KIMBLE COUNTY GROUNDWATER CONSERVATION DISTRICT

GROUNDWATER MANAGEMENT PLAN

2024 - 2029

Re-Adopted:

July 29, 2024

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CH 1 DISTRICT MISSION & OVERVIEW

1.1 DISTRICT MISSION

The mission of the Kimble County Groundwater Conservation District is to develop, promote, and implement water conservation and management strategies to conserve, preserve, and protect the groundwater supplies of the District, to protect and enhance recharge, prevent waste and pollution, and to promote efficient use of groundwater. The District seeks to maintain groundwater ownership and the rights of the landowners, and their lessees as provided in the Texas Water Code §36.002.

1.2 GUIDING PRINCIPLES

The District provides for the conservation, preservation, protection, recharge and prevention of waste of groundwater resources by consistently adhering to Chapter 36 of the Texas Water Code (TWC). The District conducts administrative and technical activities and programs to achieve these purposes by collecting, archiving water well and aquifer data, regulating water well drilling and production of permitted, non-exempt wells, promoting the capping or plugging of abandoned wells, providing information and educational material, interacting with other governmental or organizational entities, and undertaking other groundwater-related activities that may help meet the purposes of the District.

1.3 TIME PERIOD FOR THIS PLAN

This plan becomes effective upon adoption by the Board of Directors and approval by the Texas Water Development Board executive administrator. This new plan remains in effect for a five-year period or until a revised plan is approved, whichever is earlier.

1.4 GENERAL DESCRIPTION OF THE DISTRICT

The Kimble County Groundwater Conservation District was created by the 77th Texas Legislature (2001) now codified as Chapter 8858 Texas Special District Local Laws Code. The confirmation election was held on May 4, 2002, with the majority of the votes cast in favor of confirming the creation of the District. The District was created to provide for the conservation, preservation, protection, recharge and prevention of waste of the groundwater located in the District. The District is governed by a five-member locally-elected board of directors. The board includes five members from individual precincts, with elections being held every two years.

Location and Extent

The District lies within the Edwards Plateau and consists of approximately 97.45% of the land in Kimble County, Texas, excluding the part of the northeastern corner of the County that is within the boundary of the Hickory Underground Water Conservation District No. 1. The District covers an area of approximately 766,864 acres and ranges in elevation from approximately 1,783 to 2,372 feet above mean seal level. Total population in 2020 was approximately 4,566 including the county seat, the City of Junction.

Topography and Drainage
The District lies within the Colorado River Basin and is bisected by the Llano River which arises, on the North Llano River in Sutton County and, on the South Llano River in Edwards County. The North and South Llano join within the District to become the Llano River at the City of Junction. Within the District there are numerous creeks which are tributaries of the Llano. Drainage of the river is in a generally eastward direction.

1.5 REGIONAL COOPERATION AND COORDINATION

West Texas Regional Groundwater Alliance
Since 1988 the District has been involved in coordination of district activities with other GCD's managing the Edwards-Trinity (Plateau) Aquifer. In 1988, four groundwater conservation districts; Coke County UWCD, Glasscock County UWCD, Irion County WCD, and Sterling County UWCD signed an original Cooperative Agreement. As new districts were created, they too signed the Cooperative Agreement. In the fall of 1996, the original Cooperative Agreement was redrafted, and the West Texas Regional Groundwater Alliance was created. The regional alliance consists of eighteen locally created and funded groundwater conservation districts covering all or part of twenty-two counties, which encompass approximately 18.2 million acres or 28,368 square miles of West Central Texas. This West Texas region is as diverse as the State of Texas. Due to the diversity of this region, each member district provides its own unique programs to best serve its constituents. Current member districts are:

Coke Co. UWCD	Kimble Co. GCD	Plateau UWC & SD
Crockett Co. GCD	Lipan-Kickapoo WCD	Santa Rita UWCD
Glasscock GCD	Lone Wolf GCD	Sterling Co. UWCD
Hickory UWCD # 1	Menard Co. UWD	Sutton Co. UWCD
Hill Country UWCD	Middle Pecos GCD	Reeves County GCD
Irion Co. WCD	Permian Basin UWCD	Wes-Tex GCD

This Alliance was created because the local districts have a common objective: to facilitate the conservation, preservation and protection of groundwater supplies, protection and enhancement of recharge, prevention of waste and pollution, and beneficial use of water and related resources. Local districts monitor water-related activities which include but are not limited to the State's largest industries of farming, ranching and oil and gas production. The alliance provides coordination essential to the activities of these member districts as they monitor these activities in order to accomplish their objectives.

Regional Water Planning
The District has been active in the Region F, Regional Water Planning Group meetings to provide input in developing and adopting the 2001, 2006, 2011 and 2016, and 2021 Regional plans. As the Regional Planning Group moves toward adopting future Regional Plans the District will continue to participate in the planning process.

Groundwater Management Area
Groundwater Management Area 7 covers all or part of thirty-three counties and includes twenty groundwater conservation districts. These GCD's manage groundwater resources at the local level in all

or part of twenty-four counties within GMA 7 and surrounding areas. The District continues to actively participate in meetings and discussions to determine a feasible future desired condition of the aquifers within the management area and district.

CH 2 GROUNDWATER RESOURCES & MANAGEMENT

2.1 GROUNDWATER RESOURCES

Edwards-Trinity (Plateau) Aquifer

The Edwards-Trinity (Plateau) Aquifer is the principal aquifer in the District. The saturated thickness of the formation is from 100–300 feet throughout most of the county. The water levels have generally remained constant or have fluctuated only with seasonal use or with unusually large deviations from average annual rainfall. The formation is fractured, with the water supply lying in the joints and fractures of the limestone. The limestone is porous, and recharge to the aquifer is rapid because of the existence of horizontal and vertical dissolution channels in the limestone. There is little storage in the aquifer, as most of the recharge and lateral inflows into the aquifer are discharged into streams. There are very few high-production wells in this formation in the District, but supplies are presently believed to be sufficient for domestic and livestock use in the sparsely populated county where wells are drilled into the fractures and joints. Most Edwards-Trinity (Plateau) Aquifer wells in the District pump less than 15 gallons per minute. Water quality is good, though generally very hard, with 98.5% of the water supply in the District from this formation having Total Dissolved Solids (TDS) concentrations below 1,000 mg/l.3

Hickory Aquifer

The Hickory Aquifer has an average saturated thickness of 400-600 feet in the northeast corner of the district. There is no recharge to the aquifer within the District, but recoverable storage in the District is estimated to be about 4,500,000 acre-feet. The water quality varies, with only about 56% of the supply in the District having TDS <1,000 mg/l.4 The extent of radionuclides, which are known to exist in other areas of the aquifer, is not yet known in Kimble County. However, all of the formation within the District is down-dip from the outcrop area, so it is probable that the Hickory Aquifer water supply within the District will contain these radioactive decay products in most areas.

Ellenburger-San Saba Aquifer

The Ellenburger-San Saba Aquifer consists of upper Cambrian limestone and sandstone San Saba Formation overlain by the Ordovician limestone and dolomite Ellenburger formation. The quality of the water pumped in the District is good, with TDS less than 1,000mg/l.

2.2 TECHNICAL DISTRICT INFORMATION REQUIRED BY TEXAS ADMINISTRATIVE CODE AND TEXAS WATER CODE

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 § 36.108 must be collectively conducted by all groundwater conservation districts within the same GMA. The District is a member of GMA 7. GMA 7 adopted DFCs for the Edwards/Trinity (Plateau) Aquifer on August 19, 2021. The adopted DFCs were forwarded to the TWDB for development of the MAG calculations. The submittal package for the DFCs can be found here:

https://www.twdb.texas.gov/groundwater/management_areas/gma7.asp

2.2.1 MODELED AVAILABLE GROUNDWATER IN THE DISTRICT

Please refer to Appendix A – GAM Run 21-012 MAG

2.2.3 AMOUNT OF GROUNDWATER BEING USED WITHIN THE DISTRICT ON AN ANNUAL BASIS

Please refer to Appendix B – Estimated Historical Groundwater Use and 2022 State Water Plan Datasets

2.2.4 ANNUAL AMOUNT OF RECHARGE FROM PRECIPITATION

Please refer to Appendix C – GAM Run 23-06

2.2.5 ANNUAL VOLUME OF WATER THAT DISCHARGES FROM THE AQUIFER TO SPRINGS AND ANY SURFACE WATER BODIES

Please refer to Appendix C – GAM Run 23-06

2.2.6 ANNUAL VOLUME OF FLOW INTO THE DISTRICT, OUT OF THE DISTRICT, AND BETWEEN AQUIFERS

Please refer to Appendix C – GAM Run 23-06

2.2.7 PROJECTED SURFACE WATER RESOURCES

Please refer to Appendix B – Estimated Historical Groundwater Use and 2022 State Water Plan Datasets

2.2.8 PROJECTED TOTAL WATER DEMAND

Please refer to Appendix B – Estimated Historical Groundwater Use and 2022 State Water Plan Datasets

2.3 Consideration of the Water Supply Needs

2.3.1 WATER SUPPLY NEEDS

Kimble County has a water supply need for irrigation, municipal use for the City of Junction, and manufacturing in Kimble County, as shown in the chart below.

Projected Water Supply Needs
TWDB 2022 State Water Plan Data

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

KIMBLE COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
F	County-Other, Kimble	Colorado	0	0	0	0	0	0
F	Irrigation, Kimble	Colorado	-1,103	-1,103	-1,103	-1,103	-1,103	-1,103
F	Junction	Colorado	-626	-620	-609	-605	-604	-604
F	Livestock, Kimble	Colorado	0	0	0	0	0	0
F	Manufacturing, Kimble	Colorado	-603	-704	-704	-704	-704	-704
F	Mining, Kimble	Colorado	0	0	0	0	0	0
		Sum of Projected Water Supply Needs (acre-feet)	**-2,332**	**-2,427**	**-2,416**	**-2,412**	**-2,411**	**-2,411**

Please refer to Appendix B – Estimated Historical Groundwater Use and 2022 State Water Plan Datasets for more information regarding water supply needs in Kimble County.

2.3.2 WATER MANAGEMENT STRATEGIES

Projected water management strategies for Kimble County listed in the TWDB estimated historical water use/2022 state water plan data packet (Appendix B) are:

KIMBLE COUNTY

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

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
Irrigation, Kimble, Colorado (F)							
Irrigation Conservation - Kimble County	DEMAND REDUCTION [Kimble]	133	266	319	319	319	319
		133	**266**	**319**	**319**	**319**	**319**
Junction, Colorado (F)							
Develop Additional Edwards-Trinity Plateau Aquifer Supplies - Junction	Edwards-Trinity-Plateau, Pecos Valley, and Trinity Aquifers [Kimble]	370	370	370	370	370	370
Municipal Conservation - Junction	DEMAND REDUCTION [Kimble]	8	8	8	8	8	8
Subordination - Kimble County RoR	Colorado Run-of-River [Kimble]	250	250	250	250	250	250
		628	**628**	**628**	**628**	**628**	**628**
Manufacturing, Kimble, Colorado (F)							
Develop Additional Ellenburger San Saba Aquifer Supplies - Kimble County Manufacturing	Ellenburger-San Saba Aquifer [Kimble]	500	500	500	500	500	500
Subordination - Kimble County RoR	Colorado Run-of-River [Kimble]	228	228	228	228	228	228
		728	**728**	**728**	**728**	**728**	**728**
Mining, Kimble, Colorado (F)							
Mining Conservation - Kimble County	DEMAND REDUCTION [Kimble]	1	1	1	1	1	1
		1	**1**	**1**	**1**	**1**	**1**
Sum of Projected Water Management Strategies (acre-feet)		**1,490**	**1,623**	**1,676**	**1,676**	**1,676**	**1,676**

From 2020 to 2070, the total water management strategies in Kimble County are projected to increase from 1490 AF to 1676 AF.

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 provide guidance in the performance of existing District activities and practices. The district continues to encourage conservation and reuse to meet the projected strategies in the TWDB 2022 State Water Plan and the TWDB Estimated Historical Water Use.

Please refer to Appendix B – Estimated Historical Groundwater Use and 2022 State Water Plan Datasets

2.3.3 MANAGEMENT OF GROUNDWATER SUPPLIES, AND ACTIONS, PROCEDURES, PERFORMANCE, AND AVOIDANCE NECESSARY TO EFFECUTATE THE MANAGEMENT PLAN

The District will implement and utilize the provisions of this plan as a guide for determining the direction and/or priority for District activities. Operations of the District and all agreements entered into by the District will be consistent with the provisions of this plan.

The District has adopted Rules for the management of groundwater resources and will amend those Rules as necessary pursuant to TWC Chapter 36 and the provisions of this plan. Rules will be adhered to and enforced. The promulgation and enforcement of the Rules will be based on the best technical evidence available. The District will seek cooperation in the implementation of this plan and the management of groundwater supplies within the District.

Please refer to Appendix D for a copy of the District's Rules, or click: Kimble County GCD Rules

2.3.4 METHODOLOGY FOR TRACKING PROGRESS

The methodology that the District will use to trace the progress in achieving the management goals as prescribed by TWC 36.1071(a) will be as follows:

The District General Manager will prepare and present an annual report to the Board of Directors on District performance regarding management plan goals and objectives for the preceding year during the first meeting of each year. The annual report will be maintained at the District office.

CH 3 GOALS, MANAGEMENT OBJECTIVES, AND PERFORMANCE STANDARDS

The District recognizes the importance of public education to encourage efficient use, implement conservation practices, prevent waste, and preserve the integrity of groundwater. Since the District was formed in 1985, it has provided residents with materials, programs, water analysis, and other information when requested, including requests from the TWDB for water level and analysis data.

3.1 GOAL 1- §36.1071(A)(1) PROVIDING THE MOST EFFICIENT USE OF GROUNDWATER

The District, through programs and its Rules, strives to ensure the most efficient use of groundwater in order to sustain available resources for the future while maintaining the economic growth and respecting private property rights of the District.

Management Objective 1.1

The District will require that all new wells be registered in accordance with its current Rules.

Performance Standard 1.1

The Board of Directors will receive quarterly briefings by the General Manager regarding the District's well registration program for new wells. The registration data will also be included in the Annual Report to the Board of Directors.

3.2 GOAL 2- §36.1071(A)(2) CONTROLLING AND PREVENTING WASTE OF GROUNDWATER

An important goal of the District is to implement strategies that will control and prevent the waste of groundwater. The District believes education to its citizens is the best way to prevent waste of groundwater in the District.

Management Objective 2.1

The District will annually provide at least one printed publication, to provide education on eliminating and reducing wasteful practices in the use of groundwater.

Performance Standard 2.1

Printed publications will be included in the District's Annual Report to be provided to the Board of Directors.

3.3 GOAL 3 – §36.1071(A)(5) ADDRESSING NATURAL RESOURCE ISSUES

The District understands that groundwater is a natural resource that must be maintained and researched. The District is committed to continuously learning more about our Edwards-Trinity Aquifer.

Management Objective 3.1

The District will minimize the potential contamination of groundwater by monitoring the spacing and completion of wells.

Performance Standard 3.1

All new registered wells drilled within the District will be in accordance with District Spacing Rules and d information on registered wells to be reported quarterly at regular Board Meetings.

3.4 GOAL 4- §36.1071(A)(6) ADDRESSING DROUGHT CONDITIONS

Groundwater in the District is very affected by drought, and therefore one of the District's main concerns. The Texas Water Development Board provides a very useful website for information on drought called "Water Data for Texas", which can be found here: www.waterdatafortexas.org/drought.

Management Objective 4.1

A drought update will be given at least quarterly at the regularly called Board meetings.

Performance Standard 4.1

Minutes of the Board meetings will be kept in the District Office. Meetings that include a drought report will be included in the District's Annual Report.

Management Objective 4.2

The District will measure one well in the North or South Llano River alluvium at least twice a year to monitor drought conditions in Kimble County.

Performance Standard 4.2

Well measurements will be presented at the Board Meetings at least twice a year and included in the Annual Report.

3.5 GOAL 5- §36.1071(A)(7) ADDRESSING CONSERVATION

The District will continue to be a source for available informational materials and programs to improve public awareness of efficient use, wasteful practices and conservation measures including the water conservation best management practices guide presented by the Water Conservation Advisory Council: www.savetexaswater.org/bmp/.

Management Objective 5.1

Promote public awareness of the need for water conservation. Present a minimum of one public water conservation show, demonstration, event, or educational talk each year.

Performance Standard 5.1

Report these educational activities to the District Board of directors in the Annual Report.

3.8 GOAL 8- §36.1071(A)(8) ADDRESSING THE DESIRED FUTURE CONDITIONS ESTABLISHED UNDER §36.108

The District uses the best available science to establish its DFC. See Appendices A and C.

Management Objective 8.1

The District will measure 4 wells at least once a year within the water level monitoring network through steel tape or electronic sensors.

Performance Standard 8.1

Report at least once a year to the Board of Directors the measurement of water levels from at least 4 wells monitored in the District's water level monitoring network. The water level report will also be included in the District's Annual Report.

3.9 MANAGEMENT GOALS NOT APPLICABLE

Controlling and Preventing Subsidence (36.1071(a)(3))

The rigid geologic framework of the region precludes significant subsidence from occurring. This management goal is not applicable to the operations of the District, according to Figure 5.1 and Figure 5.2 of the Texas Water Development Board's subsidence risk report, 'Identification of the Vulnerability of the Major and Minor Aquifers of Texas to Subsidence with Regard to Groundwater Pumping'. The District has reviewed this report and found that the risk of subsidence is low for Kimble County. The District will continue to look for signs of subsidence and respond to any reports of potential subsidence in the District. The Texas Water Development Board's subsidence risk report can be found here: http://www.twdb.texas.gov/groundwater/models/research/subsidence/subsidence.asp.

Addressing Recharge Enhancement (36.1071(a)(7))

The diverse topography and 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.

Addressing Conjunctive Surface Water Management Issues (36.1071(a)(4))

There are no surface water management entities within the District. This management goal is not applicable to the operations of the District.

Addressing Rainwater Harvesting (36.1071(a)(7))

The semiarid nature of the area within the District makes the cost of rainwater harvesting projects economically unfeasible. Educational material and programs on rainwater harvesting are provided by the Texas AgriLife Extension Service. This management goal is not applicable to the operations of the District.

Addressing Precipitation Enhancement (36.1071(a)(7))

The management goal is not applicable to the District as there is not a precipitation enhancement program unique to the District. The District recognizes the benefits of precipitation enhancement and can find educational materials with the West Texas Weather Modification Association.

Addressing 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.

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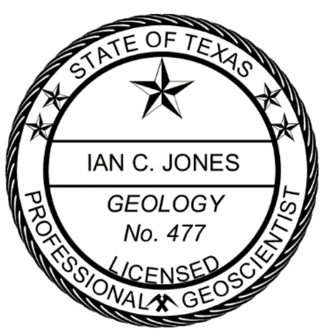
APPENDIX A

GAM RUN 23-026 MAG

GAM Run 21-012 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 Modeling Department
512-463-6641
August 12, 2022



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GAM RUN 21-012 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 Modeling Department
512-463-6641
August 12, 2022

EXECUTIVE SUMMARY:

The Texas Water Development Board (TWDB) has 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 August 19, 2021. The explanatory reports and other materials submitted to the TWDB were determined to be administratively complete on February 23, 2022.

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 for each decade from 2020 through 2070 are:

- 26,164 acre-feet per year in the Capitan Reef Complex Aquifer,
- 2,324 acre-feet per year in the Dockum Aquifer,
- 6,570 to 7,925 acre-feet per year in the Ogallala 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, 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 [Version

1.01] (Jones, 2016) for the Capitan Reef Complex Aquifer; the High Plains Aquifer System [Version 1.01] (Deeds and Jigmond, 2015) for the Dockum and Ogallala aquifers; the minor aquifers of the Llano Uplift Area [Version 1.01] (Shi and others, 2016) for the Ellenburger-San Saba and Hickory aquifers, and the Rustler Aquifer [Version 1.01] (Ewing and others, 2012) for the Rustler Aquifer. In addition, the alternative 1-layer model for the Edwards-Trinity (Plateau), Pecos Valley, and Trinity aquifers (Hutchison and others, 2011a) 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, 2011b) and the model associated with a hydrogeological study for Val Verde County and the City of Del Rio (EcoKai and Hutchison, 2014), respectively, were used to estimate modeled available groundwater.

REQUESTOR:

Ms. Meredith Allen, coordinator of Groundwater Management Area 7 districts.

DESCRIPTION OF REQUEST:

In an email dated August 28, 2021, Dr. William Hutchison on behalf of Groundwater Management Area 7 provided the TWDB with the desired future conditions for the Capitan, Dockum, Ellenburger-San Saba, Hickory, Ogallala, and Rustler aquifers, as well as for the undifferentiated Edwards-Trinity (Plateau), Pecos Valley and Trinity aquifers, in Groundwater Management Area 7. Groundwater Management Area 7 provided additional clarifications through an email to the TWDB on November 12, 2021, for the assumptions and model files to be used to calculate modeled available groundwater.

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

Capitan Reef Complex Aquifer *(Resolution #08-19-2021-2)*

a) Total net drawdown of the Capitan Reef Complex Aquifer not to exceed 56 feet in Pecos County (Middle Pecos GCD) in 2070 as compared with 2006 aquifer levels.
**(Reference: Scenario 4, GMA 7 Technical Memorandum 16-03)*

b) The Capitan Reef Complex Aquifer is not relevant for joint planning purposes in all other areas of GMA 7.

Dockum and Ogallala aquifers *(Resolution #08-19-2021-5)*

Ogallala Aquifer:

a) Total net drawdown of the Ogallala Aquifer not to exceed **6 feet in Glasscock County** in 2070 as compared with 2010 aquifer levels.

Dockum Aquifer:

b) Total net drawdown of the Dockum Aquifer not to exceed **52 feet in Pecos County** in 2070 as compared with 2010 aquifer levels.

c) Total net drawdown of the Dockum Aquifer not to exceed **14 feet in Reagan County** in 2070 as compared with 2010 aquifer levels.

**(Reference items a) through c): Scenario 17, GMA 7 Technical Memorandum 16-01)*

d) The Ogallala and Dockum Aquifers are not relevant for joint planning purposes in all other areas of GMA 7.

Edwards-Trinity (Plateau), Pecos Valley, and Trinity aquifers *(Resolution #08-19-2021-3)*

a) Total net drawdown of the Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers not to exceed **0 feet in Coke County** in 2070 as compared with 2010 aquifer levels.
b) Total net drawdown of the Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers not to exceed **10 feet in Crockett County** in 2070 as compared with 2010 aquifer levels.
c) Total net drawdown of the Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers not to exceed **4 feet in Ector County** in 2070 as compared with 2010 aquifer levels.
d) Total net drawdown of the Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers not to exceed **2 feet in Edwards County** in 2070 as compared with 2010 aquifer levels.
e) Total net drawdown of the Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers not to exceed **5 feet in Gillespie County** in 2070 as compared with 2010 aquifer levels.
f) Total net drawdown of the Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers not to exceed **42 feet in Glasscock County** in 2070 as compared with 2010 aquifer levels.
g) Total net drawdown of the Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers not to exceed **10 feet in Irion County** in 2070 as compared with 2010 aquifer levels.
h) Total net drawdown of the Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers not to exceed **1 foot in Kimble County** in 2070 as compared with 2010 aquifer levels.
i) Total net drawdown of the Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers not to exceed **1 foot in Menard County** in 2070 as compared with 2010 aquifer levels.
j) Total net drawdown of the Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers not to exceed **12 feet in Midland County** in 2070 as compared with 2010 aquifer levels.
k) Total net drawdown of the Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers not to exceed **14 feet in Pecos County** in 2070 as compared with 2010 aquifer levels.
l) Total net drawdown of the Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers not to exceed **42 feet in Reagan County** in 2070 as compared with 2010 aquifer levels.
m) Total net drawdown of the Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers not to exceed **4 feet in Real County** in 2070 as compared with 2010 aquifer levels.
n) Total net drawdown of the Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers not to exceed **8 feet in Schleicher County** in 2070 as compared with 2010 aquifer levels.
o) Total net drawdown of the Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers not to exceed **7 feet in Sterling County** in 2070 as compared with 2010 aquifer levels.
p) Total net drawdown of the Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers not to exceed **6 feet in Sutton County** in 2070 as compared with 2010 aquifer levels.
q) Total net drawdown of the Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers not to exceed **0 feet in Taylor County** in 2070 as compared with 2010 aquifer levels.
r) Total net drawdown of the Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers not to exceed **2 feet in Terrell County** in 2070 as compared with 2010 aquifer levels.
s) Total net drawdown of the Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers not to exceed **20 feet in Upton County** in 2070 as compared with 2010 aquifer levels.
t) Total net drawdown of the Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers not to exceed **2 feet in Uvalde County** in 2070 as compared with 2010 aquifer levels.
*(Reference items *a)* through *t)*: GMA 7 Technical Memorandum 18-01)

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

u) Total net drawdown in **Kinney County** in 2070, as compared with 2010 aquifer levels, shall be consistent with maintenance of an annual average flow of 23.9 cfs and an annual median flow of **23.9 cfs at Las Moras Springs.**
**(Reference: Groundwater Flow Model of the Kinney County Area by W.R. Hutchison and others, 2011).*

v) Total net drawdown 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 mgd at San Felipe Springs.**
**(Reference: EcoKai, 2014)*

w) The Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers are not relevant for joint planning purposes in all other areas of GMA 7.

Minor Aquifers of the Llano Uplift Area *(Resolution #08-19-2021-4)*

Ellenburger-San Saba Aquifer:

a) Total net drawdown of the Ellenburger-San Saba Aquifer not to exceed **8 feet in Gillespie County** in 2070 as compared with 2010 aquifer levels.
b) Total net drawdown of the Ellenburger-San Saba Aquifer not to exceed **18 foot in Kimble County** in 2070 as compared with 2010 aquifer levels.
c) Total net drawdown of the Ellenburger-San Saba Aquifer not to exceed **14 foot in Mason County** in 2070 as compared with 2010 aquifer levels.
d) Total net drawdown of the Ellenburger-San Saba Aquifer not to exceed **29 feet in McCulloch County** in 2070 as compared with 2010 aquifer levels.
e) Total net drawdown of the Ellenburger-San Saba Aquifer not to exceed **46 feet in Menard County** in 2070 as compared with 2010 aquifer levels.
f) Total net drawdown of the Ellenburger-San Saba Aquifer not to exceed **5 feet in San Saba County** in 2070 as compared with 2010 aquifer levels.

Hickory Aquifer:

g) Total net drawdown of the Hickory Aquifer not to exceed **53 feet in Concho County** in 2070 as compared with 2010 aquifer levels.
h) Total net drawdown of the Hickory Aquifer not to exceed **9 feet in Gillespie County** in 2070 as compared with 2010 aquifer levels.
i) Total net drawdown of the Hickory Aquifer not to exceed **18 feet in Kimble County** in 2070 as compared with 2010 aquifer levels.
j) Total net drawdown of the Hickory Aquifer not to exceed **17 feet in Mason County** in 2070 as compared with 2010 aquifer levels.

Minor Aquifers of the Llano Uplift Area *(continued)*

k) Total net drawdown of the Hickory Aquifer not to exceed **29 feet in McColloch County** in 2070 as compared with 2010 aquifer levels.
l) Total net drawdown of the Hickory Aquifer not to exceed **46 feet in Menard County** in 2070 as compared with 2010 aquifer levels.
m) Total net drawdown of the Hickory Aquifer not to exceed **6 feet in San Saba County** in 2070 as compared with 2010 aquifer levels.
**(Reference items a) through m): Scenario 3, GMA 7 Technical Memorandum 16-02)*
n) The Llano Uplift Region (Ellenburger-San Saba, Hickory, Marble Falls) Aquifers are not relevant for joint planning purposes in all other areas of GMA 7.

Rustler Aquifer *(Resolution #08-19-2021-6)*

a) Total net drawdown of the Rustler Aquifer not to exceed **94 feet in Pecos County** in 2070 as compared with 2010 aquifer levels.
**(Reference: Scenario 4, GMA 7 Technical Memorandum 15-05)*
b) The Rustler Aquifer not relevant for joint planning purposes in all other areas of GMA 7.

In addition to the non-relevant statements provided above in the individual resolutions, Groundwater Management Area 7 also provided additional non-relevant documentation dated August 27, 2021 and January 20, 2022 as part of their submittal to TWDB. The following aquifers or parts of aquifers are non-relevant for the purposes of joint planning:

- The entirety of the Blaine, Cross Timbers, Igneous, Lipan, Marble Falls, and Seymour aquifers.
- The Capitan Reef Complex Aquifer outside of the boundaries of the Middle Pecos Groundwater Conservation District.
- The Edwards-Trinity (Plateau) Aquifer in Concho, Mason, McCulloch, Nolan, and Tom Green counties.
- The Ellenburger-San Saba Aquifer in Coleman, Concho, and Mason counties.
- The Hickory Aquifer in Coleman and Llano counties.
- The Dockum Aquifer outside of Reagan and Pecos counties.
- The Ogallala Aquifer outside of Glasscock County.

CLARIFICATIONS:

In response to a request for clarifications from the TWDB in 2021, the Groundwater Management Area 7 Chair, Ms. Meredith Allen, and Groundwater Management Area 7 consultant, Dr. William R. Hutchison, provided the following clarifications regarding the definition of the desired future conditions. These clarifications were necessary for verifying that the desired future conditions of the aquifers were attainable and for confirming approval of the TWDB methodology to calculate modeled available groundwater volumes in Groundwater Management Area 7:

Capitan Reef Complex Aquifer

- The calculated modeled available groundwater values are based on the official TWDB aquifer boundary.
- The modeled available groundwater calculations are based on the desired future conditions with a one-foot tolerance (that is, modeled drawdown verifications within one foot of the desired future conditions are acceptable).
- Drawdown calculations used to define the desired future conditions value take into consideration the occurrence of “dry” cells, where water levels are below the base of the aquifer.

Dockum Aquifer

- The calculated modeled available groundwater values are based on the spatial extent of the Dockum Formation, as represented in the groundwater availability model for the High Plains Aquifer System, rather than the official TWDB aquifer boundary.
- Modeled available groundwater analysis excludes model pass-through cells.
- The modeled available groundwater calculations are based on the desired future conditions with a one-foot tolerance (that is, modeled drawdown verifications within one foot of the desired future conditions are acceptable).

Ogallala Aquifer

- The calculated modeled available groundwater values are based on the official TWDB aquifer boundary and use the same model assumptions used in Groundwater Management Area 7 Technical Memorandum 16-01 (Hutchison, 2016c).
- Drawdown calculations used to define the desired future conditions do not take into consideration the occurrence of “dry” cells, where water levels are below the base of the aquifer.

- The modeled available groundwater calculations are based on the desired future conditions with a one-foot tolerance (that is, modeled drawdown verifications within one foot of the desired future conditions are acceptable).

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

- The calculated modeled available groundwater values are based on the official TWDB aquifer boundaries.
- The modeled available groundwater calculations are based on the desired future conditions with a one-foot tolerance (that is, modeled drawdown verifications within one foot of the desired future conditions value are acceptable).
- Drawdown calculations used to define the desired future conditions include drawdowns for cells with water levels below the base elevation of the cell ("dry" cells).

Kinney County

- The modeled available groundwater values, model assumptions, and simulated springflow are from GAM Run 10-043 MAG Version 2 (Shi, 2012).

Val Verde County

- There is no associated drawdown as a desired future condition. The desired future condition is based solely on simulated spring flow 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 2021).

Minor Aquifers of the Llano Uplift Area

- The calculated modeled available groundwater values are based on the full spatial extent of the Ellenburger-San Saba and Hickory formations in the groundwater availability model for the aquifers of the Llano Uplift Area rather than the official TWDB aquifer boundaries and use the same model assumptions used in Groundwater Management Area 7 Technical Memorandum 16-02 (Hutchison 2016b).
- The modeled available groundwater calculations are based on the desired future conditions with a one-foot tolerance (that is, modeled drawdown verifications within one foot of the desired future conditions value are acceptable).

- The drawdown calculations used to define desired future conditions did not include "dry" cells, where water levels are below the base of the aquifer.

Rustler Aquifer

- The model used to define desired future conditions and calculate modeled available groundwater assumes that the initial model heads represent the heads at the end of 2008 (the baseline for calculating desired future conditions drawdown values).
- Calculated modeled available groundwater values are based on the full spatial extent of the Rustler Formation, as represented in the groundwater availability model for the Rustler Aquifer, rather than the official TWDB aquifer boundary.
- The predictive model used to define desired future conditions and calculate modeled available groundwater uses the same model assumptions used in Groundwater Management Area 7 Technical Memorandum 15-05 (Hutchison, 2016d).
- The modeled available groundwater calculations are based on the desired future conditions with a one-foot tolerance (that is, modeled drawdown verifications within one foot of the desired future conditions value are acceptable).

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 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 the water levels in the baseline year. These baseline years are 2005 in the groundwater availability model for the Capitan Reef Complex Aquifer and the alternative model for the Edwards-Trinity (Plateau) and Pecos Valley 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 2008 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. In most cases, these model runs were supplied by Groundwater Management Area 7 for review by TWDB staff before they were used to calculate the modeled available groundwater. 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 for all aquifers 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 was 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 was 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 is 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).

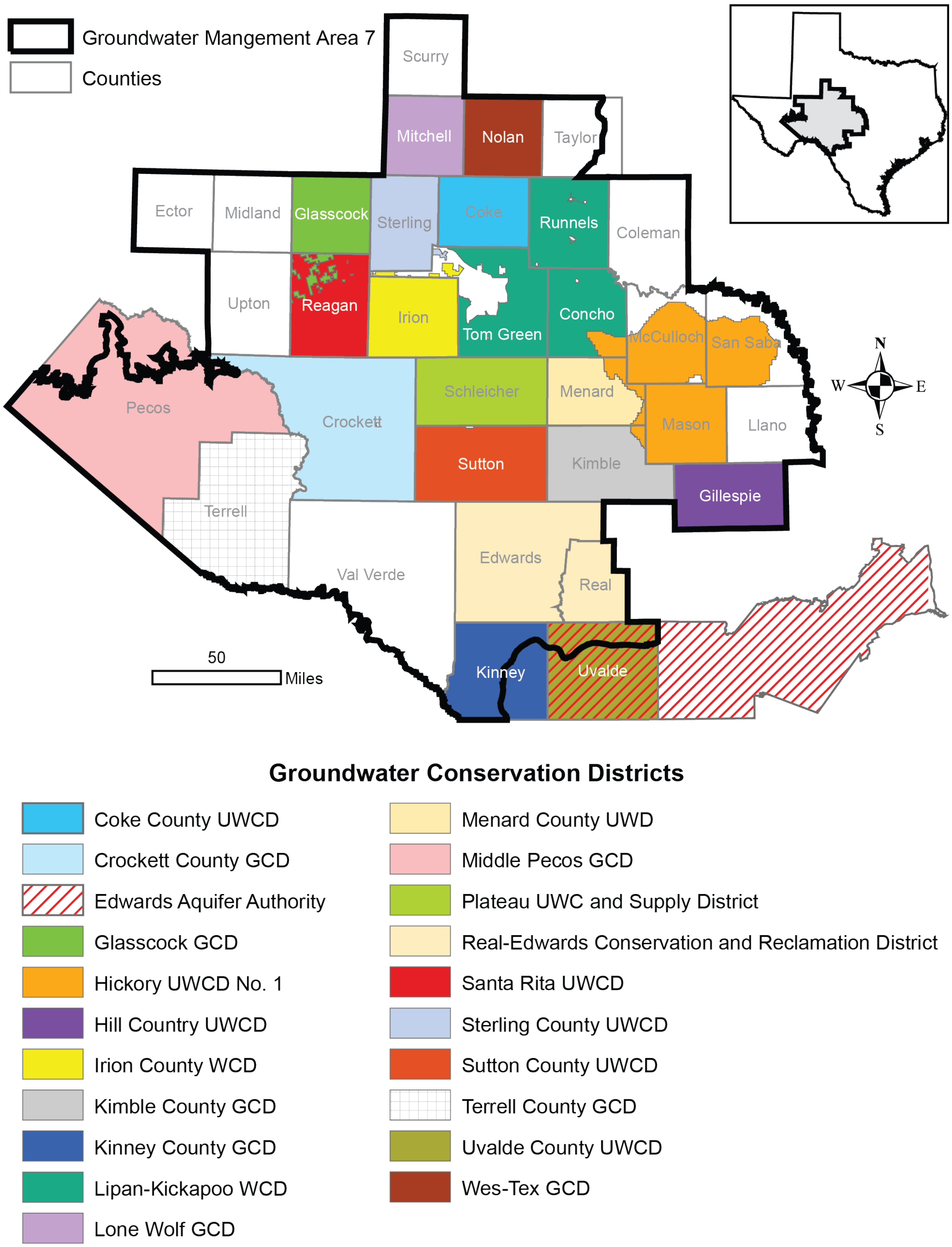

FIGURE 1. MAP SHOWING THE GROUNDWATER CONSERVATION DISTRICTS (GCD) IN GROUNDWATER MANAGEMENT AREA 7. NOTE: THE BOUNDARIES OF THE EDWARDS AQUIFER AUTHORITY OVERLAP WITH THE UVALDE COUNTY UNDERGROUND WATER CONSERVATION DISTRICT (UWCD).

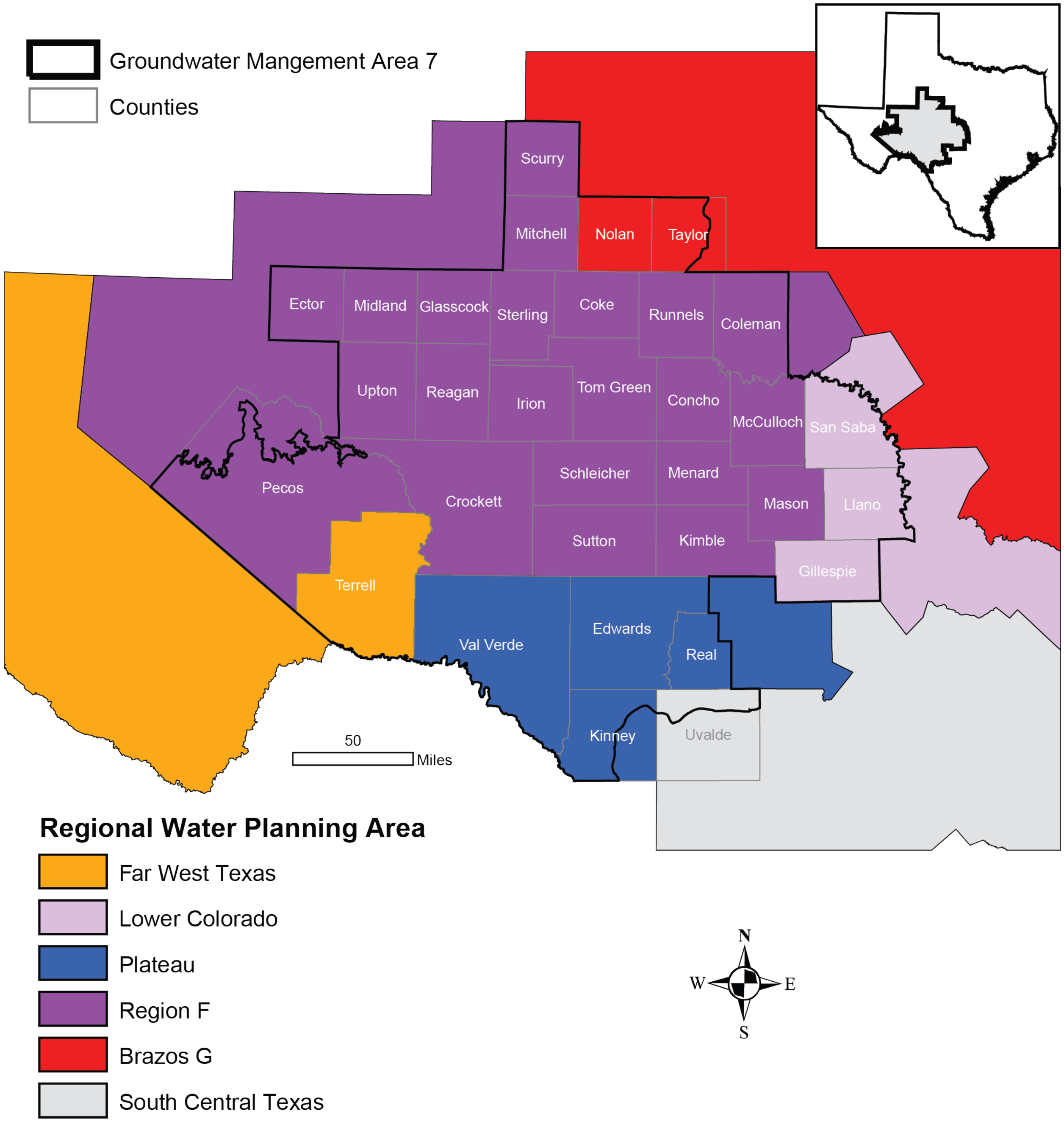

FIGURE 2. MAP SHOWING REGIONAL WATER PLANNING AREAS IN GROUNDWATER MANAGEMENT AREA 7.

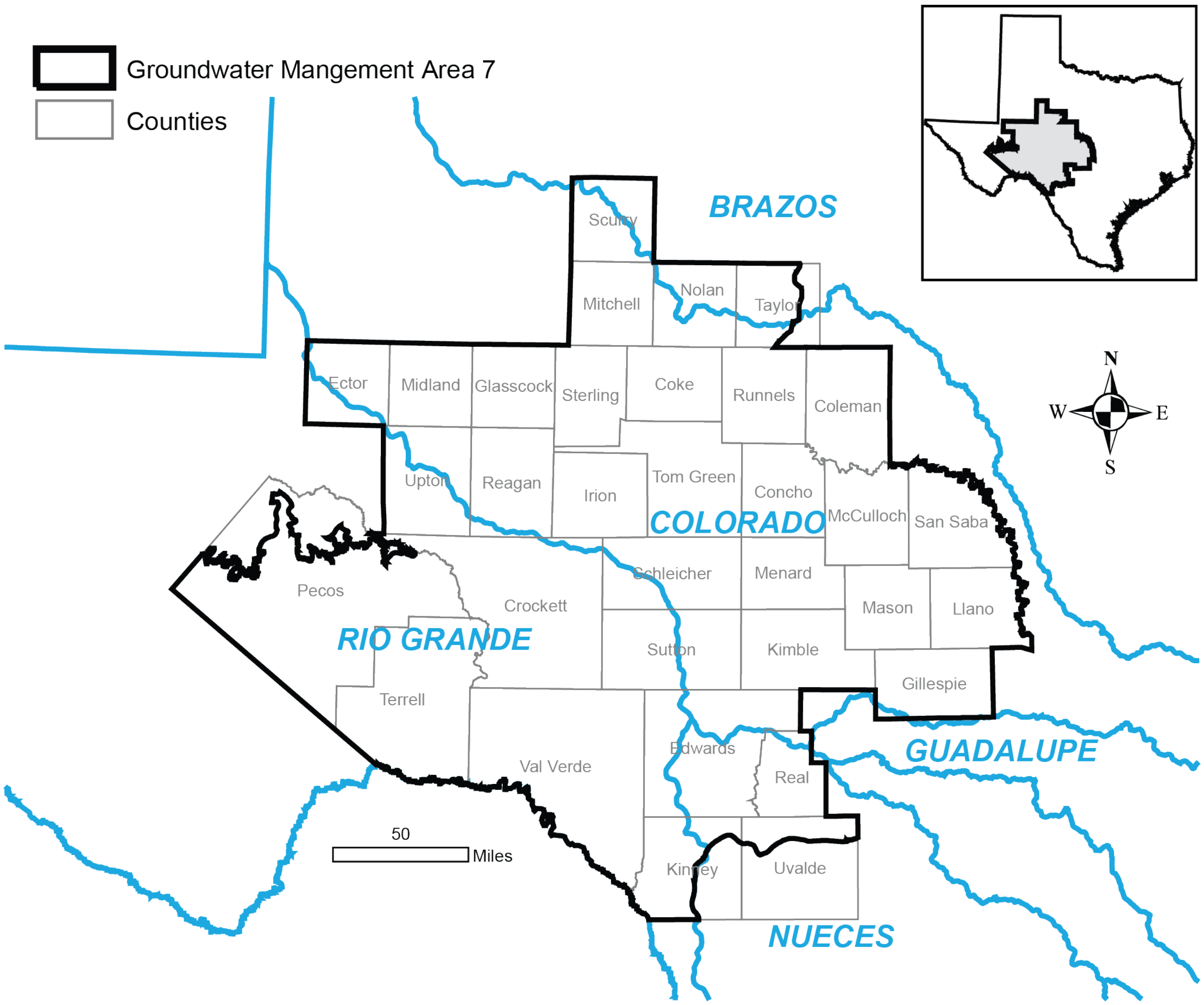

FIGURE 3. **MAP SHOWING RIVER BASINS IN GROUNDWATER MANAGEMENT AREA 7. THESE INCLUDE PARTS OF THE BRAZOS, COLORADO, GUADALUPE, NUECES, AND RIO GRANDE RIVER BASINS.**

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 (2016a) 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 TWDB 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 (2016c) 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 to hydraulically connect the Ogallala Aquifer to the Lower Dockum where the Edwards-Trinity (High Plains)

and Upper Dockum aquifers are absent. 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. Therefore, the groundwater management area should be aware that the modeled available groundwater values will be less than pumping input values if the modeled saturated thickness drops below that threshold.
- The model was run for the interval 2013 through 2070 for a 58-year predictive simulation. Drawdowns were calculated by subtracting initial 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 in the Dockum Aquifer where water levels were below the base elevation of the cell ("dry" cells). Therefore, all drawdowns were included in the averaging. However, in the Ogallala Aquifer, dry cells occurred during the predictive simulation. These dry cells were excluded from the modeled available groundwater calculations.
- Drawdown averages and modeled available groundwater volumes are based on the model boundary within Groundwater Management Area 7 for the Dockum Aquifer and the official TWDB aquifer boundary 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 was 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; 2018) 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.
- Because simulated water levels for the baseline year (2010) are not included in the original calibrated historical model, these water levels had to be verified against measured water levels to confirm that the predictive model satisfactorily matched real-world conditions. Comparison of 2010 simulated and measured water levels indicated a root mean squared error of 100 feet or 4 percent of the range in water-level elevations, which is within acceptable limits. Based on these results, we consider the predictive model an appropriate tool for evaluating the attainability of desired future conditions and for calculating modeled available groundwater.
- 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 TWDB 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 56 annual stress periods under the conditions set in Scenario 3 in Task 10-027 (Hutchison, 2011).
- Modeled available groundwater volumes are based on the official TWDB aquifer boundary 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 and Hutchison (2014) for assumptions and limitations of the model. See Hutchison (2016e; 2021) 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 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 TWDB aquifer boundary within Groundwater Management Area 7 in Val Verde County.

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 (2016b) 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.
- The model was run for the interval 2011 through 2070 for a 60-year predictive simulation. Drawdowns were calculated by subtracting initial 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.

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.
- The predictive model used to define desired future conditions uses 2008 recharge conditions throughout the predictive period.
- The predictive model used to define desired future conditions has general-head boundary heads that decline at a rate of 1.5 feet per year.
- 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.

RESULTS:

The modeled available groundwater estimates for each decade from 2020 through 2070 are:

- 26,164 acre-feet per year in the Capitan Reef Complex Aquifer,
- 2,324 acre-feet per year in the Dockum Aquifer,
- 6,570 to 7,925 acre-feet per year in the Ogallala 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, 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 5 and 6). 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.

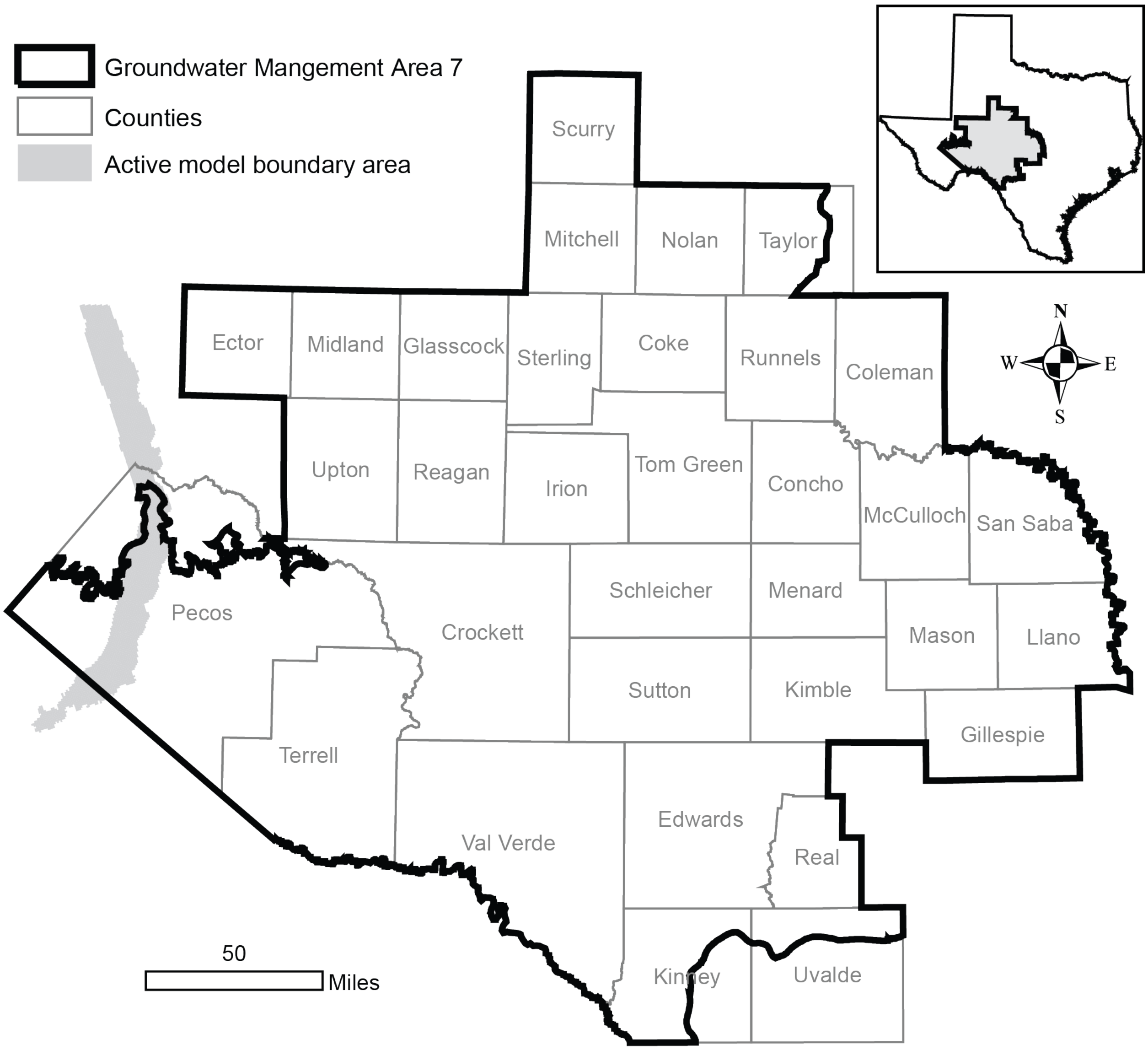

FIGURE 4. **MAP SHOWING THE AREAS COVERED BY THE CAPITAN REEF COMPLEX AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL FOR THE EASTERN ARM OF THE CAPITAN REEF COMPLEX AQUIFER IN GROUNDWATER MANAGEMENT AREA 7.**

TABLE 1. MODELED AVAILABLE GROUNDWATER FOR THE CAPITAN REEF COMPLEX AQUIFER IN GROUNDWATER MANAGEMENT AREA 7 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2070. RESULTS ARE IN ACRE-FEET PER YEAR.

District	County	Year					
		2020	2030	2040	2050	2060	2070
Middle Pecos GCD	Pecos	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**

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 2030 AND 2070. RESULTS ARE IN ACRE-FEET PER YEAR.

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

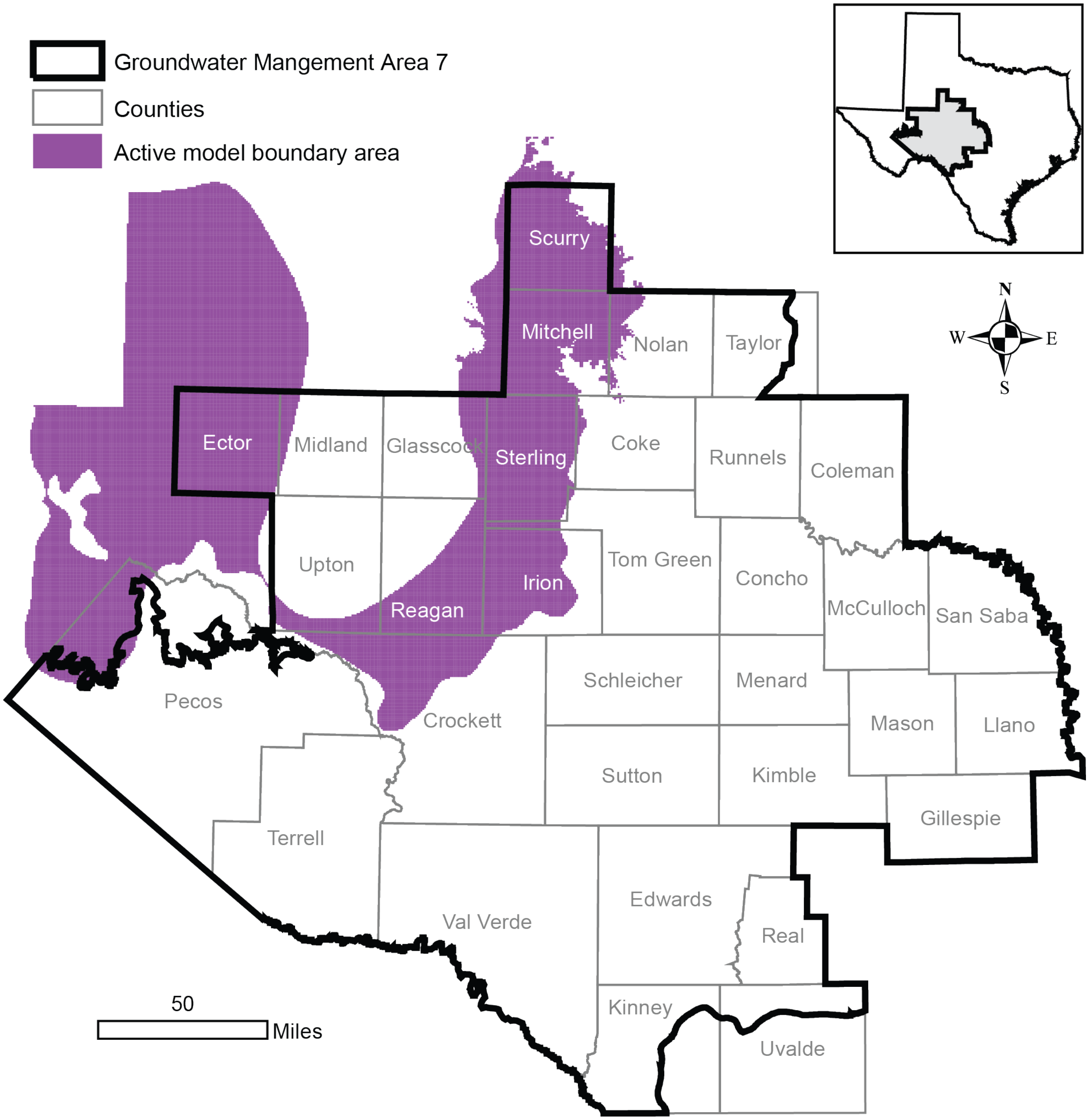

FIGURE 5. MAP SHOWING AREAS COVERED BY THE DOCKUM AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL FOR THE HIGH PLAINS AQUIFER SYSTEM IN GROUNDWATER MANAGEMENT AREA 7.

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 2020 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					
		2020	2030	2040	2050	2060	2070
Middle Pecos GCD	Pecos	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**
Santa Rita UWCD	Reagan	302	302	302	302	302	302
	Total	**302**	**302**	**302**	**302**	**302**	**302**
GMA 7		**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.

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 2030 AND 2070. RESULTS ARE IN ACRE-FEET PER YEAR.

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

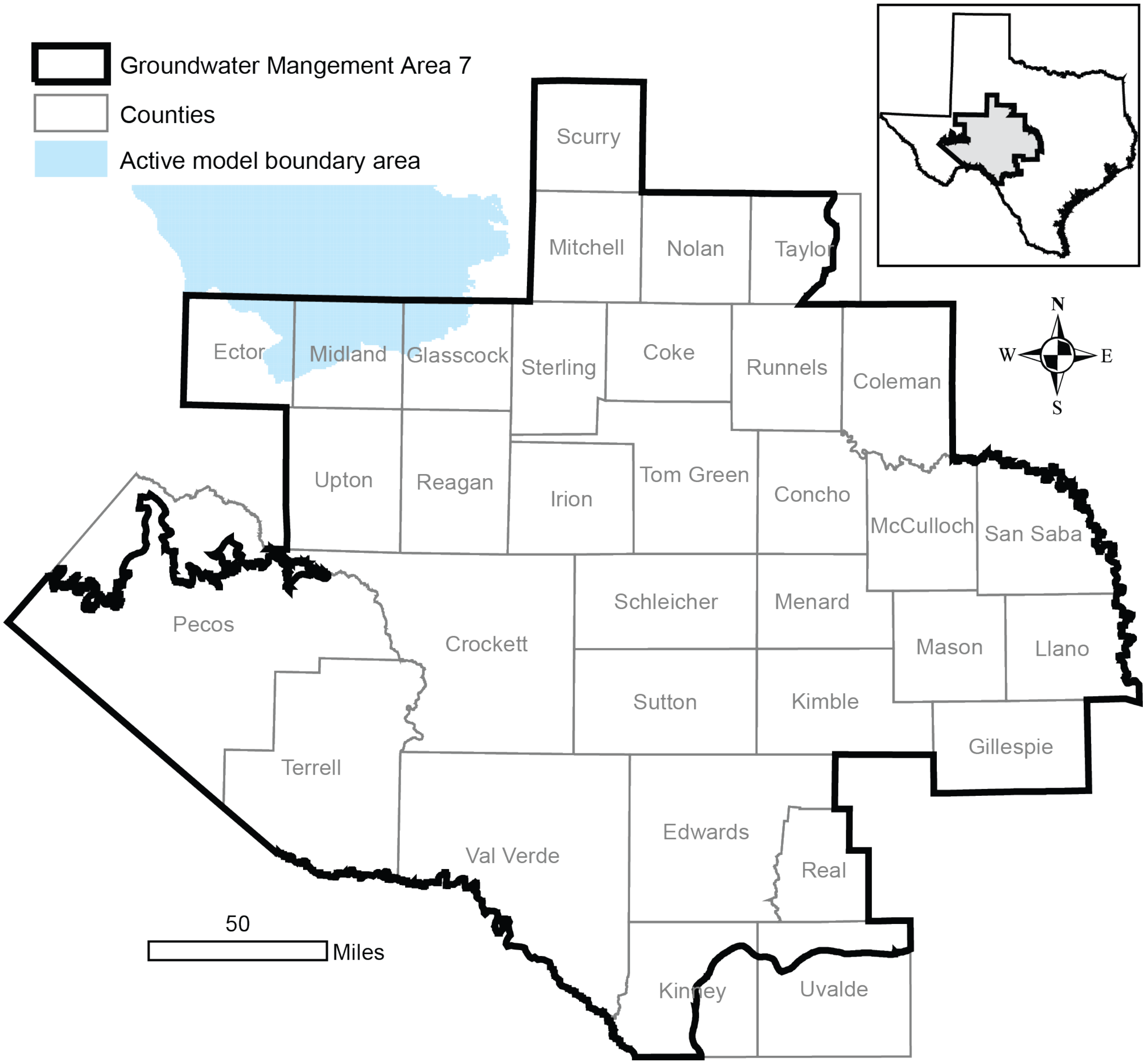

FIGURE 6. **MAP SHOWING THE AREAS COVERED BY THE OGALLALA AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL FOR THE HIGH PLAINS AQUIFER SYSTEM IN GROUNDWATER MANAGEMENT AREA 7.**

TABLE 5. MODELED AVAILABLE GROUNDWATER FOR THE OGALLALA AQUIFER IN GROUNDWATER MANAGEMENT AREA 7 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2070. RESULTS ARE IN ACRE-FEET PER YEAR.

District	County	Year					
		2020	2030	2040	2050	2060	2070
Glasscock GCD	Glasscock	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**

TABLE 6. 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 2030 AND 2070. RESULTS ARE IN ACRE-FEET PER YEAR.

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

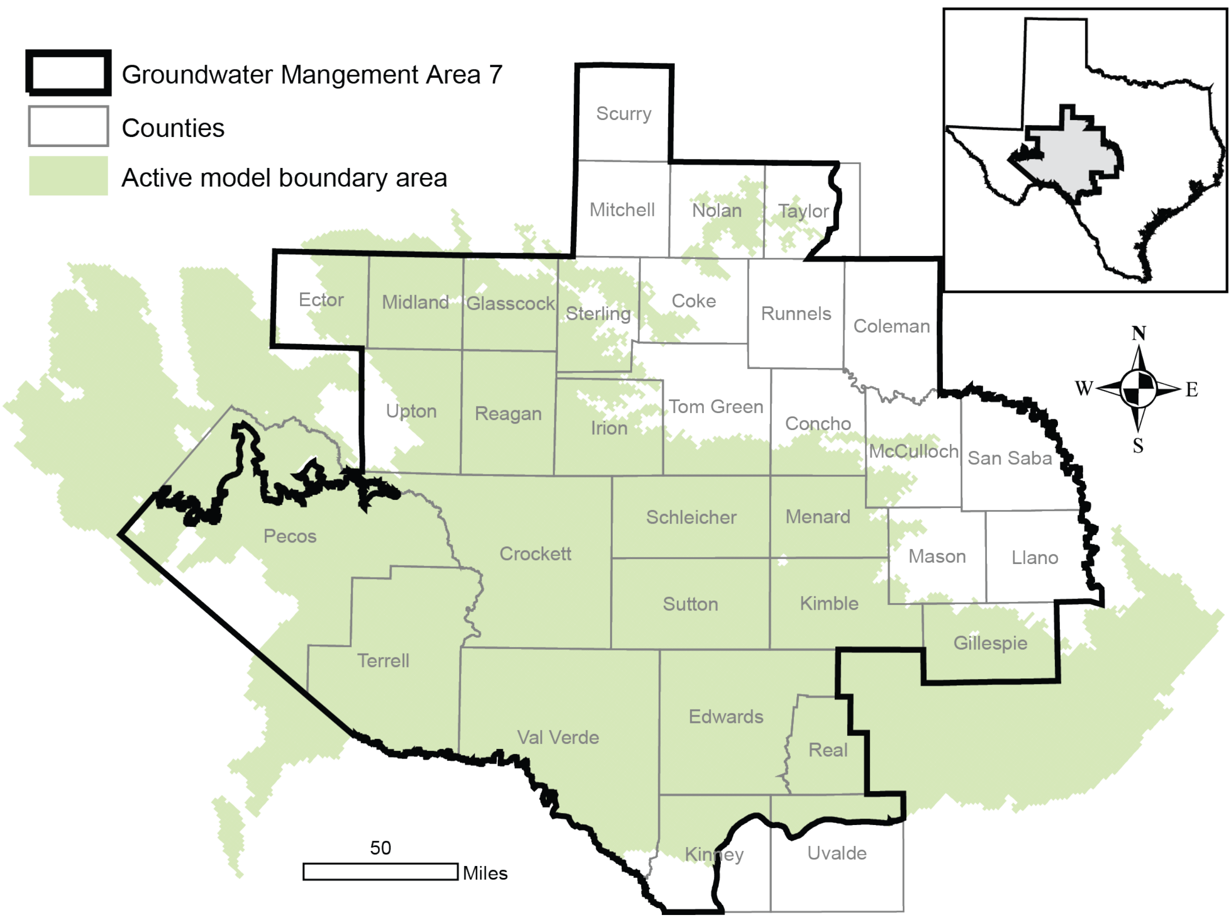

FIGURE 7. MAP SHOWING THE AREAS COVERED BY THE UNDIFFERENTIATED EDWARDS-TRINITY (PLATEAU), PECOS VALLEY, AND TRINITY AQUIFERS IN THE GROUNDWATER AVAILABILITY MODEL FOR THE EDWARDS-TRINITY (PLATEAU) AND PECOS VALLEY AQUIFERS IN GROUNDWATER MANAGEMENT AREA 7.

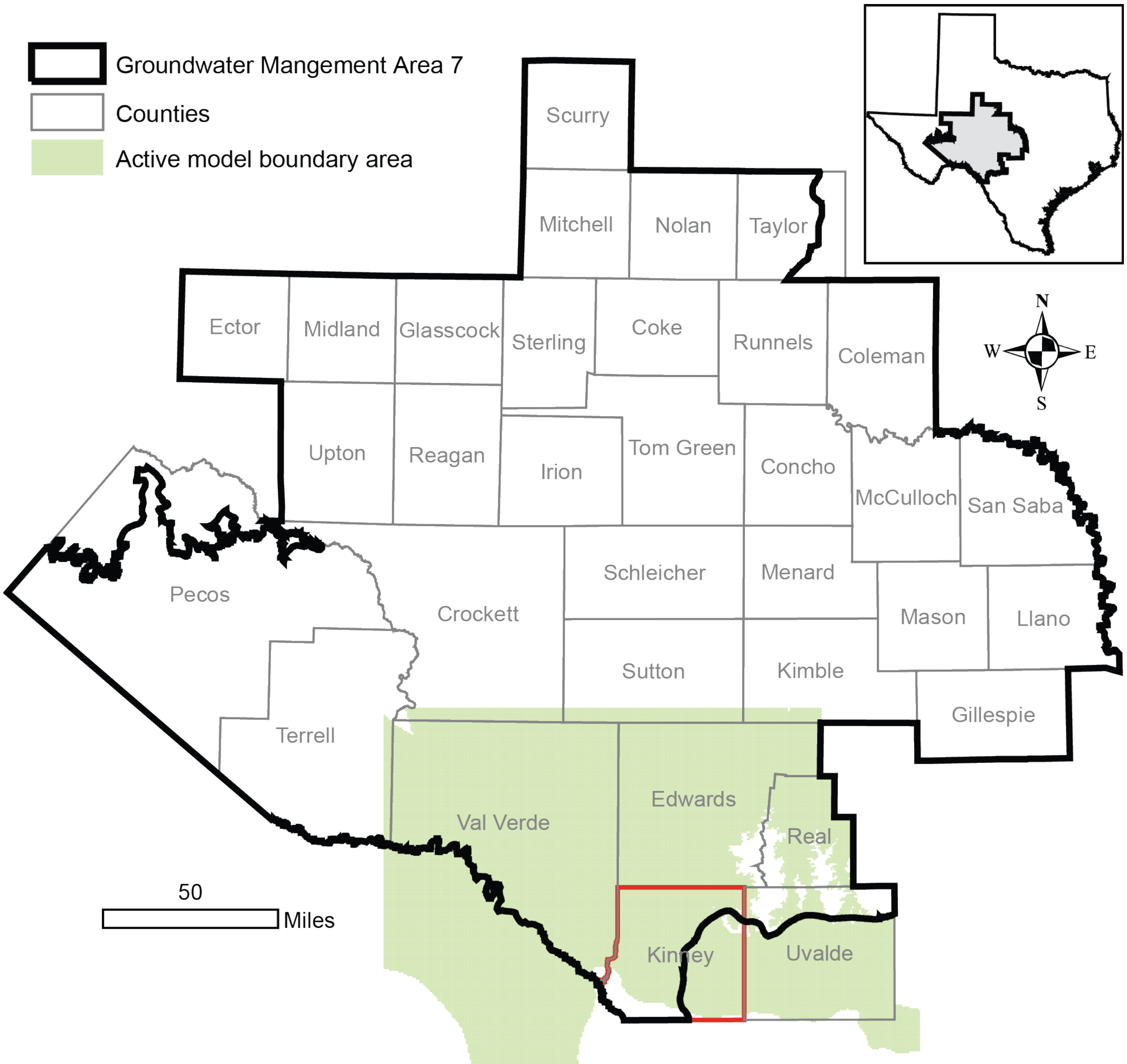

FIGURE 8. **MAP SHOWING THE AREAS COVERED BY THE EDWARDS-TRINITY (PLATEAU) AQUIFER IN THE ALTERNATIVE MODEL FOR THE EDWARDS-TRINITY (PLATEAU) AQUIFER IN KINNEY COUNTY [HIGHLIGHTED IN RED].**

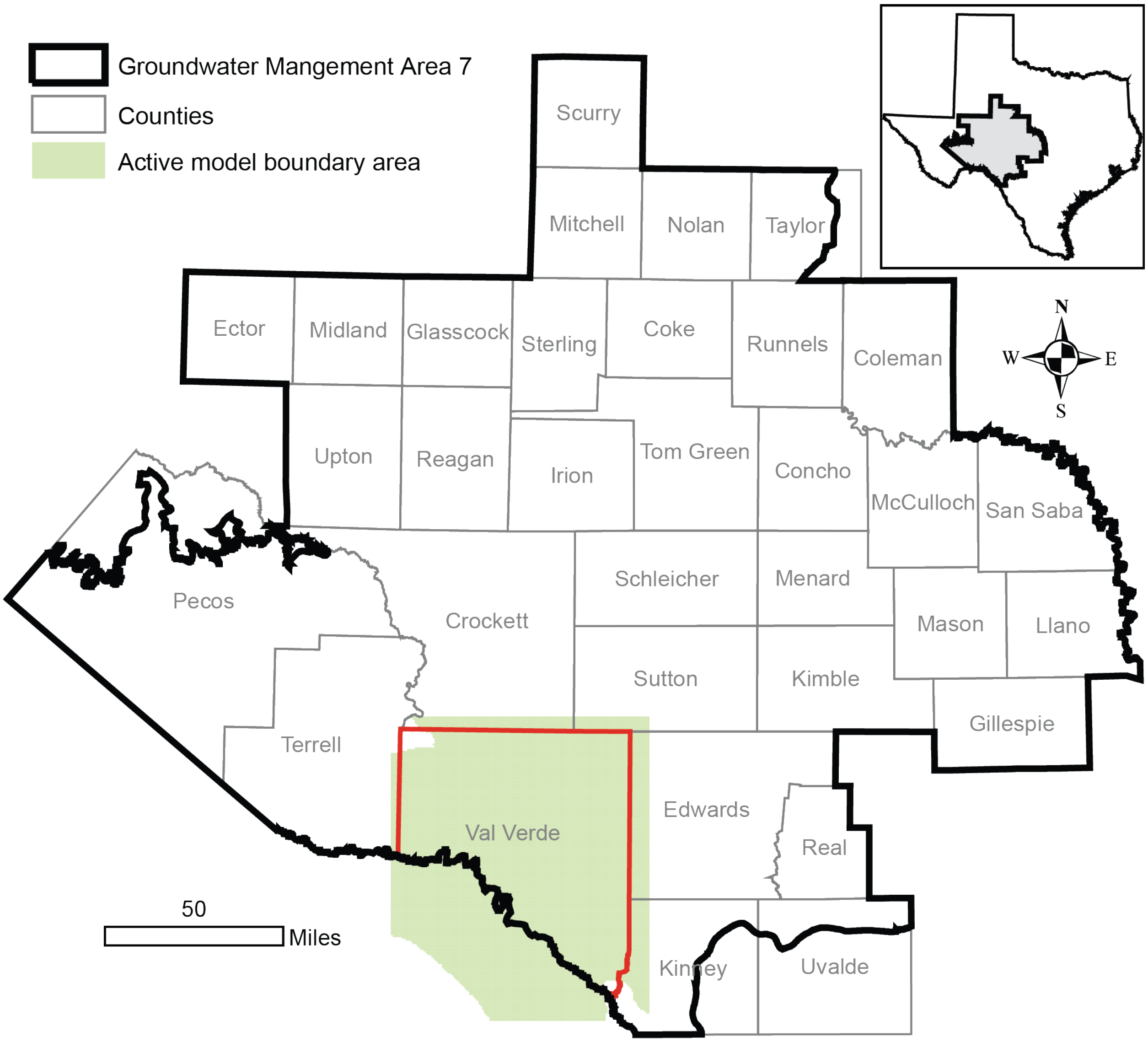

FIGURE 9. **MAP SHOWING THE AREAS COVERED BY THE EDWARDS-TRINITY (PLATEAU) AQUIFER IN THE GROUNDWATER FLOW MODEL FOR THE EDWARDS-TRINITY (PLATEAU) AQUIFER IN VAL VERDE COUNTY [HIGHLIGHTED IN RED].**

TABLE 7. 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 2020 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					
		2020	2030	2040	2050	2060	2070
Coke County UWCD	Coke	997	997	997	997	997	997
	Total	**997**	**997**	**997**	**997**	**997**	**997**
Crockett County GCD	Crockett	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**
Glasscock GCD	Glasscock	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
	Total	**106,021**	**106,021**	**106,021**	**106,021**	**106,021**	**106,021**
Hickory UWCD No. 1	Kimble	104	104	104	104	104	104
	Menard	380	380	380	380	380	380
	Total	**484**	**484**	**484**	**484**	**484**	**484**
Hill Country UWCD	Gillespie	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**
Irion County WCD	Irion	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 County GCD	Kimble	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**

TABLE 7. (CONTINUED).

District	County	Year					
		2020	**2030**	**2040**	**2050**	**2060**	**2070**
Kinney County GCD	Kinney	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**
Menard County UWD	Menard	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**
Middle Pecos GCD	Pecos	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**
Plateau UWC and Supply District	Schleicher	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**
Real-Edwards C and R District	Edwards	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
	Total	**13,199**	**13,199**	**13,199**	**13,199**	**13,199**	**13,199**

TABLE 7. (CONTINUED).

District	County	Year					
		2020	**2030**	**2040**	**2050**	**2060**	**2070**
Santa Rita UWCD	Reagan	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**
Sterling County UWCD	Sterling	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 County UWCD	Sutton	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**
Terrell County GCD	Terrell	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**
Uvalde County UWCD	Uvalde	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**
No district		102,703	102,703	102,703	102,703	102,703	102,703
GMA 7		**475,236**	**475,236**	**475,236**	**475,236**	**475,236**	**475,236**

TABLE 8. 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 2030 AND 2070. RESULTS ARE IN ACRE-FEET PER YEAR.

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

TABLE 8. (CONTINUED).

County	RWPA	River Basin	Year				
			2030	**2040**	**2050**	**2060**	**2070**
Irion	F	Colorado	3,289	3,289	3,289	3,289	3,289
		Total	**3,289**	**3,289**	**3,289**	**3,289**	**3,289**
Kimble	F	Colorado	1,386	1,386	1,386	1,386	1,386
		Total	**1,386**	**1,386**	**1,386**	**1,386**	**1,386**
Kinney	J	Nueces	12	12	12	12	12
		Rio Grande	70,329	70,329	70,329	70,329	70,329
		Total	**70,341**	**70,341**	**70,341**	**70,341**	**70,341**
Menard	F	Colorado	2,597	2,597	2,597	2,597	2,597
		Total	**2,597**	**2,597**	**2,597**	**2,597**	**2,597**
Midland	F	Colorado	23,233	23,233	23,233	23,233	23,233
		Total	**23,233**	**23,233**	**23,233**	**23,233**	**23,233**
Pecos	F	Rio Grande	117,309	117,309	117,309	117,309	117,309
		Total	**117,309**	**117,309**	**117,309**	**117,309**	**117,309**

TABLE 8. (CONTINUED).

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

TABLE 8. (CONTINUED).

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

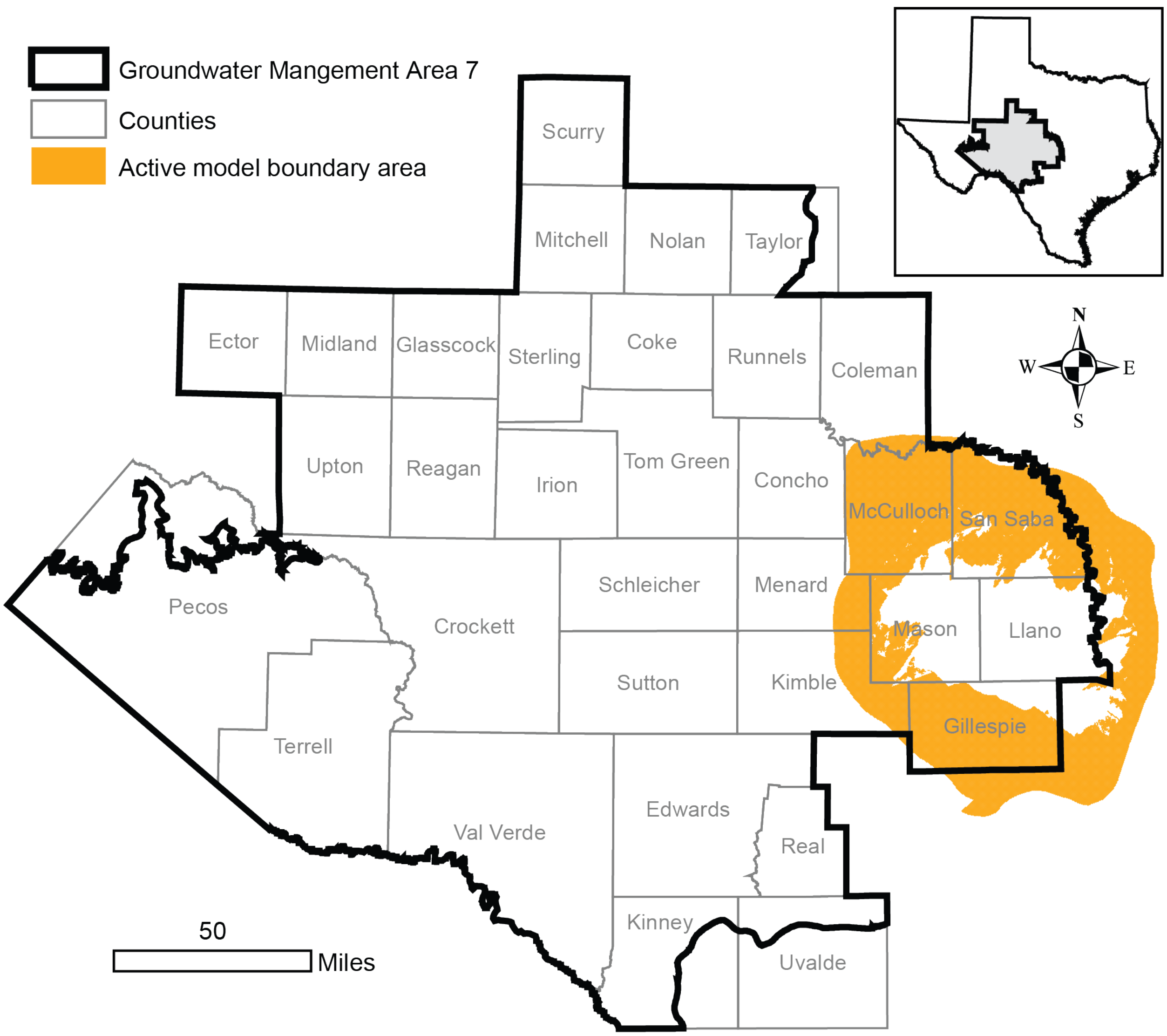

FIGURE 10. MAP SHOWING THE AREAS COVERED BY THE ELLENBURGER-SAN SABA AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL FOR THE MINOR AQUIFERS OF THE LLANO UPLIFT AREA IN GROUNDWATER MANAGEMENT AREA 7.

TABLE 9. 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 2020 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					
		2020	2030	2030	2050	2060	2070
Hickory UWCD No. 1	Kimble	344	344	344	344	344	344
	Mason	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
	Menard	282	282	282	282	282	282
	San Saba	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**
Hill Country UWCD	Gillespie	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**
Kimble County GCD	Kimble	178	178	178	178	178	178
	Total	**178**	**178**	**178**	**178**	**178**	**178**
Menard County UWD	Menard	27	27	27	27	27	27
	Total	**27**	**27**	**27**	**27**	**27**	**27**
No District	McCulloch	898	898	898	898	898	898
	San Saba	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**
GMA 7		**22,615**	**22,615**	**22,615**	**22,615**	**22,615**	**22,615**

TABLE 10. 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 2030 AND 2070. RESULTS ARE IN ACRE-FEET PER YEAR.

County	RWPA	River Basin	Year				
			2030	2040	2050	2060	2070
Gillespie	K	Colorado	6,294	6,294	6,294	6,294	6,294
		Total	**6,294**	**6,294**	**6,294**	**6,294**	**6,294**
Kimble	F	Colorado	521	521	521	521	521
		Total	**521**	**521**	**521**	**521**	**521**
Mason	F	Colorado	3,237	3,237	3,237	3,237	3,237
		Total	**3,237**	**3,237**	**3,237**	**3,237**	**3,237**
McCulloch	F	Colorado	4,364	4,364	4,364	4,364	4,364
		Total	**4,364**	**4,364**	**4,364**	**4,364**	**4,364**
Menard	F	Colorado	309	309	309	309	309
		Total	**309**	**309**	**309**	**309**	**309**
San Saba	K	Colorado	7,890	7,890	7,890	7,890	7,890
		Total	**7,890**	**7,890**	**7,890**	**7,890**	**7,890**
GMA 7			**22,615**	**22,615**	**22,615**	**22,615**	**22,615**

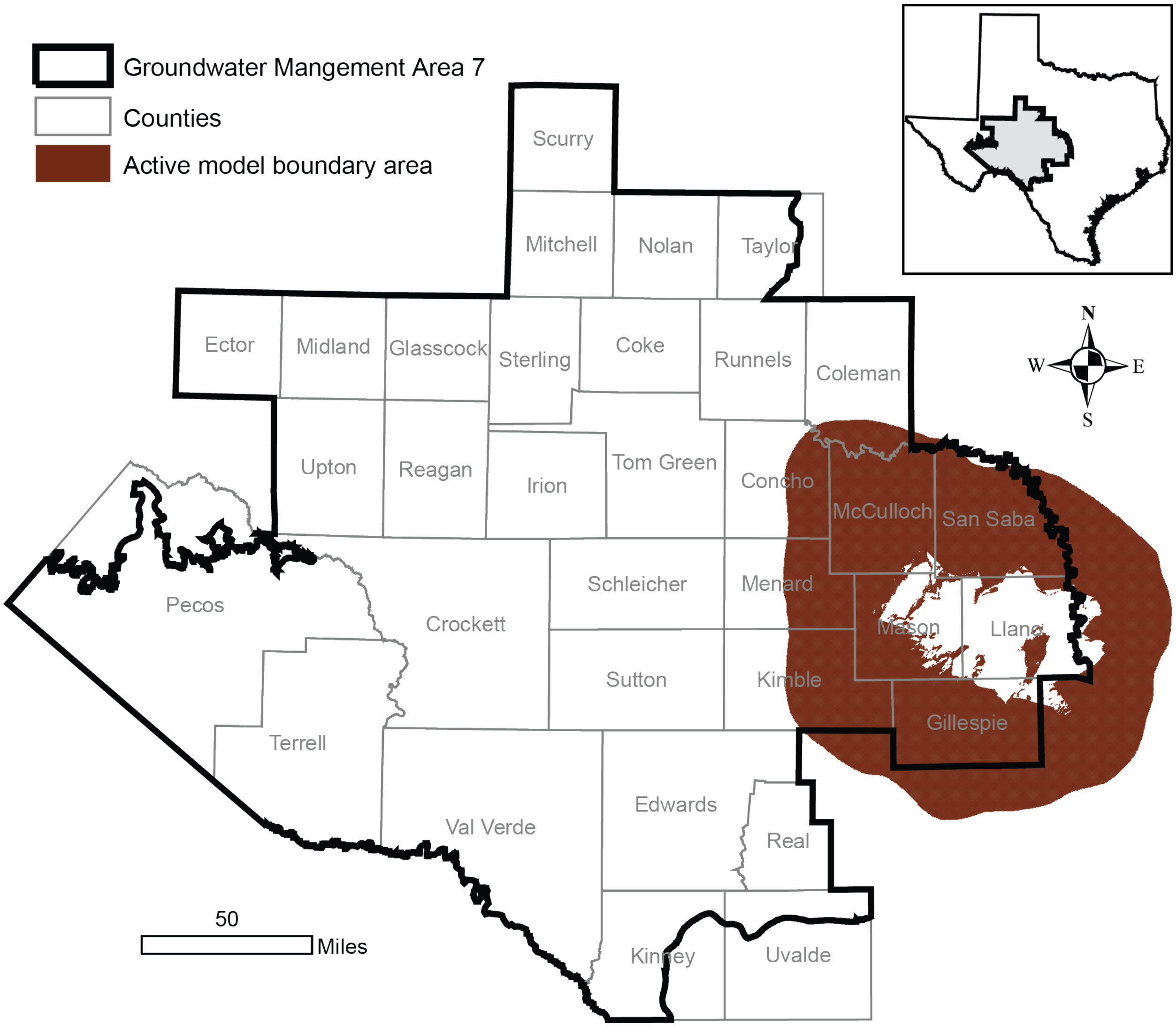

FIGURE 11. **MAP SHOWING AREAS COVERED BY THE HICKORY AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL FOR THE MINOR AQUIFERS OF THE LLANO UPLIFT AREA IN GROUNDWATER MANAGEMENT AREA 7.**

TABLE 11. MODELED AVAILABLE GROUNDWATER FOR THE HICKORY AQUIFER IN GROUNDWATER MANAGEMENT AREA 7 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2020 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					
		2020	2030	2040	2050	2060	2070
Hickory UWCD No. 1	Concho	13	13	13	13	13	13
	Kimble	42	42	42	42	42	42
	Mason	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
	Menard	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
	Total	**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
	Total	**1,751**	**1,751**	**1,751**	**1,751**	**1,751**	**1,751**
Kimble County GCD	Kimble	123	123	123	123	123	123
	Total	**123**	**123**	**123**	**123**	**123**	**123**
Lipan-Kickapoo WCD	Concho	13	13	13	13	13	13
	Total	**13**	**13**	**13**	**13**	**13**	**13**
Menard County UWD	Menard	126	126	126	126	126	126
	Total	**126**	**126**	**126**	**126**	**126**	**126**
No District	McCulloch	2,427	2,427	2,427	2,427	2,427	2,427
	San Saba	652	652	652	652	652	652
	Total	**3,080**	**3,080**	**3,080**	**3,080**	**3,080**	**3,080**
GMA 7		**49,937**	**49,937**	**49,937**	**49,937**	**49,937**	**49,937**

TABLE 12. 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 2030 AND 2070. RESULTS ARE IN ACRE-FEET PER YEAR.

County	RWPA	River Basin	Year				
			2030	2040	2050	2060	2070
Concho	F	Colorado	27	27	27	27	27
		Total	**27**	**27**	**27**	**27**	**27**
Gillespie	K	Colorado	1,751	1,751	1,751	1,751	1,751
		Total	**1,751**	**1,751**	**1,751**	**1,751**	**1,751**
Kimble	F	Colorado	165	165	165	165	165
		Total	**165**	**165**	**165**	**165**	**165**
Mason	F	Colorado	13,212	13,212	13,212	13,212	13,212
		Total	**13,212**	**13,212**	**13,212**	**13,212**	**13,212**
McCulloch	F	Colorado	24,377	24,377	24,377	24,377	24,377
		Total	**24,377**	**24,377**	**24,377**	**24,377**	**24,377**
Menard	F	Colorado	2,725	2,725	2,725	2,725	2,725
		Total	**2,725**	**2,725**	**2,725**	**2,725**	**2,725**
San Saba	K	Colorado	7,680	7,680	7,680	7,680	7,680
		Total	**7,680**	**7,680**	**7,680**	**7,680**	**7,680**
GMA 7			**49,937**	**49,937**	**49,937**	**49,937**	**49,937**

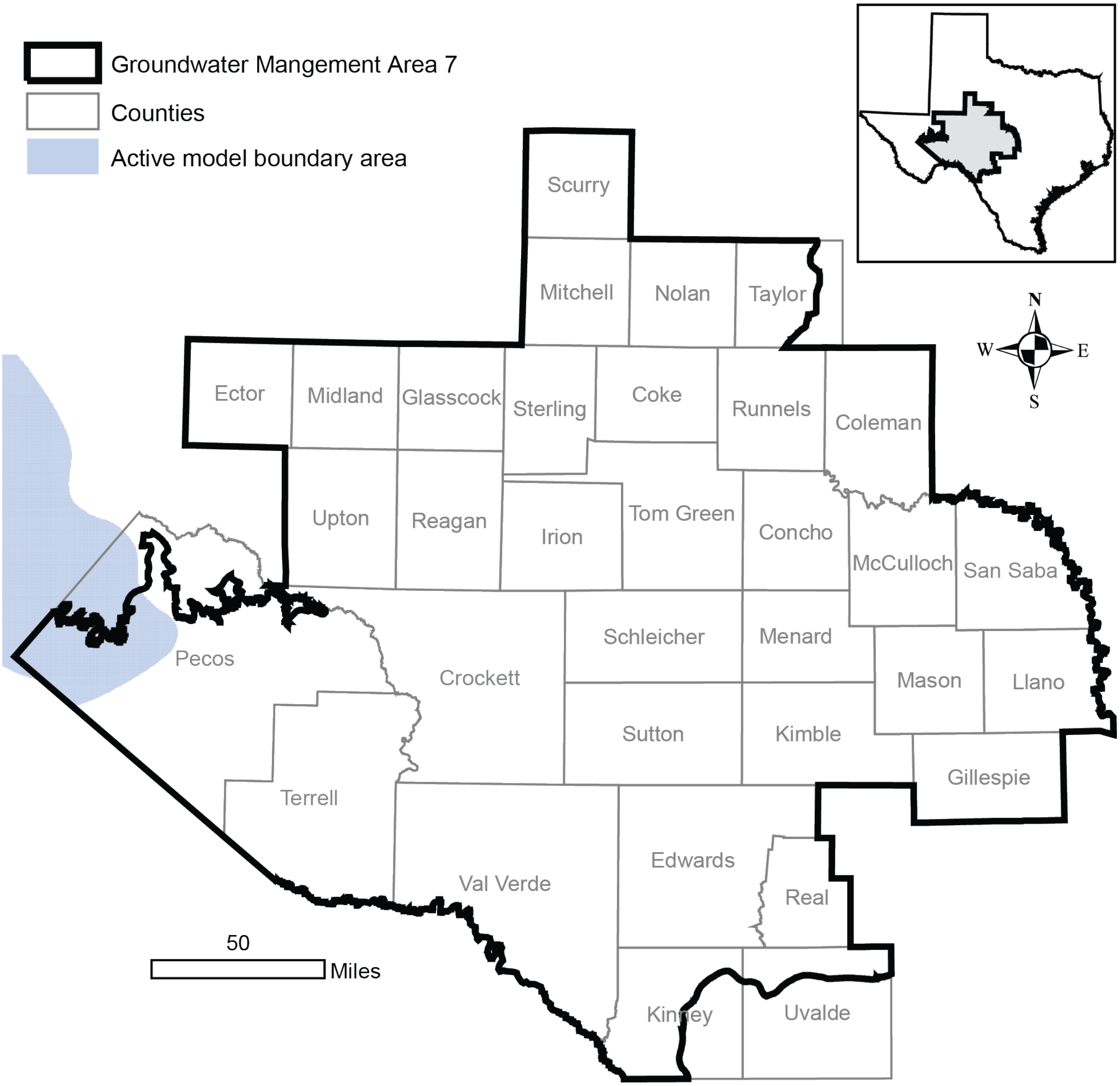

FIGURE 13. MAP SHOWING AREAS COVERED BY THE RUSTLER AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL FOR THE RUSTLER AQUIFER IN GROUNDWATER MANAGEMENT AREA 7.

TABLE 13. MODELED AVAILABLE GROUNDWATER FOR THE RUSTLER AQUIFER IN GROUNDWATER MANAGEMENT AREA 7 SUMMARIZED BY DISTRICT AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2070. RESULTS ARE IN ACRE-FEET PER YEAR.

District	County	Year					
		2020	2030	2040	2050	2060	2070
Middle Pecos GCD	Pecos	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**

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 2030 AND 2070. RESULTS ARE IN ACRE-FEET PER YEAR.

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

In some cases, the predictive model run for this analysis could result 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. This would mean that the modeled available groundwater would include imaginary "pumping" values that are coming from cells that are actually dry.

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APPENDIX B

ESTIMATED HISTORICAL GROUNDWATER USE AND 2022 STATE WATER PLAN DATASETS: KIMBLE COUNTY GROUNDWATER CONSERVATION DISTRICT

Estimated Historical Groundwater Use And 2022 State Water Plan Datasets:

Kimble County Groundwater Conservation District

Texas Water Development Board
Groundwater Division
Groundwater Technical Assistance Section
stephen.allen@twdb.texas.gov
(512) 463-7317

May 22, 2024

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 2022 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 Grayson Dowlearn, grayson.dowlearn@twdb.texas.gov, (512) 475-1552.

DISCLAIMER:

The data presented in this report represents the most up to date WUS and 2022 SWP data available as of 5/22/2024. 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 2022 SWP. District personnel must review these datasets and correct any discrepancies 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 2022 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 to “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 ideal 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 2020. TWDB staff anticipates the calculation and posting of these estimates at a later date.

KIMBLE COUNTY *97.43% (multiplier)* All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2019	GW	41	3	343	0	289	237	913
	SW	521	503	0	0	2,543	101	3,668
2018	GW	44	3	0	0	264	236	547
	SW	526	503	0	0	2,387	101	3,517
2017	GW	50	3	0	0	276	228	557
	SW	518	503	0	0	1,970	97	3,088
2016	GW	53	2	0	0	335	174	564
	SW	495	530	0	0	1,980	75	3,080
2015	GW	116	2	0	0	133	173	424
	SW	497	603	0	0	2,234	74	3,408
2014	GW	163	2	0	0	287	148	600
	SW	510	519	0	0	2,119	63	3,211
2013	GW	214	2	167	0	172	146	701
	SW	510	588	0	0	2,234	62	3,394
2012	GW	246	2	0	0	384	176	808
	SW	561	588	0	0	2,220	76	3,445
2011	GW	256	2	0	0	301	313	872
	SW	626	571	0	0	2,327	134	3,658
2010	GW	227	2	10	0	523	309	1,071
	SW	596	503	11	0	2,375	133	3,618
2009	GW	218	2	5	0	751	227	1,203
	SW	607	469	6	0	2,190	97	3,369
2008	GW	210	2	0	0	182	228	622
	SW	560	12	1	0	2,657	97	3,327
2007	GW	191	2	0	0	447	275	915
	SW	560	12	0	0	1,070	117	1,759
2006	GW	229	2	0	0	23	255	509
	SW	608	64	0	0	2,952	109	3,733
2005	GW	215	2	0	0	160	265	642
	SW	608	63	0	0	2,300	114	3,085
2004	GW	198	3	0	0	86	294	581
	SW	608	63	0	0	2,148	73	2,892

Projected Surface Water Supplies
TWDB 2022 State Water Plan Data

KIMBLE COUNTY *97.43% (multiplier)* All values are in acre-feet

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070
F	Irrigation, Kimble	Colorado	Colorado Run-of-River	1,071	1,071	1,071	1,071	1,071	1,071
F	Junction	Colorado	Colorado Run-of-River	0	0	0	0	0	0
F	Livestock, Kimble	Colorado	Colorado Livestock Local Supply	134	134	134	134	134	134
F	Manufacturing, Kimble	Colorado	Colorado Run-of-River	0	0	0	0	0	0
F	Mining, Kimble	Colorado	Colorado Run-of-River	14	14	14	14	14	14
	Sum of Projected Surface Water Supplies (acre-feet)			**1,219**	**1,219**	**1,219**	**1,219**	**1,219**	**1,219**

Projected Water Demands
TWDB 2022 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.

KIMBLE COUNTY

97.43% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
F	County-Other, Kimble	Colorado	247	242	235	231	230	230
F	Irrigation, Kimble	Colorado	2,589	2,589	2,589	2,589	2,589	2,589
F	Junction	Colorado	626	620	609	605	604	604
F	Livestock, Kimble	Colorado	312	312	312	312	312	312
F	Manufacturing, Kimble	Colorado	589	688	688	688	688	688
F	Mining, Kimble	Colorado	19	19	19	19	19	19
		Sum of Projected Water Demands (acre-feet)	**4,382**	**4,470**	**4,452**	**4,444**	**4,442**	**4,442**

Projected Water Supply Needs
TWDB 2022 State Water Plan Data

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

KIMBLE COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
F	County-Other, Kimble	Colorado	0	0	0	0	0	0
F	Irrigation, Kimble	Colorado	-1,103	-1,103	-1,103	-1,103	-1,103	-1,103
F	Junction	Colorado	-626	-620	-609	-605	-604	-604
F	Livestock, Kimble	Colorado	0	0	0	0	0	0
F	Manufacturing, Kimble	Colorado	-603	-704	-704	-704	-704	-704
F	Mining, Kimble	Colorado	0	0	0	0	0	0
		Sum of Projected Water Supply Needs (acre-feet)	**-2,332**	**-2,427**	**-2,416**	**-2,412**	**-2,411**	**-2,411**

Projected Water Management Strategies
TWDB 2022 State Water Plan Data

KIMBLE COUNTY

WUG, Basin (RWPG)

All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
Irrigation, Kimble, Colorado (F)							
Irrigation Conservation - Kimble County	DEMAND REDUCTION [Kimble]	133	266	319	319	319	319
		133	**266**	**319**	**319**	**319**	**319**
Junction, Colorado (F)							
Develop Additional Edwards-Trinity Plateau Aquifer Supplies - Junction	Edwards-Trinity-Plateau, Pecos Valley, and Trinity Aquifers [Kimble]	370	370	370	370	370	370
Municipal Conservation - Junction	DEMAND REDUCTION [Kimble]	8	8	8	8	8	8
Subordination - Kimble County RoR	Colorado Run-of-River [Kimble]	250	250	250	250	250	250
		628	**628**	**628**	**628**	**628**	**628**
Manufacturing, Kimble, Colorado (F)							
Develop Additional Ellenburger San Saba Aquifer Supplies - Kimble County Manufacturing	Ellenburger-San Saba Aquifer [Kimble]	500	500	500	500	500	500
Subordination - Kimble County RoR	Colorado Run-of-River [Kimble]	228	228	228	228	228	228
		728	**728**	**728**	**728**	**728**	**728**
Mining, Kimble, Colorado (F)							
Mining Conservation - Kimble County	DEMAND REDUCTION [Kimble]	1	1	1	1	1	1
		1	**1**	**1**	**1**	**1**	**1**
Sum of Projected Water Management Strategies (acre-feet)		**1,490**	**1,623**	**1,676**	**1,676**	**1,676**	**1,676**

APPENDIX C

GAM RUN 23-026: KIMBLE COUNTY GROUNDWATER CONSERVATION DISTRICT MANAGEMENT PLAN

GAM RUN 23-026: KIMBLE COUNTY GROUNDWATER CONSERVATION DISTRICT MANAGEMENT PLAN

Sofia Avendaño, G.I.T. and Shirley Wade, Ph.D., P.G.
Texas Water Development Board
Groundwater Division
Groundwater Modeling Department
512-936-6079
January 19, 2024

STATE OF TEXAS
SHIRLEY C. WADE
GEOLOGY
No. 525
LICENSED
PROFESSIONAL GEOSCIENTIST

Shirley C. Wade
1/19/2024

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GAM RUN 23-026: KIMBLE COUNTY GROUNDWATER CONSERVATION DISTRICT MANAGEMENT PLAN

Sofia Avendaño, G.I.T. and Shirley Wade, Ph.D., P.G.
Texas Water Development Board
Groundwater Division
Groundwater Modeling Department
512-936-6079
January 19, 2024

EXECUTIVE SUMMARY:

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

The TWDB provides data and information to the Kimble 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 Department. Please direct questions about the water data report to Mr. Stephen Allen at 512-463-7317 or stephen.allen@twdb.texas.gov. Part 2 is the required groundwater availability modeling information, which includes:

1. the annual amount of recharge from precipitation, if any, to the groundwater resources within the district;

2. the annual volume of water that discharges from the aquifer to springs and any surface-water bodies, including lakes, streams, and rivers, for each aquifer within the district; 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 Kimble County Groundwater Conservation District should be adopted by the district on or before April 13, 2024, and submitted to the executive administrator of the TWDB on or before May 13, 2024. The current management plan for the Kimble County Groundwater Conservation District expires on July 12, 2024.

Information for the Edwards-Trinity (Plateau) Aquifer is from version 1.01 of the groundwater availability model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers (Anaya and Jones, 2009). We used the groundwater availability model for the Llano Uplift Aquifer System (Shi and others, 2016) to estimate the management plan information for the Marble Falls, Ellenburger-San Saba, and Hickory aquifers within the Kimble County Groundwater Conservation District.

This report replaces the results of GAM Run 18-015 (Jones, 2018). Values may differ from the previous report as a result of routine updates to the spatial grid file used to define county, groundwater conservation district, and aquifer boundaries, which can impact the calculated water budget values. Additionally, the approach used for analyzing model results is reviewed during each update and may have been refined to better delineate groundwater flows. Tables 1, 2, 3, and 4 summarize the groundwater availability model data required by statute. Figures 1, 3, 5, and 7 show the area of the model from which the values in Tables 1, 2, 3, and 4 were extracted. Figures 2, 4, 6, and 8 provide a generalized diagram of the groundwater flow components provided in Tables 1, 2, 3, and 4. If the Kimble County Groundwater Conservation District determines that the district boundaries used in the assessment do not reflect current conditions after reviewing the figures, please notify the TWDB Groundwater Modeling Department at your earliest convenience.

The flow components presented in this report do not represent the full groundwater budget. If additional inflow and outflow information would be helpful for planning purposes, the district may submit a request in writing to the TWDB Groundwater Modeling Department for the full groundwater budget.

METHODS:

In accordance with the provisions of the Texas Water Code § 36.1071(h), the groundwater availability models mentioned above was used to estimate information for the Kimble County Groundwater Conservation District management plan. Water budgets were extracted for the historical model period in the groundwater availability model. For the Edwards-Trinity (Plateau) Aquifer the historical calibration period is 1981 through 2000, and for Marble Falls, Ellenburger-San Saba, and Hickory aquifers the historical calibration period is 1981 through 2010. Water budgets were extracted over the historical calibration periods using ZONEBUDGET Version 3.01 (Harbaugh, 2009) for the Edwards-Trinity

(Plateau) and ZONEBUDGET for MODFLOW USG Version 1.0 (Panday and others, 2013) for the Marble Falls, Ellenburger-San Saba and Hickory aquifers. The average annual water budget values for recharge, surface-water outflow, inflow to the district, outflow from the district, and the flow between aquifers within the district are summarized in this report.

PARAMETERS AND ASSUMPTIONS:

Groundwater availability model of the Edwards-Trinity (Plateau) Aquifer and Pecos Valley Aquifers

- We used version 1.01 of the groundwater availability model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers to analyze the Edwards-Trinity (Plateau) Aquifer. See Anaya and Jones (2009) for assumptions and limitations of the model.
- The model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers contains the following 2 layers:
    - Layer 1 represents the Edwards Group and equivalent limestone hydrostratigraphic units of the Edwards-Trinity (Plateau) Aquifer.
    - Layer 2 represents the undifferentiated Trinity Group hydrostratigraphic units or equivalent units of the Edwards-Trinity (Plateau) Aquifer.
- The two layers were combined for calculating water budget flows for the Edwards-Trinity (Plateau) Aquifer within the district.
- Water budget terms were averaged for the period 1981 through 2000 (stress periods 2 through 21).
- The model was run with MODFLOW-96 (Harbaugh and McDonald, 1996).

Groundwater availability model for the minor aquifers of the Llano Uplift

- We used version 1.01 of the groundwater availability model for the minor aquifers in the Llano Uplift Region to analyze the Hickory, Ellenburger-San Saba, and Marble Falls aquifers. See Shi and others (2016) for assumptions and limitations of the model.
- The groundwater availability model for the minor aquifers in the Llano Uplift Region contains eight layers:

  - Layer 1 represents the Trinity Aquifer, Edwards-Trinity (Plateau) Aquifer, and younger alluvium deposits.
  - Layer 2 represents Permian and Pennsylvanian age confining units.
  - Layer 3 represents the Marble Falls Aquifer and equivalent units.
  - Layer 4 represents Mississippian age confining units.
  - Layer 5 represents the Ellenburger-San Saba Aquifer and equivalent units.
  - Layer 6 represents Cambrian age confining units.
  - Layer 7 represents the Hickory Aquifer and equivalent units.
  - Layer 8 represents Precambrian age confining units.

- Water budgets for the district were determined for the Marble Falls Aquifer (Layer 3), the Ellenburger-San Saba (Layer 5), and the Hickory Aquifer (Layer 7).
- Water budget terms were averaged for the period 1981 to 2010 (stress periods 2 through 31).
- The model was run with MODFLOW-USG (Panday and others, 2013).

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 model results for the Edwards-Trinity (Plateau), Marble Falls, Ellenburger-San Saba, and Hickory aquifers located within the Kimble County Groundwater Conservation District and averaged over the historical calibration period, as shown in Tables 1, 2, 3, and 4.

1. Precipitation recharge—the areally distributed recharge sourced from precipitation falling on the outcrop areas of the aquifers (where the aquifer is exposed at land surface) within the district.
2. Surface-water outflow—the total water discharging from the aquifer (outflow) to surface-water features such as streams, reservoirs, and springs.
3. Flow into and out of district—the lateral flow within the aquifer between the district and adjacent counties.

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

The information needed for the district's management plan is summarized in Tables 1, 2, 3, and 4. Figures 1, 3, 5, and 7 show the area of the model from which the values in Tables 1, 2, 3, and 4 were extracted. Figures 2, 4, 6, and 8 provide a generalized diagram of the groundwater flow components provided in Tables 1, 2, 3, and 4. 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 that is needed for the Kimble County Groundwater Conservation District 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	31,462
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	57,664
Estimated annual volume of flow into the district within each aquifer in the district	Edwards-Trinity (Plateau) Aquifer	29,617
Estimated annual volume of flow out of the district within each aquifer in the district	Edwards-Trinity (Plateau) Aquifer	10,637
Estimated net annual volume of flow between each aquifer in the district	From Edwards-Trinity (Plateau) Aquifer to underlying units	1[1]

[1] Estimated from the groundwater availability model for the minor aquifers in the Llano Uplift Region (Shi and others, 2016).

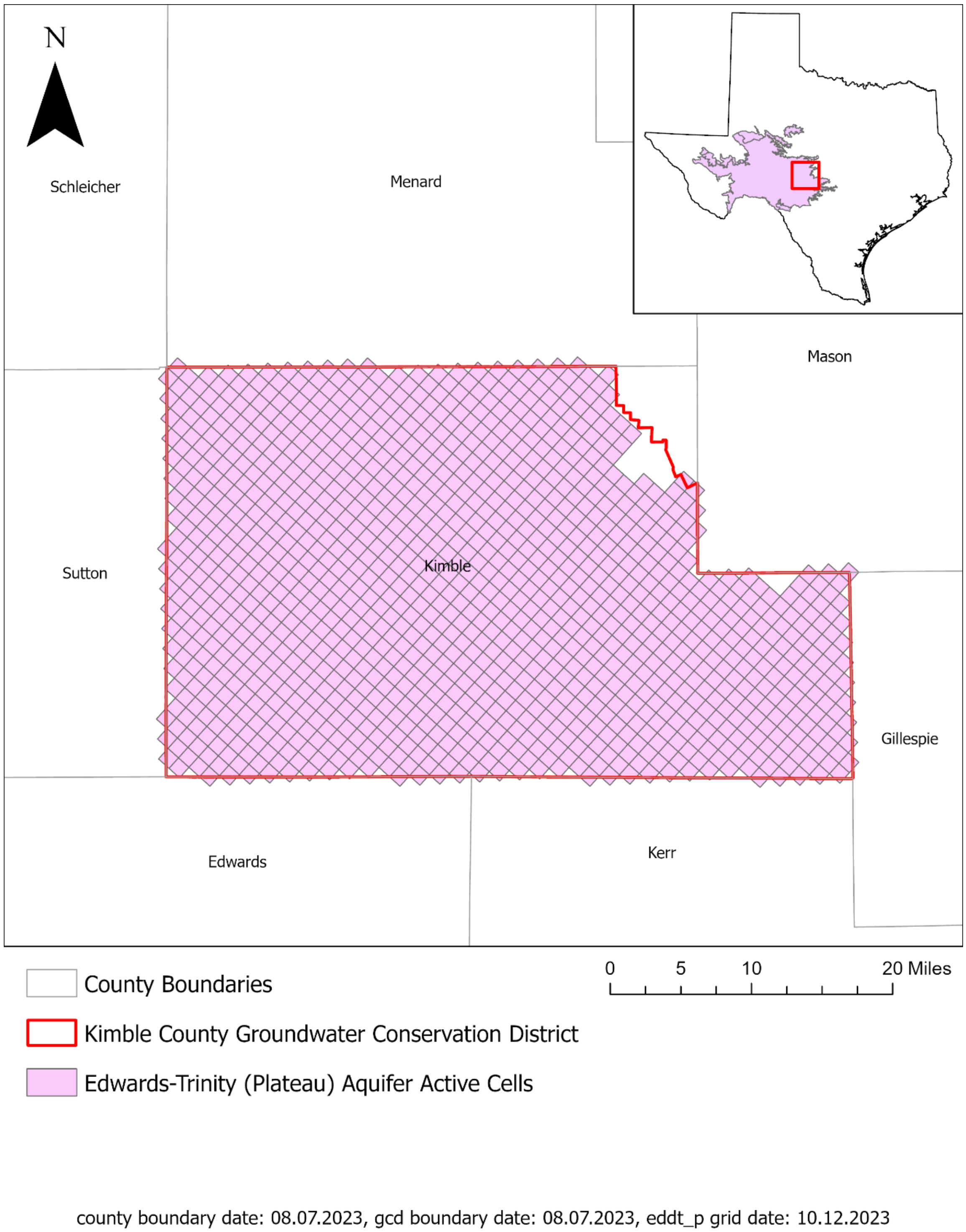
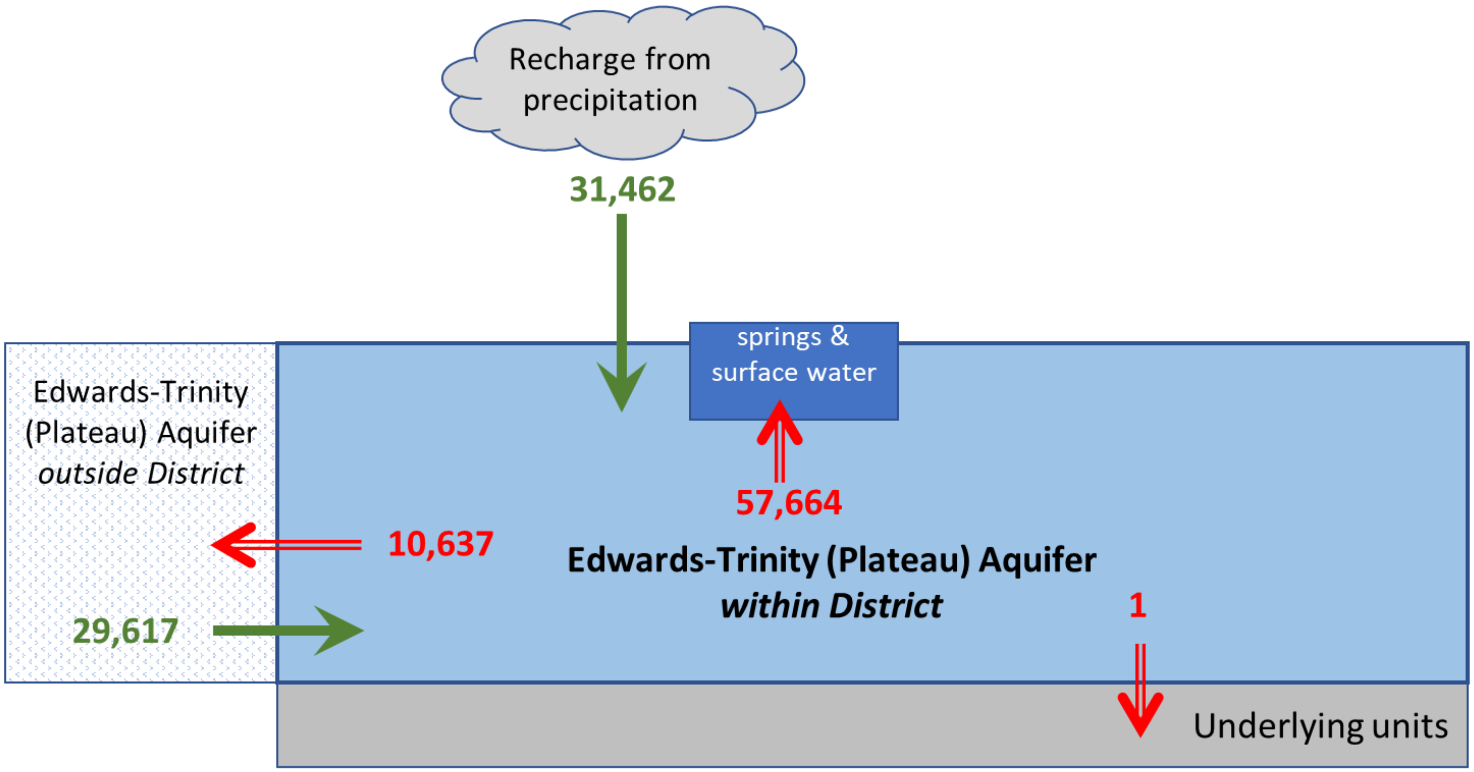


Figure 1: Area of the groundwater availability model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers from which the information in Table 1 was extracted (Edwards-Trinity [Plateau] Aquifer extent within the district boundary).



Caveat: This diagram only includes the water budget items provided in Table 1. A complete water budget would include additional inflows and outflows. For a full groundwater budget, please submit a request in writing to the Groundwater Modeling Department.

Figure 2: Generalized diagram of the summarized budget information from Table 1, representing directions of flow for the Edwards-Trinity (Plateau) Aquifer within the Kimble County Groundwater Conservation District. Flow values are expressed in acre-feet per year.

Table 2: Summarized information for the Marble Falls Aquifer that is needed for the Kimble County Groundwater Conservation District 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	Marble Falls Aquifer	14
Estimated annual volume of water that discharges from the aquifer to springs and any surface-water body including lakes, streams, and rivers	Marble Falls Aquifer	1,313
Estimated annual volume of flow into the district within each aquifer in the district	Marble Falls Aquifer	0
Estimated annual volume of flow out of the district within each aquifer in the district	Marble Falls Aquifer	76
Estimated net annual volume of flow between each aquifer in the district	To Marble Falls Aquifer from Edwards-Trinity (Plateau) Aquifer/alluvium	1
	From Marble Falls Aquifer to overlying confining units	185
	To Marble Falls Aquifer from Marble Falls equivalent units	452
	To Marble Falls Aquifer from Ellenburger-San Saba Aquifer	860
	To Marble Falls Aquifer from underlying confining units	250

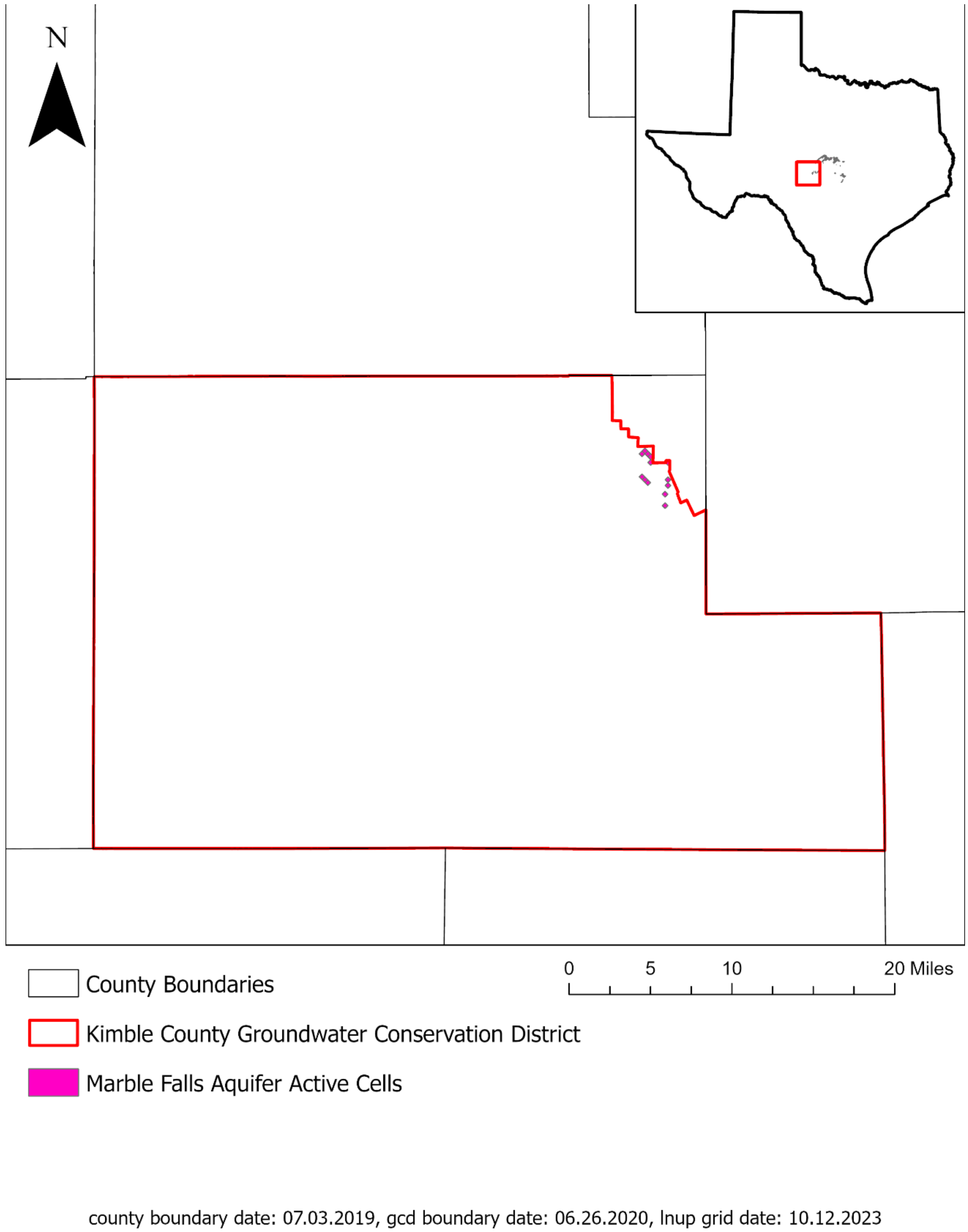
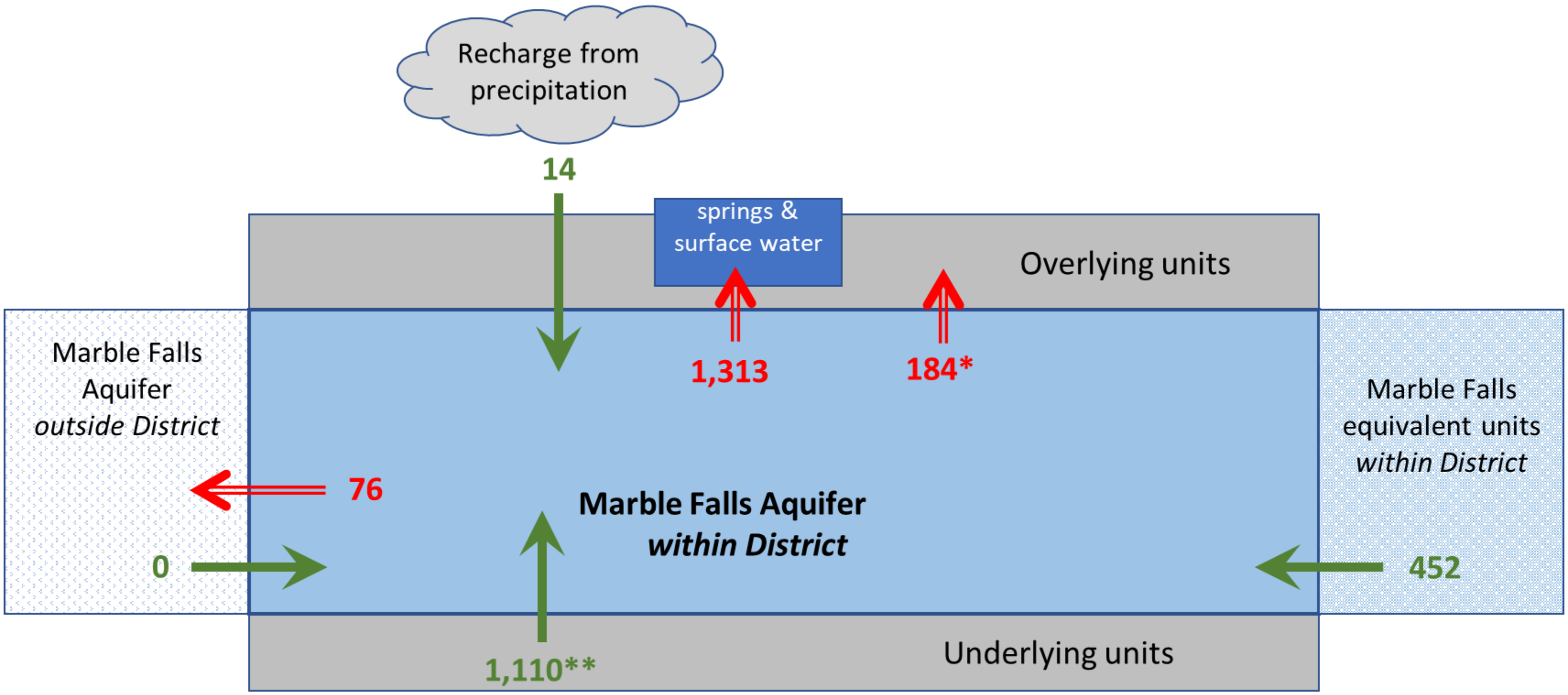


Figure 3: Area of the groundwater availability model for the minor aquifers of the Llano Uplift Region from which the information in Table 2 was extracted (the Marble Falls Aquifer extent within the district boundary).



* Flow from overlying units includes a net outflow of 185 AFY to overlying confining units and a net inflow of 1 AFY from Edwards-Trinity (Plateau)/alluvium
** Flow from underlying units includes a net inflow of 860 AFY from Ellenburger-San Saba Aquifer and 250 AFY from underlying confining units

Caveat: This diagram only includes the water budget items provided in Table 2. A complete water budget would include additional inflows and outflows. For a full groundwater budget, please submit a request in writing to the Groundwater Modeling Department.

Figure 4: Generalized diagram of the summarized budget information from Table 2, representing directions of flow for the Marble Falls Aquifer within the Kimble County Groundwater Conservation District. Flow values are expressed in acre-feet per year.

Table 3: Summarized information for the Ellenburger-San Saba Aquifer that is needed for the Kimble County Groundwater Conservation District 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	Ellenburger-San Saba Aquifer	0
Estimated annual volume of water that discharges from the aquifer to springs and any surface-water body including lakes, streams, and rivers	Ellenburger-San Saba Aquifer	0
Estimated annual volume of flow into the district within each aquifer in the district	Ellenburger-San Saba Aquifer	3,246
Estimated annual volume of flow out of the district within each aquifer in the district	Ellenburger-San Saba Aquifer	5,625
Estimated net annual volume of flow between each aquifer in the district	To Ellenburger-San Saba Aquifer from overlying confining units	6,506
	From Ellenburger-San Saba Aquifer to Marble Falls Aquifer	860
	To Ellenburger-San Saba Aquifer from Ellenburger-San Saba equivalent units	772
	From Ellenburger-San Saba Aquifer to underlying confining units	3,467
	To Ellenburger-San Saba Aquifer from Hickory Aquifer	2

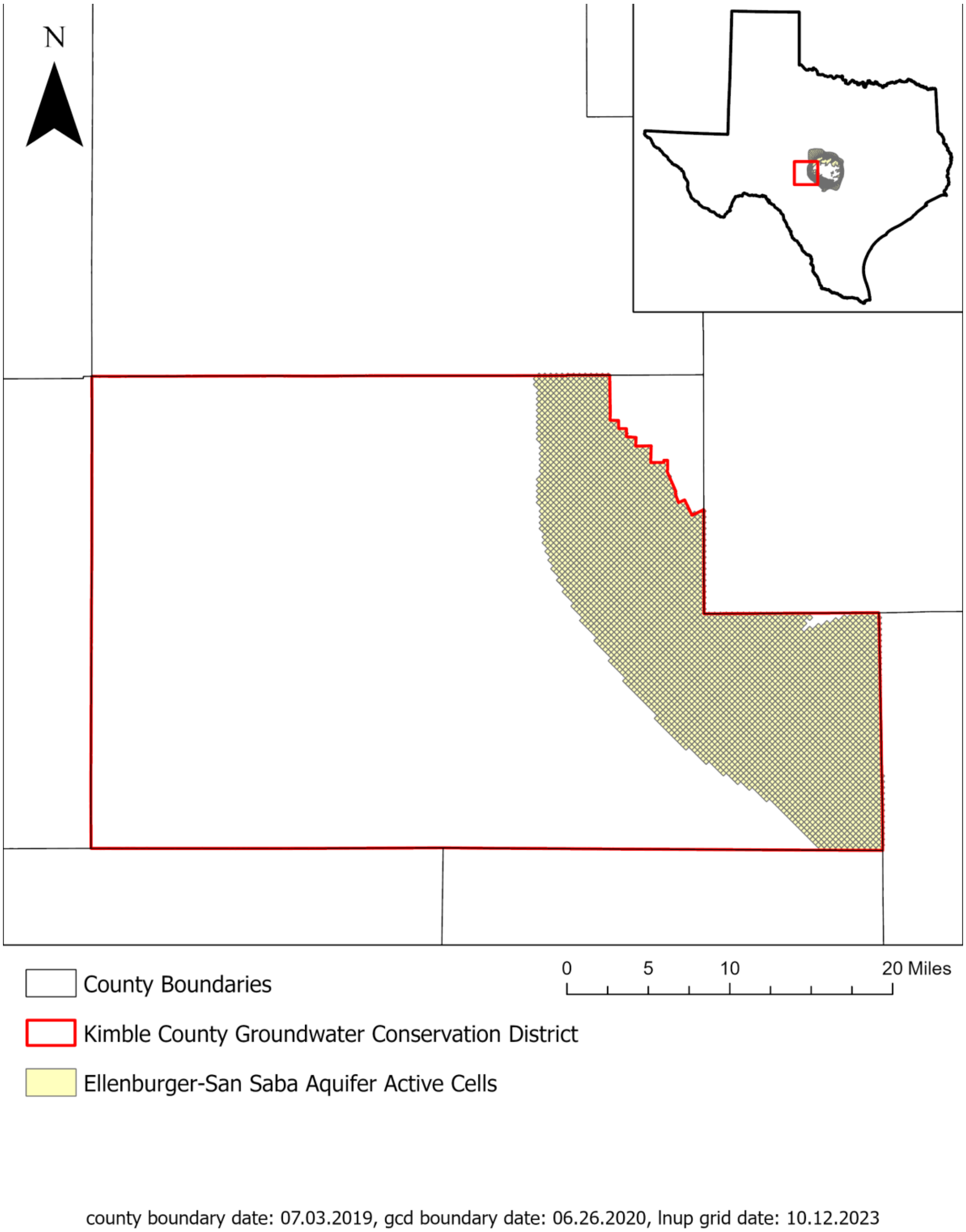
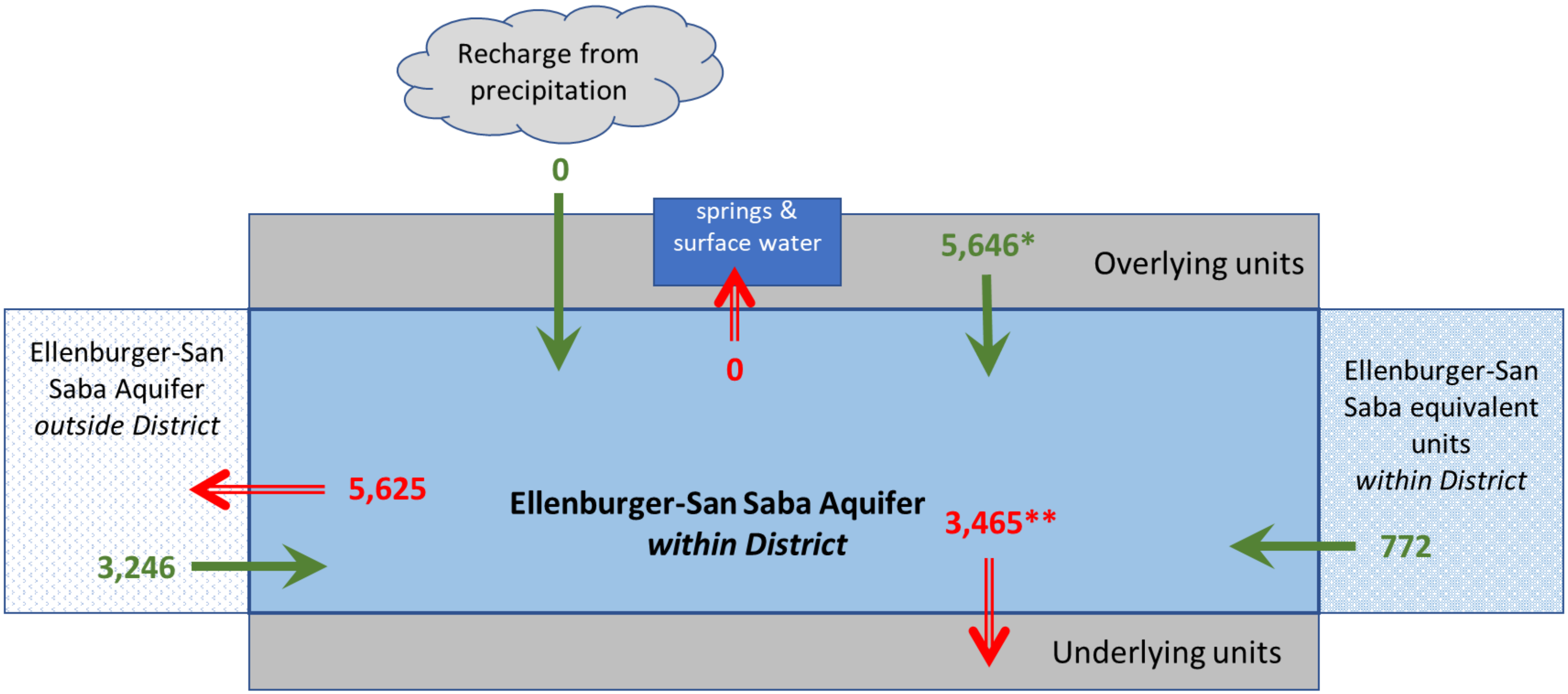


Figure 5: Area of the groundwater availability model for the minor aquifers of the Llano Uplift Region from which the information in Table 3 was extracted (the Ellenburger-San Saba Aquifer extent within the district boundary).



* Flow from overlying units includes a net inflow of 6,506 AFY from overlying confining units and a net outflow of 860 AFY to Marble Falls Aquifer
** Flow from underlying units includes a net outflow of 3,467 AFY to underlying confining units and a net inflow of 2 AFY from Hickory Aquifer

Caveat: This diagram only includes the water budget items provided in Table 3. A complete water budget would include additional inflows and outflows. For a full groundwater budget, please submit a request in writing to the Groundwater Modeling Department.

Figure 6: Generalized diagram of the summarized budget information from Table 3, representing directions of flow for the Ellenburger-San Saba Aquifer within the Kimble County Groundwater Conservation District. Flow values are expressed in acre-feet per year.

Table 4: Summarized information for the Hickory Aquifer that is needed for the Kimble County Groundwater Conservation District 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	Hickory Aquifer	0
Estimated annual volume of water that discharges from the aquifer to springs and any surface-water body including lakes, streams, and rivers	Hickory Aquifer	0
Estimated annual volume of flow into the district within each aquifer in the district	Hickory Aquifer	3,682
Estimated annual volume of flow out of the district within each aquifer in the district	Hickory Aquifer	8,204
Estimated net annual volume of flow between each aquifer in the district	To Hickory Aquifer from overlying confining units	5,311
	From Hickory Aquifer to Ellenburger-San Saba Aquifer	2
	From Hickory Aquifer to Hickory equivalent units	279
	From Hickory Aquifer to underlying confining units	458

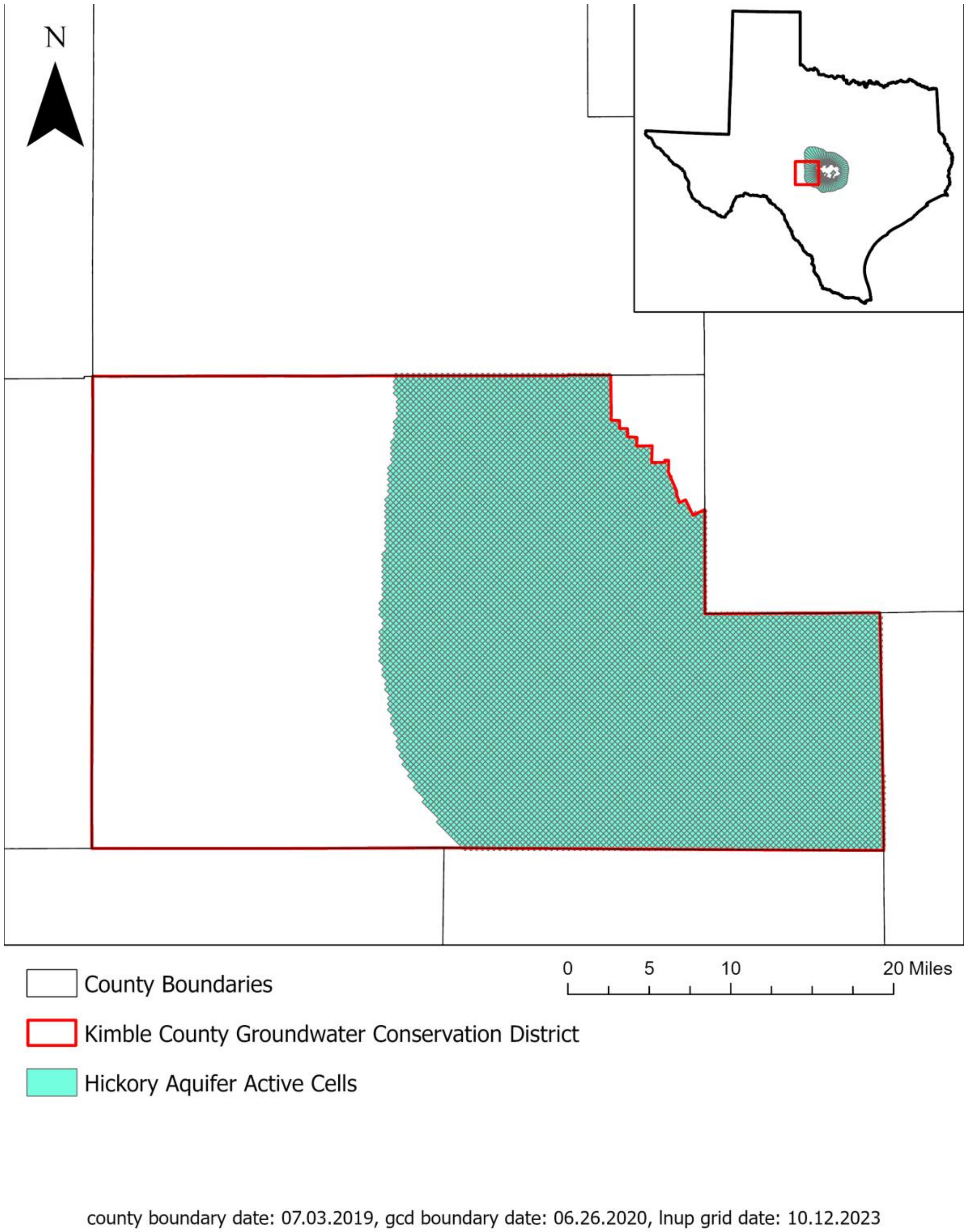
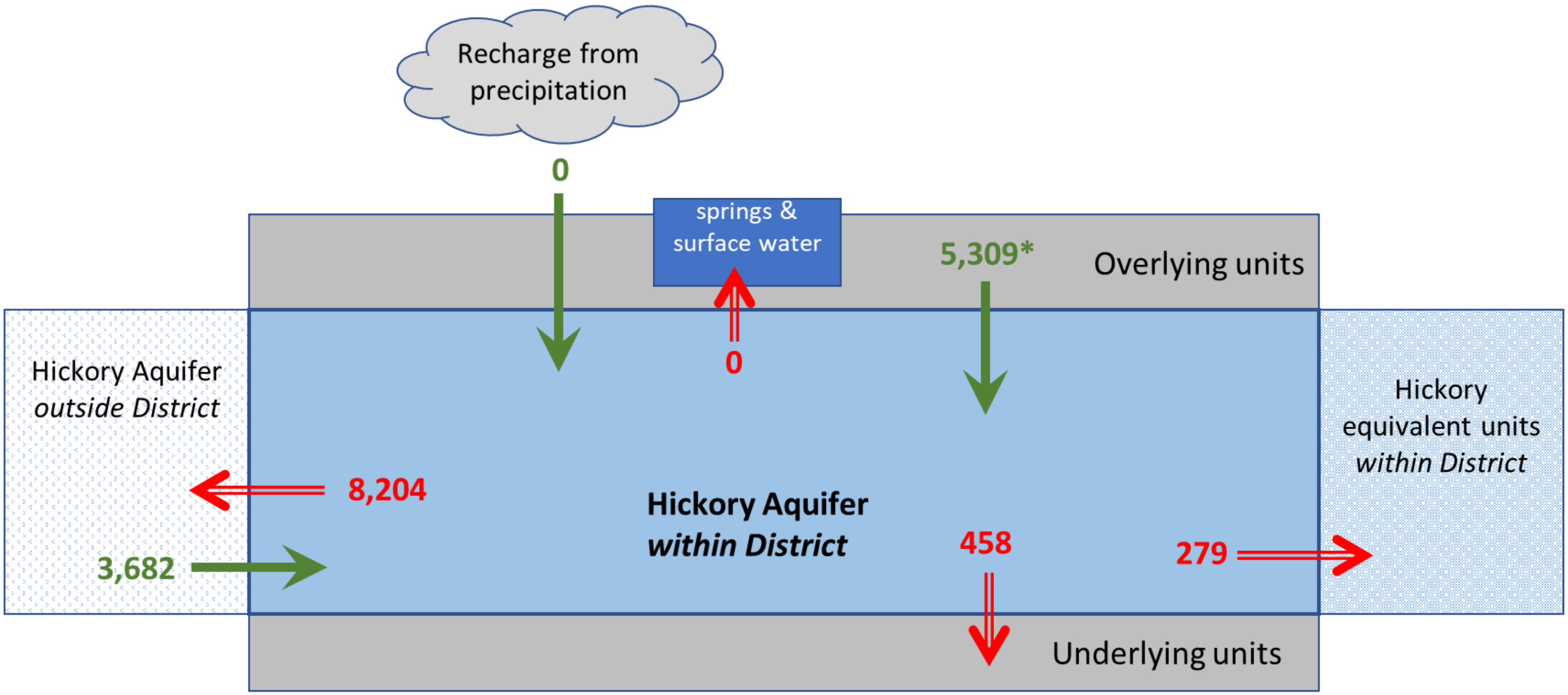


Figure 7: Area of the groundwater availability model for the minor aquifers of the Llano Uplift Region from which the information in Table 4 was extracted (the Hickory Aquifer extent within the district boundary).



* Flow from overlying units includes a net inflow of 5,311 AFY from overlying confining units and a net outflow of 2 AFY to Ellenburger-San Saba Aquifer

Caveat: This diagram only includes the water budget items provided in Table 4. A complete water budget would include additional inflows and outflows. For a full groundwater budget, please submit a request in writing to the Groundwater Modeling Department.

Figure 8: Generalized diagram of the summarized budget information from Table 4, representing directions of flow for the Hickory Aquifer within the Kimble County Groundwater Conservation District. Flow values are expressed in acre-feet per year.

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 historical pumping is as important as evaluating the volume of groundwater flow into and out of the district, between aquifers within the district (as applicable), interactions with surface water (as applicable), recharge to the aquifer system (as applicable), and other metrics that describe the impacts of that pumping. In addition, assumptions regarding precipitation, recharge, and interaction with streams are specific to particular 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:

Anaya, R., and Jones, I. C., 2009, Groundwater availability model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers of Texas: Texas Water Development Board Report 373, 103 p. http://www.twdb.texas.gov/groundwater/models/gam/eddt_p/ET-Plateau_Full.pdf

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

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

Jones, I. C., 2018, GAM Run 18-015: Kimble County Groundwater Conservation District Groundwater Management Plan, 16 p., http://www.twdb.texas.gov/groundwater/docs/GAMruns/GR18-015.pdf

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

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

Shi, J., Boghici, R., Kohlrenken, W., and Hutchison, W.R., 2016, Numerical Model Report: Minor Aquifers of the Llano Uplift Region of Texas (Marble Falls, Ellenburger-San Saba, and Hickory). Texas Water Development Board, November 2016, 403p.

Texas Water Code § 36.1071

APPENDIX D

DISTRICT RULES

10.16.2023_adopted-rules-final.pdf (kimblecountygcd.org)

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APPENDIX E

RESOLUTION ADOPTING THE MANAGEMENT PLAN

KIMBLE COUNTY GROUNDWATER CONSERVATION DISTRICT

731 Main St. Ste B
Post Office Box 31
Junction, Texas 76849

Office: 325-446-4826
E-mail: kimblecountygcd@gmail.com
Manager: Meredith Allen

President: Reginald Stapper   Vice-President: Marvin Wilson
Secretary/Treasurer: Clint Smith, Jr.   Director: Mike Carter   Director: Joe Jones

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Adoption of Management Plan 2024-2029

WHEREAS, The Kimble County Groundwater Conservation District was created by the 77th Texas Legislature (2001) now codified as Chapter 8858 Texas Special District Local Laws Code, and in accordance with Chapter 36 of the Texas Water Code, as amended; and

WHEREAS, the District is required by Chapter 36, §36.1071 of the Texas Water Code to develop and adopt a Management Plan; and

WHEREAS, the District is required by Chapter 36, §36.1072 of the Texas Water Code to review and re-adopt the plan with or without revisions at least once every five years and to submit the adopted Management Plan to the Executive Administrator of the Texas Water Development Board for review and approval; and

WHEREAS, the District's readopted revised Management Plan shall be approved by the Executive Administrator if the plan is administratively complete; and

WHEREAS, the District Board of Directors, after reviewing the existing Management Plan, has determined that this plan should be revised and replaced with a new 5-Year Management Plan expiring in 2029; and

WHEREAS, the District Board of Directors has determined that the 5-Year Management Plan addresses the requirements of Chapter 36, §36.1071.

NOW, THEREFORE, be it resolved that the Board of Directors of the Kimble County Groundwater Conservation District, following notice and hearing, hereby adopts this 5-Year Management Plan; and

FUTHER, be it resolved, that this new Management Plan shall become effective immediately upon adoption.

Adopted this 29th day of July 2024, by the Board of Directors of the Kimble County Groundwater Conservation District.

Presiding Officer

Attesting Signature

APPENDIX F

EVIDENCE OF NOTICES AND HEARINGS

PUBLIC NOTICE

KIMBLE COUNTY GROUNDWATER CONSERVATION DISTRICT ADOPTION OF THE MANAGEMENT PLAN

The Kimble County Groundwater Conservation District will hold a public hearing on the 2024-2029 Management Plan on Monday, July 29, 2024, at 6:00 p.m. at the District office located at 731 Main Street, Suite B, Junction, Texas.

All citizens are invited to attend and may inspect the proposed management plan at the District office, Tuesday or Thursday from 9:00 a.m. until 4:00 p.m. until July 29th 2024. For any questions, please contact Meredith Allen at kimblecountygcd@gmail.com or by phone 325-446-4826.

Filed July 8, 24
at 8:40 o'clock A.M.
Karen E. Page
Karen E. Page County Clerk, Kimble County, Texas
By Kendra Powers Deputy
KENDRA POWERS

AFFIDAVIT OF PUBLICATION

THE STATE OF TEXAS §
§
COUNTY OF KIMBLE §

BEFORE ME, the undersigned authority, a Notary Public in and for the State of Texas, on this day personally appeared **ASIA HAPPNER**, who, after being by me duly sworn, upon oath says that she is a representative of **THE JUNCTION EAGLE**, a newspaper of general circulation in the City of Junction, County of Kimble, Texas, and that the notice was published in issues dated: **JULY 3 & 10, 2024**

Signature Asia Happner

SUBSCRIBED AND SWORN TO before me, the undersigned authority, on the 6 day of August 2024, to verify which witness my hand and seal of office.

India Houser

Notary Public in and for the
State of Texas

(NOTARY SEAL)

NOTARY PUBLIC STATE OF TEXAS
INDIA HOUSER
Notary Public, State of Texas
Notary ID# 133155440
My Commission Expires
JUNE 14, 2025

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PUBLIC NOTICE
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Junction ISD
Public Notice

Junction I.S.D. will accept proposals for 2024-2025 for maintenance/custodial/transportation supplies, repair services, gasoline and diesel for buses and all school vehicles.

Unless otherwise noted, effective dates for said proposals will be September 1, 2024, through August 31, 2025.

Proposals will be accepted through 1:00 p.m. August 1, 2024.

Please contact Cheryl Herring with any questions or concerns at 325-446-3537.

Electronic submission is preferred by scanning or emailing your proposal to cheryl.herring@junctionisd.net or you may mail them to:

Junction I.S.D.
1700 College Street
Junction, TX 76849

Junction I.S.D. reserves the right to waive any formalities, reject any or all proposals (or any portions thereof), and to accept the proposals considered most advantageous to the district.

Junction Independent School District is accepting proposals for the Property and Vehicle Insurance for the 2024-2025 school year.

Unless otherwise noted, effective dates for said proposals will be September 1, 2024, through August 31, 2025.

Proposals will be accepted through 1:00 p.m. August 1, 2024.

Electronic submission is accepted by scanning or emailing your proposal to cheryl.herring@junctionisd.net or you may deliver or mail them to:

Junction Independent School District
Property/Vehicle Proposal
1700 College Street
Junction, Texas 76849

If you have any questions, contact Cheryl Herring at 325-446-3537 or cheryl.herring@junctionisd.net

Junction I.S.D. reserves the right to waive any formalities, reject any or all bids (or any portions thereof), and to accept the bid(s) considered most advantageous to the district.

- General Liability
- School Board Legal Liability
- Automobile Liability – Medical Payments (Automobile)
- Automobile Physical Damage
- Property/Equip Breakdown Coverage
- Contractors/Mobile Equipment
- Electronic Data Processing/ Computer Equipment
- Musical/Band Instruments & Uniforms
- Crime
- Crisis Management Coverage
- Cyber Liability Coverage
- Foreign & Domestic Terrorism

Pass background investigation
Pass drug screening

Kimble County is looking for hard working, motivated, self-c fident candidates looking to serve our community. This agency provide all training that is required for this job position.

Candidates interested in the jailer positions (Correctional Offi can apply at the Kimble County Sheriff's Office, located at Pecan St., Junction, Texas, 76849 or contact Jail Administrator K Harames at 325-446-2766 or Kelli.harames@co.kimble.tx.us further information in reference to this position. This opening remain open until filled by this agency. K-2

FOR RENT

FOR RENT: 50 amp covered RV spot. $350 per month + electri deposit. Private property NW Kimble County. Call/text 325-2 1461 FMI. References required. M-28

HOUSE FOR RENT south of Junction on the S. Llano Ri Available 8/1/24. 2 bedroom, 1 bath, garage, nice porch and la fenced yard on our ranch. Just renovated. Will consider tradin portion of rent for ranch help. Tom (512) 633-3811 L-29-3p

ARTS