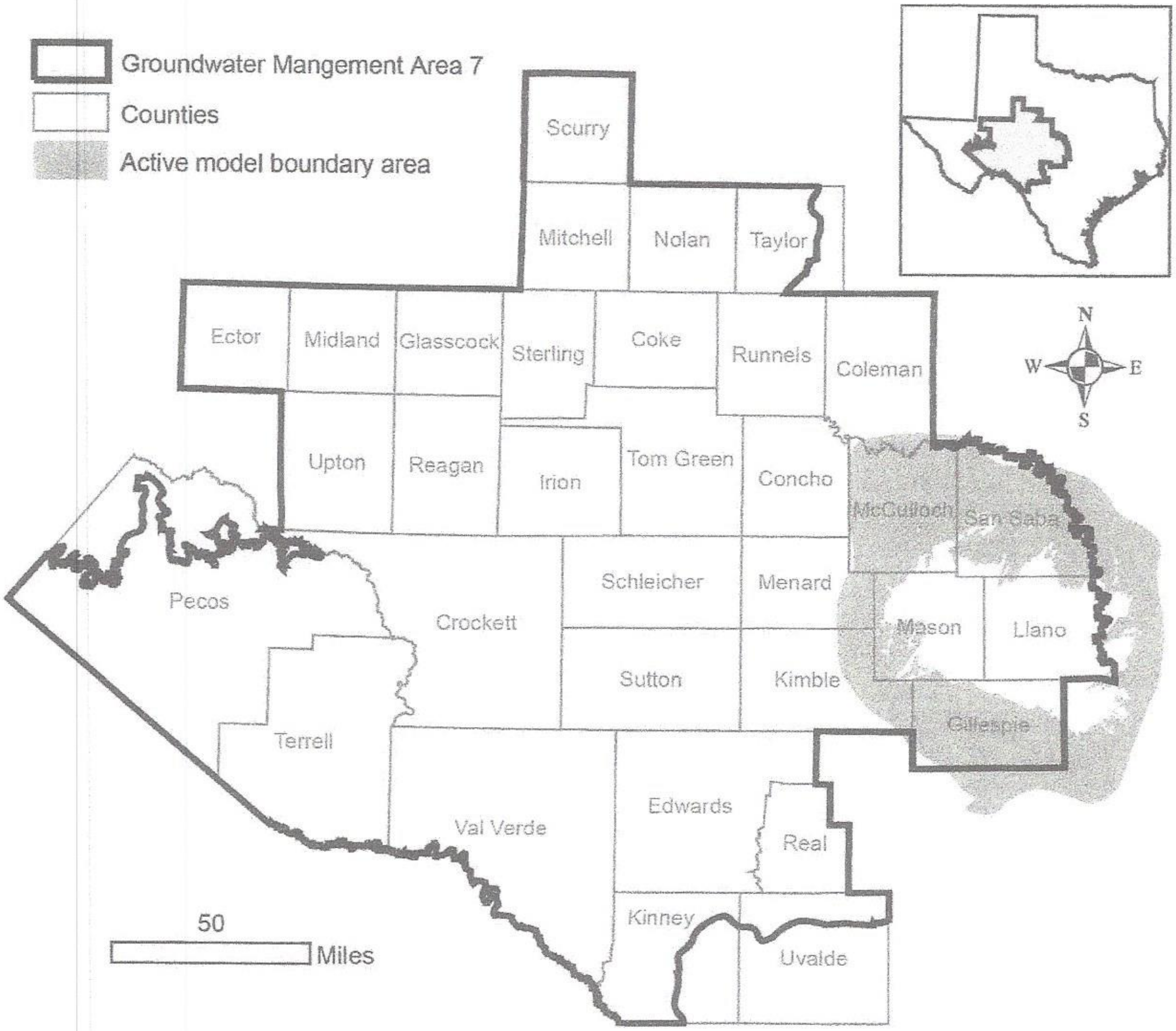

FIGURE 9. **MAP SHOWING THE AREAS COVERED BY THE ELLENBURGER-SAN SABA AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL FOR THE MINOR AQUIFERS OF THE LLANO UPLIFT AREA IN GROUNDWATER MANAGEMENT AREA 7.**

TABLE 7. MODELED AVAILABLE GROUNDWATER FOR THE ELLENBURGER-SAN SABA AQUIFER IN GROUNDWATER MANAGEMENT AREA 7 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2011 AND 2070. RESULTS ARE IN ACRE-FEET PER YEAR. UWCD IS THE ABBREVIATION FOR UNDERGROUND WATER CONSERVATION DISTRICT AND UWD IS UNDERGROUND WATER DISTRICT.

District	County	Year						
		2011	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Hickory UWCD No. 1	Kimble	344	344	344	344	344	344	344
	Mason	3,237	3,237	3,237	3,237	3,237	3,237	3,237
	McCulloch	3,466	3,466	3,466	3,466	3,466	3,466	3,466
	Menard	282	282	282	282	282	282	282
	San Saba	5,559	5,559	5,559	5,559	5,559	5,559	5,559
	Total	**12,887**	**12,887**	**12,887**	**12,887**	**12,887**	**12,887**	**12,887**
Hill Country UWCD	Gillespie	6,294	6,294	6,294	6,294	6,294	6,294	6,294
	Total	**6,294**	**6,294**	**6,294**	**6,294**	**6,294**	**6,294**	**6,294**
Kimble County GCD	Kimble	178	178	178	178	178	178	178
	Total	**178**	**178**	**178**	**178**	**178**	**178**	**178**
Menard County UWD	Menard	27	27	27	27	27	27	27
	Total	**27**	**27**	**27**	**27**	**27**	**27**	**27**
No District	McCulloch	898	898	898	898	898	898	898
	San Saba	2,331	2,331	2,331	2,331	2,331	2,331	2,331
	Total	**3,229**	**3,229**	**3,229**	**3,229**	**3,229**	**3,229**	**3,229**
GMA 7		**22,616**	**22,616**	**22,616**	**22,616**	**22,616**	**22,616**	**22,616**

Note: The year 2011 is used because the 2010 desired future condition baseline year for the Ellenburger-San Saba Aquifer is an initial condition in the predictive model run.

TABLE 8. MODELED AVAILABLE GROUNDWATER FOR THE ELLENBURGER-SAN SABA AQUIFER IN GROUNDWATER MANAGEMENT AREA 7 SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN FOR EACH DECADE BETWEEN 2020 AND 2070. RESULTS ARE IN ACRE-FEET PER YEAR.

County	RWPA	River Basin	Year					
			2020	2030	2040	2050	2060	2070
		Colorado	6,294	6,294	6,294	6,294	6,294	6,294
Gillespie	K	**Total**	**6,294**	**6,294**	**6,294**	**6,294**	**6,294**	**6,294**
		Colorado	521	521	521	521	521	521
Kimble	F	**Total**	**521**	**521**	**521**	**521**	**521**	**521**
		Colorado	3,237	3,237	3,237	3,237	3,237	3,237
Mason	F	**Total**	**3,237**	**3,237**	**3,237**	**3,237**	**3,237**	**3,237**
		Colorado	4,364	4,364	4,364	4,364	4,364	4,364
McCulloch	F	**Total**	**4,364**	**4,364**	**4,364**	**4,364**	**4,364**	**4,364**
		Colorado	309	309	309	309	309	309
Menard	F	**Total**	**309**	**309**	**309**	**309**	**309**	**309**
		Colorado	7,890	7,890	7,890	7,890	7,890	7,890
San Saba	K	**Total**	**7,890**	**7,890**	**7,890**	**7,890**	**7,890**	**7,890**
GMA 7			**22,616**	**22,616**	**22,616**	**22,616**	**22,616**	**22,616**

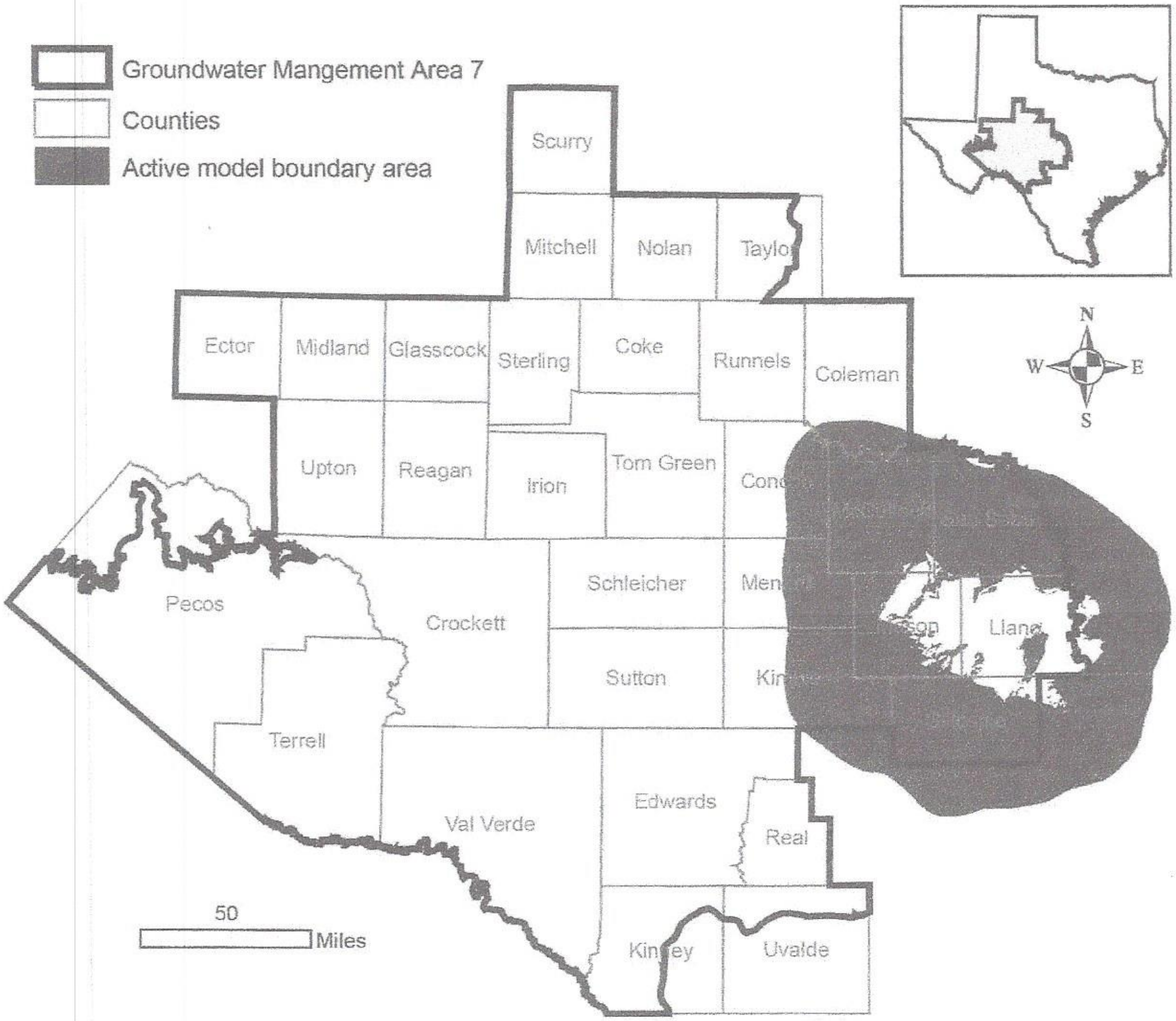

FIGURE 10. MAP SHOWING AREAS COVERED BY THE HICKORY AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL FOR THE MINOR AQUIFERS OF THE LLANO UPLIFT AREA IN GROUNDWATER MANAGEMENT AREA 7.

TABLE 9. MODELED AVAILABLE GROUNDWATER FOR THE HICKORY AQUIFER IN GROUNDWATER MANAGEMENT AREA 7 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2011 AND 2070. RESULTS ARE IN ACRE-FEET PER YEAR. UWCD IS THE ABBREVIATION FOR UNDERGROUND WATER CONSERVATION DISTRICT AND UWD IS UNDERGROUND WATER DISTRICT.

District	County	Year						
		2011	2020	2030	2040	2050	2060	2070
Hickory UWCD No. 1	Concho	13	13	13	13	13	13	13
	Kimble	42	42	42	42	42	42	42
	Mason	13,212	13,212	13,212	13,212	13,212	13,212	13,212
	McCulloch	21,950	21,950	21,950	21,950	21,950	21,950	21,950
	Menard	2,600	2,600	2,600	2,600	2,600	2,600	2,600
	San Saba	7,027	7,027	7,027	7,027	7,027	7,027	7,027
	Total	**44,843**	**44,843**	**44,843**	**44,843**	**44,843**	**44,843**	**44,843**
Hill Country UWCD	Gillespie	1,751	1,751	1,751	1,751	1,751	1,751	1,751
	Total	**1,751**	**1,751**	**1,751**	**1,751**	**1,751**	**1,751**	**1,751**
Kimble County GCD	Kimble	123	123	123	123	123	123	123
	Total	**123**	**123**	**123**	**123**	**123**	**123**	**123**
Lipan-Kickapoo WCD	Concho	13	13	13	13	13	13	13
	Total	**13**	**13**	**13**	**13**	**13**	**13**	**13**
Menard County UWD	Menard	126	126	126	126	126	126	126
	Total	**126**	**126**	**126**	**126**	**126**	**126**	**126**
No District	McCulloch	2,427	2,427	2,427	2,427	2,427	2,427	2,427
	San Saba	652	652	652	652	652	652	652
	Total	**3,080**	**3,080**	**3,080**	**3,080**	**3,080**	**3,080**	**3,080**
GMA 7		**49,936**	**49,936**	**49,936**	**49,936**	**49,936**	**49,936**	**49,936**

Note: The year 2011 is used because the 2010 desired future condition baseline year for the Hickory Aquifer is an initial condition in the predictive model run.

TABLE 10. MODELED AVAILABLE GROUNDWATER FOR THE HICKORY AQUIFER IN GROUNDWATER MANAGEMENT AREA 7 SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN FOR EACH DECADE BETWEEN 2020 AND 2070. RESULTS ARE IN ACRE-FEET PER YEAR.

County	RWPA	River Basin	Year					
			2020	2030	2040	2050	2060	2070
Concho	F	Colorado	27	27	27	27	27	27
		Total	**27**	**27**	**27**	**27**	**27**	**27**
Gillespie	K	Colorado	1,751	1,751	1,751	1,751	1,751	1,751
		Total	**1,751**	**1,751**	**1,751**	**1,751**	**1,751**	**1,751**
Kimble	F	Colorado	165	165	165	165	165	165
		Total	**165**	**165**	**165**	**165**	**165**	**165**
Mason	F	Colorado	13,212	13,212	13,212	13,212	13,212	13,212
		Total	**13,212**	**13,212**	**13,212**	**13,212**	**13,212**	**13,212**
McCulloch	F	Colorado	24,377	24,377	24,377	24,377	24,377	24,377
		Total	**24,377**	**24,377**	**24,377**	**24,377**	**24,377**	**24,377**
Menard	F	Colorado	2,725	2,725	2,725	2,725	2,725	2,725
		Total	**2,725**	**2,725**	**2,725**	**2,725**	**2,725**	**2,725**
San Saba	K	Colorado	7,680	7,680	7,680	7,680	7,680	7,680
		Total	**7,680**	**7,680**	**7,680**	**7,680**	**7,680**	**7,680**
GMA 7			**49,936**	**49,936**	**49,936**	**49,936**	**49,936**	**49,936**

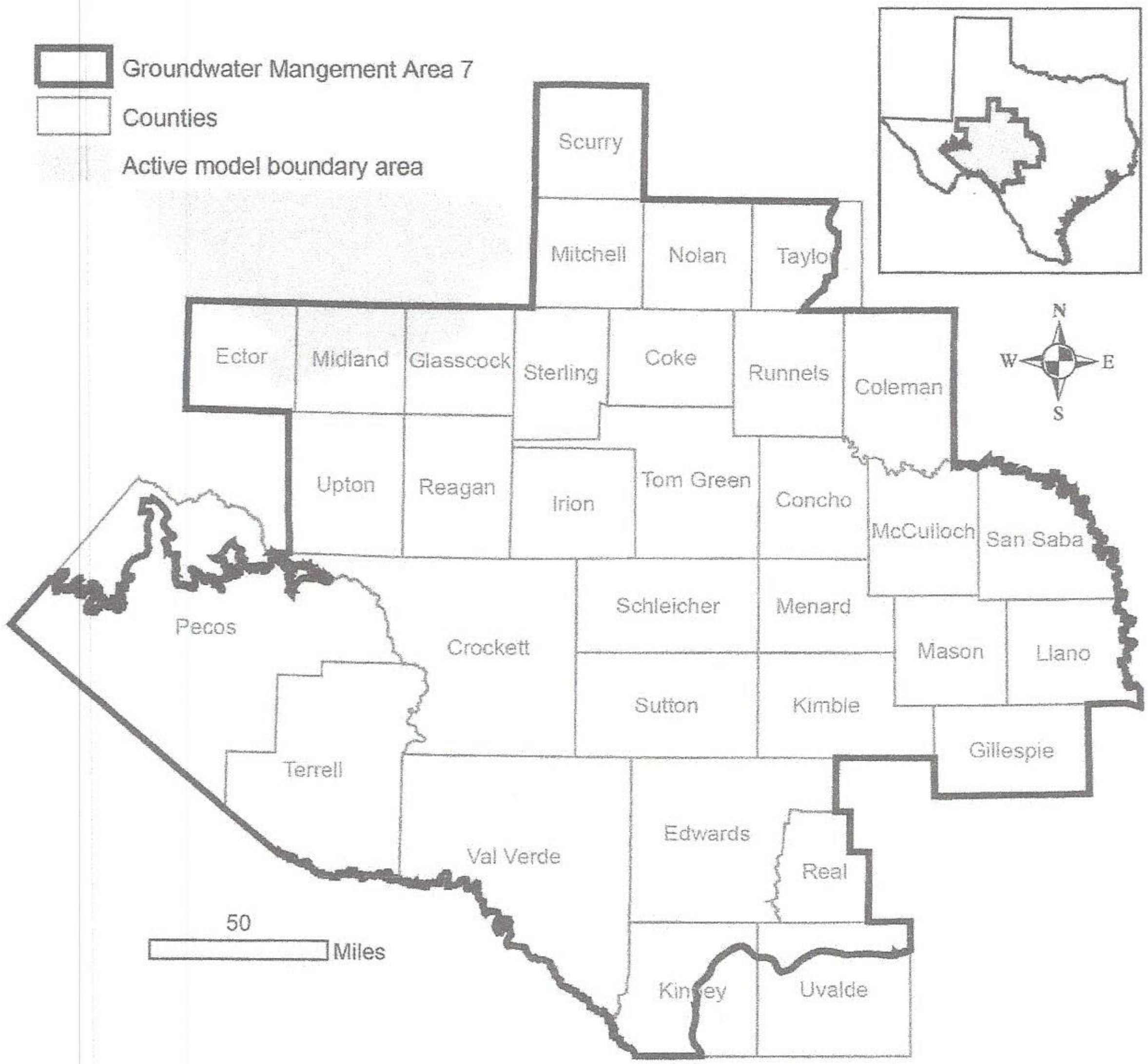

FIGURE 11. **MAP SHOWING THE AREAS COVERED BY THE OGALLALA AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL FOR THE HIGH PLAINS AQUIFER SYSTEM IN GROUNDWATER MANAGEMENT AREA 7.**

TABLE 11. MODELED AVAILABLE GROUNDWATER FOR THE OGALLALA AQUIFER IN GROUNDWATER MANAGEMENT AREA 7 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2013 AND 2070. RESULTS ARE IN ACRE-FEET PER YEAR.

District	County	Year						
		2013	2020	2030	2040	2050	2060	2070
Glasscock GCD	Glasscock	8,019	7,925	7,673	7,372	7,058	6,803	6,570
	Total	**8,019**	**7,925**	**7,673**	**7,372**	**7,058**	**6,803**	**6,570**
GMA 7		**8,019**	**7,925**	**7,673**	**7,372**	**7,058**	**6,803**	**6,570**

Note: The year 2013 is used because the 2012 desired future condition baseline year for the Ogallala Aquifer is an initial condition in the predictive model run.

TABLE 12. MODELED AVAILABLE GROUNDWATER FOR THE OGALLALA AQUIFER IN GROUNDWATER MANAGEMENT AREA 7 SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN FOR EACH DECADE BETWEEN 2020 AND 2070. RESULTS ARE IN ACRE-FEET PER YEAR.

County	RWPA	River Basin	Year					
			2020	2030	2040	2050	2060	2070
Glasscock	F	Colorado	7,925	7,673	7,372	7,058	6,803	6,570
		Total	**7,925**	**7,673**	**7,372**	**7,058**	**6,803**	**6,570**
GMA 7			**7,925**	**7,673**	**7,372**	**7,058**	**6,803**	**6,570**

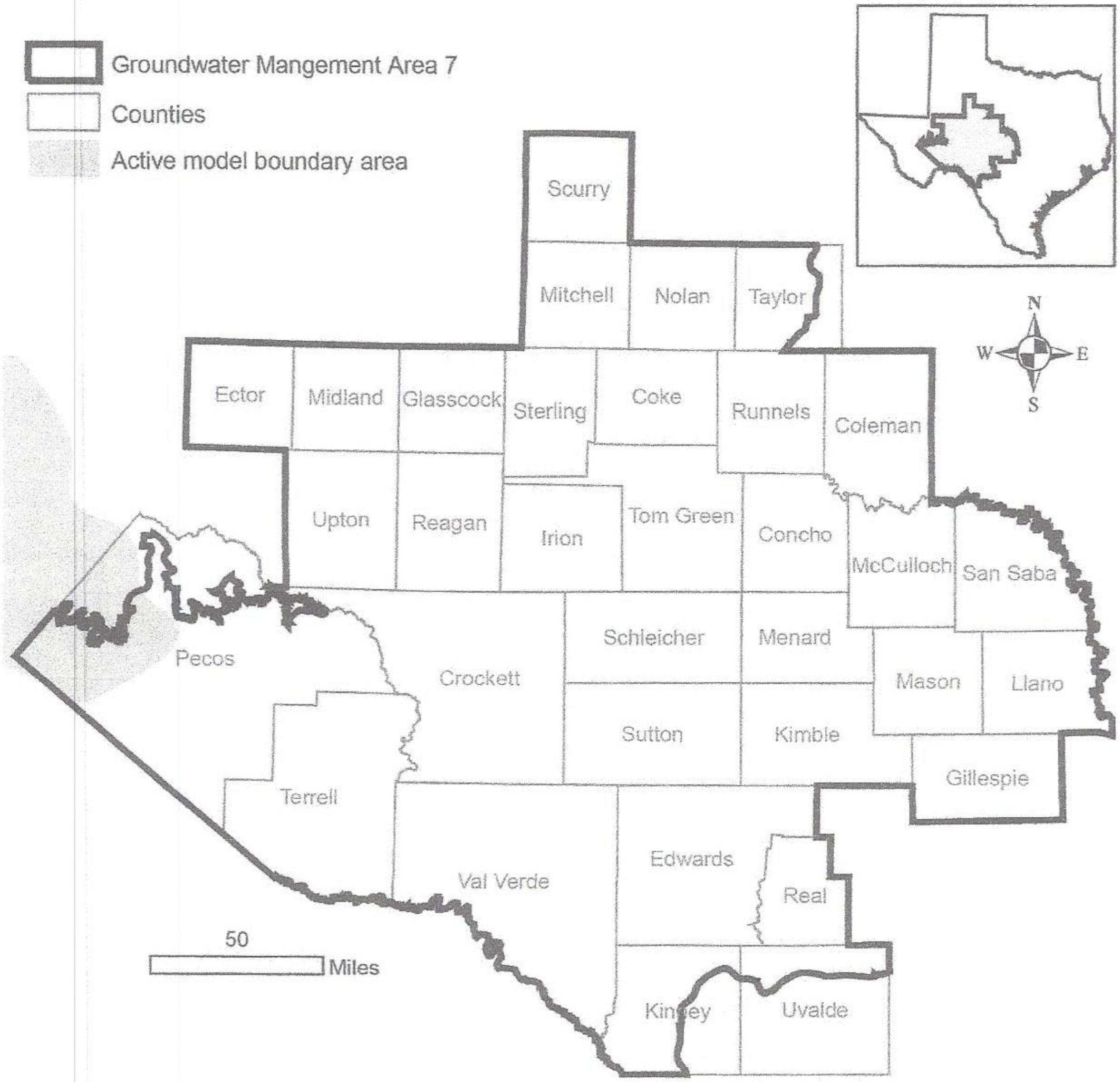

FIGURE 12. **MAP SHOWING AREAS COVERED BY THE RUSTLER AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL FOR THE RUSTLER AQUIFER IN GROUNDWATER MANAGEMENT AREA 7.**

TABLE 13. MODELED AVAILABLE GROUNDWATER FOR THE RUSTLER AQUIFER IN GROUNDWATER MANAGEMENT AREA 7 SUMMARIZED BY DISTRICT AND COUNTY FOR EACH DECADE BETWEEN 2009 AND 2070. RESULTS ARE IN ACRE-FEET PER YEAR.

District	County	Year							
		2009	2010	2020	2030	2040	2050	2060	2070
Middle Pecos GCD	Pecos	7,040	7,040	7,040	7,040	7,040	7,040	7,040	7,040
	Total	**7,040**	**7,040**	**7,040**	**7,040**	**7,040**	**7,040**	**7,040**	**7,040**

TABLE 14. MODELED AVAILABLE GROUNDWATER FOR THE RUSTLER AQUIFER IN GROUNDWATER MANAGEMENT AREA 7 SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN FOR EACH DECADE BETWEEN 2020 AND 2070. RESULTS ARE IN ACRE-FEET PER YEAR.

County	RWPA	River Basin	Year					
			2020	2030	2040	2050	2060	2070
Pecos	F	Rio Grande	7,040	7,040	7,040	7,040	7,040	7,040
		Rio Grande	**7,040**	**7,040**	**7,040**	**7,040**	**7,040**	**7,040**

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

Model "Dry" Cells

The predictive model run for this analysis results in water levels in some model cells dropping below the base elevation of the cell during the simulation. In terms of water level, the cells have gone dry. However, as noted in the model assumptions the transmissivity of the cell remains constant and will produce water.

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APPENDIX
B

Estimated Historical Groundwater Use And 2017 State Water Plan Datasets:

Crockett County Groundwater Conservation District

by Stephen Allen
Texas Water Development Board
Groundwater Division
Groundwater Technical Assistance Section
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May 9, 2018

GROUNDWATER MANAGEMENT PLAN DATA:

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

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

The five reports included in this part are:

1. Estimated Historical Groundwater 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 5/9/2018. Although it does not happen frequently, either of these datasets are subject to change pending the availability of more accurate WUS data or an amendment to the 2017 SWP. District personnel must review these datasets and correct any discrepancies in order to ensure approval of their groundwater management plan.

The WUS dataset can be verified at this web address:

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

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

The values presented in the data tables of this report are county-based. In cases where groundwater conservation districts cover only a portion of one or more counties the data values are modified with an apportioning multiplier to create new values that more accurately represent conditions within district boundaries. The multiplier used in the following formula is a land area ratio: (data value * (land area of district in county / land area of county)). For two of the four SWP tables (Projected Surface Water Supplies and Projected Water Demands) only the county-wide water user group (WUG) data values (county other, manufacturing, steam electric power, irrigation, mining and livestock) are modified using the multiplier. WUG values for municipalities, water supply corporations, and utility districts are not apportioned; instead, their full values are retained when they are located within the district, and eliminated when they are located outside (we ask each district to identify these entity locations).

The remaining SWP tables (Projected Water Supply Needs and Projected Water Management Strategies) are not modified because district-specific values are not statutorily required. Each district needs only "consider" the county values in these tables.

In the WUS table every category of water use (including municipal) is apportioned. Staff determined that breaking down the annual municipal values into individual WUGs was too complex.

TWDB recognizes that the apportioning formula used is not perfect but it is the best available process with respect to time and staffing constraints. If a district believes it has data that is more accurate it can add those data to the plan with an explanation of how the data were derived. Apportioning percentages that the TWDB used are listed above each applicable table.

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 2016. TWDB staff anticipates the calculation and posting of these estimates at a later date.

CROCKETT COUNTY *99.94% (multiplier)* All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2015	GW	1,175	30	1,322	0	16	425	2,968
	SW	0	0	0	0	0	22	22
2014	GW	1,401	8	2,784	0	21	420	4,634
	SW	0	0	0	0	0	22	22
2013	GW	1,367	13	2,688	0	16	468	4,552
	SW	0	0	0	0	0	24	24
2012	GW	1,497	14	1,612	0	208	497	3,828
	SW	0	0	0	0	0	27	27
2011	GW	1,747	14	464	0	284	553	3,062
	SW	0	0	89	0	0	30	119
2010	GW	1,418	10	123	0	148	562	2,261
	SW	0	0	23	0	0	30	53
2009	GW	1,400	9	188	0	0	611	2,208
	SW	0	0	33	0	0	32	65
2008	GW	1,312	18	258	0	363	618	2,569
	SW	0	0	44	0	0	32	76
2007	GW	1,290	18	25	0	381	637	2,351
	SW	0	0	0	0	0	34	34
2006	GW	1,293	18	40	0	485	647	2,483
	SW	0	0	0	0	0	34	34
2005	GW	1,297	14	49	0	427	613	2,400
	SW	0	0	0	0	0	32	32
2004	GW	1,194	14	50	0	315	492	2,065
	SW	0	0	0	0	0	163	163
2003	GW	1,205	14	50	647	376	439	2,731
	SW	0	0	0	0	0	145	145
2002	GW	1,306	14	42	907	195	520	2,984
	SW	0	0	0	0	0	172	172
2001	GW	1,229	14	22	907	214	577	2,963
	SW	0	0	0	0	0	190	190
2000	GW	1,549	14	31	937	160	614	3,305
	SW	0	0	0	0	0	153	153

Projected Surface Water Supplies
TWDB 2017 State Water Plan Data

CROCKETT COUNTY *99.94% (multiplier)* All values are in acre-feet

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070
F	LIVESTOCK, CROCKETT	COLORADO	COLORADO LIVESTOCK LOCAL SUPPLY	11	11	11	11	11	11
F	LIVESTOCK, CROCKETT	RIO GRANDE	RIO GRANDE LIVESTOCK LOCAL SUPPLY	127	127	127	127	127	127
	Sum of Projected Surface Water Supplies (acre-feet)			**138**	**138**	**138**	**138**	**138**	**138**

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.

CROCKETT COUNTY *99.94% (multiplier)* All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
F	COUNTY-OTHER, CROCKETT	RIO GRANDE	28	20	19	18	17	17
F	CROCKETT COUNTY WCID #1	RIO GRANDE	1,533	1,642	1,655	1,672	1,678	1,681
F	IRRIGATION, CROCKETT	COLORADO	12	12	12	12	12	11
F	IRRIGATION, CROCKETT	RIO GRANDE	467	458	449	443	434	426
F	LIVESTOCK, CROCKETT	COLORADO	18	18	18	18	18	18
F	LIVESTOCK, CROCKETT	RIO GRANDE	663	663	663	663	663	663
F	MINING, CROCKETT	RIO GRANDE	1,731	1,842	1,260	682	207	63
F	STEAM ELECTRIC POWER, CROCKETT	RIO GRANDE	776	906	1,066	1,261	1,499	1,661
	Sum of Projected Water Demands (acre-feet)		**5,228**	**5,561**	**5,142**	**4,769**	**4,528**	**4,540**

Projected Water Supply Needs
TWDB 2017 State Water Plan Data

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

CROCKETT COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
F	COUNTY-OTHER, CROCKETT	RIO GRANDE	0	0	0	0	0	0
F	CROCKETT COUNTY WCID #1	RIO GRANDE	0	0	0	0	0	0
F	IRRIGATION, CROCKETT	COLORADO	0	0	0	0	0	1
F	IRRIGATION, CROCKETT	RIO GRANDE	0	0	0	0	0	-1
F	LIVESTOCK, CROCKETT	COLORADO	0	0	0	0	0	0
F	LIVESTOCK, CROCKETT	RIO GRANDE	14	14	14	14	14	14
F	MINING, CROCKETT	RIO GRANDE	-1,182	-1,293	-711	-132	0	0
F	STEAM ELECTRIC POWER, CROCKETT	RIO GRANDE	-776	-907	-1,067	-1,262	-1,500	-1,662
	Sum of Projected Water Supply Needs (acre-feet)		**-1,958**	**-2,200**	**-1,778**	**-1,394**	**-1,500**	**-1,663**

Projected Water Management Strategies
TWDB 2017 State Water Plan Data

CROCKETT COUNTY

WUG, Basin (RWPG)

All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
CROCKETT COUNTY WCID #1, RIO GRANDE (F)							
MUNICIPAL CONSERVATION - CROCKETT COUNTY WCID	DEMAND REDUCTION [CROCKETT]	21	23	23	24	24	24
		21	**23**	**23**	**24**	**24**	**24**
IRRIGATION, CROCKETT, COLORADO (F)							
IRRIGATION CONSERVATION - CROCKETT COUNTY	DEMAND REDUCTION [CROCKETT]	1	1	2	2	2	2
WEATHER MODIFICATION	WEATHER MODIFICATION [ATMOSPHERE]	1	1	1	1	1	1
		2	**2**	**3**	**3**	**3**	**3**
IRRIGATION, CROCKETT, RIO GRANDE (F)							
IRRIGATION CONSERVATION - CROCKETT COUNTY	DEMAND REDUCTION [CROCKETT]	23	46	67	67	67	67
WEATHER MODIFICATION	WEATHER MODIFICATION [ATMOSPHERE]	8	8	8	8	8	8
		31	**54**	**75**	**75**	**75**	**75**
MINING, CROCKETT, RIO GRANDE (F)							
MINING CONSERVATION - CROCKETT COUNTY	DEMAND REDUCTION [CROCKETT]	121	129	88	48	14	4
REUSE - MINING, CROCKETT - SALES FROM CROCKETT WCID #1	DIRECT REUSE [CROCKETT]	75	75	75	75	75	75
		196	**204**	**163**	**123**	**89**	**79**
STEAM ELECTRIC POWER, CROCKETT, RIO GRANDE (F)							
DEVELOP ADDITIONAL EDWARDS-TRINITY PLATEAU AQUIFER SUPPLIES - CROCKETT COUNTY SEP	EDWARDS-TRINITY-PLATEAU AQUIFER [CROCKETT]	776	907	1,067	1,262	1,500	1,662
		776	**907**	**1,067**	**1,262**	**1,500**	**1,662**
Sum of Projected Water Management Strategies (acre-feet)		**1,026**	**1,190**	**1,331**	**1,487**	**1,691**	**1,843**

Guidelines for a successful groundwater district management plan pre-review by TWDB staff

Please number the pages of your groundwater management plan so TWDB reviewers have a page number to refer to when preparing your recommendation report.

A table of contents is not required but if you use one please ensure that all the page numbers are correct.

Please provide a contact page with the official address, contact email, and phone number for the person responsible for ongoing correspondence during the pre-review process. Please indicate if a consultant hired by the district is to be responsible for correspondence with TWDB staff.

Consider organizing the plan to match the order of the required items on the TWDB review checklist. This will speed up our review and is helpful with audits that may be conducted by the State Auditor's Office.

If you have a web link to your rules we recommend you include it in the Actions, procedures, performance, and avoidance... section of the plan (checklist item 11).

When presenting each management goal in the plan please consider using the identical language you see in the first column of the review checklist for each goal heading. These items are directly from statute. If a goal is not applicable please state explicitly "this goal is not applicable" and provide reasons why.

If your MAG values have not been received from the TWDB, and your plan is due, please present the current MAGs in your plan and then append the plan with the new MAGs when they are available from the TWDB.

Please review your plan for errors before sending it to us, for example: dates, spelling, format, grammar, sentence completion, and correct statutory references (if used). Our primary role is to ensure your plan is ready to be administratively complete and, as a courtesy, provide additional input to improve your plan. Our task is not to act as the primary proofreaders for your management plan. And as always, please run spell and grammar check on the plan.

Always use the most current <u>estimated historical water use</u> and <u>state water plan</u> data which is found in the data packet we send you approximately six months before your plan's expiration date, because some plans are still submitted with old data from previous state water plans. We are currently on the 2017 State Water Plan, so this is the data that should be used.

We prefer that you insert the TWDB provided GAM management plan reports, MAG reports, and estimated historical water use /2017 state water plan report as appendices and then refer the reader to them from within the text. If these are inserted as appendices and referenced in the text, you will automatically fulfill the requirements of items 1-9 in the management plan review checklist. That's 80% of page one of the review checklist! If you create your own tables of values from our reports, experience tells us that there will be errors in your tables, which need to be corrected. So, make sure you triple-check your user created tables before you submit them.

Because we work with almost 100 groundwater conservation districts, please identify all email correspondence by stating in the subject box something like "Groundwater Management Plan – Texas Country GCD". This way we can easily search for correspondence with your district when needed. And when we are actively working on a review we may trade numerous emails with a district. Please use a single email thread so we can easily see the whole history of our communication in one thread.

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.*

Texas Water Use Estimates

2014 Summary

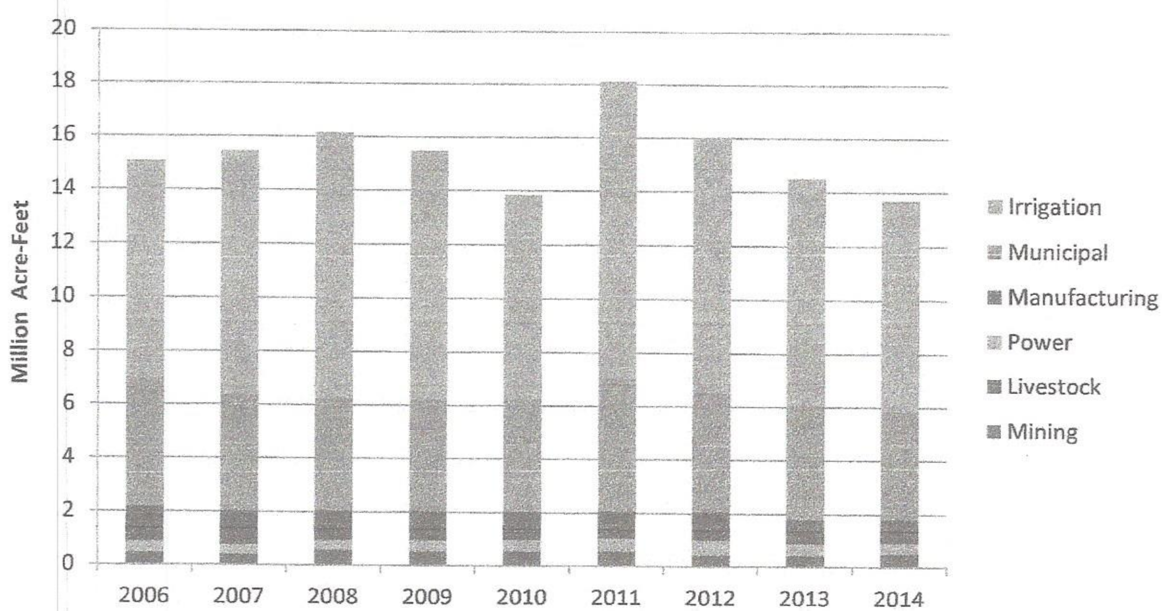
Updated September 6, 2016

The Texas Water Development Board Water Use Survey program conducts an annual survey of about 4,300 public water systems and 2,000 industrial facilities. The water use survey collects the volume of both ground and surface water used, the source of the water, water sales, and other pertinent data from the users. This data provides an important source of information in helping guide water supply studies as well as regional and state water planning that is dependent upon the accuracy and completeness of the information water users provide.

Of the approximately 6,300 systems/facilities surveyed, 84% submitted their water use survey for 2014 water use. This represents about 90% of the total surveyed water use in the state. For those systems/facilities that did not submit their survey, estimates were carried-over from the most current available year. Estimates are also revised as additional or more accurate data becomes available through survey responses.

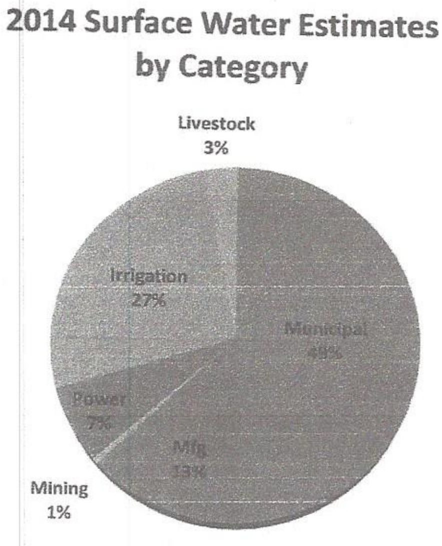
2014 Estimated Annual Statewide Water Use

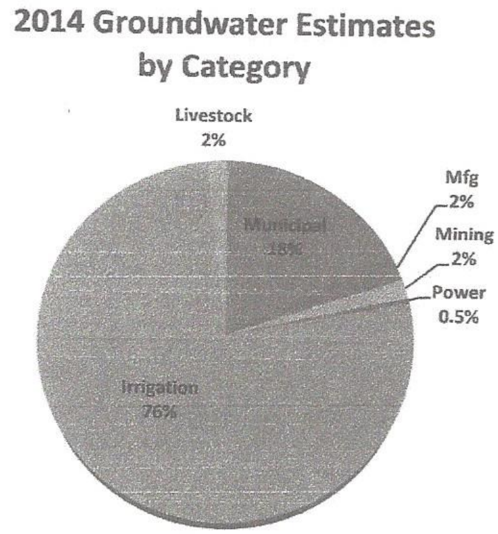
Total estimated water use for 2014 was about 13.70 million acre-feet *(1 acre-foot = 325,851 gallons)* and was down from 2013 which was estimated at about 14.49 million acre-feet. Compared with 2013, the total 2014 estimated municipal water use decreased from 4.28 million acre-feet to 4.09 million acre-feet. Below is a breakdown of the categorical estimated uses from 2006 to 2014. Irrigation water use **(58%)** topped the largest water use category in the State in 2014 with an estimated 7.83 million acre-feet. Municipal water use **(30%)** was the second largest water use category with an estimated 4.09 million acre-feet. Manufacturing **(6%)**, Power **(3%)**, Livestock **(2%)**, and Mining **(1%)** estimated water use collectively comprised about 1.78 million acre-feet.



2014 Surface & Groundwater Use Estimates

Approximately **62%** of the 2014 estimated water use in Texas was from **groundwater** sources (about 8.42 million acre-feet) with the remaining **38%** from **surface water** sources (about 5.27 million acre-feet). The two graphs below illustrate the categorical differences in use between surface water and groundwater sources.





Detailed reports of historical water use estimates and historical groundwater pumpage in Texas can be found at:

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

http://www.twdb.texas.gov/waterplanning/waterusesurvey/historical-pumpage.asp

APPENDIX
C

GAM RUN 17-022: CROCKETT COUNTY GROUNDWATER CONSERVATION DISTRICT GROUNDWATER MANAGEMENT PLAN

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STATE OF TEXAS
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GAM RUN 17-022: CROCKETT COUNTY GROUNDWATER CONSERVATION DISTRICT GROUNDWATER MANAGEMENT PLAN

Ian C. Jones, Ph.D., P.G.
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(512) 463-6641
March 31, 2017

EXECUTIVE SUMMARY:

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

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

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

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

management plan for the Crockett County Groundwater Conservation District expires on December 17, 2018.

We used the groundwater availability models for the Edwards-Trinity (Plateau) Aquifer (Anaya and Jones, 2009) and High Plains Aquifer System (Deeds and Jigmond, 2015) to estimate the management plan information for the aquifers within Crockett County Groundwater Conservation District. This report replaces the results of GAM Run 12-004 (Jones, 2012). GAM Run 17-022 meets current standards set after the release of GAM Run 12-004 and includes information from the groundwater availability model for the High Plains Aquifer System. Tables 1 through 3 summarize the groundwater availability model data required by statute and Figures 1 and 2 show the areas of the respective models from which the values in the tables were extracted. If after reviewing the figures, the Crockett County Groundwater Conservation District determines that the district boundaries used in the assessment do not reflect current conditions, please notify the TWDB at your earliest convenience.

METHODS:

In accordance with the provisions of the Texas State Water Code, Section 36.1071, Subsection (h), the groundwater availability models for the High Plains Aquifer System and the Edwards-Trinity (Plateau) Aquifer were used to estimate information for the Crockett County Groundwater Conservation District management plan. Water budgets were extracted for the respective historical model periods (1929 through 2012, and 1980 through 2000 for the groundwater availability model for the High Plains Aquifer System and Edwards-Trinity (Plateau) Aquifer, respectively) using ZONEBUDGET Version 3.01 (Harbaugh, 2009). The average annual water budget values for recharge, surface-water outflow, inflow to the district, and outflow from the district for the aquifers within the district are summarized in this report.

PARAMETERS AND ASSUMPTIONS:

Dockum Aquifer

- We used version 1.01 of the groundwater availability model for the High Plains Aquifer System. See Deeds and Jigmond (2015) for assumptions and limitations of the model.
- The model was run with MODFLOW-NWT (Niswonger and others, 2011).
- The groundwater availability model for the High Plains Aquifer System contains four layers:

  - Layer 1—the Ogallala Aquifer and the Pecos Valley Alluvium Aquifer
  - Layer 2—the Rita Blanca Aquifer, the Edwards-Trinity (High Plains) Aquifer, the Edwards-Trinity (Plateau) Aquifer, and pass through cells of the Dockum Aquifer
  - Layer 3—the upper Dockum Group and pass through cells of the lower Dockum Group
  - Layer 4—the lower Dockum Group

- While the model for the High Plains Aquifer System includes the Pecos Valley Alluvium and Edwards-Trinity (Plateau) aquifers, the focus of the model run was to extract information for the Dockum Aquifer.

- Perennial rivers and reservoirs were simulated using the MODFLOW-NWT river package. Springs, seeps, and draws were simulated using the MODFLOW-NWT drain package. For this analysis, groundwater discharge to surface water includes groundwater leakage to the river and drain packages.

Edwards-Trinity (Plateau) and Pecos Valley Aquifers

- We used version 1.01 of the groundwater availability model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers. See Anaya and Jones (2009) for assumptions and limitations of the groundwater availability model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers.

- This groundwater availability model includes two layers within Crockett County Groundwater Conservation District, which generally represent the Edwards Group (Layer 1) and the Trinity Group (Layer 2) of the Edwards-Trinity (Plateau) Aquifer. Individual water budgets for the district were determined for the Edwards-Trinity (Plateau) Aquifer (Layer 1 and Layer 2 combined).

- 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 groundwater availability models for the High Plains Aquifer System and the Edwards-Trinity (Plateau) Aquifer within Crockett County Groundwater Conservation District and averaged over the respective historical calibration periods, as shown in Tables 1 through 3.

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

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

The information needed for the district's management plan is summarized in Tables 1 through 3. It is important to note that sub-regional water budgets are not exact. This is due to the size of the model cells and the approach used to extract data from the model. To avoid double accounting, a model cell that straddles a political boundary, such as a district or county boundary, is assigned to one side of the boundary based on the location of the centroid of the model cell. For example, if a cell contains two counties, the cell is assigned to the county where the centroid of the cell is located.

TABLE 1: SUMMARIZED INFORMATION FOR THE EDWARDS-TRINITY (PLATEAU) AQUIFER FOR THE CROCKETT COUNTY GROUNDWATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT.

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Edwards-Trinity (Plateau) Aquifer	43,599
Estimated annual volume of water that discharges from the aquifer to springs and any surface-water body including lakes, streams, and rivers	Edwards-Trinity (Plateau) Aquifer	19,835
Estimated annual volume of flow into the district within each aquifer in the district	Edwards-Trinity (Plateau) Aquifer	23,447
Estimated annual volume of flow out of the district within each aquifer in the district	Edwards-Trinity (Plateau) Aquifer	49,313
Estimated net annual volume of flow between each aquifer in the district	From the Edwards-Trinity (Plateau) Aquifer into the Pecos Valley	1,384
	From the Dockum Aquifer into the Edwards-Trinity (Plateau) Aquifer	512[1]

[1] From the groundwater availability model for the High Plains Aquifer System.

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

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Pecos Valley Aquifer	127
Estimated annual volume of water that discharges from the aquifer to springs and any surface-water body including lakes, streams, and rivers	Pecos Valley Aquifer	3,143
Estimated annual volume of flow into the district within each aquifer in the district	Pecos Valley Aquifer	1,975
Estimated annual volume of flow out of the district within each aquifer in the district	Pecos Valley Aquifer	341
Estimated net annual volume of flow between each aquifer in the district	From the Edwards-Trinity (Plateau) Aquifer into the Pecos Valley	1,384

FIGURE 1: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE EDWARDS-TRINITY (PLATEAU) AQUIFER FROM WHICH THE INFORMATION IN TABLE 1 WAS EXTRACTED (THE EXTENT OF THE EDWARDS-TRINITY (PLATEAU) AND PECOS VALLEY AQUIFERS WITHIN THE DISTRICT BOUNDARY).

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

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Dockum Aquifer	0
Estimated annual volume of water that discharges from the aquifer to springs and any surface-water body including lakes, streams, and rivers	Dockum Aquifer	0
Estimated annual volume of flow into the district within each aquifer in the district	Dockum Aquifer	510
Estimated annual volume of flow out of the district within each aquifer in the district	Dockum Aquifer	18
Estimated net annual volume of flow between each aquifer in the district	From the Dockum Aquifer into the Edwards-Trinity (Plateau) Aquifer	512

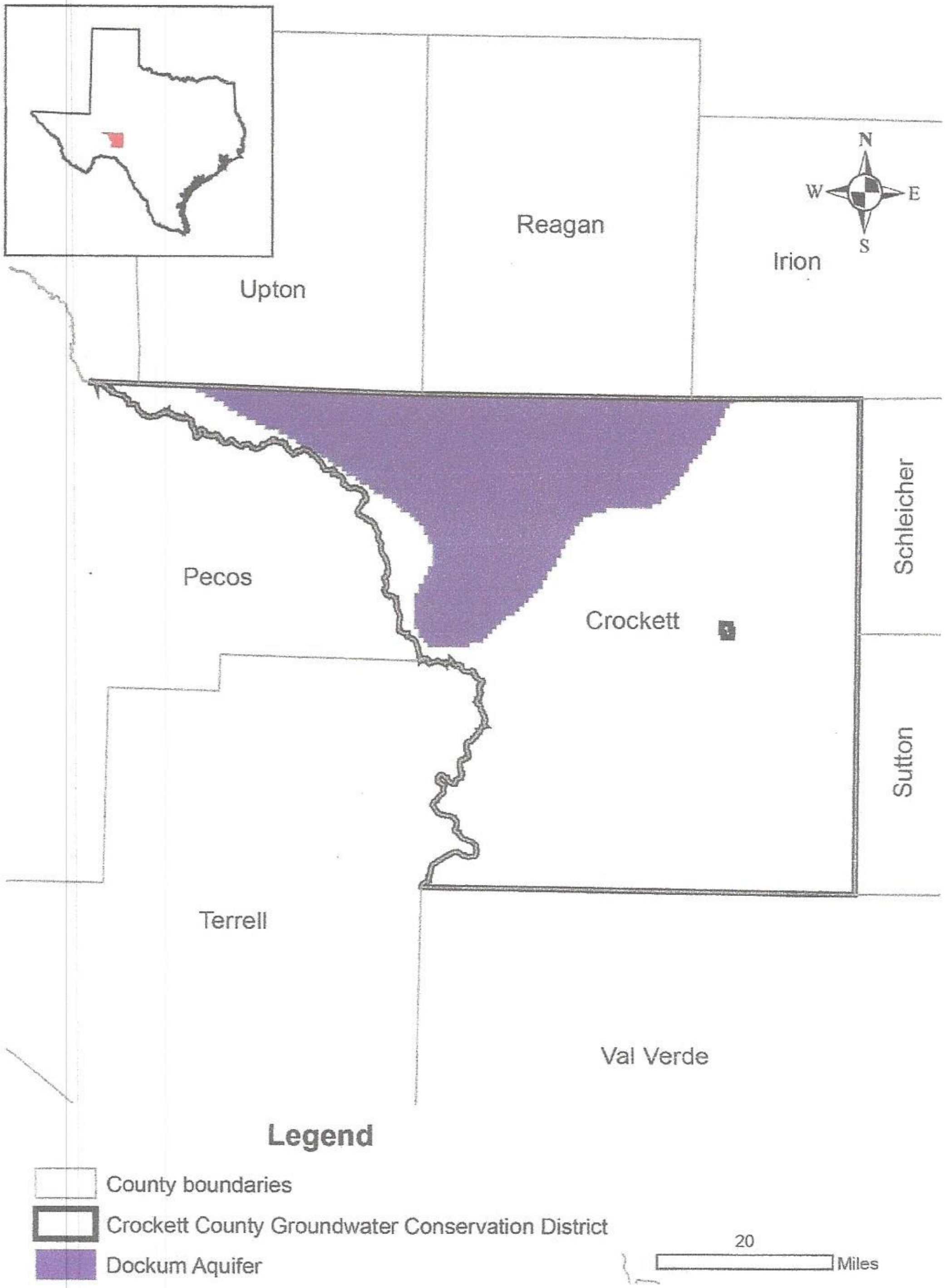

FIGURE 2: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE HIGH PLAINS AQUIFER SYSTEM FROM WHICH THE INFORMATION IN TABLE 2 WAS EXTRACTED (THE DOCKUM AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).

LIMITATIONS:

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

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

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

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

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

REFERENCES:

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APPENDIX
C

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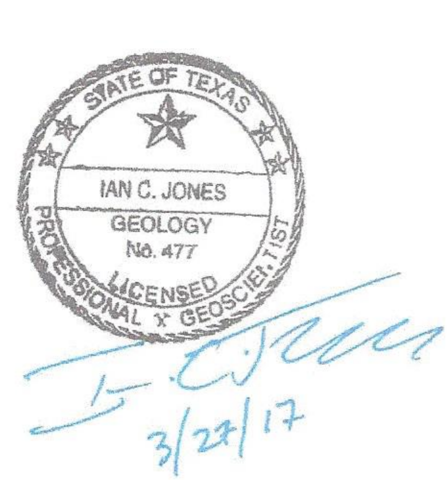

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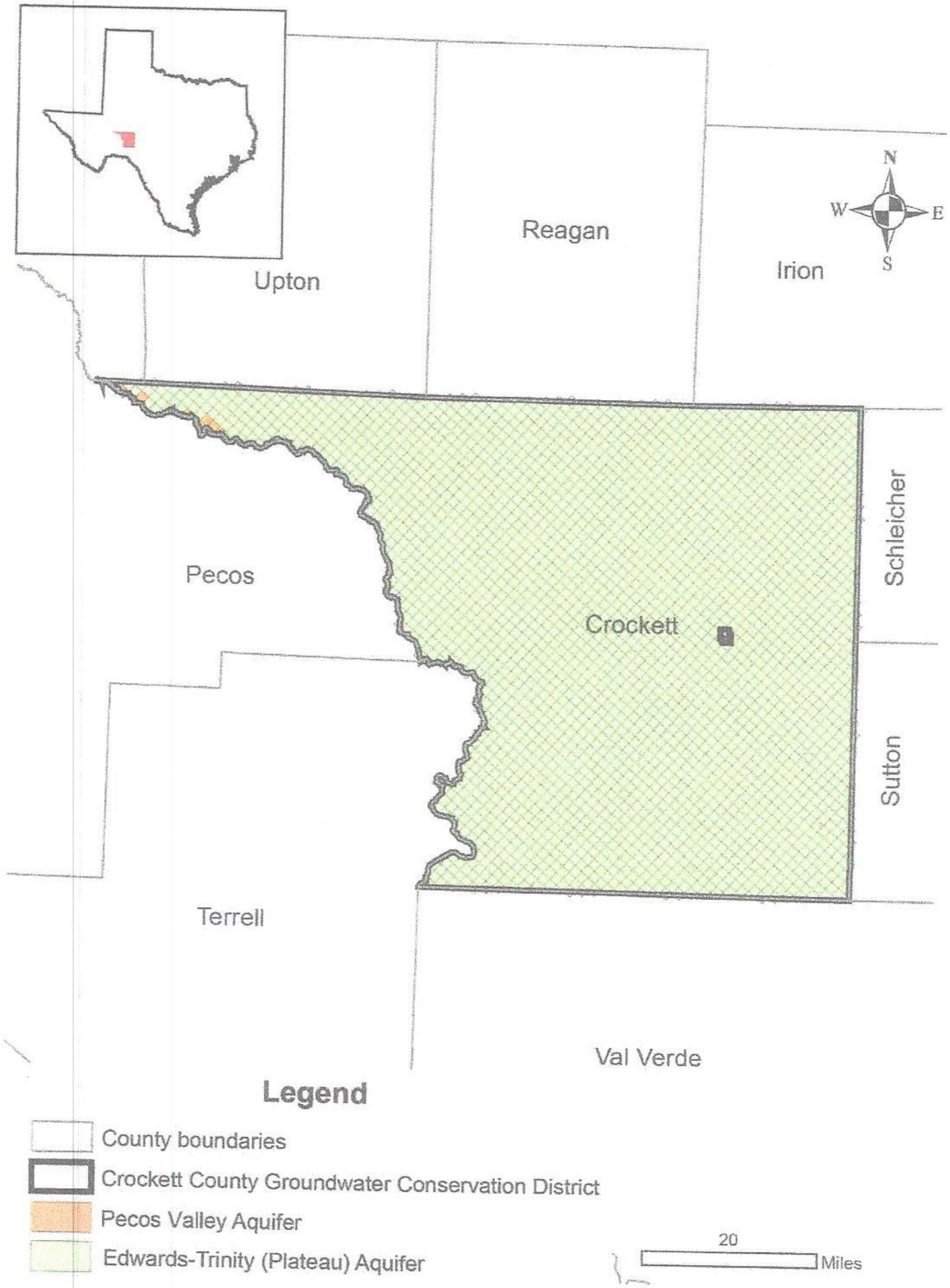

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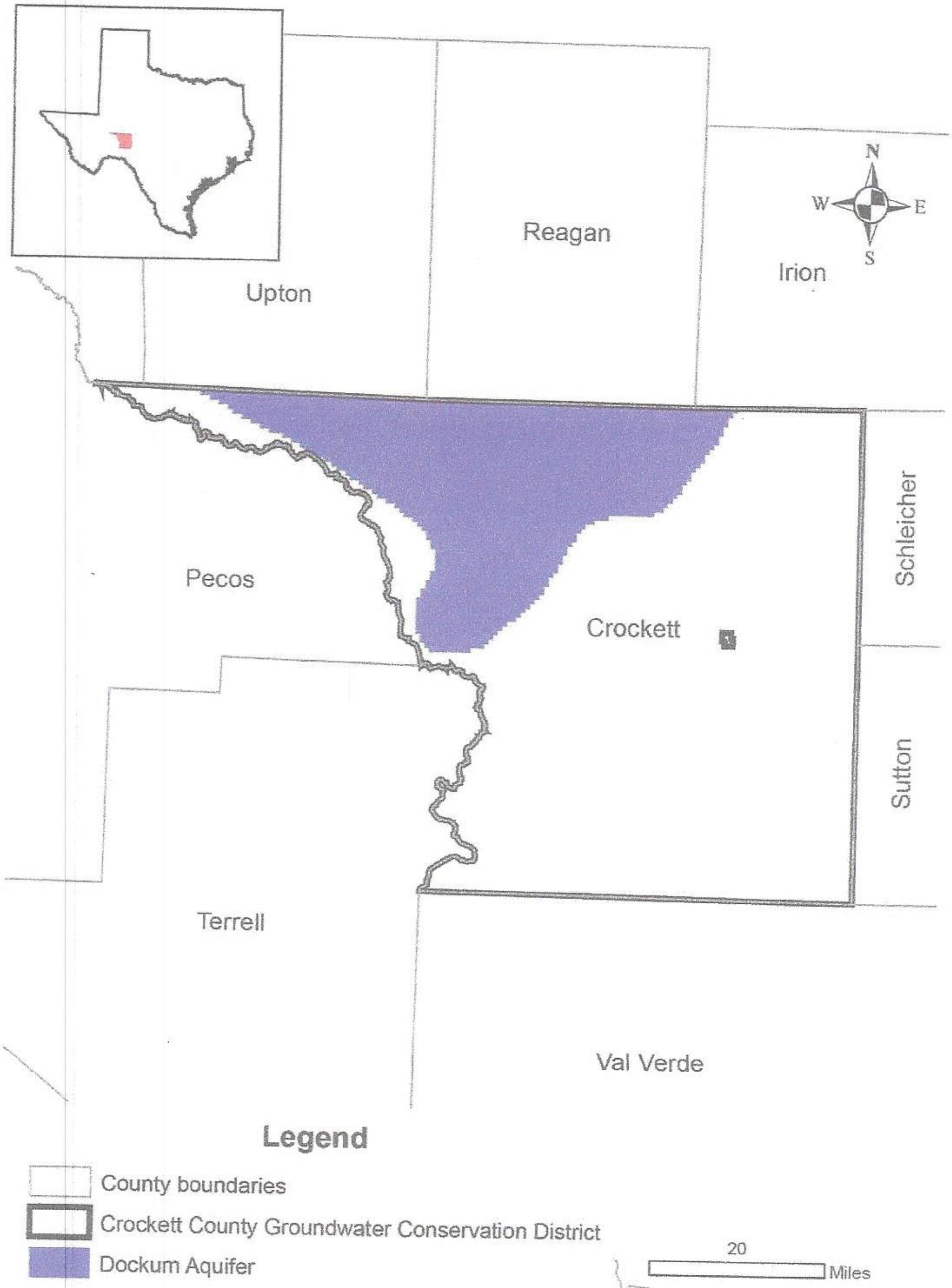

FIGURE 2: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE HIGH PLAINS AQUIFER SYSTEM FROM WHICH THE INFORMATION IN TABLE 2 WAS EXTRACTED (THE DOCKUM AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).

LIMITATIONS:

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