COKE COUNTY
UNDERGROUND WATER
CONSERVATION DISTRICT

MANAGEMENT PLAN

2013-2018

Adopted: July 9, 2013

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Conservation District
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COKE COUNTY UNDERGROUND
WATER CONSERVATION DISTRICT

DISTRICT MISSION

The overall objective of the Coke County Underground Water Conservation District is to preserve the integrity of the groundwater in the aquifer over which the land in the district is located. This objective may be accomplished as the district provides for the conservation, preservation, protection recharge, and prevention of waste of the groundwater reservoirs. This Management Plan will help provide guidance to accomplish the overall objective of the district. The plan is an open-ended document and can be revised or updated as needed to help meet the district goals and objectives.

REGIONAL COOPERATION AND COORDINATION

The District is a member of the West Texas Regional Groundwater Alliance (WTRGA). This regional alliance consists of seventeen (17) locally created and locally funded districts that encompass approximately eighteen (18.2) million acres or twenty eight thousand three hundred sixty eight (28,368) square miles of West Texas. To put this in perspective, this area is larger than many individual states including Rhode Island (1,045 sq mi), Delaware (1,954 sq mi), Puerto Rico (3,425 sq mi), Connecticut (4,845 sq mi), Hawaii(96,423 sq mi), New Jersey (7,417 sq mi) Massachusetts (7,840 sq mi), New Hampshire (8,968 sq mi), Vermont (9,250 sq mi) Maryland (9,774 sq mi), and West Virginia (24,230 sq mi). This West Texas region is as diverse as the State of Texas. Due to the diversity of the region, each member district provides it's own unique programs to best serve its constituents.

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

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

This Alliance was created because the local districts have a common objective to facilitate the conservation, preservation, and beneficial use of water and related resources. Local districts monitor the water-related activities of the State's largest industries such as farming & ranching, oil & gas and municipalities. The alliance provides coordination essential to the activities of these member districts as they monitor these activities in order to accomplish their objectives.

TIME PERIOD FOR THIS PLAN

This amended plan becomes effective upon adoption by the Board of Directors and reapproved by the Texas Water Development Board executive administrator due to change in statue several years ago. This amended plan remains in effect for a ten year period or until such time as a revised or amended plan is approved.

STATEMENT OF GUIDING PRINCIPIES

The District recognizes that the groundwater resources of the region are of vital importance. The preservation of this most valuable resource can be managed in a prudent and cost effective manner through regulation and permitting. The greatest threat to prevent the District from achieving the stated mission is inappropriate management, based in part on a lack of understanding of local conditions. A basic understanding of the aquifers and their hydrogeologic properties, as well as a quantification of resources is the foundation from which to build prudent planning measures. This management document is intended as a tool to focus the thoughts and actions of those given the responsibility for the execution of district activities.

General Description

The Coke County Underground Water District was created by Acts of 69th Legislature (1985), p. 6960, Ch. O50, H.B. 2418 under authority of Articles XVI, Section 59 of the Constitution of Texas.

The residents confirmed the District and also voted to fund the District operations through local property taxes. It became an active district on April 5, 1986. On April 5, 1986, the District adopted rules and by-laws which became effective immediately and on this date the District adopted a management plan. With the adoption of these rules, the District implemented a well-permitting and registration program. The current members of the Board of Directors are: President Joe R. Ash, Vice-President LeDrew Arrott, Secretary Jimmie Byrne, and members Wes Washam, Shane Webb. The District General Manager is Winton Milliff. The Coke County UWCD covers all of Coke County. Recreational areas include golf, hunting and fishing.

Location and Extent

The District has an area extent of 911 square miles located approximately 32 miles north of San Angelo and 65 miles southwest of Abilene. The population of the District was about 3,231 in 2012. Two incorporated cities lie within the boundaries of the District: Robert Lee, population 1046, the county seat and Bronte, population 999.

The economy of Coke County is based on ranching, farming, and oil & gas production. The annual income from agriculture is approximately $16,615 million. Cattle, sheep and goats sales represent more than 90 percent of the farm and ranch income. In 2012, the county produced 774,897 barrels of oil and 4,399,465 MCF gas. The highly volatile price of petroleum products makes it very hard to estimate. The water used in Coke County comes from both groundwater and surface water sources. The District has one small lakes Mountain Creek and two major reservoirs in the county impounding surface water runoff. The two largest is E.V. Spence Reservoir, which is formed on the Colorado River near Robert Lee, Oak Creek Reservoir, in the northeast corner of the county, furnishes water to the towns of Sweetwater, Bronte, Robert Lee and Blackwell. Bronte's water well field supplements Oak Creek water. Water for livestock needs is furnished by either small surface water catchment tanks or by wells. Groundwater of varying quality is used in drilling and fracturing of oil and gas wells in the District.

Topography and Drainage

The southwestern part of Coke County is in the Edwards Plateau section of the Great Plains physiographical province; the northwestern part of the county is in the Central Texas section, which includes the Callahan Divide. The county is bisected diagonally by the southeastward flowing Colorado River. Altitudes range from about 1,700 feet above mean sea level in the river valley to more than 2,600 feet on the Edwards Plateau.

Except for the rugged and dissected escarpment, the Edwards Plateau is relatively flat. The soils are mostly thin, dark-colored, calcareous loams. The Central Texas section is characterized by a rolling topography and deep red-brown loam soils. Much of the area, however, is capped with caliche.

Surface drainage on the plateau is mostly internal, but during periods of heavy rainfall, some intermittent low-gradient streams flow southward to the North Concho River. Intermittent streams in canyons along the escarpment flow to the Colorado River. The Central Texas section is drained by the Colorado River and its intermittent tributaries, many of which enter Robert Lee Reservoir.

Groundwater Resources of the Coke County UWCD

The oldest geologic units cropping out in the county are the westward-dipping Permian "red beds". These rocks are composed mainly of shale and fine-grained sandstone, and scattered beds, lenses and stringers of gypsum, anhydrite, and dolomite. In the western and southern plateau areas, the Permian rocks are overlain by eastward-dipping sand, clay and limestone of Cretaceous age. Alluvial deposits of Quaternary age occur in the valleys of the Colorado River and its tributaries.

Water in the alluvium and in the Cretaceous rocks (Fredericksburg and Trinity Groups) occurs under water-table conditions. Water in the Permian rocks (Clear Fork, Pease River and Artesian Groups, and Ochoa Series) occurs under both water- tables and artesian conditions. The water producing zones in the geological units are (1) sand and gravel in the alluvium, (2) fine sands or fractures and solution openings in limestone beds of the Fredericksburg and Trinity Groups and (3) sand, gypsum and dolomite strings or lenses in the Permian rocks.

The Edwards-Trinity (Plateau) aquifer enters Coke County on the West and progresses to the southeast. Wells in the southeast corner of the county produce large volumes of water. The northeast part of the county lays over the Trinity aquifer.

Chemical quality of the Edwards-Trinity (Plateau) water ranges from fresh to slightly saline. The water is typically hard and may vary widely in concentrations of dissolved solids made up mostly of calcium anbicarbonate. The principal sources of recharge to the aquifers of Coke County are (1)direct precipitation on the outcrops; (2)infiltration of water from surface reservoirs, rivers, and numerous intermittent streams; and (3) subsurface inflow from adjoining counties. (3)

Groundwater Availability
Model Run 07-39 TWDB

Table 1: Selected flow terms for each aquifer layer, into of the Coke County Underground Water Conservation District, averaged for the years 1980 to 1999from the groundwater availability model of the Edwards-Trinity (Plateau) Aquifer and 1980 to 1998 from the model of the Lipan Aquifer. Flows are reported in acre-feet per year. Note: a negative value refers to flow out of the aquifer in the district. A positive value refers to flow into the aquifer in the district. All numbers are rounded to the nearest 1 acre-foot per year. Flow into and out of the confining layers are negligible compared to the aquifers and are not included.

Aquifer	Surface water inflow	Surface water outflow	Lateral inflow into district	Lateral outflow from district	Net inter-aquifer flow (upper)	Net inter-aquifer flow (lower)
Edward-Trinity (Plateau)	0	-6,790	1,238	-549	0	0
Lipan	0	0	489	-2,223	0	0

Source: TWDB Groundwater Availability Model Run 07-39

Table 2: Summarized information needed for the Coke County Underground Water Conservation District's management plan. All values are reported in acre-feet per year. All numbers are rounded to the nearest 1 acre-foot per year.

Management Plan requirement	**Aquifer or confining unit**	**Results**
Estimated annual amount of recharge From precipitation to the district	Edward-Trinity (Plateau)	5,957
	Lipan	1,745
Estimated annual volume of water That discharges from the aquifer to Springs and any surface water body Including lakes, streams, and rivers	Edward-Trinity (Plateau)	6,790
	Lipan	0
Estimated annual volume of flow into The district within each aquifer in the District	Edward-Trinity (Plateau)	1,238
	Lipan	489

Source: TWDB Groundwater Availability Model Run 07-39

Table 2 is continued on the next page.

Groundwater Availability
Model Run 07-39 TWDB

Table 2 Continued

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual volume of flow out of the district within each aquifer in the district	Edward-Trinity (Plateau)	549
	Lipan	2,223
Estimated annual net volume of flow between each aquifer in the district	Edward-Trinity (Plateau)	0
	Lipan	0

Source: Kan Tu, P.G. Model Run 07-39 on April 8, 2008

Annual Amount of Additional Natural
Or Artificial Recharge in Coke County UWCD

Based on Region F Table 3-1-1 Annual Groundwater Availability, is estimated natural annual recharge within the District is 12 acre feet from the Dockum aquifer and 3,242 acre feet the Edward-Trinity. Due to the minimum amount of annual rainfall in the District, no increase in natural or artificial recharge can be expected. An estimate of the existing total usable amount of groundwater in the District is equal to the recharge.

Table 3-1-1

County	Aquifer	Basin	Annual Recharge During Drought	Annual Supply From Storage	Annual Availability
Coke	Dockum	Colorado	12	0	12
	Edward-Trinity	Colorado	3,242	0	3,242

Source: Region Water Plan March 2005

Tables 1-2-3 on pages 4-5 This data Model Run 07-39 is presented here for comparison purposes. Latest GAM Run 12-019 data in Appendix B is data for Coke County Underground Water Conservation District Management Plan.

DESIRED FUTURE CONDITIONS (DFC)

On July 29, 2010, upon completion of the first cycle of joint planning among districts in Groundwater Management Area 7 mandated by section 36.108 of the Texas Water Code, GMA 7 adopted the following Desired Future Conditions for aquifers of the Coke County Underground Water District. An average drawdown of 7 feet for the Edwards-Trinity (Plateau) aquifer, except for the Kinney County GCD based on Scenario 10 of the which is TWDB GAM Run 09-35 incorporated in its entirety into this resolution.

The latest DFC data is found in Appendix C GAM Run 10-043 MAG (Version 2) for Draw Down Data in the Texas State Water Plan.

Surface Water Resources
Coke County UWCD

There are 3 surface water lakes in Coke County UWCD, Lake Spence, Mountain Creek Lake located at Robert Lee and Oak Creek Lake located near Blackwell. The water supply from these 3 lakes is estimated.

Projected Surface Water Supplies
Coke Country UWCD

RWPG	Water User Group	County	River Basin	Source Name	2000	2010	2020	2030	2040	2050	2060
F	Bronte Village	Coke	Colorado	Oak Creek Lake/ Reservoir	403	0	0	0	0	0	0
F	Robert Lee	Coke	Colorado	Colorado River MWD System	350	256	231	340	317	302	281
F	Robert Lee	Coke	Colorado	Mountain Creek Lake/Reservoir	342	0	0	0	0	0	0
F	Robert Lee	Coke	Colorado	Colorado River Run-Of-River City of R.L.	0	7	7	7	7	7	7
F	County Other	Coke	Colorado	Colorado River MWD System	120	77	65	95	86	82	76
F	Steam Electric Power	Coke	Colorado	Oak Creek Lake/ Reservoir	1,000	0	0	0	0	0	0
F	Mining	Coke	Colorado	Colorado River MWD System	0	232	239	378	378	380	372
F	Irrigation	Coke	Colorado	Colorado River Combined Run-of-River Irrigation	275	41	41	41	41	41	41
F	Livestock	Coke	Colorado	Livestock Local Supply	542	370	370	370	370	370	370
Total Projected Surface Water Supplies (acre-feet per year) =					**3,032**	**983**	**953**	**1,231**	**1,199**	**1,182**	**1,147**

Source: Volume 3, 2007 State Water Plan Projected Surface Water Supplies.

The latest Surface Water Projection data is in Appendix A of the 2012 Texas State Water Plan.

Projected Water Supplies to Users
Coke County UWCD
Table 3.5-1

County	Year 2010	Year 2020	Year 2030	Year 2040	Year 2050	Year 2060
Coke	2,115	2,105	2,349	2,358	2,366	2,345

Source: Region F Water Plan and TWDB Currently available supply reflect the most limiting factor affecting water availability to users in the District These limitations include firm yield of reservoirs and other factors. Current supply to Water users.

Latest Data:
Appendix C Gam Rum 10-043 Mag (Version 2) Modeled Available Groundwater For The
Edwards-Trinity (Plateau), Trinity, And Pecos Valley Aquifer in Groundwater Management Area 7.

Historical Groundwater Pumpage
Summary for Coke County
Unit Acre Feet

	TOTAL
1999	701 acre-feet per year
2000	1,070 acre-feet per year
2001	963 acre-feet per year
2002	1,138 acre-feet per year
2003	715 acre-feet per year

Source: TWDB Water Use Survey Database 03/28/2007

Latest data Table 1 specified pumpage used in this model simulation in comparison with both GAM Run 07-03 (Donnelly, 2007) baseline pumpage and the groundwater availability numbers from the 2007 State Water Plan.

Potential Supply and Demands Issues and Solutions

Surface water and aquifer supply for Coke County UWCD was projected to be 105,030 acre-feet per year in 2000. Water demands for 2000 were 2,845 acre-feet per year. While water supply for 2050 is projected to be 90,358 acre-feet per year, the demands for 2050 is projected to be 3,310 acre-feet per year. Based on these calculations, it is projected that the Coke County UWCD supply exceeds its demands in year 2050. Data supplied by the Texas Water Supplies Section and Texas Water Planning Databases Volume 3, 2007 and the 2007 State Water Plan.

Information by Source
(Values in Acre-Feet)
(TWDB Water Supplies Section)

Reservoir/ Aquifer Name	Basin or County	2000	2010	2020	2030	2040	2050
Oak Creek	Colorado	4,800	4,700	4,600	4,500	4,400	4,300
CRMWD	Colorado	96,500	94,000	91,100	88,100	85,200	82,395
Surface Total		101,300	98,700	95,700	92,600	89,600	86,695
Edwards Trinity	Coke	3,145	3,145	3,145	3,145	3,145	3,183
Trinity	Coke	585	585	585	585	858	480
Aquifer Total		3,730	3,730	3,730	3,730	3,730	3,663
Grand Total		**105,030**	**102,430**	**99,430**	**96,330**	**93,330**	**90,358**

Source: TWDB Water Supplies Section.

The latest data in Water Sources is found in Appendix A of the 2012 Texas State Water Plan.

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Projected Water Demands
Coke County UWCD

RWPG	Water User Group	County	River Basin	2000	2010	2020	2030	2040	2050	2060
F	Bronte Village	Coke	Colorado	231	248	266	266	266	266	266
F	Robert Lee	Coke	Colorado	365	354	354	354	354	354	354
F	County Other	Coke	Colorado	161	178	170	170	170	170	170
F	Steam Electric Power	Coke	Colorado	372	310	247	289	339	401	477
F	Mining	Coke	Colorado	405	488	528	550	572	593	614
F	Irrigation	Coke	Colorado	937	936	936	934	933	933	933
F	Livestock	Coke	Colorado	374	593	593	593	593	593	593
Total Projected Water Demands (acre-feet per year)=				2,845	3,107	3,094	3,156	3,227	3,310	3,407

Source: Volume 3, 2007 State Water Plan Projected Water Demands
All estimates of groundwater availability, usage, supplies, recharge, storage, and future demands are from data supplied by the Texas Water Development Board, unless otherwise noted. Data sources include "Water for Texas-2002" 2007 State Water Plan, data included in the Region F Regional Water Plan adopted in January 2006. These estimates will be used until other data is available from ongoing studies of the region."

The latest Water Demands data is found in Appendix A of the 2012 Texas State Water Plan.

Management of Groundwater Supplies and Actions, Procedures, Performance and Avoidance for Plan Implementation

The District will manage the supply of groundwater within the District in order to preserve and protect the resource, while seeking to maintain the economic viability of all of the groundwater user groups. In consideration of the economic and cultural activities occurring within the District, the District will identify and engage in such activities and practices that if implemented, would result in preservation and protection of the groundwater. The District will implement provisions of this plan and will utilize the provisions of this plan as guideposts for determining the direction or priority for Districts. Rules adopted by the District shall be pursuant to TWC Chapter 36 and the provisions of this plan. All rules will be enforced and will be based on the best technical evidence available. The District adopted rules in 1989 and amended rules in 1994 and 2003 and will amend the rules as necessary. A copy of the rules is attached.

Methodology for Tracking Progress

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

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

Coke County Water Budget

Table A-I. Annual water budget for each county at the end of the 51-year predictive portion of the model run using the requested pumpage and normal rainfall condition in the groundwater availability model for the Edwards-Trinity (Plateau) Aquifer (in acre-feet per year). Total pumpage for each county listed in Tables 1 and 2 matches the total value listed for wells in the water budget. The model includes two layers, representing the Edwards and associated limestones (Layer 1) and undifferentiated Trinity units (Layer 2). The Pecos Valley Aquifer is included in Layer 1 of the model

Water Budget	In	Out
Model Layer 1		
Reservoirs (Constant Head Cells)	--	n
Storage	--	n
Springs and Seeps (Drain Package)	n	n
Inter-aquifer Flow (GHB Package)	..	--
Wells	n	--
Streams and Rivers (Stream Package)	--	n
Recharge	n	--
Lateral Inflow	--	--
Vertical Leakage Downward	n	--
Model Layer 2		
Reservoirs (Constant Head Cells)	0	0
Storage	2	0
Springs and Seeps (Drain Package)	0	3,343
Inter-aqulfer Flow (GHB Package)	0	50
Wells	0	3,243
Streams and Rivers (Stream Package)	0	0
Recharge	5,916	0
Vertical Leakage Upward	--	--
Lateral Inflow	1,164	446
Total Pumpage		3,243

Source: Groundwater Availability Model provided by the TWDB. Flow terms expressed in acre-feet per year.

The latest Budget data is found Appendix C GAM Run 10-43 MAG (Version 2) 2012 Texas State Water Plan.

2007 State Water Plan Projected Water Needs
Coke County UWCD

RWPG	Water User Group	County	River Basin	2010	2020	2030	2040	2050	2060
F	Bronte Village	Coke	Colorado	-129	-129	-129	-129	-129	-129
F	Robert Lee	Coke	Colorado	-88	-108	5	-14	-27	-48
F	County Other	Coke	Colorado	-28	-32	0	-6	-9	-15
F	Steam Electric Power	Coke	Colorado	-310	-247	-289	-339	-401	-477
F	Mining	Coke	Colorado	-86	-119	-2	-24	-43	-72
F	Irrigation	Coke	Colorado	-363	-363	-361	-360	-360	-360
F	Livestock	Coke	Colorado	0	0	0	0	0	0
Total Projected Water Needs (acre-feet per year) =				**-1,004**	**-998**	**-776**	**-872**	**-969**	**-1,101**

Source: Volume 3, 2007 State Water Plan Projected Water Needs.

The latest Water Needs data is found in Appendix A of the 2012Texas State Water Plan.

Projected Water Management Strategies Coke County UWCD

RWPG	WUG	WUG County	River Basin	Water Management Strategy	Source Name	Source County	2010	2020	2030	2040	2050	2060
F	Bronte Village	Coke	Colorado	Subordination	Oak Creek Lake/Reservoir	Reservoir	129	129	129	129	129	129
F	Bronte Village	Coke	Colorado	Rehabilitation of Pipeline	Oak Creek Lake/Reservoir	Reservoir	129	129	129	129	129	129
F	Bronte Village	Coke	Colorado	Develop Other Aquifer Supplies	Other Aquifer	Coke	100	100	100	100	100	100
F	Bronte Village	Coke	Colorado	Reuse	Direct Reuse	Coke	0	0	0	110	110	110
F	Bronte Village	Coke	Colorado	Municipal Conservation	Conservation	Coke	16	45	48	48	50	51
F	Robert Lee	Coke	Colorado	Municipal Conservation	Conservation	Coke	16	40	44	45	46	48
F	Robert Lee	Coke	Colorado	New WTP and Storage Facilities	Colorado River MWD System	Reservoir	200	200	200	200	200	200
F	Robert Lee	Coke	Colorado	Reuse	Direct Reuse	Coke	0	0	0	110	110	110
F	Steam Electric	Coke	Colorado	Subordination	Oak Creek Lake/Reservoir	Reservoir	310	247	289	339	401	477
F	Bronte Village	Coke	Colorado	New Pipeline from San Angelo Desalination Plant	Other Aquifer	Tom Green	0	280	280	280	280	280
F	Robert Lee	Coke	Colorado	New Pipeline from San Angelo Desalination Plant	Other Aquifer	Tom Green	0	448	448	448	448	448
F	Bronte Village	Coke	Colorado	Regional System from Lake Brownwood	Brownwood Lake/Reservoir	Reservoir	280	280	280	280	280	280
F	Robert Lee	Coke	Colorado	Regional System from Lake Brownwood	Brownwood Lake/Reservoir	Reservoir	448	448	448	448	448	448
F	Robert Lee	Coke	Colorado	Desalination	Colorado River MWD System	Reservoir	448	448	448	448	448	448
F	Robert Lee	Coke	Colorado	New Reservoir Intake	Mountain Creek Lake/Reservoir	Reservoir	50	50	50	50	50	50
F	County Other	Coke	Colorado	Subordination	Colorado River MWD System	Reservoir	28	32	0	6	9	15
F	Mining	Coke	Colorado	Subordination	Colorado River MWD System	Reservoir	86	119	2	24	43	72
F	Robert Lee	Coke	Colorado	Subordination	Colorado River MWD System	Reservoir	95	115	2	21	34	55
F	Robert Lee	Coke	Colorado	Brush Control	Mountain Creek Lake/Reservoir	Reservoir	0	0	0	0	0	0
Total Projected Water Management Strategies (ac/ft per year)=							2,335	3,110	2,897	3,215	3,315	3,450

Source: TWDB Water Use Survey

The latest Water Management Strategies are found in Appendix A of the Texas State Water Plan.

GOALS, MANAGEMENT OBJECTIVES AND PERFORMANCE STANDARDS

Goal

1.0 Provide for the efficient use and control of groundwater within the District (356.5(a)

Management Objective

1.1 Each year the District will locate at least 1 or more water wells for map location, check water levels and chemical analysis.

Performance Standards

1.1a Annual report to the Board of Directors will include the number of wells located, the number of wells sampled for water levels, and the number of wells sampled for chemical analysis.

Goal

2.0 Control and prevent waste of water (356.5(a)(1)(B)

Management Objective

2.1 Annually, investigate every wasteful practices reported by the public or identified by District personnel within the District.

Performance Standards

2.1a Annual report to Board of Directors will include the number of wasteful practices identified and a summary of action taken to resolve the waste of groundwater in each identified case.

Goal

3.0 District Tracking Process (356.6)(a)

Management Objective

3.1 District Manager will prepare and present an annual report to the Board of Directors on District performance in regards to achieving the management goals and objectives. This annual report will be maintained on file in the District office.

Goal

4.0 Conjunctive surface management issues 356.5(a)(D)

Management Objective

4.1 Monitor rainfall events on the watersheds within the District that will impact surface water runoff and groundwater recharge.

Performance Standards

4.1a District will maintain files on rainfall events in order to monitor surface water runoff and underground recharge within the District through a voluntary rainfall network. These rainfall totals will be reported annually to the Board.

Goal
5.0 Natural Resource Issues 356.5(a)(1)(E)

Management Objective

5.1 To measure, record and accumulate a historic record of static water levels in monitor network wells on a periodic basis.

Performance Standards

5.1a The District will establish a water level monitoring network and annually measure at least 5 wells in the network.

Goal
6.0 Drought Condition (356.5(a)(1)(F)

Management Objective

6.1 District will monitor the Palmer Drought Severity Index (PDSI) by Texas Climate Divisions. If PDSI indicates that the District will experience severe drought conditions, the District will notify all public water suppliers within the District.

Performance Standard

6.1a The District staff will monitor the PDSI and report the number of times the PDSI is less than-1 (mild drought) to the District Board of Directors on a quarterly basis.

Goal
7.0 Conservation, Recharge Enhancement, Rainwater-Harvesting, Precipitation Enhancement and Brush Control where appropriate and cost effective (356.5)(a)(1)(G)

Management Objective

7.1 Each year the District will provide and distribute literature on water conservation to promote conservation and efficient use of water.

Performance Standard

7.1a-The District staff will publish an article concerning water conservation in a local news paper at least one time a year.

Management Objective: Recharge Enhancement

7.2 Provide information to area residents about recharge enhancement.

Performance Standard

7.2a District staff will provide information, upon request, to area residents about recharge enhancement.

Management Objective: Rainwater Harvesting

7.3 Provide information to area residents about rainwater harvesting.

Performance Standard

7.3a District staff will provide information, upon request to area residents about rainwater harvesting.

Management Objective: Precipitation Enhancement

7.4 Provide information to area residents about precipitation enhancement.

Performance Standard

7.4a District staff will provide information, upon request to area residents about precipitation enhancement.

Management Objective Brush Control

7.5 Provide information to area residents about brush control.

Performance Standard

7.5a District staff will provide information, upon request to area residents about brush control.

Goal

8.0 Addressing the Desired Future Conditions Adopted by the District (36.1071(a)((8)

8.1 Management Objective

Each year the District will collect at least 90% of their static level monitoring wells.

8.1 Performance Standard

Each year the District will post the static levels measurements collected from the monitoring wells and post them in the news paper and present them to the Board of Directors in the Annual Report.

Management Goal Determined Not-Applicable

Goal

9.0 Control and prevention of Subsidence (356.5)(a)(1)(c)

There is no history of subsidence of aquifer formations within the District upon water level depletion and available scientific information is that the formations are of sufficient rigidity that subsidence will not occur.

Summary definitions.

"Abandoned Well" - shall mean:

1) a well or borehole the condition of which is causing or is likely to cause pollution of groundwater in the District. A well is considered to be in use in the following cases:
   (A) a well which contains the casing, pump and pump column in good condition; or
   (B) a well in good condition which has been capped.

2) a well or borehole which is not in compliance with applicable law, including the Rules and Regulations of the District, the Texas Water well Drillers' Act, Texas Natural Resource Conservation Commission, or any other state or federal agency or political subdivision having jurisdiction, if presumed to be an abandoned or deteriorated well.

"Board" - the Board of Directors of the Coke County Underground Water Conservation District

"District" - the Coke County Underground Water Conservation District

"TCEQ" - Texas Commission on Environmental Quality.

"TWDB" - Texas Water Development Board

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

(1) withdrawal of groundwater from a groundwater reservoir at a rate and in an amount that caused or threatens to cause intrusion into the reservoir of water unsuitable for agricultural, gardening, domestic or stock raising purposes;

(2) the flowing or producing of wells from a groundwater reservoir if the water produced is not used for a beneficial purpose;

(3) escape of groundwater from a groundwater reservoir to any other reservoir or geologic strata that does not contain groundwater;

(4) pollution or harmful alteration of groundwater in a groundwater reservoir by saltwater or by other deleterious matter admitted from another stratum or from the surface of the ground;

(5) willfully or negligently causing, suffering, or allowing groundwater to escape into any river, natural watercourse, depression, lake, reservoir, drain, sewer, street, highway, road or creek, ditch, or onto any land other than that of the owner of the well unless such discharge is authorized by permit, rule or order issued by the commission under Chapter 26;

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

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

"Well"- means an artificial excavation that is dug or drilled for the purpose of producing groundwater.

COKE COUNTY UNDERGROUND WATER

COMSERVATION DISTRICT

RULES

RULES OF THE COKE COUNTY UNDERGROUND WATER CONSERVATION DISTRICT

The Rules of Coke County Underground Water Conservation District and as amended are hereby published as of the 27th day of March, 1989.

In accordance with Section 59 of Article 16 of the Texas Constitution and with Acts of the 69th Legislature (1985), p. 3210, Ch. 950, H. B. 2418 and Chapters 51 and 52 of the Texas Water Code, the following rules are hereby ratified and adopted as the rules of the District by its Board. All rules or parts of rules in conflict with these rules are hereby repealed. Each rule as worded herein has been in effect since date of passage and as may be hereafter amended.

The rules, regulations and modes of procedure herein contained are and have been adopted for the purpose of simplifying procedure, avoiding delays, saving expense, and facilitating the administration of the ground water laws of the State and the rules of this District. To the end that these objectives be attained, these rules shall be so construed.

These rules may be used as guides in the exercise of discretion, where discretion is vested. However, under no circumstances and in no particular case shall they, or any of them, be construed as a limitation or restriction upon the exercise of any discretion, where such exists; nor shall they in any event be construed to deprive the Board of an exercise of powers, duties and jurisdiction conferred by law, nor to limit or restrict the amount and character of data or information which may be required for the proper administration of the law.

RULE 1 — DEFINITIONS

Unless the context hereof indicates a contrary meaning, the words hereinafter defined shall have the following meaning in these rules:

(a) "Abandonment" shall mean the intentional discontinuation of use.

(b) The "Board" shall mean the Board of Directors of the Coke County Underground Water Conservation District, consisting of five (5) duly elected members.

(c) "Capping" shall mean equipping a well with a suitable device that will prevent the entrance of surface pollutants into the well.

(d) "Casing" shall mean a tubular watertight structure installed in the excavated or drilled hole to maintain the well opening and, along with cementing, to confine ground waters to their zones of origin and prevent the entrance of surface pollutants.

(e) "Cement" shall mean a neat Portland or construction cement mixture of not more than seven gallons of water per 94-pound sack of dry cement, or a cement slurry which contains cement along with bentonite, gypsum, or other additives; the well driller will adhere to the manufacturer's recommended water content for the mix.

(f) "Completion" shall mean the sealing off access of undesirable water to the well bore by proper casing and/or cementing procedures.

(g) "District" shall mean the Coke County Underground Water Conservation District, maintaining its principal office in Robert Lee, Texas. Where applications, reports and other papers are required to be filed with or sent to "the District", this means the District's headquarters in Robert Lee, Texas.

(h) The term "Well" or "Water Well" shall mean and include any artificial excavation constructed to produce or which produces more than 25,000 gallons of water per day or 17.36 gallons per minute.

(i) "Water" shall mean underground water.

(j) "Owner" shall mean and include any person, firm, partnership or corporation that has the right to produce water from the land either by ownership, contract, lease, easement, or any other estate in the land.

(k) "Person" shall mean any individual, partnership, firm, or corporation.

(l) The word "Waste" as used herein shall have the same meaning as defined by the Legislature, as follows:

(1) The withdrawal of underground water from an underground water reservoir at such rate and in such amount so as to cause the intrusion therein of water not suitable for agricultural, gardening, domestic, or stock raising purposes.

(2) The flowing or producing of wells from an underground water reservoir when the water produced therefrom is not used for a beneficial purpose.

(3) The escape of underground water from one underground water reservoir to any other reservoir not containing underground water.

(4) The pollution or harmful alteration of the character of the underground water within the underground water reservoir of the District by means of salt water or other deleterious matter admitted from some other stratum or strata or from the surface of the ground; and

(5) Willfully or negligently causing, suffering, or permitting underground water to escape into any river, creek, watercourse, depression, or lake, reservoir, drain, sewer, street, highway, road, or road ditch, or onto any land of any other person than the owner of such well.

(m) An "Authorized Well Site" shall be:

(1) The location of a proposed well on an application duly filed until such application is denied; or

(2) The location of a proposed well on a valid permit. (An authorized well site is not a permit to drill.)

(n) "Open or Uncovered Well" shall mean any artificial excavation drilled or dug for the purpose of producing water from the underground reservoir, not capped or covered as required by these rules, which is as much as ten (10) feet deep, nor more than six (6) feet in diameter.

(o) "Exempt Well" shall mean and include any artificial excavation constructed to produce or which produces less than 25,000 gallons per day or 17.36 gallons per minute. For all purposes herein, an "exempt well" as defined herein shall be exempt from any and all rules and regulations created hereunder.

(p) "Mud" shall mean a relatively homogenous, relatively viscuous fluid produced by the suspension of clay-size particles in water.

(q) "Plugging" shall mean an absolute sealing of the well bore.

(r) "Pollution" shall mean the alteration of the physical, thermal, chemical, or biological quality of, or the contamination of, any water in the District that renders the water harmful, detrimental, or injurious to humans, animal life, vegetation, or property or to public health, safety, or welfare, or impairs the usefulness or the public enjoyment of the water for any lawful or reasonable purpose.

(s) "Undesirable Water" shall mean water that is injurious to vegetation, to land or to fresh water, or water that can cause pollution.

(t) "Well log" shall mean a log accurately kept, on forms prescribed by the Water Well Drillers Board of Texas, or any successor regulatory agency with jurisdiction therefor, at the time of drilling showing the depth, thickness, character of the different strata penetrated, location of water-bearing strata, depth, size and character of casing installed, together with any other data or information required by the Water Well Drillers Board of Texas or of this Board. Each copy of a well log shall include the name, mailing address, and telephone number of the District as well as the Water Well Drillers Board of Texas and the Texas Water Commission.

RULE 2 — WASTE

(a) Underground water shall not be produced within, or used within or without the District, in such a manner or under such conditions as to constitute waste as defined in Rule 1 hereof.

(b) Any person producing or using underground water shall use every possible precaution, in accordance with the most approved methods, to stop and prevent waste of such water.

(c) No person shall pollute or harmfully alter the character of the underground water reservoir of the District by means of salt water or other deleterious matter admitted from some other stratum or strata or from the surface of the ground.

(d) No person shall commit waste as that term is defined by Section (l), Rule 1 of the Rules of the Coke County Underground Water Conservation District.

RULE 3 — PERMIT REQUIRED

(a) No person shall hereafter begin to drill or drill a well, or increase the size of a well or pump therein, which well could reasonably be expected to produce, or a pump designed to produce, in excess of 25,000 gallons of water per day, without having first applied to the Board, and had issued a permit to do so, unless the drilling and operation of the well is exempt by the law or by these rules.

ADDITION

The following addition is being made to the Rules of the Coke County Underground Water Conservation District effective as of May 12, 2003.

RULE 3

Rule 3 (a) and (b) shall remain as written. Rule 3 (c) will be added as follows:

(c) Preregistration required for exempt wells. A completed application for the drilling of an exempt well (preregistration) must be filed with the District on forms provided by the District prior to the drilling of an exempt well. Preregistration is required for all wells defined as exempt under Rule 1 (o).

Preregistration shall include the following information submitted on forms provided by the District.

(1) name and address of the well owner,
(2) location of the well or proposed location including the county, section, block, survey, abstract, acreage or lot size, and the number of feet to the nearest non-parallel property lines.
(3) Distance in feet to nearest well;
(4) Well use or proposed use;
(5) Signed statement by the applicant indicating that
  (i) the proposed well is to be for domestic use on 2 acres or less of land or is exempt from permitting; and
  (ii) the applicant will furnish the District with a completed Well Registration form within 30 days after completion of the well.
(6) The application to drill an exempt well shall be signed by the owner of the land or his duly appointed agent, including a partner, operator, driller or any other person who has the authority to construct the well and/or operate the well for the proposed use.
(7) Such additional data as may be required by the Board.

ATTEST:

Secretary of Board

President of Board

(b) No permit shall be required for the drilling of temporary wells exempt by Subsection 118 of Chapter 52, Texas Water Code (being generally wells used for the production of oil, gas, or other minerals and water wells used in conjunction therewith).

RULE 4 — DEPOSITS

Each application for a permit to drill a well shall be accompanied by a $50.00 deposit which shall be accepted by the District. Said deposit shall be returned to the applicant by the District if: (1) the application is denied; or (2) if the application is granted, upon receipt of correctly completed registration and log of the well; or (3) if said permit location is abandoned without having been drilled, upon return and surrender of said permit marked "abandoned" by the applicant. In the event neither the registration and log of the well nor the permit marked abandoned is returned to such District within six (6) months after the approval date of the permit or the extension date thereof, the said deposit shall become the property of the District. All deposits heretofore made or which shall hereafter be made shall become the property of the District if such registration and log or permit has not been returned or is not returned to the District with which deposit was made within six months from the approval date of the permit.

RULE 5 — ISSUANCE OF PERMITS

(a) The Board shall issue or cause to be issued a drilling permit for a well properly spaced upon proper application executed and filed by the owner with the District and containing the matters specified below. An application shall be considered filed when properly made out, completed, and signed and tendered to the District or a person duly designated by such District to receive the same.

Such applications shall be on forms provided by the District and shall be in writing and shall be prepared in accordance with and contain the information called for in the form of application, if any, prescribed by the Board, and all instructions which may have been issued by the Board with respect to the filing of an application. Otherwise, the application will not be considered.

(b) Rules for the filing of applications:

(1) If the applicant is an individual, the application shall be signed by the applicant or his duly appointed agent. The agent may be requested to present satisfactory evidence of his authority to represent the applicant.

(2) If the application is by a partnership, the applicant shall be designated by the firm name followed by the words "a Partnership" and the application shall be signed by at least one of the general partners who is duly authorized to bind all of the partners.

(3) In the case of a corporation, public district, county or municipality, the application shall be signed by a duly authorized official. A copy of the resolution or other authorization to make the application may be required by the officer or agent receiving the application.

(4) In the case of an estate or guardianship, the application shall be signed by the duly appointed guardian or representative of the estate.

(c) Such applications shall set forth the following:

The following amendments to Rules of The Coke County Underground Water Conservation District became effective on 6-6-94.

RULE VII --MINIMUM SPACING OF WELLS

Amend Rule VII, Section A-1 as follows:

A. Distance Requirements.

1. No well to be drilled subsequent to the date of enactment of this rule shall be drilled such that said well shall be located nearer than the distances shown below from the nearest property line.

WELLS PRODUCING	MINIMUM DISTANCE FROM PROPERTY LINE
Up to 50gpm	exempt
50gpm to 100gpm	50 feet
over 100gpm	100 feet

The Board, in order to prevent waste or to prevent confiscation of property, may grant exceptions to permit drilling within shorter distances than described above when the Board shall determine that such exceptions are necessary either to prevent waste or to prevent confiscation of property. The balance of Rule VII is not affected by this amendment.

RULE XXI --TRANSPORTATION OF WATER FROM THE DISTRICT - OMIT

RULE XXIV --DISPOSAL OF HAZARDOUS WASTES - OMIT

ATTEST:

[signature]
Secretary of Board

[signature] Wayne McCabe
President of Board

(1) The exact proposed location of the well to be drilled as provided in the application including the county, the section, block, survey and township; labor and league; and exact number of yards to the two nearest non-parallel property lines (legal survey line); or other adequate legal description.

(2) The proposed use of the well to be drilled, whether municipal, industrial, or irrigation.

(3) The size of the pump.

(4) The approximate date drilling operations are to begin.

(5) The location of the three (3) nearest wells within a quarter of a mile of the proposed location, and the names and addresses of the owners thereof.

(6) An agreement by the applicant that a completed well registration and log will be furnished to the District (on forms furnished by it) by the applicant upon completion of this well and prior to the production of water therefrom (except for such production as may be necessary to the drilling and testing of such well).

(7) Such additional data as may be required by the Board.

(8) The name and address of the fee owner of the land upon which the well location is to be made.

RULE 6 — REQUIREMENT OF DRILLER'S LOG, CASING AND PUMP DATA

(a) Complete records shall be kept and reports thereof made to the District concerning the drilling, maximum production potential, equipping and completion of all wells drilled. Such records shall include an accurate driller's log, any electric log which shall have been made, and such additional data concerning the description of the well, its potential, hereinafter referred to as "maximum rate of production" and its actual equipment and rate of discharge permitted by said equipment as may be required by the Board. Such records shall be filed with the District Board within 30 days after completion of the well.

(b) No person shall produce water from any well hereafter drilled and equipped within the District, except that necessary to the drilling and testing of such well and equipment, unless or until the District has been furnished an accurate driller's log, any electric log which shall have been made, and a registration of the well correctly furnishing all available information required on the forms furnished by the District.

(c) No person shall be required to equip and produce any well to its maximum rate of production; provided, however, that for purposes of reworking, redrilling or replacing a well pursuant to Rule 10 hereof, the maximum rate of production of each well established hereunder shall be considered the actual production rate even though said well is produced at a lesser rate of production.

RULE 7 — MINIMUM SPACING OF WELLS

(a) Distance Requirements.

(1) No well to be drilled subsequent to the date of enactment of this rule shall be drilled such that said well shall be located nearer than three hundred thirty (330') feet from the nearest

property line; provided that the Board, in order to prevent waste or to prevent confiscation of property, may grant exceptions to permit drilling within shorter distances than above described when the Board shall determine that such exceptions are necessary either to prevent waste or to prevent confiscation of property.

(2) In the interest of protecting life and for the purpose of preventing waste and preventing confiscation of property, the Board reserves the right in particular subterranean water zones and/or reservoirs to enter special orders increasing or decreasing distances provided by this rule.

(3) (i) In applying this rule and in applying every special rule with relation to spacing in all the of subterranean water zones and/or reservoirs underlying the confines of this District, no subdivision of property made subsequent to the adoption of the original spacing rule will be considered in determining whether or not any property is being confiscated within the terms of such spacing rule, and no subdivision of property will be regarded in applying such spacing rule or in determining the matter of confiscation if such subdivision took place subsequent to the promulgation and adoption of the original spacing rule.

(ii) Any subdivision of property creating a tract of such size and shape that it is necessary to obtain an exception to the spacing rule before a well can be drilled thereon is a voluntary subdivision and not entitled to a permit to prevent confiscation of property if it were either, (a) segregated from a larger tract in contemplation of water resource development, or (b) segregated by fee title conveyance from a larger tract after the spacing rule became effective and the voluntary subdivision rule attached.

(iii) The date of attachment of the voluntary subdivision rule is the date of discovery of underground water production in a certain continuous reservoir regardless of the subsequent lateral extensions of such reservoir, provided that such rule does not attach in the case of a segregation of a small tract by fee title conveyance which is not located in an underground water production area having a discovery date prior to the date of such segregation.

(iv) The date of attachment of the voluntary subdivision rule for a reservoir under any special circumstance which the Board deems sufficient to provide for an exception, may be established other than above so that innocent parties may have their rights protected.

(b) Well Density. Subject to paragraph (a)(1) et seq. above, no more than a cumulative total of 16 wells, whether drilled prior to or subsequent to enactment of this rule, shall be permitted per section (hereinafter referred to as "drilled to density". In the event the applicant owns less than a full section, then the number of wells permitted for said tract shall be proportionately reduced so that the total number of wells permitted shall be established by multiplying sixteen (16) times the quotient of the number of acres owned by the Applicant divided by the number of acres in the section; provided, however, that this density rule shall not apply to acreage drilled to density pursuant to these rules where the cumulative average of water production allowed per acre per minute is less than 2 gallons per acre per minute. In this event the landowner shall be permitted to drill additional water wells on said lands until the 2 gallons/acre/minute basis is attained. Said cumulative average gallonage per acre per minute basis shall be computed by District personnel according to maximum pumping capability of the water well established at the time the well is drilled.

RULE 8 — EXCEPTION TO SPACING RULE

(a) In order to protect vested property rights, to prevent waste, to prevent confiscation of property, or to protect correlative rights, the Board may grant exception to the above spacing regulations. This rule shall not be construed so as to limit the power of the Board, and the powers stated are cumulative only of all other powers possessed by the Board.

(b) If an exception to such spacing regulations is desired, application therefor shall be submitted by the applicant in writing to the Board at its district office on forms furnished by the District. The application shall be accompanied by a plat or sketch, drawn to scale of one (1) inch equalling two hundred (200) yards. The plat or sketch shall show thereon the property lines in the immediate area and shall show accurately to scale all wells within a quarter mile of the proposed well site. The application shall also contain the names and addresses of all property owners adjoining the tract on which the well is to be located and the ownership of the wells within a quarter mile of the proposed location. Such application and plat shall be certified by some person actually acquainted with the facts who shall state that all the facts therein are true and correct.

(c) Such exception may be granted ten (10) days after written notice has been given to the applicant and all adjoining owners and all well owners within a quarter mile of the proposed location and a after public hearing at which all interested parties may appear and be heard, and after the Board has decided that an exception should be granted. Provided, however, that if all such owners execute a waiver in writing stating that they do not object to the granting of such exception, the Board may thereupon proceed to decide upon the granting or refusing of such application without notice of hearing except to the applicant. The applicant may also waive notice or hearing or both.

RULE 9 — PLACE OF DRILLING OF WELL

After an application for a well permit has been granted, the well, if drilled, must be drilled within ten yards of the location specified in the permit, and not elsewhere. If the well should be commenced or drilled at a different location, the drilling or operation of such well may be enjoined by the Board pursuant to Chapter 52, Texas Water Code.

RULE 10 — REWORKING OR REPLACING OF WELL

(a) No person shall rework, redrill, or re-equip a well in a manner that would increase the maximum rate of production of water from such well beyond any previous actual rate of production of such well as established by Rule 6 above without first having made an application to the Board, and having been granted a permit by the Board to do so. Nor shall any person replace a well without a permit from the Board. A replacement well, in order to be considered as such, must be drilled within one hundred fifty (150) feet of the old well and not elsewhere. It must not be located toward any other well or authorized well site unless the new location complies with the minimum spacing requirements set out in Rule 7; otherwise the replacement well shall be considered to to be a new well for which application must be made under Rule 7 above. Provided, however, that the Board may grant an exception without notice or hearing in any instance where the replacement well is placed farther away from any existing wells or authorized well sites.

The location of the old well (the well being replaced) shall be protected in accordance with the spacing rules of the District until the replacement well is drilled and tested. The landowner or his agent must within 120 days of the issuance of the permit declare in writing to the District which one of these two wells he desires to produce. If the landowner does not notify the District of his choice within this 120 days, then it will be conclusively presumed that the new well is the well he desires to retain. Immediately after determining which well will be retained for production, the other well shall be:

(1) Plugged and abandoned; or

(2) Properly equipped in such a manner that it cannot produce more than 25,000 gallons of water a day; or

(3) Closed in accordance with Article 9202, Vernon's Annotated Civil Statues, as amended. Violation of such Article is made punishable thereby a fine of not less than $100.00 nor more than $500.00.

An application to rework, re-equip, redrill or replace an existing well may be granted by the Board without notice or hearing.

(b) The size or maximum rate of production of a well shall not be hereafter changed to a larger size or capacity so as to substantially increase the rate of production of a well without a permit from the Board. (For example, increasing the size of the well bore from six inches to eight inches.) Such permit may be granted only after written notice to adjacent owners and owners of a well within a quarter of a mile from such well and a public hearing, as provided in Rule 8(c) above, and after a decision by the Board that such change will not cause unreasonable drawdown of the water table or unreasonable interference between wells, waste, or confiscation of property. Provided that if the adjacent owners and owners of a well within a quarter of a mile indicate to the Board in writing that they have no objection to the proposed change, then the Board may proceed to decide such matter. Provided that if the well is a sufficient distance from other wells to comply with spacing regulations for new wells of the desired capacity the Board may proceed to act on such application.

(c) In the event the application meets all spacing requirements and no contest is filed, the Board may grant such application without further action.

RULE 11 — TIME DURING WHICH A PERMIT SHALL REMAIN VALID

Any permit granted hereunder shall be valid if the work permitted shall have been completed within four (4) months from the filing date of the application. It shall thereafter be void. Provided, however, that the Board, for good cause, may extend the life of such permit for an additional four (4) months if an application for such extension shall have been made to the District during the first four (4) months period. Provided, further, that when it is made known to the Board that a proposed project will take more time to complete, the Board, upon receiving written application may grant such time as is reasonably necessary to complete such project.

RULE 12 — CHANGED CONDITIONS

The decision of the Board on any matter contained herein may be reconsidered by it on its own motion or upon motion showing changed conditions, or upon the discovery of new or different conditions or facts after the hearing or decision on such matter. If the Board should decide to reconsider a matter after having announced a ruling or decision, or after having finally granted or denied an application, it shall give notice to persons who were proper parties to the original action, and such persons shall be entitled to a hearing thereon if they file a request therefor within fifteen days from the date of the mailing of such notice.

RULE 13 — RIGHT TO INSPECT AND TEST WELLS

Any authorized officer, employee, agent, or representative of the District shall have the right at all reasonable times to enter upon lands upon which a well or wells may be located within the boundaries of the District, to inspect such well or wells and to read, or interpret any meter, weir box or other instrument for the purpose of measuring production of water from said well or wells or for determining the pumping capacity of said well or wells; and any authorized officer, employee, agent, or representative of the District shall have the right at all reasonable times to enter upon any lands upon which a well or wells may be located within the boundaries of the District for the purposes of testing the pump and the power unit of the well or wells and of making any other reasonable and necessary inspections and tests that may be required or necessary for the information or the enforcement of the rules and regulations of the District. The operation of any well may be enjoined by the Board immediately upon the refusal to permit the gathering of information as above provided from such well.

RULE 14 — OPEN WELLS TO BE CAPPED

Every owner or operator of any land within the District upon which is located any open or uncovered well is, and shall be, required to close or cap the same permanently with a covering capable of sustaining weight of not less than four hundred (400) pounds, except when said well is in actual use by the owner or operator thereof; and no such owner or operator shall permit or allow any open or uncovered well to exist in violation of this requirement. Officers, agents and employees of the District are authorized to serve or cause to be served written notice upon any owner or operator of a well in violation of this rule, thereby requesting such owner and/or operator to close or cap such well permanently with a covering in compliance herewith. In the event any owner or operator fails to comply with such request within ten (10) days after such written notice, any officer, agent, or employee of the District may go upon said land and close or cap said well in a manner complying with this rule and all expenditures thereby incurred shall constitute a lien upon the land where such well is located, provided, however, no such lien shall exceed the sum of One Hundred Dollars ($100.00) for any single closing. Any officer, agent, or employee of the District, is authorized to perfect said lien by the filing of the affidavit authorized by Section 52.119 of the Texas Water Code. All of the powers and authority granted in such section are hereby adopted by the District, and its officers, agents, and employees are hereby bestowed with all of such powers and authority.

RULE 15 — FINAL ORDERS OF THE BOARD

The orders of the Board in any non-contested application or proceeding shall become the final order of the Board on the day it is entered by the Board. All orders of the Board in contested applications, appeals or other proceedings shall contain a statement that the same was contested. In such event the order will become final after fifteen (15) days from the entry thereof and be binding on the parties thereto unless a motion for rehearing is filed under Rule 16 hereof.

RULE 16 — REHEARING

(a) Any person whose application is denied, whose contest is overruled, or who is not granted the relief desired, may file with the Board a motion for rehearing within fifteen (15) days from the announcement by the Board of its decision or action. The Board shall act thereon within a reasonable time. If such a motion for rehearing is filed and is overruled, the order of the Board shall be final on the date the motion is overruled.

(b) The Board may, in a proper case, find that an emergency exists and that substantial injustice will result from delay. In that event, and upon recitation of such finding, the order of the Board will become final on the date of the announcement of the order by the Board, and no motion for rehearing will be considered thereon.

(c) If an application or a contest is denied by the Board, and if the applicant or contestant shall not have had and shall not have been afforded an opportunity for a hearing before the Board, as elsewhere provided by these rules, the applicant or contestant shall be entitled to a hearing before the Board. A written request to the Board for such a hearing, stating such facts, must be filed with the Board within the above fifteen (15) day period. If such motion is in order and is duly filed, the Board shall give notice to the applicant and all proper and necessary parties of the time and place of such hearing, and shall proceed to conduct such a hearing.

RULE 17 — RULES GOVERNING PROTESTS

(a) NOTICE OF PROTEST: In the event anyone should desire to protest or oppose any pending matter before the Board, a written notice of protest or opposition shall be filed with the Board on or before the date on which such application or matter has been set for hearing. For the convenience of the Board, it is urged that protests be filed at least five days before the hearing date.

(b) PROTEST REQUIREMENTS: Protests shall be submitted in writing with a duplicate copy to the opposite party or parties and shall comply in substance with the following requirements:

(1) Each protest shall show the name and address of the protestant and show that protestant has read either the application or a notice relative thereto published by the Board.

(2) There shall be an allegation of injury to protestant which will result from the proposed action or matter to be considered by the Board.

(3) If the protest is based upon claim of interference with some present right of protestant, it shall include a statement of the basis of protestant's claim of right.

(4) Protestant should call attention to any amendment of the application or adjustment which, if made, would result in withdrawal of the protest.

(c) CONTESTED APPLICATIONS OR PROCEEDINGS DEFINED: An application, appeal, motion or proceedings pending before the Board is considered contested when either protestants or intervenors, or both, files the notice of protest as above set out and appears at the hearing held on the application, motion or proceeding and present testimony or evidence in support of their contentions, or present a question or questions of law with regard to the application, motion or proceedings. Where neither protestants nor intervenors so appear and offer testimony or evidence in support of their contentions, or raise a question of law with reference to any pending application, motion or proceeding, the same shall be considered as non-contested.

(d) In the event of a contested hearing each party shall furnish other parties to the proceeding with a copy of all motions, amendments or briefs filed by him with the Board.

RULE 18 — GENERAL RULES OF PROCEDURE FOR HEARING

(a) Hearings will be conducted in such manner as the Board deems most suitable to the particular case, and technical rules of legal and court procedure need not be applied. It is the purpose of the Board to obtain all the relevant information and testimony pertaining to the issue before it as conveniently, inexpensively and expeditiously as possible without prejudicing the rights of either applicants or protestants.

(b) WHO MAY APPEAR: Any party at interest in a proceeding, may appear either in person or by attorney or both in such proceedings. A party at interest is any person owning a water right within the bounds of the District who is or may be affected by such proceeding. At the discretion of the Board anyone not a party at interest in a proceeding may appear.

(c) ADMISSIBILITY: Evidence will be admitted if it is of that quality upon which reasonable persons are accustomed to rely in the conduct of serious affairs. It is intended that needful and proper evidence shall be conveniently, inexpensively and speedily produced while preserving the substantial rights of the parties to the proceeding.

(d) TESTIMONY SHALL BE PERTINENT: The testimony shall be confined to the subject matter contained in the application or contest. In the event that any party at a hearing shall pursue a line of testimony or interrogation of a witness that is clearly irrelevant, incompetent or immaterial, the person conducting the hearing may forthwith terminate such line of interrogation.

(e) A STIPULATION: Evidence may be stipulated by agreement of all parties at interest.

(f) LIMITING NUMBER OF WITNESSES: The right is reserved to the Board in any proceeding to limit the number of witnesses appearing whose testimony may be merely cumulative.

RULE 19 — GENERAL RULES

(a) COMPUTING TIME: In computing any period of time prescribed or allowed by these rules, by order of the Board, or by any applicable statute, the day of the act, event or default from which the designated period of time begins to run, is not to be included, but

The following amendments to Rules of The Coke County Underground Water Conservation District became effective on 6-6-94.

RULE VII --MINIMUM SPACING OF WELLS

Amend Rule VII, Section A-1 as follows:

A. Distance Requirements.

1. No well to be drilled subsequent to the date of enactment of this rule shall be drilled such that said well shall be located nearer than the distances shown below from the nearest property line.

WELLS PRODUCING	MINIMUM DISTANCE FROM PROPERTY LINE
Up to 50gpm	exempt
50gpm to 100gpm	50 feet
over 100gpm	100 feet

The Board, in order to prevent waste or to prevent confiscation of property, may grant exceptions to permit drilling within shorter distances than described above when the Board shall determine that such exceptions are necessary either to prevent waste or to prevent confiscation of property. The balance of Rule VII is not affected by this amendment.

RULE XXI --TRANSPORTATION OF WATER FROM THE DISTRICT - OMIT

RULE XXIV --DISPOSAL OF HAZARDOUS WASTES - OMIT

ATTEST:

Secretary of Board

Wayne McCabe
President of Board

the last day of the period so computed is to be included, unless it be a Sunday or legal holiday, in which event the period runs until the end of the next day which is neither a Sunday nor a legal holiday.

(b) TIME LIMIT: Applications, requests, or other papers or documents required or permitted to be filed under these rules or by law must be received for filing at the Board's offices at Robert Lee, Texas, or, in a proper case, at the office of the proper county committee, within the time limit, if any, for such filing. The date of receipt and not the date of posting is determinative.

(c) SHOW CAUSE ORDERS AND COMPLAINTS: The Board, either on its own motion or upon receipt of sufficient written protest or complaint, may at any time, after due notice to all interested parties, cite any person operating within the District to appear before it in a public hearing and require him to show cause why his operating authority or permit should not be suspended, cancelled, or otherwise restricted and limited, for failure to comply with the orders or rules of the Board or the relevant statutes of the State, or for failure to abide by the terms and provisions of the permit or operating authority itself. The matter of evidence and all other matters of procedure at any such hearing will be conducted in accordance with these rules of procedures and practice.

RULE 20 — WELL VALIDATION

In order to provide for the validation of existing water wells that are subject to the rules and regulations of the Coke County Underground Water Conservation District (hereinafter referred to as the District), it shall be the policy of this Board that a certification of validation for a well can be issued only after the location of the well and the wellhead equipment of the well has been determined by field survey by District personnel, and/or designated agents acting for said District.

It is the privilege of this Board to cause to be issued a validation certificate for wells drilled and equipped within the District for which the landowner or his agent has not applied for an Application For Water Well Permit; or for wells not otherwise properly permitted, provided that such wells were not drilled, equipped and operated (pumped) in such a manner as to violate any other rules and regulations of the District; and provided that the costs of such well validation are paid to the District as provided by this resolution. Nothing in this resolution is intended to limit the powers of this Board to any other course of action granted within Texas Law, or within its rules and regulations, or within the prerogative of the Board.

The District's Manager is hereby directed to establish and administer the District's program for well validation; with appeals to the Manager's well validating decisions being subject to Board review at any of its regularly called meetings, or at special called meetings.

RULE 21 — TRANSPORTATION OF WATER FROM THE DISTRICT

I. Every person must obtain a permit from the District for the transporting of water by pipeline, channel, ditch, watercourse or other natural or artificial facilities, or any combination of such facilities, if such water is produced from wells located or to be located within the District, and if all or any part of such water is used or is intended for use outside of the boundaries of the District. However, the requirement for a permit hereunder shall not apply to any well currently in operation located within the District prior to the effective date of this Rule provided the amount of water transported from such well annually shall not exceed the amount of water so transported in either the calendar year 1986 or 1987 or 1988, whichever was the greatest.

(a) The permit provided for herein must be applied for and filed with the District in the form or forms promulgated by the District hereunder and such permit must be obtained from the District prior to the proposed transporting of water, all in accordance with the provisions of this rule.

(b) An application for the transportation of water for which a permit is required under this Rule must:

(1) be in writing and sworn to;

(2) contain the name, post office address and place of residence or principal office of the applicant;

(3) identify the location of the well from which the water to be transported is produced or to be produced;

(4) describe specifically the proposed transportation facilities;

(5) state the nature and purposes of the proposed use and the amount of water to be used for each purpose;

(6) state the time within which the proposed construction or alteration is to begin;

(7) state the length of time required for the proposed use of the water;

(8) provide information showing the effect of the proposed transportation on the quantity and quality of water available within the District;

(9) identify any other possible sources which could be used for the stated purposes, including quality and quantity of such alternate sources;

(10) identify any other liquids that could be substituted for the fresh ground water and possible sources of such liquid including quantity and quality.

(c) The application must be accompanied by a map or plat drawn on a scale not less than one inch equals 4,000 feet, showing substantially:

(1) the location of the existing or proposed well; and

(2) the location of the existing or proposed water transporting facilities; and

(3) the location of the proposed or increased use or uses.

(d) The application must be accompanied by an application fee in an amount of $50.00.

(e) The District shall determine whether the application, maps, and other materials comply with the requirements of this Act. The District may require amendment of the application, maps, or other materials to achieve necessary compliance.

(f) The District shall conduct a hearing on each application within ninety (90) days of the filing of the complete application.

(g) The District shall give notice of the hearing on the application as prescribed by this Rule, stating:

(1) the name and address of the applicant;

(2) the date the application was filed;

(3) the location and purpose of the well from which the water to be transported is produced or to be produced;

(4) the time and place of the hearing; and

(5) any additional information the District considers necessary.

(h) At the time and place stated in the notice, the District shall hold a hearing on the application. The hearing may be held in conjunction with any regular or special meeting of the District, or a special meeting may be called for the purpose of holding a hearing. Any person may appear at the hearing, in person or by attorney, or may enter his appearance in writing. Any person who appears may present objections to the issuance of the permit. The District may receive evidence, orally or by affidavit, in support or in opposition to the issuance of the permit, and it may hear arguments.

(i) After the hearing the District shall make a written decision granting or denying the application. The application may be granted in whole or in part. Any decision to grant a permit, in whole or in part, shall require a majority vote of Directors present.

(j) Such application shall not be approved unless the Board of Directors finds and determines that the transporting of water for use outside the District applied for will not substantially affect the quantity and quality of water available to any person or property within the District; that all other feasible sources of water available to the person requesting a permit have been developed and used to the fullest; that no other liquid could be feasibly substituted for the use of fresh ground water; and that the proposed use, or any part of the proposed use, will not constitute waste as defined under the laws of the State of Texas. In evaluating the application, the District shall consider the quantity of water proposed to be transported; the term for which the transporting is requested; the safety of the proposed transportation facilities with respect to the contamination of the aquifer; the nature of the proposed use; the effect of the proposed use of the water to be transported on District residents taking into account all beneficial use of District residents, including municipal, agricultural, industrial, recreational and other categories; and such other factors as are consistent with the purposes of the District.

(k) On approval of an application, the District shall issue a permit to the applicant. The applicant's right to transport shall be limited to the extent and purposes stated in the permit. A permit shall not be transferable except as provided in Paragraph (O).

(l) The permit shall be in writing and attested by the seal of the District and it. shall contain substantially the following information:

(1) the name of the person to whom the permit is issued;

(2) the date the permit is issued;

(3) the term for which the permit is issued;

(4) the date the original application was filed;

(5) the destination and use or purpose for which the water is to be transported;

(6) the maximum quantity of water to be transported annually;

(7) the time within which construction or work on the well transportation facilities must begin and the time within which it must be completed; and

(8) any other information the District prescribed.

(m) The permittee shall file with the District quarterly reports describing the amount of water transported and used for the permitted purpose. Such report shall be filed on the appropriate form or forms provided by the District within ten (10) days of the March 31, June 30, September 30, and December 31 next following the commencement of transporting of water, and within ten (10) days of each such quarterly date thereafter.

(n) All transporting facilities for wells subject to the requirements of this Subsection shall be equipped with flow monitoring devices approved by the District available for District inspection at any time.

(o) A permittee may apply for an extension of any permit granted under this Subsection or for transfer of a permit to another person. The District shall consider and grant or deny such application for extension or trânsfer of a permit in the same manner as is provided herein for the application for a permit.

(p) Any permit granted under this Subsection shall be subject to revocation for nonuse or waste by the permittee, or for substantial deviation from the purposes or other terms stated in the permit. Revocation of a permit for nonuse shall require that no water is transported under the permit for a period of five years.

II. Any person transporting water produced from wells located within the District for use outside of the District, regardless of the amount of water so transported, must register such transporting with the District. Such registration shall be made within one hundred eighty (180) days after the effective date of this Rule.

(a) Any person subject to the requirements of this Subsection (II) shall file with the District quarterly reports describing the amount of water transported, the destination and use of such water. Such report shall be filed on the appropriate form or forms provided by the District within ten (10) days of the March 31, June 30, September 30 and December 31 next following the commencement of transporting of water and within ten (10) days of each such quarterly date thereafter.

(b) All transporting facilities for wells subject to the requirements of this Subsection shall be equipped with flow monitoring devices approved by the District and available for District inspection at any time.

RULE 22 — WELL DRILLING, COMPLETION, CAPPING, AND PLUGGING

(a) Responsibility

(1) All well drillers and persons having a well drilled, deepened. or otherwise altered shall adhere to the provisions of this Rule prescribing the location of wells and proper drilling, completion, capping, and plugging.

(b) Location of Domestic, Industrial, Injection and Irrigation Wells.

(1) Except as noted in paragraph (c)(1) of this Rule (relating to Standards of Completion for Domestic, Industrial, Injection and Irrigation Wells), a well shall be located a minimum horizontal distance of 50 feet from any water-tight sewage and liquid-waste collection facility.

(2) Except as noted in paragraph (c)(1) of this Rule (relating to Standards of Completion for Domestic, Industrial, Injection and Irrigation Wells), a well shall be located a minimum horizontal distance of 150 feet from any concentrated sources of contamination, such as existing or proposed livestock or poultry yards, privies, and septic system absorption fields.

(3) A well shall be located at a site not generally subject to flooding; provided, however, that if a well must be placed in a flood prone area, it shall be completed with a watertight sanitary well seal and steel casing extending a minimum of 24 inches above known flood level.

(c) Standards of Completion For Domestic, Industrial, Injection and Irrigation Wells. Domestic, industrial, injection and irrigation wells shall be completed in accordance with the following specifications and in compliance with local county and/or incorporated city ordinances:

(1) The annular space between the borehole and the casing shall be filled from ground level to a depth of not less than 10 feet below the land surface or well head with cement slurry. The distances given in Paragraph (b)(1) and (2) of this Paragraph (relating to Location of Domestic, Industrial, Injection and Irrigation Wells) may be decreased provided the total depth of cement slurry is increased by twice the horizontal reduction. In areas of shallow, unconfined groundwater aquifers, the cement need not be placed below the static water level. In areas of shallow, confined groundwater aquifers having artesian head, the cement need not be placed below the top of the water-bearing strata.

(2) In all wells where plastic casing is used, a concrete slab or sealing block shall be placed above the cement slurry around the well at the ground surface.

(i) The slab or block shall extend at least two feet from the well in all directions and have a minimum thickness of four inches and shall be separated from the well casing by a plastic or mastic coating or sleeve to prevent bonding of the slab to the casing.

(ii) The surface of the slab shall be sloped to drain away from the well.

(iii) The top of the casing shall extend a minimum of one foot above the top of the slab.

(3) In all wells where steel casing is used:

(i) The casing shall extend a minimum of one foot above the original ground surface; and

(ii) A slab or block as described in Paragraph (2)(i) is required above the cement slurry except when a pitless adapter is used.

Pitless adapters may be used in such wells provided that:

(a) the adapter is welded to the casing or fitted with another suitably effective seal; and

(b) the annular space between the borehole and the casing is filled with cement to a depth not less than 15 feet below the adapter connection.

(4) All wells, especially those that are gravel packed, shall be completed so that aquifers or zones containing waters that are known to differ significantly in chemical quality are not allowed to commingle through the borehole-casing annulus or the gravel pack and cause quality degradation of any aquifer or zone.

(5) The well casing shall be capped or completed in a manner that will prevent pollutants from entering the well.

(d) <u>Standards for Completion for Wells Encountering Undesirable Water</u>.

(1) If a well encounters undesirable water and the well is not plugged, the licensed well driller or owner shall see that the well drilled, deepened or otherwise alters is forthwith completed in accordance with the following:

(i) When undesirable water is encountered in a well, the undesirable water shall be sealed off and confined to the zone(s) of origin.

(ii) When undesirable water is encountered in a zone overlying fresh water, the well shall be cased from the top of the fresh water zone to the land surface.

(iii) The annular space between the casing and the wall of the borehole shall be cemented to the land surface.

(iv) When undesirable water is encountered in a zone underlying a fresh water zone, the part of the well bore opposite the undesirable water zone shall be filled with cement to a height that will prevent the entrance of the undesirable water into the pumping well.

(2) The person who performs the well completion on a well shall, within 30 days after completing the well, submit a well completion report to the District Manager, on forms supplied by the District Manager.

(e) <u>Standards for Wells Producing Undesirable Water</u>.

(1) Wells completed to produce undesirable water shall be cased from the top of the undesirable water zone or 50 feet below the lowermost fresh water zone to the land surface.

(2) The annular space between the casing and the wall of the borehole shall be cemented to the land surface, or as a minimum, to a height greater than the hydrostatic head of the undesirable water aquifer plus the uppermost 10 feet of casing.

(3) If the undesirable water does not enter the cased part of the well, the lowermost and uppermost 10 feet (minimum) of the casing shall be cemented in order to seal off all other water-bearing or other permeable sections from the well.

(f) Recompletions.

(1) The landowner shall have the continuing responsibility of insuring that a well does not allow the commingling of undesirable water and fresh water or the unwanted loss of water through the wellbore to other porous strata.

(2) If a well is allowing the commingling of undesirable water and fresh water or the unwanted loss of water, and the casing in the well cannot be removed and the well recompleted with the applicable rules, the casing in the well shall be perforated and squeeze cemented in a manner that will prevent the commingling or loss of water. If such a well has no casing then the well shall be cased and cemented, or plugged in a manner that will prevent such commingling or loss of water.

(3) The District Manager may direct the landowner to take proper steps to prevent the commingling of undesirable water and fresh water, or the unwanted loss of water.

(g) Well Plugging and Capping.

(1) It is the responsibility of the landowner or person having the well drilled, deepened, or otherwise altered, to cap or have capped, under standards set forth in this Rule (relating to Well Drilling, Completion, Capping, and Plugging), any well which is open at the surface.

(2) It is the responsibility of the landowner or person having the well drilled, deepened or otherwise altered to plug or have plugged a well which is abandoned.

(3) It shall be the responsibility of the landowner or person having the well drilled, deepened, or otherwise altered to see that any well which encounters undesirable water is plugged under the standards set forth in this Rule (relating to Well Drilling, Completion, Capping and Plugging).

(4) The person that plugs such a well shall, within 30 days after completion or plugging is complete, submit a well completion and plugging report to the District Manager, on forms supplied by the District Manager.

(h) Standards for Plugging Wells.

(1) If the use of a well that does not contain any undesirable water zones is permanently discontinued, all removable casing shall be removed from the well and the entire well filled with cement to the land surface.

The following amendments to Rules of The Coke Count Underground Water Conservation District became effective on 6-6-94.

RULE VII --MINIMUM SPACING OF WELLS

Amend Rule VII, Section A-1 as follows:

A. Distance Requirements.

1. No wel to be drilled subsequent to the date of enactment of this rule shall be drilled such that said well shall be located nearer than the distances shown below from the nearest property line.

WELLS PRODUCING	MINIMUM DISTANCE FROM PROPERTY LINE
Up to 50gpm	exempt
50gpm to 100gpm	50 feet
over 100gpm	100 feet

The Board, in order to prevent waste or to prevent confiscation of property, may grant exceptions to permit drilling within shorter distances than described above when the Board shall determine that such exceptions are necessary either to prevent waste or to prevent confiscation of property. The balance of Rule VII is not affected by this amendment.

RULE XXI --TRANSPORTATION OF WATER FROM THE DISTRICT - OMIT

RULE XXIV --DISPOSAL OF HAZARDOUS WASTES - OMIT

ATTEST:

[signature]
Secretary of Board

Wayne McCabe
President of Board

(2) In lieu of the procedure in subsection (1) of this paragraph, the well may be filled with heavy mud followed by a cement plug extending from land surface to a depth of not less than 10 feet.

(i) Standards for Plugging Wells That Penetrate Undesirable Water Zones.

(1) If the use of well that penetrates undesirable water is to be permanently discontinued, all removable casing shall be removed from the well and the entire well filled with cement to the land surface.

(2) In lieu of the procedure in subsection (1) of this paragraph, either the zone(s) contributing undesirable water, or the fresh water zone(s), shall be isolated with cement plugs and the remainder of the wellbore filled with heavy mud to form a base for a cement plug extending from land surface to a depth of not less than 10 feet.

RULE 23 — REPORTING UNDESIRABLE WATER

(1) Each licensed well driller shall immediately inform the landowner of person having a well drilled, deepened, or otherwise altered when undesirable water has been encountered.

(2) The well driller shall submit to the District Manager and the landowner or person having the well drilled, deepened, or otherwise altered, on forms supplied by the District Manager, a statement signed by the well driller indicating that the landowner or person having the well drilled, deepened, or otherwise altered, has been informed that undesirable water has been encountered and shall note on all logs filed the depth such undesirable water was found.

(3) The statement indicated in subsection (2) of this Rule must be submitted within 30 days after encountering undesirable water.

RULE 24 — DISPOSAL AND STORAGE OF WASTES

(1) None of the following materials and substances may be imported from outside the district to a point within the district, nor moved within the district from point to point, for the purpose of temporarily, or permanently disposing, discharging or storing of such materials or substances within the district without first obtaining a permit from the district:

(a) Radioactive wastes;
(b) Toxic substances;
(c) Hazardous substances;
(d) Polychlorinated biphenyls;
(e) Oil, gas, and mineral production and refinement wastes;
(f) Soil, fluids or other materials or substances contaminated with any of the above; and
(g) Any other substance that presents a threat to the quality or quantity of groundwater used within the district.

(2) Exclusions. The following substances are hereby expressly excluded from this rule:

(a) Agricultural insecticides, pesticides, herbicides or other agri-chemicals applied to the surface at the appropriate rate and for their intended use only; provided, however, that this rule shall not exclude the disposal from washing out of equipment used for applying the chemicals by any operator.

(3) The following activities are prohibited unless a permit is granted by the district:

(a) Construction, operation, maintenance or use of waste disposal wells for disposal of any of the materials or substances enumerated in subparagraphs (1)(a) through (1)(g) inclusive of this Rule 24; and

(b) Construction, operation, maintenance or use of tanks, reservoirs, pits, depressions, sites, land fills, or other manner of storage of any of the materials or substances enumerated in subparagraphs (1)(a) through (1)(g) inclusive of this Rule 24 on either a temporary or a permanent basis within the district.

(4) Exceptions. This rule shall be strictly enforced in its application; provided, however, circumstances may arise that are materially different from those normally encountered in, or resulting from, any of the disposal or storage operations or activities described or prohibited by this rule. However, an exception may be granted at the discretion of the board upon due evidence presented that such prohibition shall cause undue hardship and the board finds that such disposal, or means of disposal, does not constitute a threat of waste, pollution or harmful alteration of groundwater within the district.

(a) Any person, firm, corporation, partnership, association of persons, or other entity desiring an exception to any of the provisions contained in this Rule shall file a written, sworn application with the District Office in Robert Lee, Texas which shall state the following:

(1) The nature of the exception requested;
(2) The type of substance or material for which the exception is requested;
(3) The quantity of the substance or material to be stored and/or disposed of;
(4) The rate of disposal and method of disposal of such substance or material;
(5) The exact location of storage and/or disposition of such substance or material;
(6) A description of the present place facilities and environment of the substance or material including the method of storage and safeguards afforded thereby;
(7) The justification for granting the exception; and
(8) Any information that the Applicant deems appropriate in support of said Application.

(b) Seven copies of any Application for an Exception under this rule shall be submitted to the district at its general office in Robert Lee, Texas.

(c) All Applications for an Exception shall be heard and considered by the Board of Directors meeting in regular or special session within ninety (90) days after submittal. Thirty (30) days prior to the date of hearing the district shall give notice of such hearing to the applicant and any known interested parties, including, but not limited to all governmental agencies having potential concurrent jurisdiction, and notice shall also be given to the public by appropriate notice given by the district by appropriate notice published in a newspaper of general circulation within the district at least thirty (30) days prior to the date of hearing.

(d) Upon hearing of the evidence presented, within sixty (60) days the Board shall enter an order granting or denying an Application for Exception, with any such conditions as it shall deem proper and necessary to protect the quality and/or quality of the groundwaters underlying said district. In this regard, as one of such conditions, the district may require the installation of requisite equipment at the sole expense of the applicant to monitor water quality, as well as require testing and water analysis of the groundwater from areas around the waste disposal site. In addition, this monitoring equipment shall be in place and in working condition at all times and district personnel and/or agents or its contractors shall have the right to inspect and obtain samples from said equipment at any time deemed necessary by the district.

(e) Any hearings hereunder shall be public in nature and shall be conducted pursuant to Rules 15 through 19, inclusive, provided herein.

(f) At the hearing the Applicant will be given the opportunity to present evidence with respect to the type of substance or materials for which an exception is sought, the quantity, location, description of the present facilities and environment of the materials or substances, whether the substances or materials will alter or harm the groundwater, and protective devices and/or techniques to be employed by the Applicant to prevent such alteration or harm to the groundwater.

(g) The decision of the Board shall be based upon a preponderance of the evidence submitted at the hearing by the Applicant, by the district, or by other interested parties, local, state or federal agencies or public officials.

(h) The board may grant an exception to more than one applicant with the same waste disposal process.

(5) All persons, firms, partnerships, corporations, associations of persons, or other legal entities having in their possession or under their care, custody and control within the district any of the materials and substances enumerated in subparagraphs (1)(a) through (1)(g) inclusive of this rule as of the date on which this rule becomes effective, whether for use, storage or disposal, shall report by sworn inventory to the district office in Robert Lee, Texas within sixty (60) days of the effective date of this rule. The report shall include a description of the materials or substances possessed, amount, location, status and whether a plan or schedule has be formulated for the ultimate disposal of the materials or substances and the place of such disposal.

Within sixty (60) days after receipt of such report, the board shall either approve same or set a hearing according to the procedures outlined herein.

(6) In the event of a change in the quality or quantity of the groundwater which would indicate possible contamination of the groundwater, at any time, the board shall have the right, power and authority to require the disposal facility to shut down until the source of the contamination is located and measures have been taken to correct the source of contamination and restore the water quality to its previous condition.

Repeal of Prior Regulations

All of the previous rules and regulations of the District have been revised and amended; and except as they are herein republished, they are repealed. Any previous rule or regulation which conflicts with or is contrary to these rules is hereby repealed.

Savings Clause

If any section, sentence, paragraph, clause, or part of these rules and regulations should be held or declared invalid for any reason by a final judgment of the courts of this state or of the United States, such decision or holding shall not affect the validity of the remaining portions of these rules; and the Board does hereby declare that it would have adopted and promulgated such remaining portions of such rules irrespective of the fact that any other sentence, section, paragraph, clause, or part thereof may be declared invalid.

ENTERED this 21 day of March, A.D. 1989.

Attest:

Arch C. Matthews
Secretary of Board of Directors

Royce Stewart
President of Board of Directors

Fred H. McCaleb Jr.
Director

Otis Smith
Director

J. D. Harmon
Director

Accepted this 21 day of March, 1989.

[signature]
Manager of the District

APPENDIX A

ESTIMATED HISTORIAL GROUNDWATER USE and

2012 TEXAS STATE WATER PLAN DATASETS

Estimated Historical Water Use And 2012 State Water Plan Datasets:

Coke County Underground Water Conservation District

by Stephen Allen
Texas Water Development Board
Groundwater Resources Division
Groundwater Technical Assistance Section
stephen.allen@twdb.texas.gov
(512) 463-7317
February 6, 2013

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:

https://www.twdb.state.tx.us/groundwater/docs/GCD/GMPchecklist0113.pdf

The five reports included in part 1 are:

1. Estimated Historical Water Use (checklist Item 2)

   from the TWDB Historical Water Use Survey (WUS)

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

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

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

DISCLAIMER:

The data presented in this report represents the most updated Historical Water Use and 2012 State Water Planning data available as of 2/6/2013. Although it does not happen frequently, neither of these datasets are static and are subject to change pending the availability of more accurate data (Historical Water Use data) or an amendment to the 2012 State Water Plan (2012 State Water Planning data). District personnel must review these datasets and correct any discrepancies in order to ensure approval of their groundwater management plan.

The Historical Water Use dataset can be verified at this web address:

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

The 2012 State Water Planning dataset can be verified by contacting Wendy Barron (wendy.barron@twdb.texas.gov or 512-936-0886).

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

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

Groundwater and surface water historical use estimates are currently unavailable for calendar years 2005, 2011 and 2012. TWDB staff anticipates the calculation and posting of these estimates at a later date.

COKE COUNTY

All values are in acre-feet/year

Year	Source	Municipal	Manufacturing	Steam Electric	Irrigation	Mining	Livestock	Total
1974	GW	33	6	0	20	0	145	204
	SW	389	15	429	746	172	573	2,324
1980	GW	118	0	0	250	23	60	451
	SW	382	0	549	275	421	526	2,153
1984	GW	47	0	0	512	391	42	992
	SW	795	0	478	0	0	381	1,654
1985	GW	39	0	0	500	292	45	876
	SW	801	0	381	0	207	406	1,795
1986	GW	25	0	0	500	275	33	833
	SW	589	0	611	0	193	302	1,695
1987	GW	16	0	0	500	258	38	812
	SW	552	0	457	0	197	343	1,549
1988	GW	0	0	0	500	248	40	788
	SW	739	0	508	0	147	365	1,759
1989	GW	38	0	0	469	231	39	777
	SW	652	0	553	102	220	357	1,884
1990	GW	41	0	0	367	231	39	678
	SW	552	0	445	80	220	358	1,655
1991	GW	55	0	0	316	170	41	582
	SW	553	0	476	69	166	370	1,634
1992	GW	54	0	0	111	170	60	395
	SW	550	0	590	24	125	542	1,831
1993	GW	64	0	0	534	170	52	820
	SW	702	0	555	133	125	464	1,979
1994	GW	58	0	0	470	170	51	749
	SW	714	0	389	102	131	460	1,796
1995	GW	40	0	0	454	170	54	718
	SW	658	0	497	113	134	490	1,892
1996	GW	46	0	0	532	170	45	793
	SW	738	0	581	133	134	409	1,995
1997	GW	58	0	0	434	170	46	708

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

Groundwater and surface water historical use estimates are currently unavailable for calendar years 2005, 2011 and 2012. TWDB staff anticipates the calculation and posting of these estimates at a later date.

Year	Source	Municipal	Manufacturing	Steam Electric	Irrigation	Mining	Livestock	Total
1997	SW	492	0	515	108	110	414	1,639
1998	GW	65	0	0	1,264	170	38	1,537
	SW	709	0	527	316	3	342	1,897
1999	GW	59	0	0	434	170	38	701
	SW	844	0	527	108	3	342	1,824
2000	GW	60	0	0	803	170	37	1,070
	SW	698	0	372	134	235	337	1,776
2001	GW	89	0	0	799	178	41	1,107
	SW	756	0	389	130	115	366	1,756
2002	GW	50	0	0	980	178	35	1,243
	SW	427	0	410	160	115	319	1,431
2003	GW	63	0	0	411	178	23	675
	SW	538	0	410	37	115	209	1,309
2004	GW	86	0	0	755	178	26	1,045
	SW	725	0	410	37	115	230	1,517
2006	GW	173	0	0	937	0	248	1,358
	SW	216	0	0	28	18	70	332
2007	GW	147	0	0	609	0	227	983
	SW	283	124	274	0	293	64	1,038
2008	GW	301	0	0	685	0	336	1,322
	SW	144	0	0	5	337	95	581
2009	GW	116	0	0	394	62	323	895
	SW	613	0	0	0	39	91	743
2010	GW	316	0	0	871	96	293	1,576
	SW	319	0	0	0	50	83	452

Projected Surface Water Supplies
TWDB 2012 State Water Plan Data

COKE COUNTY

All values are in acre-feet/year

RWPG	WUG	WUG Basin	Source Name	2010	2020	2030	2040	2050	2060
F	BRONTE VILLAGE	COLORADO	OAK CREEK LAKE/RESERVOIR	0	0	0	0	0	0
F	COUNTY-OTHER	COLORADO	COLORADO RIVER MWD LAKE/RESERVOIR SYSTEM	77	65	95	86	82	76
F	IRRIGATION	COLORADO	COLORADO RIVER COMBINED RUN-OF-RIVER IRRIGATION	41	41	41	41	41	41
F	LIVESTOCK	COLORADO	LIVESTOCK LOCAL SUPPLY	370	370	370	370	370	370
F	MINING	COLORADO	COLORADO RIVER MWD LAKE/RESERVOIR SYSTEM	232	239	378	378	380	372
F	ROBERT LEE	COLORADO	COLORADO RIVER MWD LAKE/RESERVOIR SYSTEM	256	231	340	317	302	281
F	ROBERT LEE	COLORADO	COLORADO RIVER RUN-OF-RIVER CITY OF ROBERT LEE	7	7	7	7	7	7
F	ROBERT LEE	COLORADO	MOUNTAIN CREEK LAKE/RESERVOIR	0	0	0	0	0	0
F	STEAM ELECTRIC POWER	COLORADO	OAK CREEK LAKE/RESERVOIR	0	0	0	0	0	0
	Sum of Projected Surface Water Supplies (acre-feet/year)			**983**	**953**	**1,231**	**1,199**	**1,182**	**1,147**

Projected Water Demands
TWDB 2012 State Water Plan Data

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

COKE COUNTY

All values are in acre-feet/year

RWPG	WUG	WUG Basin	2010	2020	2030	2040	2050	2060
F	BRONTE VILLAGE	COLORADO	245	258	254	250	249	249
F	ROBERT LEE	COLORADO	351	346	342	338	336	336
F	COUNTY-OTHER	COLORADO	175	162	159	154	152	152
F	STEAM ELECTRIC POWER	COLORADO	310	247	289	339	401	477
F	MINING	COLORADO	488	528	550	572	593	614
F	IRRIGATION	COLORADO	936	936	934	933	933	933
F	LIVESTOCK	COLORADO	593	593	593	593	593	593
	Sum of Projected Water Demands (acre-feet/year)		3,098	3,070	3,121	3,179	3,257	3,354

Projected Water Supply Needs
TWDB 2012 State Water Plan Data

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

COKE COUNTY

All values are in acre-feet/year

RWPG	WUG	WUG Basin	2010	2020	2030	2040	2050	2060
F	BRONTE VILLAGE	COLORADO	5	-20	-28	-35	-45	-55
F	COUNTY-OTHER	COLORADO	-28	-32	0	-6	-9	-15
F	IRRIGATION	COLORADO	-363	-363	-361	-360	-360	-360
F	LIVESTOCK	COLORADO	0	0	0	0	0	0
F	MINING	COLORADO	-86	-119	-2	-24	-43	-72
F	ROBERT LEE	COLORADO	-88	-108	5	-14	-27	-48
F	STEAM ELECTRIC POWER	COLORADO	-310	-247	-289	-339	-401	-477
	Sum of Projected Water Supply Needs (acre-feet/year)		**-875**	**-889**	**-680**	**-778**	**-885**	**-1,027**

Projected Water Management Strategies
TWDB 2012 State Water Plan Data

COKE COUNTY

WUG, Basin (RWPG)

All values are in acre-feet/year

Water Management Strategy	Source Name [Origin]	2010	2020	2030	2040	2050	2060
BRONTE VILLAGE, COLORADO (F)							
MUNICIPAL CONSERVATION	CONSERVATION [COKE]	16	45	48	48	50	51
REHABILITATION OF PIPELINE	OAK CREEK LAKE/RESERVOIR [RESERVOIR]	0	0	0	0	0	0
SUBORDINATION	OAK CREEK LAKE/RESERVOIR [RESERVOIR]	129	129	129	129	129	129
COUNTY-OTHER, COLORADO (F)							
SUBORDINATION	COLORADO RIVER MWD LAKE/RESERVOIR SYSTEM [RESERVOIR]	28	32	0	6	9	15
MINING, COLORADO (F)							
SUBORDINATION	COLORADO RIVER MWD LAKE/RESERVOIR SYSTEM [RESERVOIR]	86	119	2	24	43	72
ROBERT LEE, COLORADO (F)							
MUNICIPAL CONSERVATION	CONSERVATION [COKE]	16	40	44	45	46	48
NEW WTP AND STORAGE FACILITIES	COLORADO RIVER MWD LAKE/RESERVOIR SYSTEM [RESERVOIR]	0	0	0	0	0	0
SUBORDINATION	COLORADO RIVER MWD LAKE/RESERVOIR SYSTEM [RESERVOIR]	95	115	2	21	34	55
STEAM ELECTRIC POWER, COLORADO (F)							
SUBORDINATION	OAK CREEK LAKE/RESERVOIR [RESERVOIR]	310	247	289	339	401	477
Sum of Projected Water Management Strategies (acre-feet/year)		**680**	**727**	**514**	**612**	**712**	**847**

APPENDIX B

GAM RUN 12-019

COKE COUNTY UNDERGROUND WATER CONSERVATION DISTRICT

GAM RUN 12-019: COKE COUNTY UNDERGROUND WATER CONSERVATION DISTRICT MANAGEMENT PLAN

by William Kohlrenken
Texas Water Development Board
Groundwater Resources Division
Groundwater Availability Modeling Section
(512) 463-8279
November 16, 2012

Cynthia K. Ridgeway is the Manager of the Groundwater Availability Modeling Section and is responsible for oversight of work performed by William Kohlrenken under her direct supervision. The seal appearing on this document was authorized by Cynthia K. Ridgeway, P.G. 471 on November 16, 2012.

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GAM Run 12-019: Coke County Underground Water Conservation District Management Plan

by William Kohlrenken
Texas Water Development Board
Groundwater Resources Division
Groundwater Availability Modeling Section
(512) 463-8279
November 16, 2012

EXECUTIVE SUMMARY:

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

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

The purpose of this report is to provide Part 2 of a two-part package of information to Coke County Underground Water Conservation District for its groundwater management plan. The groundwater management plan for the Coke County Underground Water Conservation District is due for approval by the executive administrator of the TWDB before December 4, 2013.

This report discusses the method, assumptions, and results from model runs using the groundwater availability model for the Edwards-Trinity (Plateau) Aquifer, the Lipan Aquifer, and the Dockum Aquifer. Tables 1 through 3 summarize the groundwater availability model data required by the statute, and figures 1 through 3 show the area

of the models from which the values in the tables were extracted. This model run replaces the results of GAM Run 07-39 (Tu, 2007). GAM Run 12-019 meets current standards set after the release of GAM Run 07-39 and it is based on the most current groundwater district boundaries and water budget extraction methods. If after review of the figures, Coke County Underground Water Conservation District determines that the district boundaries used in the assessment do not reflect current conditions, please notify the TWDB immediately. The TWDB has also approved, for planning purposes, alternative models that can have water budget information extracted for the district. These alternative models include the 1-layer alternative model for the Edwards-Trinity (Plateau) Aquifer and the alternative model for the Dockum Aquifer. Please contact the author of this report if a comparison report using these models is desired.

METHODS:

Groundwater availability models for the Edwards-Trinity (Plateau) Aquifer (1981-2000), Lipan Aquifer (1980-1999), and the Dockum Aquifer (1980-1997) were run for this analysis. Water budgets for each year of the transient model period were extracted using ZONEBUDGET Version 3.01 (Harbaugh, 2009) and the average annual water budget values for recharge, surface water outflow, inflow to the district, outflow from the district, net inter-aquifer flow (upper), and net inter-aquifer flow (lower) for the portions of the aquifers located within the district are summarized in this report.

PARAMETERS AND ASSUMPTIONS:

Edwards-Trinity (Plateau) Aquifer

- We used Version 1.01 of the groundwater availability model of the Edwards-Trinity (Plateau) Aquifer for this analysis. See Anaya and Jones (2009) for assumptions and limitations of the model.
- The model has two layers which represent the Edwards portions of the Edwards-Trinity (Plateau) Aquifer in layer one, and Trinity portions of the Edwards-Trinity (Plateau) Aquifer in layer two.
- The root mean square error (a measure of the difference between simulated and actual water levels during model calibration) is 143 feet for the

transient calibration period. This represents 6 percent of the range of measured water levels (Anaya and Jones, 2009).

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

Lipan Aquifer

- We used Version 1.01 of the groundwater availability model for the Lipan Aquifer for this analysis. See Beach and others (2004) for assumptions and limitations of the groundwater availability model.
- The Lipan Aquifer model includes one layer representing the Quaternary Leona Formation, portions of the underlying Permian Formations, and the Edwards-Trinity (Plateau) Aquifer to the west, south, and north.
- The model uses general head boundaries to simulate the eastern and western aquifer boundaries. Inflow on the general-head boundary to the west represents inflow from the Edwards-Trinity (Plateau) Aquifer. The mean absolute error (a measure of the difference between simulated and actual water levels during model calibration) in the groundwater availability model for the Lipan Aquifer is 18 feet for the calibration period (1980-89) and 17 feet for the verification period (1990-99: Beach and others, 2004).
- The model was run with MODFLOW-96 (Harbaugh and MacDonald, 1996).

Dockum Aquifer

- We used Version 1.01 of the groundwater availability model for the Dockum Aquifer. See Ewing and others (2008) for assumptions and limitations of the groundwater availability model.
- The model includes three layers representing the younger geologic units overlying the Dockum Aquifer (layer 1), the upper portion of the Dockum Aquifer (layer 2), and the lower portion of the Dockum Aquifer (layer 3).
- Of the three layers, individual water budgets for the district were determined for the Dockum Aquifer (Layers 2 and 3). The water budgets for Layers 2 and 3 are combined.
- The aquifers represented in Layer 1 of the groundwater availability model are only included in the model for the purpose of more accurately representing flow between these units and the Dockum Aquifer. This model

is not intended to explicitly simulate flow in these overlying units (Ewing and others, 2008).

- The root mean square error (a measure of the difference between simulated and actual water levels during model calibration) in the groundwater availability model is 82 feet for the Upper Dockum Aquifer, and 108 feet for the Lower Dockum Aquifer for the calibration period (1980 to 1990) and 83 and 78 feet for the same aquifers, respectively, in the verification period (1991 to 1999) (Ewing and others, 2008). These root mean square errors are between three and five percent of the range of measured water levels (Ewing and others, 2008).
- The MODFLOW Drain package was used to simulate both evapotranspiration and springs. However, there were no model grid cells representing springs within the district so there was no drain flow incorporated into the surface water outflow values.
- Groundwater in the Dockum Aquifer ranges from fresh to brine in composition (Ewing and others, 2008). Groundwater with total dissolved solids of less than 1,000 milligrams per liter are considered fresh, total dissolved solids of 1,000 to 10,000 milligrams per liter are considered brackish, and total dissolved solids greater than 10,000 to 35,000 milligrams per liter are considered saline.
- The model was run with MODFLOW-2000 (Harbaugh and others, 2000).

RESULTS:

A groundwater budget summarizes the amount of water entering and leaving the aquifer according to the groundwater availability model. Selected groundwater budget components listed below were extracted from the model results for the aquifers located within the district and averaged over the duration of the calibration and verification portion of the model runs in the district. The components of the modified budget shown in tables 1 through 3 include:

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

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

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

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

The information needed for the district's management plan is summarized in tables 1 through 3. It is important to note that sub-regional water budgets are not exact. This is due to the size of the model cells and the approach used to extract data from the model. To avoid double accounting, a model cell that straddles a political boundary, such as district or county boundaries, 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 (see figures 1 through 3).

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

Management Plan requirement	*Aquifer or confining unit*	*Results*
Estimated annual amount of recharge from precipitation to the district	Edwards-Trinity (Plateau) Aquifer	5,832
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	6,693
Estimated annual volume of flow into the district within each aquifer in the district	Edwards-Trinity (Plateau) Aquifer	1,235
Estimated annual volume of flow out of the district within each aquifer in the district	Edwards-Trinity (Plateau) Aquifer	545
Estimated net annual volume of flow between each aquifer in the district	From Edwards-Trinity (Plateau) to older underlying units	56

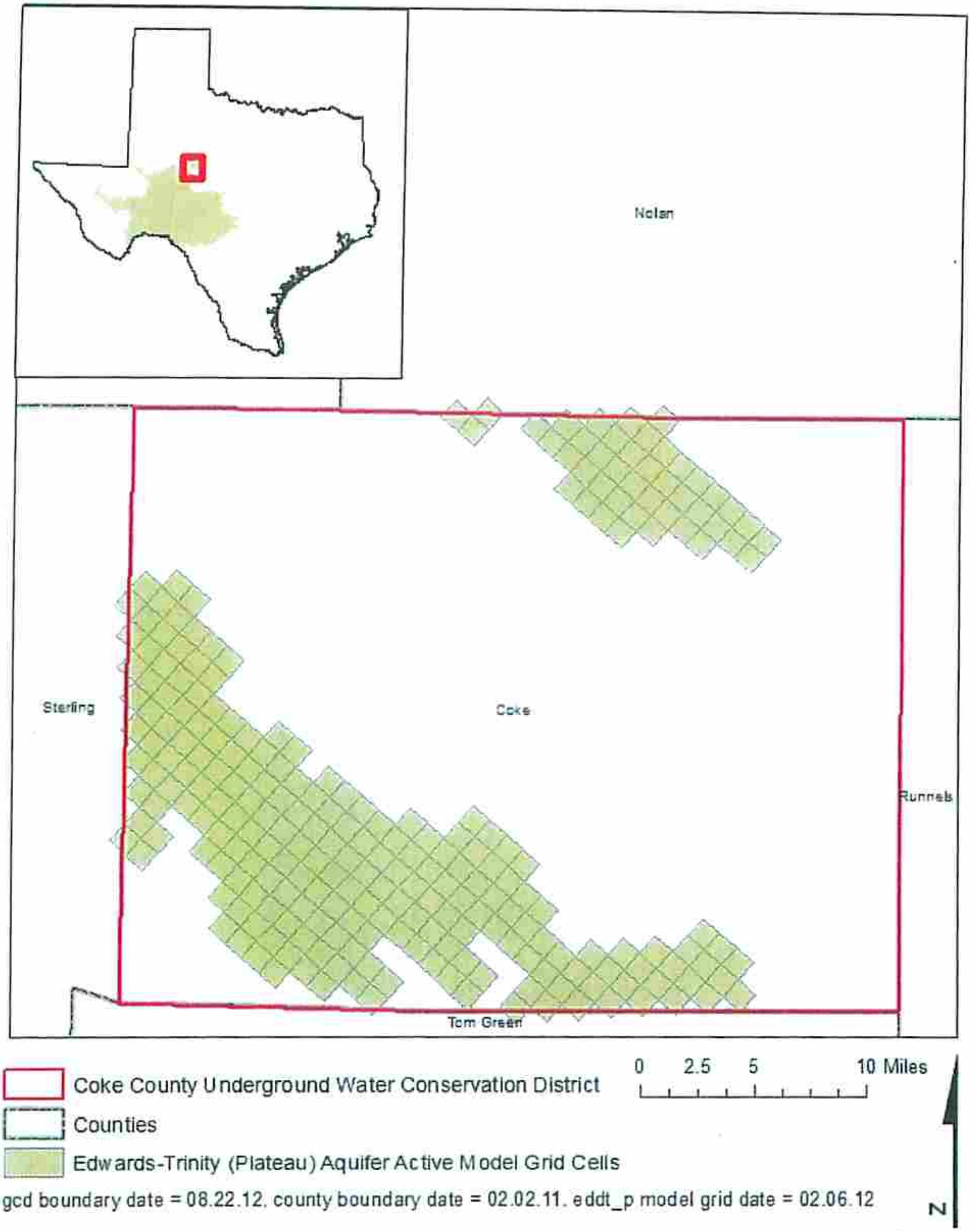

FIGURE 1: AREA OF ACTIVE MODEL CELLS FOR THE EDWARDS-TRINITY (PLATEAU) AQUIFER IN COKE COUNTY UNDERGROUND WATER CONSERVATION DISTRICT FROM WHICH THE INFORMATION IN TABLE 1 WAS EXTRACTED (THE AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).

TABLE 2: SUMMARIZED INFORMATION FOR THE LIPAN AQUIFER THAT IS NEEDED FOR COKE COUNTY UNDERGROUND WATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT.

Management Plan requirement	*Aquifer or confining unit*	*Results*
Estimated annual amount of recharge from precipitation to the district	Lipan Aquifer	265
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Lipan Aquifer	0
Estimated annual volume of flow into the district within each aquifer in the district	Lipan Aquifer	299
Estimated annual volume of flow out of the district within each aquifer in the district	Lipan Aquifer	930
Estimated net annual volume of flow between each aquifer in the district	From the Edwards-Trinity (Plateau) and other units into the Lipan Aquifer	385

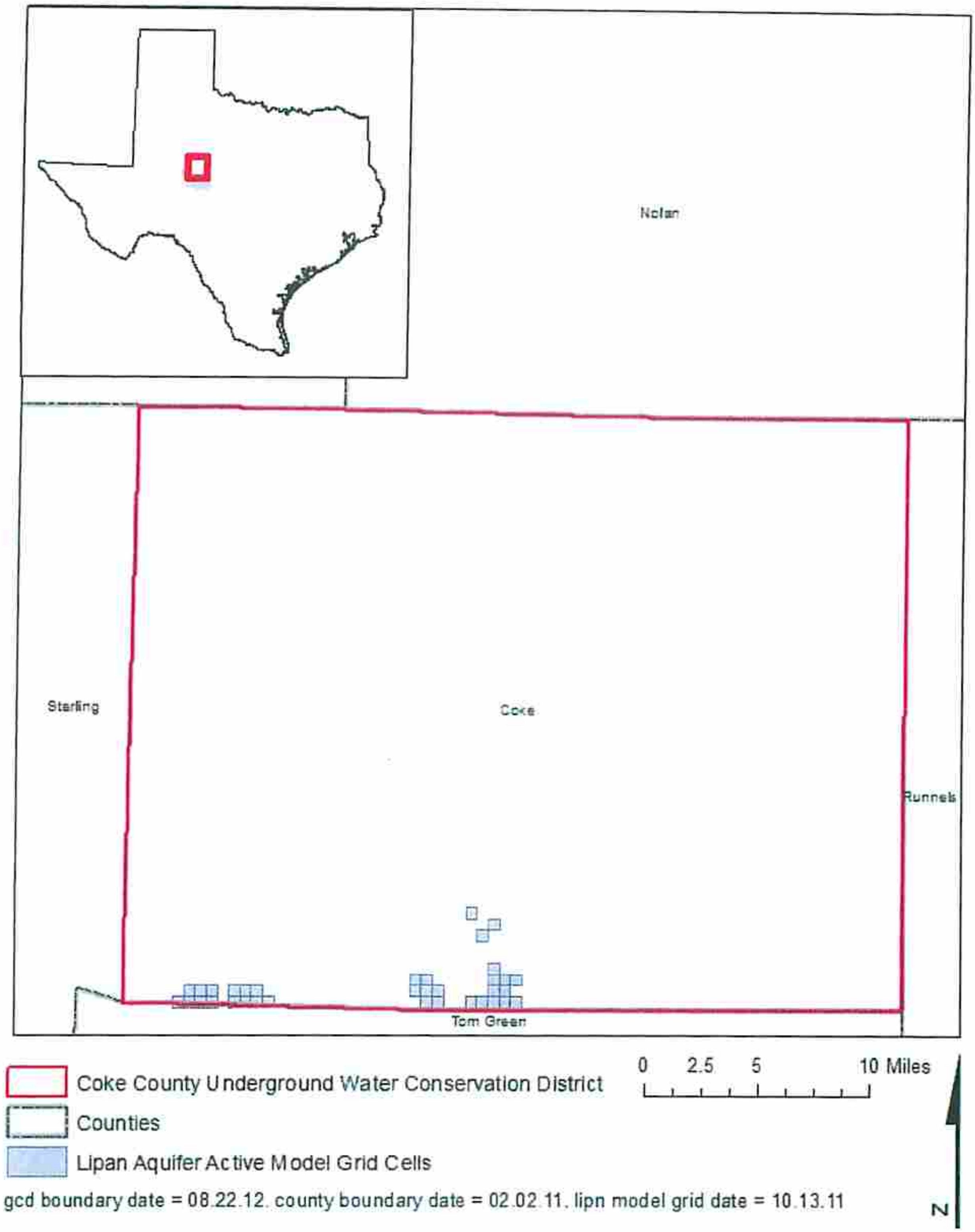

FIGURE 2: AREA OF ACTIVE MODEL CELLS FOR THE LIPAN AQUIFER IN COKE COUNTY UNDERGROUND WATER CONSERVATION DISTRICT FROM WHICH THE INFORMATION IN TABLE 2 WAS EXTRACTED (THE AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).

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

Management Plan requirement	*Aquifer or confining unit*	*Results*
Estimated annual amount of recharge from precipitation to the district	Dockum Aquifer	105
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Dockum Aquifer	0
Estimated annual volume of flow into the district within each aquifer in the district	Dockum Aquifer	37
Estimated annual volume of flow out of the district within each aquifer in the district	Dockum Aquifer	27
Estimated net annual volume of flow between each aquifer in the district	From Dockum Aquifer to younger overlying units	116

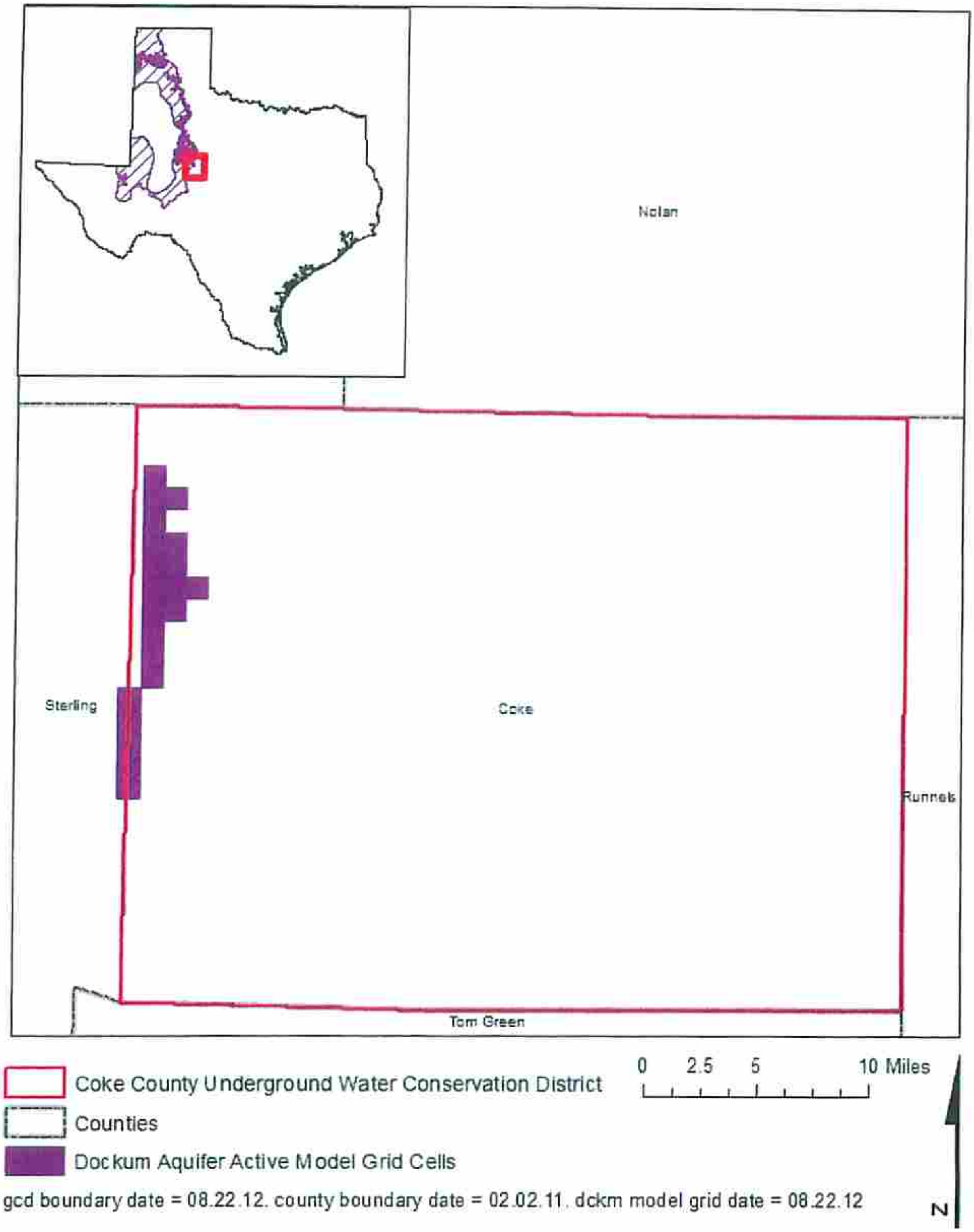

FIGURE 3: AREA OF ACTIVE MODEL CELLS FOR THE DOCKUM AQUIFER IN COKE COUNTY UNDERGROUND WATER CONSERVATION DISTRICT FROM WHICH THE INFORMATION IN TABLE 3 WAS EXTRACTED (THE AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).

LIMITATIONS:

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

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

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

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

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

REFERENCES:

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APPENDIX C

GAM RUN 10-043

MAG (Version 2)

GAM RUN 10-043 MAG (VERSION 2): MODELED AVAILABLE GROUNDWATER FOR THE EDWARDS-TRINITY (PLATEAU), TRINITY, AND PECOS VALLEY AQUIFERS IN GROUNDWATER MANAGEMENT AREA 7

by Jerry Shi, Ph.D., P.G.
Texas Water Development Board
Groundwater Resources Division
Groundwater Availability Modeling Section
(512) 463-5076
November 12, 2012

The seal appearing on this document was authorized by Jianyou (Jerry) Shi, P.G. 11113 on November 12, 2012.

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GAM RUN 10-043 MAG (VERSION 2): MODELED AVAILABLE GROUNDWATER FOR THE EDWARDS-TRINITY (PLATEAU), TRINITY, AND PECOS VALLEY AQUIFERS IN GROUNDWATER MANAGEMENT AREA 7

by Jerry Shi, Ph.D., P.G.
Texas Water Development Board
Groundwater Resources Division
Groundwater Availability Modeling Section
(512) 463-5076
November 12, 2012

EXECUTIVE SUMMARY:

The modeled available groundwater values for Groundwater Management Area 7 for the Edwards-Trinity (Plateau), Trinity, and Pecos Valley aquifers are summarized in Table 1. These values are also listed by county (Table 2), river basin (Table 3), and regional water planning area (Table 3). The modeled available groundwater values for the relevant aquifers in Groundwater Management Area 7 were initially based on Scenario 10 of GAM Run 09-035. In GAM Run 09-035, the Edwards-Trinity (Plateau), Trinity, and Pecos Valley aquifers were simulated and reported together. Though the desired future condition statement, specifying an average drawdown of 7 feet, only explicitly references the Edwards-Trinity (Plateau) Aquifer, it is the intent of the districts to also incorporate the Trinity and Pecos Valley aquifers. This was confirmed by Ms. Caroline Runge of Menard Underground Water District acting on behalf of Groundwater Management Area 7 in an e-mail to Ms. Sarah Backhouse at the Texas Water Development Board on June 6, 2012. The results here, therefore, contain information for each of these three aquifers. The modeled available groundwater from the Edwards-Trinity (Plateau), Trinity, and Pecos Valley aquifers in Groundwater Management Area 7 that achieves the requested desired future conditions is approximately 449,400 acre-feet per year from 2010 to 2060.

Earlier draft versions of this report showed modeled available groundwater for portions of the Edwards-Trinity (Plateau) Aquifer within the Lipan-Kickapoo Water Conservation District, the Lone Wolf Groundwater Conservation District, the Hickory Underground Water Conservation District No. 1, and the portion of the Trinity Aquifer within the Uvalde Underground Water Conservation District. However, Groundwater Management Area 7 declared those counties "not relevant" for joint planning purposes. Since modeled available groundwater only applies to areas with a specified desired future condition, we updated this report to depict modeled available groundwater only in counties with specified desired future conditions.

The modeled available groundwater for Kinney County Groundwater Conservation District previously reported in Draft GAM Run 10-043 MAG (Shi and Oliver, 2011) dated January 26, 2011, has been updated in a new model run and is presented in this report. The new model run is an update of Scenario 3 of Groundwater Availability Modeling Task 10-027, which meets the desired future conditions for the area adopted by the districts of Groundwater Management Area 7.

REQUESTOR:

Mr. Allan Lange of Lipan-Kickapoo Water Conservation District on behalf of Groundwater Management Area 7.

DESCRIPTION OF REQUEST:

In a letter dated August 13, 2010, Mr. Lange provided the Texas Water Development Board (TWDB) with the desired future conditions of the Edwards-Trinity (Plateau) Aquifer in Groundwater Management Area 7. On June 6, 2012 TWDB clarified through e-mail with Ms. Caroline Runge of Menard Underground Water District acting on behalf of Groundwater Management Area 7 that the intent of the districts within Groundwater Management Area 7 was to also incorporate the Trinity and Pecos Valley aquifers, except where explicitly stated as non-relevant in the desired future conditions of the Edwards-Trinity (Plateau) Aquifer. The desired future conditions for the aquifer[s], as described in Resolution # 07-29-10-9 and adopted July 29, 2010 by the groundwater conservation districts within Groundwater Management Area 7, are described below:

1) An average drawdown of 7 feet for the Edwards-Trinity (Plateau)[, Pecos Valley, and Trinity] aquifer[s], except for the Kinney County [Groundwater Conservation District], based on Scenario 10 of the TWDB [Groundwater Availability Model] run 09-35 which is incorporated in its entirety into this resolution; and

2) In Kinney County, that drawdown which is consistent with maintaining, at Las Moras Springs, an annual average flow of 23.9 [cubic feet per second] and a median flow of 24.4 [cubic feet per second] based on Scenario 3 of the Texas Water Development Board's flow model presented on July 27, 2010; and

3) the Edwards-Trinity [Aquifer] is not relevant for joint planning purposes within the boundaries of the Lipan-Kickapoo [Water Conservation District], the Lone Wolf [Groundwater Conservation District], and the Hickory Underground Water Conservation District No. 1; and

4) the Trinity (Hill Country) portion of the aquifer is not relevant for joint planning purposes within the boundaries of the Uvalde [Underground Water Conservation District] in [Groundwater Management Area] 7.

METHODS, PARAMETERS AND ASSUMPTIONS:

The desired future condition for Kinney County was evaluated in a new model run (Shi and others, 2012). The new model run is an update of Scenario 3 of Groundwater Availability Modeling (GAM) Task 10-027 (Hutchison, 2010a). Both model runs were based on the MODFLOW-2000 model developed by the TWDB to assist with the joint planning process regarding the Kinney County Groundwater Conservation District (Hutchison and others, 2011b). In both model runs, the total pumping in Kinney County, which lies within Groundwater Management Areas 7 and 10, was maintained at approximately 77,000 acre-feet per year to achieve the desired future conditions at Las Moras Springs. Details regarding this new model run are summarized in Shi and others (2012).

The desired future condition for the remaining areas in Groundwater Management Area 7 was based on Scenario 10 of GAM Run 09-035 using a MODFLOW-2000 model developed by the TWDB (Hutchison and others, 2011a). Details regarding this scenario can be found in Hutchison (2010b). In GAM Run 09-035, the Edwards-Trinity (Plateau), Trinity, Pecos Valley, and Trinity aquifers were simulated and reported together. The desired future condition statement specifying of an average drawdown of 7 feet, which is achieved in the above simulation, only explicitly references the Edwards-Trinity (Plateau) Aquifer. By stating that the above simulation is "incorporated in its entirety" into the resolution, it is the intent of the districts to also incorporate the Trinity and Pecos Valley aquifers. The results below, therefore, contain information on the Trinity and Pecos Valley aquifers in addition to the Edwards-Trinity (Plateau) Aquifer. This interpretation has been confirmed by Ms. Caroline Runge on behalf of Groundwater Management Area 7 to Ms. Sarah Backhouse at the Texas Water Development Board.

The locations of the Edwards-Trinity (Plateau), Trinity, and Pecos Valley aquifers are shown in Figure 1.

RESULTS:

The modeled available groundwater values from aquifers in Groundwater Management Area 7 that achieve the desired future conditions is approximately 445,000 acre-feet per year for the Edwards-Trinity (Plateau) aquifer, 2,500 acre-feet per year for the Trinity Aquifer, and 1,600 acre-feet per year for the Pecos Valley Aquifer (Tables 1, 2, and 3). These tables contain the modeled available groundwater for the aquifers subdivided by county, regional water planning area, and river basin for use in the regional water planning process. These areas are shown in Figure 2.

Tables 4, 5, and 6 show the modeled available groundwater for the Edwards-Trinity (Plateau), Trinity, and Pecos Valley aquifers summarized by county, regional water planning area, and river basin, respectively, within Groundwater Management Area 7.

The modeled available groundwater for the aquifers within and outside the groundwater conservation districts in Groundwater Management Area 7 where they were determined to be relevant for the purposes of joint planning are presented in Table 7. As shown in Table 7, the modeled available groundwater within the groundwater conservation districts in Groundwater Management Area 7 is approximately 370,000 acre-feet per year from 2010 to 2060.

LIMITATIONS:

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

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

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

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

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

REFERENCES:

Hutchison, William R., 2010a, GAM Task 10-027: Texas Water Development Board, GAM Task 10-027 Report, 7 p.

Hutchison, William R., 2010b, GAM Run 09-035 (version 2): Texas Water Development Board, GAM Run 09-035 Report, 10 p.

Hutchison, William R., Jones, Ian, and Anaya, Roberto, 2011a, Update of the Groundwater Availability Model for the Edwards-Trinity (Plateau) and Pecos Valley Aquifers of Texas, Texas Water Development Board, 59 p.

Hutchison, William R., Shi, Jerry, and Jigmond, Marius, 2011b, Groundwater Flow Model of the Kinney County Area, Texas Water Development Board, 138 p.

Shi, Jerry, Ridgeway, Cindy, and French, Larry, 2012, Draft GAM Task Report 12-002: Modeled Available Groundwater in Kinney County (April 11, 2012).

Shi, Jerry and Oliver, Wade, 2011, GAM Run 10-043 MAG (January 26, 2011).

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

TABLE 1. MODELED AVAILABLE GROUNDWATER FOR THE EDWARDS-TRINITY (PLATEAU) AQUIFER IN GROUNDWATER MANAGEMENT AREA 7. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE DIVIDED BY COUNTY, REGIONAL WATER PLANNING AREA, AND RIVER BASIN.

County	Regional Water Planning Area	River Basin	Year					
			2010	2020	2030	2040	2050	2060
Coke	F	Colorado	998	998	998	998	998	998
Crockett	F	Colorado	19	19	19	19	19	19
		Rio Grande	5,407	5,407	5,407	5,407	5,407	5,407
Ector	F	Colorado	4,918	4,918	4,918	4,918	4,918	4,918
		Rio Grande	504	504	504	504	504	504
Edwards	J	Colorado	2,306	2,306	2,306	2,306	2,306	2,306
		Nueces	1,632	1,632	1,632	1,632	1,632	1,632
		Rio Grande	1,700	1,700	1,700	1,700	1,700	1,700
Gillespie	K	Colorado	2,378	2,378	2,378	2,378	2,378	2,378
		Guadalupe	136	136	136	136	136	136
Glasscock	F	Colorado	65,213	65,213	65,213	65,213	65,213	65,213
Irion	F	Colorado	2,293	2,293	2,293	2,293	2,293	2,293
Kimble	F	Colorado	1,283	1,283	1,283	1,283	1,283	1,283
Kinney	J	Nueces	12	12	12	12	12	12
		Rio Grande	70,326	70,326	70,326	70,326	70,326	70,326
McCulloch	F	Colorado	4	4	4	4	4	4
Menard	F	Colorado	2,194	2,194	2,194	2,194	2,194	2,194
Midland	F	Colorado	23,251	23,251	23,251	23,251	23,251	23,251
Nolan	G	Brazos	302	302	302	302	302	302
		Colorado	391	391	391	391	391	391
Pecos	F	Rio Grande	115,938	115,938	115,938	115,938	115,938	115,938
Reagan	F	Colorado	68,250	68,250	68,250	68,250	68,250	68,250
		Rio Grande	28	28	28	28	28	28
Real	J	Colorado	278	278	278	278	278	278
		Guadalupe	3	3	3	3	3	3
		Nueces	7,196	7,196	7,196	7,196	7,196	7,196
Schleicher	F	Colorado	6,410	6,410	6,410	6,410	6,410	6,410
		Rio Grande	1,640	1,640	1,640	1,640	1,640	1,640
Sterling	F	Colorado	2,497	2,497	2,497	2,497	2,497	2,497
Sutton	F	Colorado	386	386	386	386	386	386
		Rio Grande	6,052	6,052	6,052	6,052	6,052	6,052

TABLE 1. MODELED AVAILABLE GROUNDWATER FOR THE EDWARDS-TRINITY (PLATEAU) AQUIFER IN GROUNDWATER MANAGEMENT AREA 7. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE DIVIDED BY COUNTY, REGIONAL WATER PLANNING AREA, AND RIVER BASIN.

County	Regional Water Planning Area	River Basin	Year					
			2010	2020	2030	2040	2050	2060
Taylor	G	Brazos	331	331	331	331	331	331
		Colorado	158	158	158	158	158	158
Terrell	E	Rio Grande	1,421	1,421	1,421	1,421	1,421	1,421
Tom Green	F	Colorado	426	426	426	426	426	426
Upton	F	Colorado	21,257	21,257	21,257	21,257	21,257	21,257
		Rio Grande	1,122	1,122	1,122	1,122	1,122	1,122
Uvalde	L	Nueces	1,635	1,635	1,635	1,635	1,635	1,635
Val Verde	J	Rio Grande	24,988	24,988	24,988	24,988	24,988	24,988
Grand Total			**445,283**	**445,283**	**445,283**	**445,283**	**445,283**	**445,283**

TABLE 2. MODELED AVAILABLE GROUNDWATER FOR THE TRINITY AQUIFER IN GROUNDWATER MANAGEMENT AREA 7. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE DIVIDED BY COUNTY, REGIONAL WATER PLANNING AREA, AND RIVER BASIN.

County	Regional Water Planning Area	River Basin	Year					
			2010	2020	2030	2040	2050	2060
Gillespie	K	Colorado	2,482	2,482	2,482	2,482	2,482	2,482
Real	J	Nueces	52	52	52	52	52	52
Total			**2,534**	**2,534**	**2,534**	**2,534**	**2,534**	**2,534**

TABLE 3. MODELED AVAILABLE GROUNDWATER FOR THE PECOS VALLEY AQUIFER IN GROUNDWATER MANAGEMENT AREA 7. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE DIVIDED BY COUNTY, REGIONAL WATER PLANNING AREA, AND RIVER BASIN.

County	Regional Water Planning Area	River Basin	Year					
			2010	2020	2030	2040	2050	2060
Crockett	F	Rio Grande	31	31	31	31	31	31
Ector	F	Rio Grande	113	113	113	113	113	113
Pecos	F	Rio Grande	1,448	1,448	1,448	1,448	1,448	1,448
Upton	F	Rio Grande	2	2	2	2	2	2
Total			**1,594**	**1,594**	**1,594**	**1,594**	**1,594**	**1,594**

TABLE 4. MODELED AVAILABLE GROUNDWATER FOR THE EDWARDS-TRINITY (PLATEAU), TRINITY, AND PECOS VALLEY AQUIFERS IN GROUNDWATER MANAGEMENT AREA 7 BY COUNTY FOR EACH DECADE BETWEEN 2010 AND 2060. RESULTS ARE IN ACRE-FEET PER YEAR.

County	2010	2020	2030	2040	2050	2060
Coke	998	998	998	998	998	998
Crockett	5,457	5,457	5,457	5,457	5,457	5,457
Ector	5,535	5,535	5,535	5,535	5,535	5,535
Edwards	5,638	5,638	5,638	5,638	5,638	5,638
Gillespie	4,996	4,996	4,996	4,996	4,996	4,996
Glasscock	65,213	65,213	65,213	65,213	65,213	65,213
Irion	2,293	2,293	2,293	2,293	2,293	2,293
Kimble	1,283	1,283	1,283	1,283	1,283	1,283
Kinney	70,338	70,338	70,338	70,338	70,338	70,338
Mcculloch	4	4	4	4	4	4
Menard	2,194	2,194	2,194	2,194	2,194	2,194
Midland	23,251	23,251	23,251	23,251	23,251	23,251
Nolan	693	693	693	693	693	693
Pecos	117,386	117,386	117,386	117,386	117,386	117,386
Reagan	68,278	68,278	68,278	68,278	68,278	68,278
Real	7,529	7,529	7,529	7,529	7,529	7,529
Schleicher	8,050	8,050	8,050	8,050	8,050	8,050
Sterling	2,497	2,497	2,497	2,497	2,497	2,497
Sutton	6,438	6,438	6,438	6,438	6,438	6,438

TABLE 4. MODELED AVAILABLE GROUNDWATER FOR THE EDWARDS-TRINITY (PLATEAU), TRINITY, AND PECOS VALLEY AQUIFERS IN GROUNDWATER MANAGEMENT AREA 7 BY COUNTY FOR EACH DECADE BETWEEN 2010 AND 2060. RESULTS ARE IN ACRE-FEET PER YEAR.

County	2010	2020	2030	2040	2050	2060
Taylor	489	489	489	489	489	489
Terrell	1,421	1,421	1,421	1,421	1,421	1,421
Tom Green	426	426	426	426	426	426
Upton	22,381	22,381	22,381	22,381	22,381	22,381
Uvalde	1,635	1,635	1,635	1,635	1,635	1,635
Val Verde	24,988	24,988	24,988	24,988	24,988	24,988
Total	**449,411**	**449,411**	**449,411**	**449,411**	**449,411**	**449,411**

TABLE 5. MODELED AVAILABLE GROUNDWATER FOR THE EDWARDS-TRINITY (PLATEAU), TRINITY, AND PECOS VALLEY AQUIFERS IN GROUNDWATER MANAGEMENT AREA 7 BY REGIONAL WATER PLANNING AREA FOR EACH DECADE BETWEEN 2010 AND 2060. RESULTS ARE IN ACRE-FEET PER YEAR.

Regional Water Planning Area	Year					
	2010	2020	2030	2040	2050	2060
E	1,421	1,421	1,421	1,421	1,421	1,421
F	331,684	331,684	331,684	331,684	331,684	331,684
G	1,182	1,182	1,182	1,182	1,182	1,182
J	108,493	108,493	108,493	108,493	108,493	108,493
K	4,996	4,996	4,996	4,996	4,996	4,996
L	1,635	1,635	1,635	1,635	1,635	1,635
Total	**449,411**	**449,411**	**449,411**	**449,411**	**449,411**	**449,411**

TABLE 6. MODELED AVAILABLE GROUNDWATER FOR THE EDWARDS-TRINITY (PLATEAU), TRINITY, AND PECOS VALLEY AQUIFERS IN GROUNDWATER MANAGEMENT AREA 7 BY RIVER BASIN FOR EACH DECADE BETWEEN 2010 AND 2060. RESULTS ARE IN ACRE-FEET PER YEAR.

River Basin	Year					
	2010	2020	2030	2040	2050	2060
Brazos	633	633	633	633	633	633
Colorado	207,392	207,392	207,392	207,392	207,392	207,392
Guadalupe	139	139	139	139	139	139
Nueces	10,527	10,527	10,527	10,527	10,527	10,527
Rio Grande	230,720	230,720	230,720	230,720	230,720	230,720
Total	**449,411**	**449,411**	**449,411**	**449,411**	**449,411**	**449,411**

TABLE 7. MODELED AVAILABLE GROUNDWATER FOR THE EDWARDS-TRINITY (PLATEAU), TRINITY, AND PECOS VALLEY AQUIFERS IN GROUNDWATER MANAGEMENT AREA 7 BY GROUNDWATER CONSERVATION DISTRICT FOR EACH DECADE BETWEEN 2010 AND 2060. RESULTS ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District	Year					
	2010	2020	2030	2040	2050	2060
Coke County UWCD	998	998	998	998	998	998
Crockett County GCD	4,685	4,685	4,685	4,685	4,685	4,685
Glasscock GCD	106,075	106,075	106,075	106,075	106,075	106,075
Hill Country UWCD	4,996	4,996	4,996	4,996	4,996	4,996
Irion County WCD	2,435	2,435	2,435	2,435	2,435	2,435
Kimble County GCD	1,283	1,283	1,283	1,283	1,283	1,283
Kinney County GCD	70,338	70,338	70,338	70,338	70,338	70,338
Menard County UWD	2,194	2,194	2,194	2,194	2,194	2,194
Middle Pecos GCD	117,386	117,386	117,386	117,386	117,386	117,386
Plateau UWC and SD	8,050	8,050	8,050	8,050	8,050	8,050
Real-Edwards CRD	13,167	13,167	13,167	13,167	13,167	13,167
Santa Rita UWCD	27,416	27,416	27,416	27,416	27,416	27,416
Sterling County UWCD	2,497	2,497	2,497	2,497	2,497	2,497
Sutton County UWCD	6,438	6,438	6,438	6,438	6,438	6,438
Uvalde County UWCD (Edwards-Trinity Plateau)	1,635	1,635	1,635	1,635	1,635	1,635
Wes-Tex GCD	693	693	693	693	693	693

TABLE 7. MODELED AVAILABLE GROUNDWATER FOR THE EDWARDS-TRINITY (PLATEAU), TRINITY, AND PECOS VALLEY AQUIFERS IN GROUNDWATER MANAGEMENT AREA 7 BY GROUNDWATER CONSERVATION DISTRICT FOR EACH DECADE BETWEEN 2010 AND 2060. RESULTS ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District	Year					
	2010	2020	2030	2040	2050	2060
Total (areas in districts relevant for joint planning)	**370,286**	**370,286**	**370,286**	**370,286**	**370,286**	**370,286**
No District	79,125	79,125	79,125	79,125	79,125	79,125
Total (all areas)	**449,411**	**449,411**	**449,411**	**449,411**	**449,411**	**449,411**

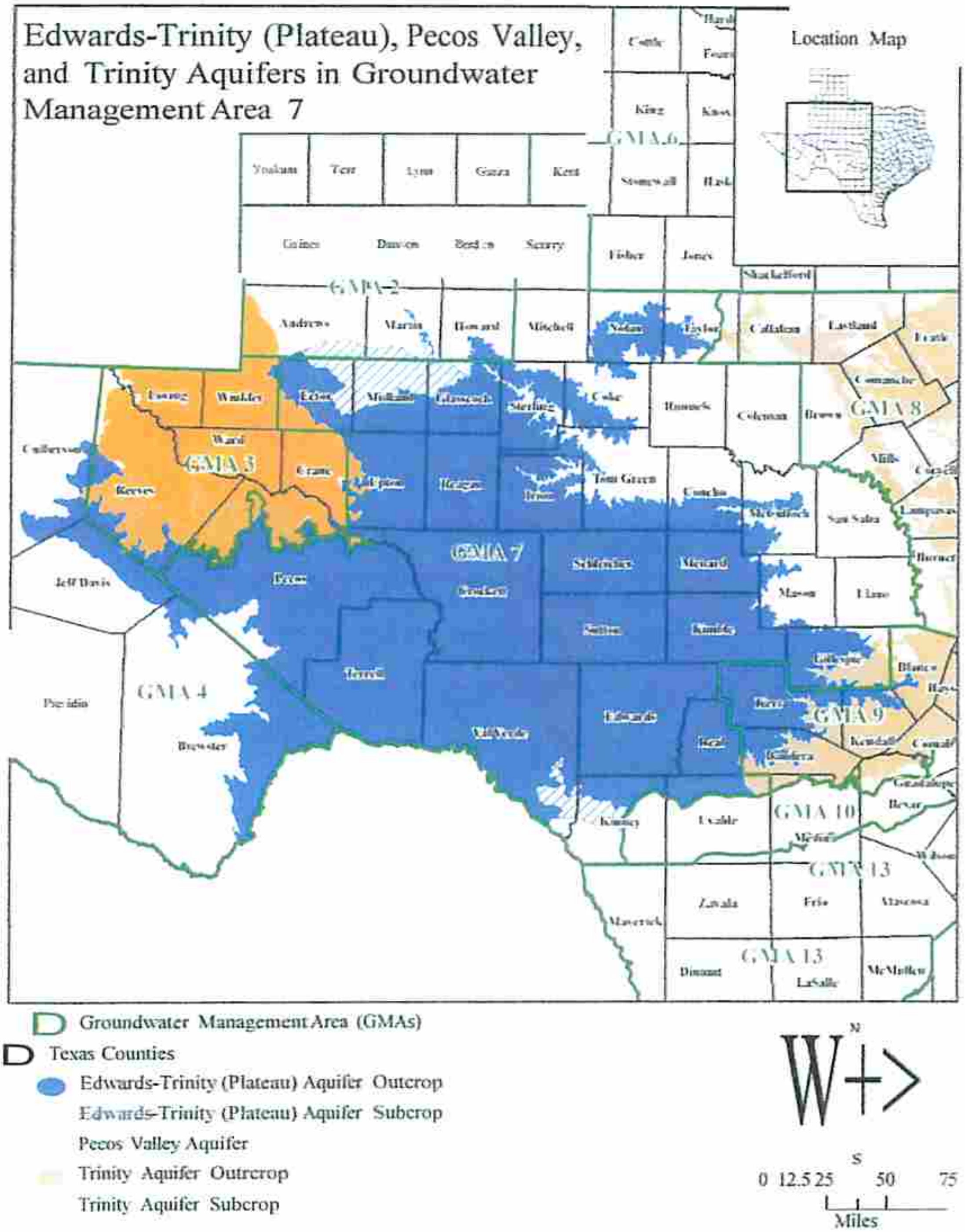


FIGURE 1. MAP SHOWING THE BOUNDARY OF THE EDWARDS-TRINITY (PLATEAU), PECOS VALLEY, AND TRINITY AQUIFERS ACCORDING TO THE 2007 STATE WATER PLAN (TWDB, 2007).

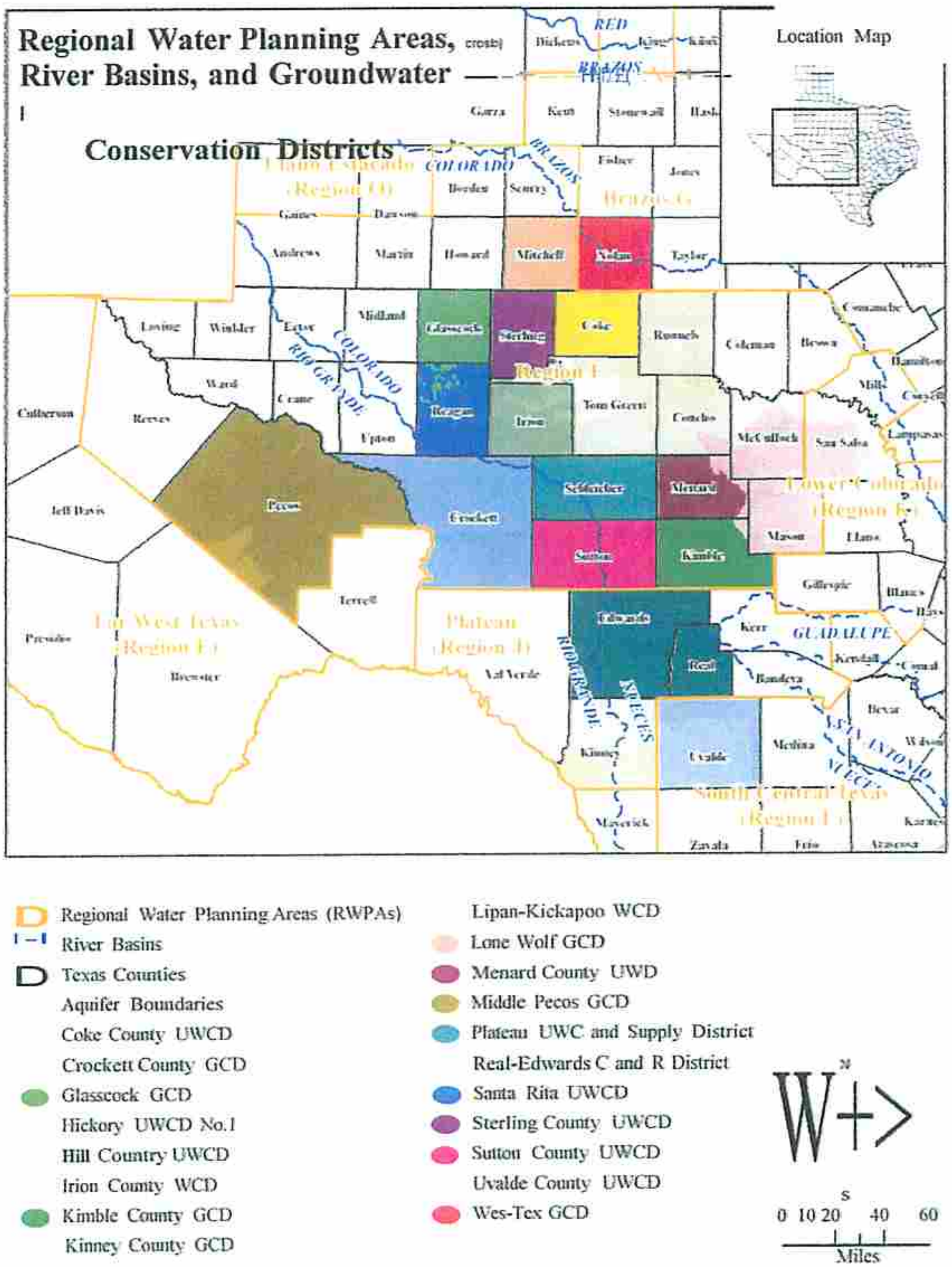


FIGURE 2. MAP SHOWING REGIONAL WATER PLANNING AREAS, GROUNDWATER CONSERVATION DISTRICTS, COUNTIES, AND RIVER BASINS IN AND NEIGHBORING GROUNDWATER MANAGEMENT AREA 7.

APPENDIX D

RESOLUTION #07-29-10-9

Desired Future Conditions

STATE OF TEXAS §
§ RESOLUTION # 07-29-10-9
GROUNDWATER §
MANAGEMENT AREA 7 §

Designation of Desired Future Conditions For the Edwards-Trinity (Plateau) Aquifer in Groundwater Management Area 7

WHEREAS, Groundwater Conservation Districts (GCDs) located within or partially within Groundwater Management Area 7 (GMA 7) are required under Chapter 36.108, Texas Water Code to conduct joint planning and designate the Desired Future Conditions of all relevant aquifers within GMA 7 for the next fifty year horizon, no later than September 1, 2010; and

WHEREAS, the Board Presidents or their Designated Representatives of GCDs in GMA 7 have held public meetings noticed and posted in accordance with state law and have reviewed and discussed groundwater availability model (GAM) runs and/or Aquifer Assessments or other technical advice with input and comment from stakeholders within GMA7; and

WHEREAS, the GMA 7 designated representatives have received and considered GAM Runs 07-03, 07-32, 07-37, and 09-35, Aquifer Assessments # 08-05 and # 08-06, and/or other technical advice, hereby designate the following Desired Future Conditions for the Edwards-Trinity (Plateau) Aquifer located within GMA 7 through the year 2060:

1) An average drawdown of 7 feet for the Edwards-Trinity (Plateau) aquifer, except for the Kinney County GCD, based on Scenario 10 of the TWDB GAM run 09-35 which is incorporated in its entirety into this resolution; and

2) In Kinney County, that drawdown which is consistent with maintaining, at Los Moras Springs, an annual average flow of 23.9 cfs and a median flow of 24.4 cfs based on Scenario 3 of the Texas Water Development Board's flow model presented on July 27, 2010; and

3) the Edwards-Trinity aquifer is not relevant for joint planning purposes within the boundaries of the Lipan-Kickapoo WCD, the Lone Wolf GCD, and the Hickory Underground Water Conservation District No. 1; and

4) the Trinity (Hill Country) portion of the aquifer is not relevant for joint planning purposes within the boundaries of the Uvalde County UWCD in GMA 7.

NOW, THEREFORE BE IT RESOLVED, that the members of Groundwater Management Area 7 do hereby adopt the above described designation of the Desired Future Conditions for the Edwards-Trinity (Plateau) Aquifer;

AND IT IS SO ORDERED AND PASSED THIS 29th DAY OF JULY, 2010.

Ayes:

DESIGNATED REPRESENTATIVE - COKE COUNTY UWCD

DESIGNATED REPRESENTATIVE - CROCKETT COUNTY GCD

DESIGNATED REPRESENTATIVE - EDWARDS AQUIFER AUTHORITY

DESIGNATED REPRESENTATIVE - GLASSCOCK GCD

DESIGNATED REPRESENTATIVE - HICKORY UWCD #1

DESIGNATED REPRESENTATIVE - HILL COUNTRY UWCD

DESIGNATED REPRESENTATIVE - IRION COUNTY WCD

DESIGNATED REPRESENTATIVE - KIMBLE COUNTY GCD

DESIGNATED REPRESENTATIVE - KINNEY COUNTY GCD

DESIGNATED REPRESENTATIVE - LIPAN-KICKAPOO WCD

DESIGNATED REPRESENTATIVE - LONE WOLF GCD

DESIGNATED REPRESENTATIVE - MENARD COUNTY UWD

DESIGNATED REPRESENTATIVE - MIDDLE PECOS GCD

DESIGNATED REPRESENTATIVE - PLATEAU UWC & SD

DESIGNATED REPRESENTATIVE - REAL- EDWARDS CON & REC DIST

DESIGNATED REPRESENTATIVE - SANTA RITA UWCD

DESIGNATED REPRESENTATIVE - STERLING COUNTY UWCD

DESIGNATED REPRESENTATIVE - SUTTON COUNTY UWCD

DESIGNATED REPRESENTATIVE - UVALDE COUNTY WCD

DESIGNATED REPRESENTATIVE - WES-TEX GCD

Nays:

DESIGNATED REPRESENTATIVE -

DESIGNATED REPRESENTATIVE -

Abstaining:

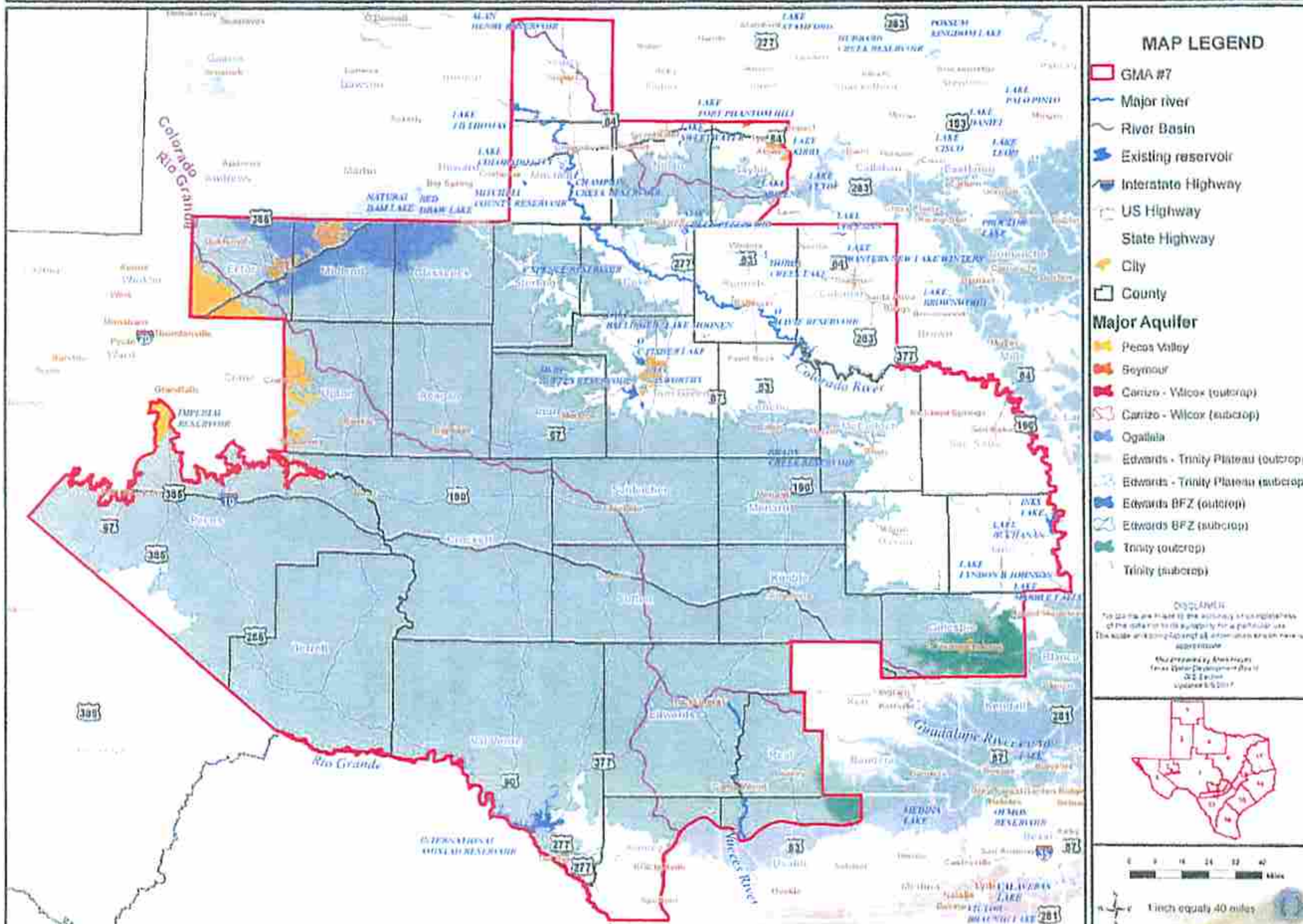
DESIGNATED REPRESENTATIVE -

DESIGNATED REPRESENTATIVE -

APPENDIX E

GMA 7

Groundwater Management Area #7



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GAM Run 07-37

by **Kan Tu, Ph.D., P.G.**
Texas Water Development Board
Groundwater Availability Modeling Section
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April 9, 2008

EXECUTIVE SUMMARY:

We ran the groundwater availability model for the Edwards-Trinity (Plateau) Aquifer for a 71-year simulation, which consisted of 20 years (1980-1999) of historic conditions followed by a 51-year (2000-2050) predictive time period. Average recharge conditions were used for the entire 51 years of the predictive portion of the simulation. The pumpage used in this simulation was based on the groundwater availability estimates from the 2007 State Water Plan and baseline pumpage discussed in GAM Run 07-03 (Donnelly, 2007).

Results of this model run indicate that water-level declines after 51 years range from 50 feet to 100 feet for most counties in the model area. This mainly resulted from the increase in pumpage from the baseline pumpage that was approved by the Groundwater Management Area 7 and used in the previous GAM Run 07-03 (Donnelly, 2007). Extreme drawdowns (up to 600 feet) in Pecos, Glasscock, and Reagan counties in the Trinity part of the Edwards-Trinity (Plateau) Aquifer were predicted by the model at the end of 51 years, but research into the model performance during the calibration time period indicates that the model is not appropriately simulating the response of the Trinity Aquifer to pumpage in these areas (Donnelly, 2007). It is recommended that this model not be used to evaluate groundwater conditions in Pecos, Glasscock, and Reagan counties.

REQUESTOR:

Ms. Caroline Runge from the Menard County Underground Water Conservation District (on behalf of Groundwater Management Area 7).

DESCRIPTION OF REQUEST:

Ms. Runge asked for a new model run using the groundwater availability model for the Edwards-Trinity (Plateau) Aquifer. This model run would be a 71-year simulation, with the first 20 years being the historic portion of the simulation followed by a 51-year predictive period. Average recharge conditions were used for the predictive portion of the simulation. Each year of the predictive portion of the simulation would use a specified pumpage based on groundwater availability estimates from the 2007 State Water Plan and pumpage approved by members of Groundwater Management Area 7.

METHODS:

Recharge and initial streamflow were averaged for the 1961 to 1990 time period. These averages were then used in the 51-year predictive portion of the model simulation along with adjustments to the baseline pumpage to reflect availability estimates from the 2007 State Water Plan. Resulting water levels and drawdowns using 1999 water levels as a baseline were then evaluated and are described in the Results section below.

PARAMETERS AND ASSUMPTIONS:

The groundwater availability model for the Edwards-Trinity (Plateau) Aquifer was used for this model run. The parameters and assumptions for this model are described below:

- We used version 1.01 of the groundwater availability model of the Edwards-Trinity (Plateau) Aquifer, which includes the Pecos Valley Aquifer (formerly known as the Cenozoic Pecos Alluvium Aquifer). See Anaya and Jones (2004) for assumptions and limitations of the model.

- The root mean squared error (a measure of the difference between simulated and actual water levels during model calibration) in the entire Edwards-Trinity (Plateau) and Pecos Valley (formerly the Cenozoic Pecos Alluvium) groundwater availability model for the period of 1990 to 2000 is 143 feet, or six percent of the range of measured water levels (Anaya and Jones, 2004).

- The model includes two layers, representing the Edwards and associated limestones (Layer 1) and undifferentiated Trinity units (Layer 2). The Pecos Valley Aquifer is included in Layer 1 of the model.

- The model run was 71 years in length. The first 20 years were the historic calibration-verification portion of the simulation, followed by a 51-year predictive period.

- The groundwater availability model simulates discharge to springs and seeps mostly along the northern and eastern margins of the aquifer. Spring and seep parameters used in the model are from the calibrated model.

- Recharge was distributed in the groundwater availability model based on a percent of annual precipitation and aquifer outcrop (surface geology).

- The groundwater availability model simulates the interaction between the aquifer(s) and major streams and rivers flowing in the region. Flow both from the stream to the aquifer and from the aquifer to the stream is allowed, and the direction of flow is determined by the water levels in the aquifer and the surface water elevation of the stream during each stress period in the simulation. The stream parameters, including streambed conductance and initial flow values, used in the model are from the calibrated model.

- The groundwater availability model uses general head boundary cells to simulate cross-formational groundwater flow between the Edwards-Trinity (Plateau) and adjacent aquifers, including the Ogallala, Dockum, Edwards (Balcones Fault Zone), and Llano Uplift area aquifers. Parameters assigned to the general head boundary cells such as aquifer conductance and water levels were from the calibrated model.

- We used Groundwater Vistas Version 5 as the interface to process model output.

Specified Pumpage

The pumpage for this model run considered the individual county groundwater availability estimates from the 2007 State Water Plan. The baseline pumpage approved by the Groundwater Management Area 7 and used in GAM Run 07-03 (Donnelly, 2007) was used as the basis for generating the new pumpage data set. The following modifications were made to the GAM Run 07-03 (Donnelly, 2007) baseline pumpage to create the specified pumpage used in this simulation.

- The baseline pumpage totals were increased in most counties in the model area. The total amount of pumpage used in each county in this simulation is shown in Tables 1 and 2. For each county, the higher pumpage of either the 2007 State Water Plan or the GAM Run 07-03 (Donnelly, 2007) baseline pumpage was determined for this specified pumpage. In addition, Groundwater Management Area 7 requested that 59,234 acre-feet per year of pumpage be used for Kinney County.

- For all counties listed in Table 1 the specified pumpage maintains the existing model spatial pumping distribution used in the baseline simulation discussed in GAM Run 07-03 (Donnelly, 2007). When the groundwater availability per aquifer and county from the 2007 State Water Plan value exceeded the baseline pumpage from GAM Run 07-03, then this additional amount of pumpage was evenly distributed among all cells that had pumpage in baseline GAM Run 07-03 (Donnelly, 2007) on a county-by-county and aquifer basis. This information is presented under the column 'Added Pumpage to Each Cell' in Table 1

- Pumpage was distributed in a slightly different manner in Crockett, Irion, Kimble, Kinney, Schleicher, Sutton, and Val Verde counties (Table 2). The additional Edwards-Trinity (Plateau) Aquifer pumpage was allocated proportionally to both model layer 1 and 2 based on the existing baseline pumpage distributions. For model layer 1 (the Edwards layer in the area of interest), the additional pumpage was evenly distributed among all cells that had existing pumpage in the GAM Run 07-03 (Donnelly, 2007) baseline run. However, for model layer 2 (the Trinity layer), the additional pumpage was assigned evenly across all active cells per county.

Table 1. The specified pumpage used in this model simulation in comparison with both GAM Run 07-03 (Donnelly, 2007) baseline pumpage and the groundwater availability numbers from the 2007 State Water Plan. All pumpage numbers are reported in acre-feet per year

County	Aquifer	GAM Run 07-03 baseline pumpage	2007 State Water Plan availability	Specified pumpage used in this run	Addition to baseline pumpage	Total number of well cells	Added pumpage to each cell
Andrews	Pecos Valley Aquifer	60	1,189	1,189	1,129	267	4
Andrews	Edwards-Trinity (Plateau) Aquifer	8	4,640	4,640	4,632	163	28
Andrews	Total	68	5,829	5,829	5,761	430	
Bandera	Edwards-Trinity (Plateau) Aquifer	327	17,310	17,310	16,983	242	70
Bandera	Trinity Aquifer	2,004	18,558	18,558	16,554	574	29
Bandera	Total	2,331	35,868	35,868	33,537	816	
Bexar	Trinity Aquifer	2,399	1,175	2,399	0	245	0
Blanco	Edwards-Trinity (Plateau) Aquifer	17	157	157	140	17	8
Blanco	Trinity Aquifer	727	1,600	1,600	873	535	2
Blanco	Total	744	1,757	1,757	1,013	552	
Brewster	Edwards-Trinity (Plateau) Aquifer	673	300	673	0	976	0
Burnet	Trinity Aquifer	114	2,550	2,550	2,436	23	106
Coke	Edwards-Trinity (Plateau) Aquifer	21	3,242	3,242	3,221	244	13
Comal	Trinity Aquifer	3,059	1,800	3,059	0	343	0
Concho	Edwards-Trinity (Plateau) Aquifer	277	12,278	12,278	12,001	348	34
Crane	Pecos Valley Aquifer	549	2,537	2,537	1,988	561	4
Crane	Edwards-Trinity (Plateau) Aquifer	8	115	115	107	21	5
Crane	Total	557	2,652	2,652	2,095	582	
Culberson	Edwards-Trinity (Plateau) Aquifer	37	55	55	18	142	0
Ector	Pecos Valley Aquifer	48	3,143	3,143	3,095	101	31
Ector	Edwards-Trinity (Plateau) Aquifer	5,489	11,324	11,324	5,835	666	9
Ector	Total	5,538	14,467	14,467	8,929	767	
Edwards	Edwards-Trinity (Plateau) Aquifer	7,794	8,699	8,699	905	2,239	0
Gillespie	Edwards-Trinity (Plateau) Aquifer	1,494	1,500	1,500	6	611	0
Gillespie	Trinity Aquifer	2,476	3,400	3,400	924	366	3
Gillespie	Total	3,970	4,900	4,900	930	977	

County	Aquifer	GAM Run 07-03 baseline pumpage	2007 State Water Plan availability	Specified pumpage used in this run	Addition to baseline pumpage	Total number of well cells	Added pumpage to each cell
Glasscock	Edwards-Trinity (Plateau) Aquifer	59,280	20,938	59,280	0	942	0
Hays	Trinity Aquifer	2,818	3,713	3,713	895	370	2
Howard	Edwards-Trinity (Plateau) Aquifer	585	1,700	1,700	1,115	72	15
Jeff Davis	Edwards-Trinity (Plateau) Aquifer	141	200	200	59	325	0
Kendall	Edwards-Trinity (Plateau) Aquifer	124	905	905	781	89	9
	Trinity Aquifer	3,391	3,935	3,935	544	576	1
	Total	3,515	4,840	4,840	1,325	665	
Kerr	Edwards-Trinity (Plateau) Aquifer	1,762	16,410	16,410	14,648	1,102	13
	Trinity Aquifer	2,419	17,324	17,324	14,905	278	54
	Total	4,181	33,734	33,734	29,553	1,380	
Loving	Edwards-Trinity (Plateau) Aquifer	32	4,363	4,363	4,331	98	44
Martin	Edwards-Trinity (Plateau) Aquifer	94	3,398	3,398	3,304	62	53
Mason	Edwards-Trinity (Plateau) Aquifer	3	3,828	3,828	3,825	91	42
McCulloch	Edwards-Trinity (Plateau) Aquifer	31	8,249	8,249	8,218	201	41
Medina	Trinity Aquifer	69	860	860	791	113	7
Menard	Edwards-Trinity (Plateau) Aquifer	1,844	19,000	19,000	17,156	962	18
Midland	Edwards-Trinity (Plateau) Aquifer	21,140	19,395	21,140	0	876	0
Nolan	Edwards-Trinity (Plateau) Aquifer	151	1,000	1,000	849	463	2
Pecos	Pecos Valley Aquifer	44,038	58,578	58,578	14,540	1,049	14
	Edwards-Trinity (Plateau) Aquifer	41,471	114,849	114,849	73,378	3,641	20
	Total	85,509	173,427	173,427	87,918	4,690	
Reagan	Edwards-Trinity (Plateau) Aquifer	61,816	31,235	61,816	0	1,769	0
Real	Edwards-Trinity (Plateau) Aquifer	11,375	5,737	11,375	0	734	0
	Trinity Aquifer	150	380	380	230	14	16
	Total	11,525	6,117	11,755	230	748	
Reeves	Pecos Valley	54,401	60,520	60,520	6,119	1,220	5
	Edwards-Trinity (Plateau) Aquifer	53,346	53,845	53,845	499	1,139	0
	Total	107,747	114,365	114,365	6,618	2,359	

County	Aquifer	GAM Run 07-03 baseline pumpage	2007 State Water Plan availability	Specified pumpage used in this run	Addition to baseline pumpage	Total number of well cells	Added pumpage to each cell
Sterling	Edwards-Trinity (Plateau) Aquifer	375	5,168	5,168	4,793	521	9
Taylor	Edwards-Trinity (Plateau) Aquifer	117	500	500	383	166	2
Terrell	Edwards-Trinity (Plateau) Aquifer	1,032	2,100	2,100	1,068	3,419	0
Tom Green	Edwards-Trinity (Plateau) Aquifer	741	15,037	15,037	14,296	601	24
Travis	Trinity Aquifer	1,721	3,900	3,900	2,179	186	12
Upton	Edwards-Trinity (Plateau) Aquifer	20,604	18,929	20,604	0	1,467	0
Uvalde	Edwards-Trinity (Plateau) Aquifer	566	3,185	3,185	2,619	323	8
	Trinity Aquifer	176	580	580	404	84	5
	Total	742	3,765	3,765	3,023	407	
Ward	Pecos Valley Aquifer	5,821	17,288	17,288	11,467	658	17
Winkler	Pecos Valley Aquifer	558	51,994	51,994	51,436	747	69
	Edwards-Trinity (Plateau) Aquifer	1	517	517	516	8	64
	Total	559	52,511	52,511	51,952	755	

Table 2. The specified pumpage used in this model simulation in comparison with GAM Run 07-03 (Donnelly, 2007) baseline pumpage and the groundwater availability numbers from the 2007 State Water Plan. All pumpage numbers are reported in acre-feet per year.

County	GAM Run 07-03 baseline pumpage	2007 State Water Plan availability	Addition to baseline pumpage	Model layer	Total number of active cells	Total number of well cells	Added pumpage
Crockett	5,493	25,460	19,967	Layer 1	2,662	2,560	17,429
				Layer 2	2,744	1,436	2,539
				Total	5,406	3,996	19,968
Irion	432	9,445	9,013	Layer 1	674	625	4,836
				Layer 2	664	387	4,177
				Total	1,338	1,012	9,013
Kimble	843	23,965	23,122	Layer 1	943	858	6,888
				Layer 2	1,197	952	16,235
				Total	2,140	1,810	23,122
Kinney	6,832	59,234	52,402	Layer 1	556	529	31,817
				Layer 2	564	211	20,585
				Total	1,120	740	52,402
Schleicher	3,732	16,164	12,432	Layer 1	1,310	1,310	12,400
				Layer 2	996	4	31
				Total	2,306	1,314	12,431
Sutton	3,445	20,775	17,330	Layer 1	1,454	1,448	17,227
				Layer 2	1,351	69	103
				Total	2,805	1,517	17,330
Val Verde	14,562	49,607	35,045	Layer 1	3,112	3,052	34,668
				Layer 2	3,213	555	377
				Total	6,325	3,607	35,045

RESULTS:

Included in Appendix A are estimates of the water budgets after running the model for 51 years. The components of the water budget are described below.

- Wells—water produced from wells in each aquifer. This component is always shown as "Outflow" from the water budget, because all wells included in the model produce (rather than inject) water. Wells are modeled using the MODFLOW Well package.

- Springs and seeps—water that drains from an aquifer to seeps and springs along the margins of the aquifer. This component is always shown as "Outflow", or discharge, from the water budget. Springs and seeps are modeled using the MODFLOW Drain package.

- Recharge—simulates areally distributed recharge due to precipitation falling on the outcrop areas of aquifers. Recharge is always shown as "Inflow" into the water budget. Recharge is modeled using the MODFLOW Recharge package.

- Vertical Leakage (Upward or Downward)—describes the vertical flow, or leakage, between two aquifers. This flow is controlled by the water levels in each aquifer and aquifer properties of each aquifer that define the amount of leakage that can occur. "Inflow" to an aquifer from an overlying or underlying aquifer will always equal the "Outflow" from the other aquifer.

- Storage—water stored in the aquifer. The storage component that is included in "Inflow" is water that is removed from storage in the aquifer (that is, water level declines). The storage component that is included in "Outflow" is water that is added back into storage in the aquifer (that is, water level increases). This component of the budget is often seen as water both going into and out of the aquifer because this is a regional budget, and water levels will decline in some areas (water is being removed from storage) and will rise in others (water is being added to storage).

- Lateral flow—describes lateral flow within an aquifer between a county and adjacent counties.

- Rivers and Streams—water that flows between perennial streams and rivers and an aquifer. The direction and amount of flow depends on the water level in the stream or river and the aquifer. In areas where water levels in the stream or river are above the water level in the aquifer, water flows into the aquifer and out of the stream and is shown as "Inflow" in the budget. In areas where water levels in the aquifer are above the water level in the stream or river, water flows out of the aquifer and into the stream and is shown as "Outflow" in the budget. Rivers and streams are modeled using the MODFLOW Stream package.

- Inter-aquifer Flow—The model uses general-head boundaries to simulate the movement of water between the Edwards or Trinity aquifer units and adjacent aquifers, including the Ogallala, Dockum, Edwards (Balcones Fault Zone), and Llano Uplift area aquifers.

The results of the model run are described for the individual aquifers units, the Edwards and associated limestones (Layer 1) and the undifferentiated Trinity unit (Layer 2). The Pecos Valley Aquifer is included in Layer 1.

Water levels from the end of the transient calibration portion of the model run (the end of 1999) for layers 1 and 2 are shown in Figures 1 and 2, respectively. These figures show the starting water levels for the 51-year (2000 to 2050) predictive portion of the model run. Water levels at the end of the 51-year predictive portion of the simulation for layers 1 and 2 are shown in Figures 3 and 4, respectively. Because differences between initial water levels and water levels after 51 years of pumpage are sometimes difficult to discern in these figures, maps of water level changes were made. A water-level change map shows the difference between the water levels at the end of the historic portion of the model run (1999) and the water levels at the end of the 51-year predictive portion of the model run (2050). Water-level changes over the 51-year predictive portion of the model simulation for Layers 1 and 2 are shown in Figures 5 and 6, respectively. Average and maximum water-level changes for each aquifer in each county of the model are provided in Table 3.

Table 3. Average and maximum water level changes by county and aquifer. Negative values indicate an average lowering of water levels between 1999 and 2050 while a positive value indicates an increase in water levels since 1999. A dashed line indicates the aquifer does not exist or was not modeled for a particular county.

	Edwards and Pecos Valley aquifers (Layer 1)			Trinity Aquifer (Layer 2)		
County Name	Area (square miles)	Average change (feet)	Maximum change (feet)	Area (square miles)	Average change (feet)	Maximum change (feet)
Andrews	267	-27	-66	163	-78	-172
Bandera	52	-34	-48	798	-68	-177
Bexar	--	--	--	245	37	11
Blanco	--	--	--	552	41	-33
Brewster	774	-25	-126	712	-77	-219
Burnet	--	--	--	26	-49	-152
Coke	--	--	--	244	-19	-41
Comal	--	--	--	302	31	6
Concho	194	-64	-120	189	-323	-487
Crane	573	-9	-39	9	-176	-177
Crockett	2,662	-62	105	2,744	-65	-134
Culberson	142	-24	-29	--	--	--
Ector	105	-24	-45	667	-157	-207
Edwards	2.015	-26	-75	2.120	-72	-156
Gillespie	313	5	0	889	-7	-75
Glasscock	572	18	2	761	-465	-613

	Edwards and Pecos Valley aquifers (Layer 1)			Trinity Aquifer (Layer 2)		
Hays	--	--	--	370	29	0
Howard	--	--	--	72	-64	-107
Irion	674	-34	-72	664	-105	-307
Jeff Davis	325	-54	-96	--	--	--
Kendall	--	--	--	665	18	-34
Kerr	625	-11	-39	1,106	-90	-166
Kimble	943	-8	-59	1,197	-61	-163
Kinney	556	-78	-140	564	-125	-182
Loving	98	-12	-27	--	--	--
Martin	--	--	--	110	-347	-506
Mason	28	-13	-32	78	-87	-184
Medina	--	--	--	119	-17	-66
Menard	756	-39	-120	472	-107	-170
Midland	158	9	5	862	-242	-505
McCulloch	24	-20	-30	198	-198	-357
Nolan	--	--	--	464	2	-2
Pecos	4,269	-70	-166	1,634	-301	-620
Reagan	1,173	-7	-72	1,141	-316	-603
Real	421	-10	-36	700	-88	-158
Reeves	2,359	-20	-67	--	--	--
Schleicher	1,310	-64	-117	996	-58	-81
Sterling	215	2	-6	360	-111	-441
Sutton	1,454	-48	-85	1,351	-62	-156
Taylor	--	--	--	166	1	0
Terrell	2,343	-24	-64	2,380	-86	-307
Tom Green	346	-45	-116	372	-83	-337
Travis	--	--	--	254	1	-21
Upton	922	8	-33	940	-229	-429
Uvalde	157	-7	-22	394	-23	-68
Val Verde	3,206	-21	-112	3,213	-71	-174
Ward	658	-21	-62	--	--	--
Winkler	749	-52	-83	8	-207	-211

Figure 5 indicates that water levels in Layer 1 (Edwards and associated limestones and the Pecos Valley Aquifer) show mainly decreases in water levels ranging from 0 to 50 feet over the 51-year predictive portion of the run. Several localized areas of higher water level declines of greater than 100 feet can be seen in Figure 5, centering in Pecos, Kinney, Schleicher, and Concho counties.

Figure 6 indicates that water levels in Layer 2 (Trinity Aquifer) decrease throughout most of the region, generally less than 100 feet. Very large cones of depression are centered in Glasscock, Reagan, and Pecos counties, that are present at the end of the historic portion of the model run (Figure 2), continue to deepen with the model predicting up to 600 feet of decline in this area over the 51-year predictive time period. Several other smaller localized areas of higher water level declines can be seen in Figure 6, including in Kinney, Bandera, Menard, and Concho counties.

During previous model runs, the model response for the Trinity Aquifer was evaluated. It was determined that the model did not correctly simulate the response of water levels in Glasscock and Reagan counties appropriately during model calibration, and in fact water level declines during the historic calibration-verification time period were much lower than the model simulated water level declines (Donnelly, 2007). While using the model results without consideration of this could be viewed as taking a conservative approach, the water level declines predicted by the model are so great that we recommend taking another approach to evaluate the desired future conditions in this area, especially if a "managed depletion" approach to aquifer management is being considered.

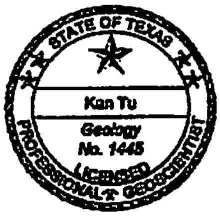
Another change in water levels that can be observed in Figure 6 is an area of increasing water levels centered Blanco, Hays, Kendall, and Comal counties. The reason for this increase is not known at this time and will require further evaluation, but it occurs primarily outside of the Groundwater Management Area 7 boundaries. Blanco, Hays, Kendall, and Comal counties are also included in the groundwater availability model for the Trinity Hill Country Aquifer, which may be a better tool for evaluating aquifer conditions in this area than the groundwater availability model for the Edwards-Trinity (Plateau) Aquifer.

Because some of the desired future conditions for the groundwater management area may be based on discharge to springs or baseflow to rivers and streams, we also evaluated the water budgets for each of these components for each county in the model area. These budgets are provided in Appendix A. The components of the water budget are divided up into "In" and "Out", representing water that is coming into and leaving from the budget. As might be expected, water from wells is only in the "Out" column, representing water that is removed from the aquifer from wells. Likewise, recharge is only found in the "In" column. Streams and rivers, however, have values in both the "In" and "Out" columns. This is because some stream reaches lose water to the aquifer, and some gain water from the aquifer depending on the water levels in the aquifer. Also included in these budgets are values for vertical leakage to overlying and underlying formations as well as lateral inflow from adjacent counties. Future model runs can be compared to these budgets to determine the impact of additional pumpage compared to this baseline run.

REFERENCES:

Anaya, R., and Jones, I., 2004, Groundwater availability model for the Edwards-Trinity (Plateau) and Cenozoic Pecos Alluvium aquifer systems, Texas: Texas Water Development Board, GAM Report, 208 p.

Donnelly, A.C.A., 2007, GAM Run 07-03, Texas Water Development Board GAM Run Report, 49 p.



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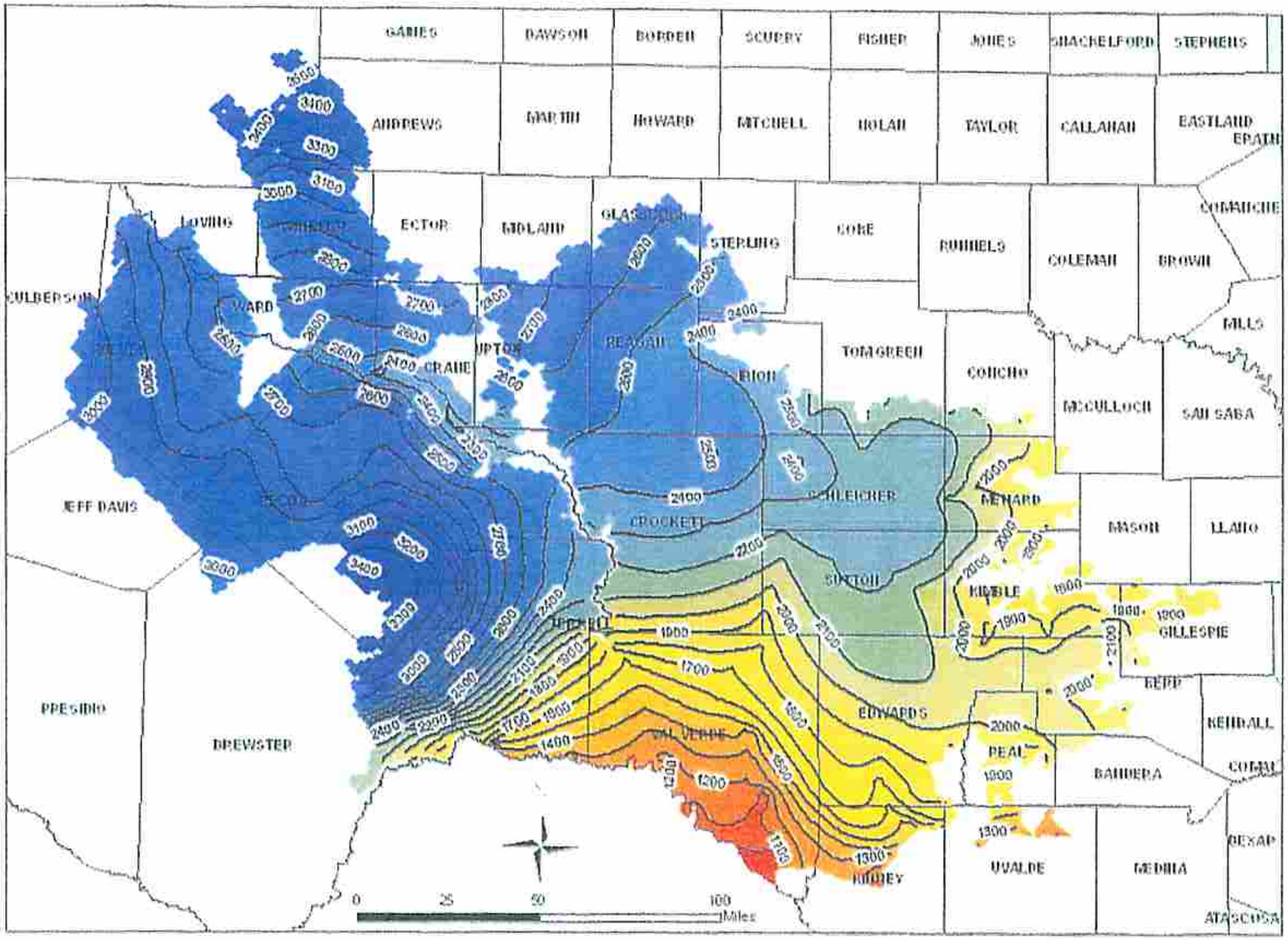

Figure 1. Initial water level elevations for the predictive model run in Layer 1 (Edwards and associated limestones and the Pecos Valley Aquifer) of the groundwater availability model for Edwards-Trinity (Plateau) Aquifer. Water level elevations are in feet above mean sea level. Contour interval is 100 feet.

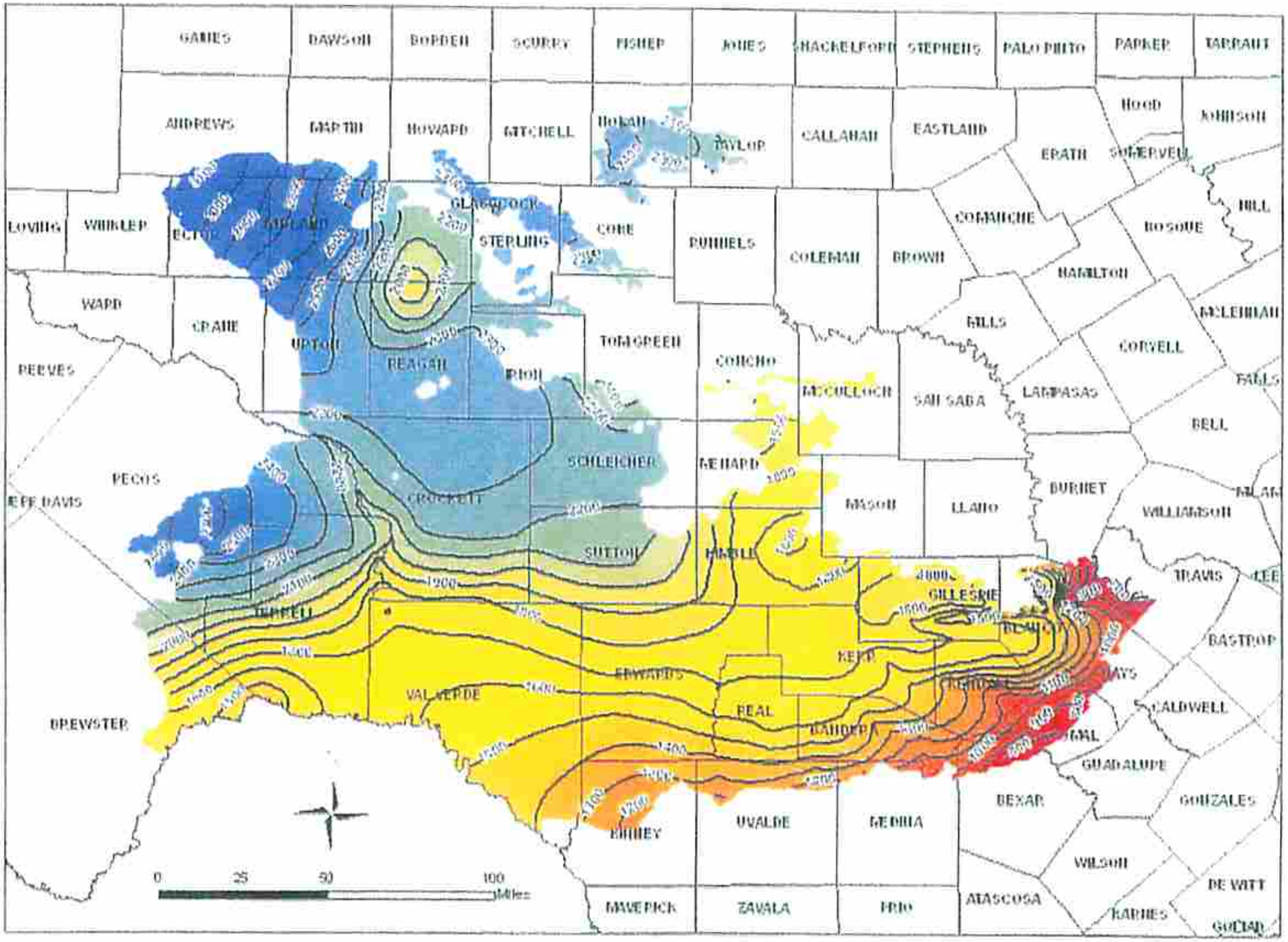

Figure 2. Initial water level elevations for the predictive model run in Layer 2 (Trinity Aquifer) of the groundwater availability model for Edwards- Trinity (Plateau) Aquifer. Water level elevations are in feet above mean sea level. Contour interval is 100 feet.

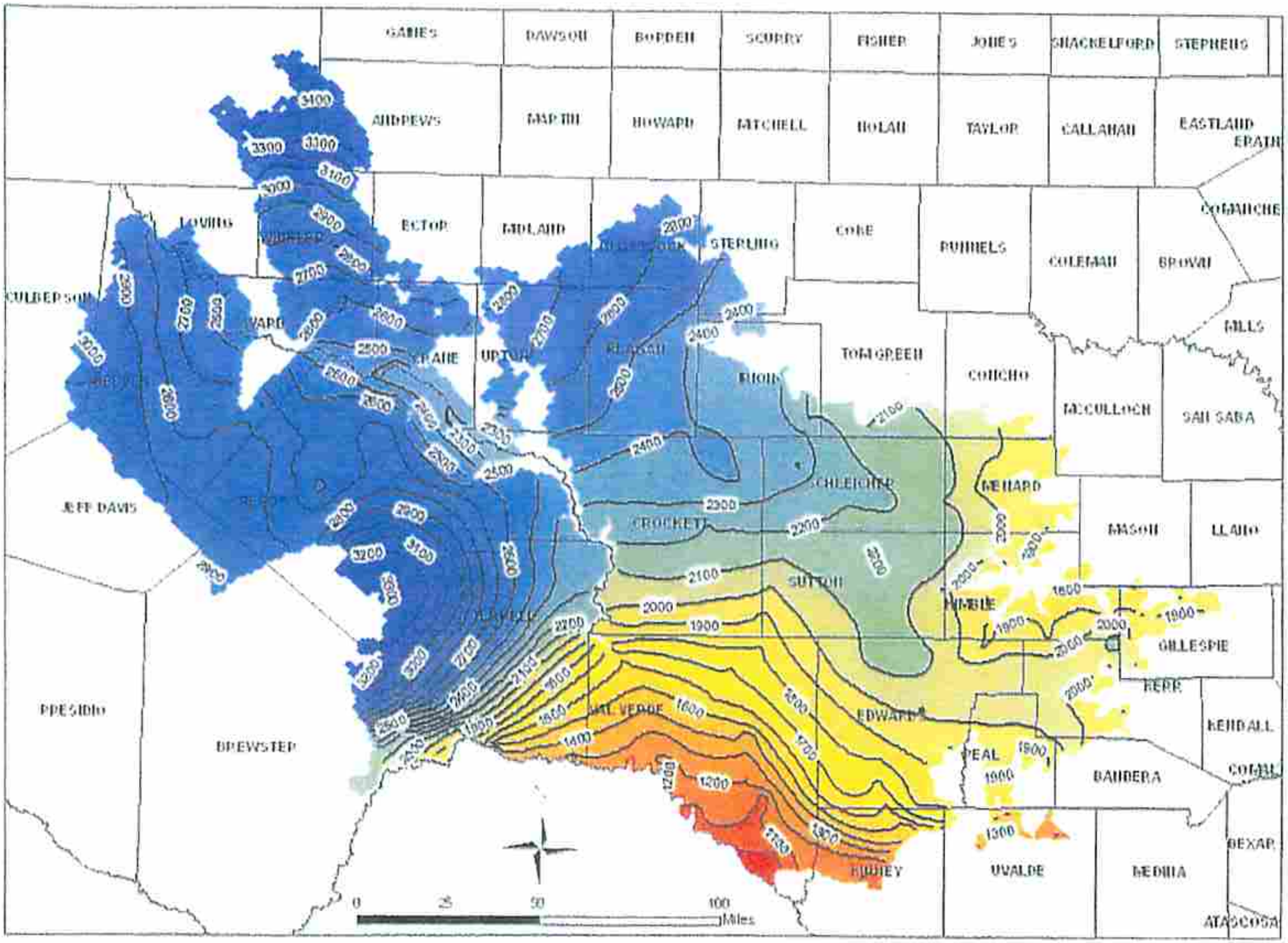

Figure 3. Water level elevations after 51 years using baseline pumpage in Layer 1 (Edwards and associated limestones and the Pecos Valley Aquifer). Water level elevations are in feet above mean sea level. Contour interval is 100 feet.

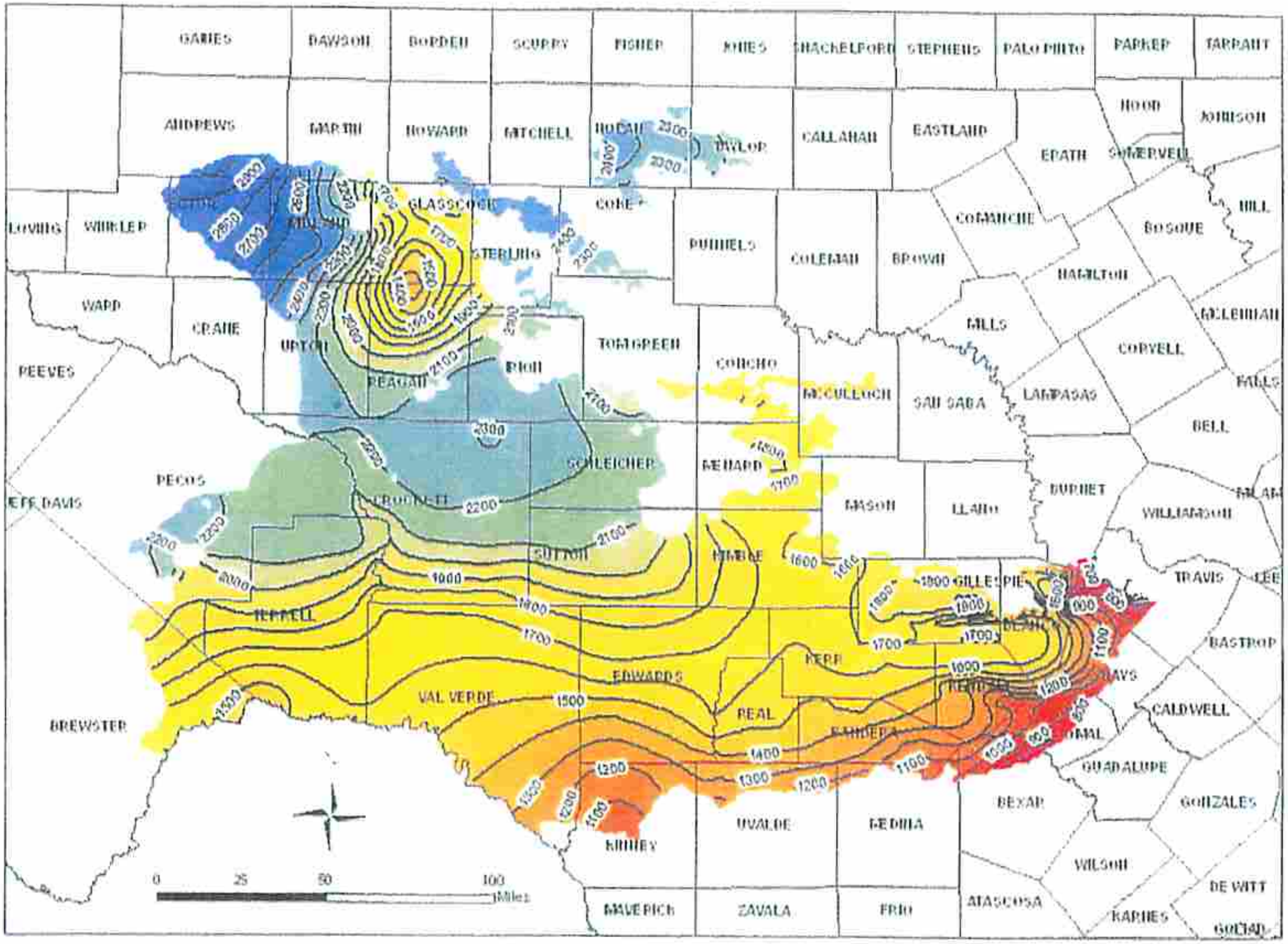

Figure 4. Water level elevations after 51 years using baseline pumpage in Layer 2 (Trinity Aquifer). Water level elevations are in feet above mean sea level. Contour interval is 100 feet.

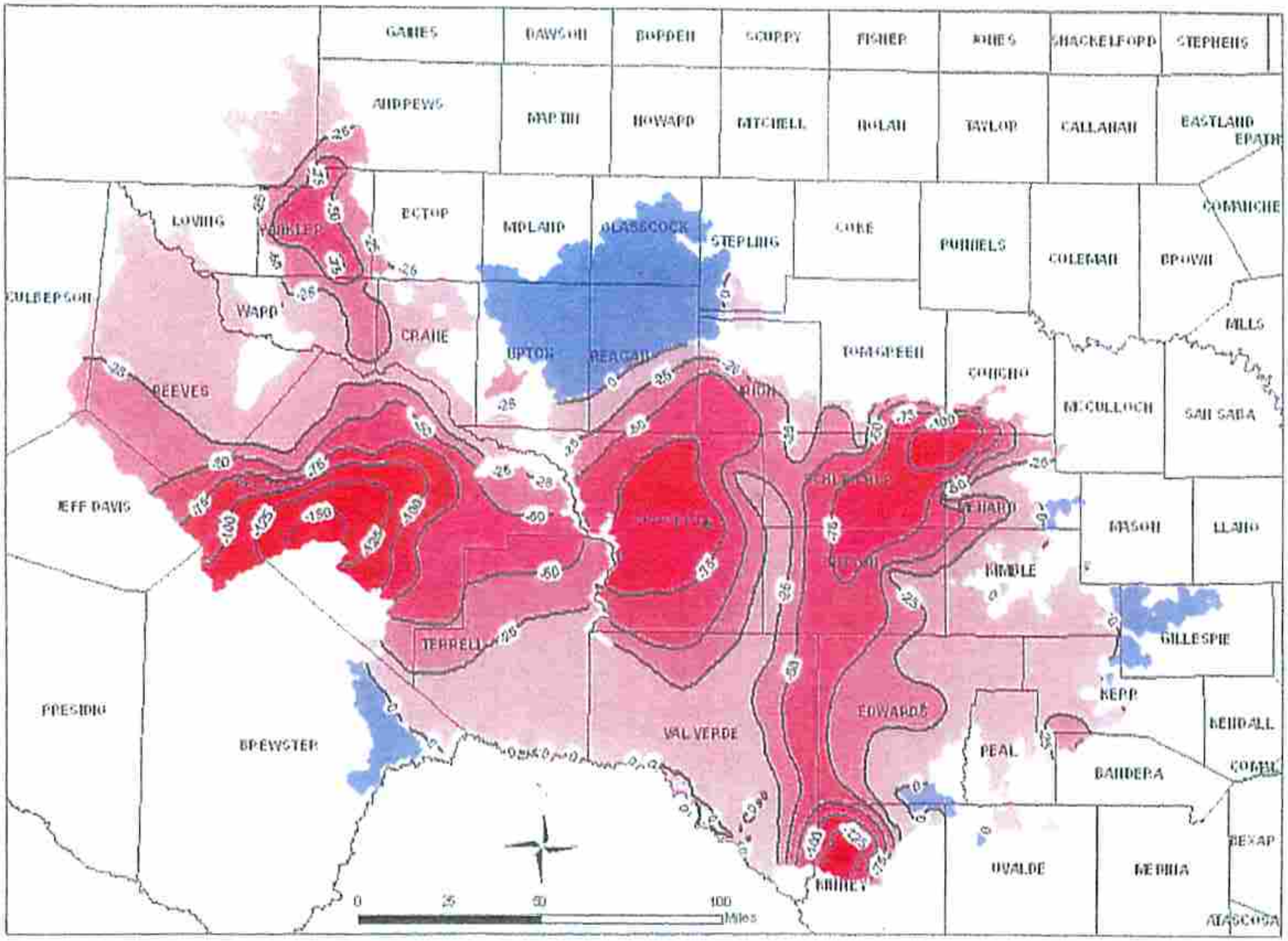

Figure 5. Changes in water levels (in feet) after 51 years using the specified pumpage in Layer 1 (Edwards and associated limestones and the Pecos Valley Aquifer). Decreases in water levels (drawdowns) are shown in red and increases in water levels are shown in blue. Contour interval is 25 feet.

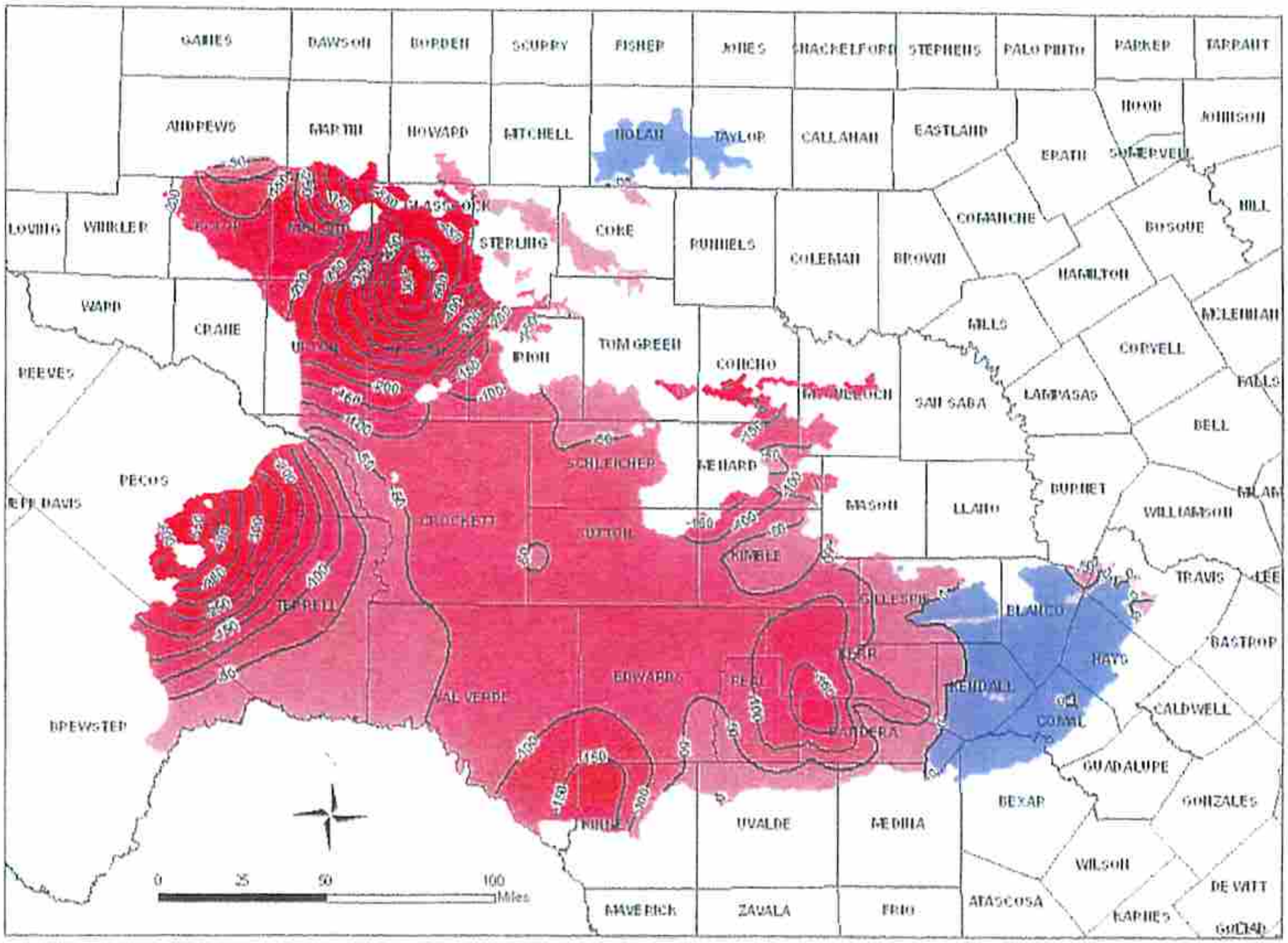

Figure 6. Changes in water levels after 51 years using the specified pumpage in Layer 2 (Trinity Aquifer). Decreases in water levels (drawdowns) are shown in red and increases in water levels are shown in blue. Contour interval is 50 feet.

Table A-1. Annual water budgets for each county at the end of the 51-year predictive portion of the model run using the requested pumpage and normal rainfall condition in the groundwater availability model for the Edwards-Trinity (Plateau) Aquifer (in acre-feet per year). Total pumpage for each county listed in Tables 1 and 2 matches the total value listed for wells in the water budget. The model includes two layers, representing the Edwards and associated limestones (Layer 1) and undifferentiated Trinity units (Layer 2). The Pecos Valley Aquifer is included in Layer 1 of the model

	Andrews		Bandera		Bexar		Blanco		Brewster		Burnet	
	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out
Model Layer 1												
Reservoirs (Constant Head Cells)	0	0	0	0	--	--	--	--	0	0	--	--
Storage	1,616	0	0	0	--	--	--	--	945	0	--	--
Springs and Seeps (Drain Package)	0	0	0	816	--	--	--	--	0	22,808	--	--
Inter-aquifer Flow (GHB Package)	0	1,189	0	0	--	--	--	--	0	0	--	--
Wells	0	1,188	0	3,537	--	--	--	--	0	85	--	--
Streams and Rivers (Stream Package)	0	0	3,785	282	--	--	--	--	0	0	--	--
Recharge	2,079	0	1,579	0	--	--	--	--	19,850	0	--	--
Lateral Inflow	1,172	2,490	1,127	1,803	--	--	--	--	7,033	4,932	--	--
Vertical Leakage Downward	--	--	9	63	--	--	--	--	1,161	1,163	--	--
Model Layer 2												
Reservoirs (Constant Head Cells)	0	0	381	2,280	0	0	0	0	0	0	0	226
Storage	214	0	1,022	0	0	0	0	420	1,331	0	0	0
Springs and Seeps (Drain Package)	0	0	0	0	0	0	0	15,533	0	0	0	260
Inter-aquifer Flow (GHB Package)	7,680	521	0	1,972	0	30,505	0	8	0	0	0	0
Wells	0	4,641	0	32,332	0	2,399	0	1,758	0	588	0	2,550
Streams and Rivers (Stream Package)	0	0	6,466	12,992	0	0	0	10,961	1,730	10,454	0	0
Recharge	3,912	0	48,555	0	21,238	0	45,580	0	5,854	0	1,877	0
Vertical Leakage Upward	--	--	63	9	--	--	--	--	1,163	1,161	--	--
Lateral Inflow	228	6,873	16,316	23,217	18,973	7,307	4,742	21,653	2,796	671	1,877	718
Total Pumpage		5,829		35,869		2,399		1,758		673		2,550

Table A-1. (continued)

	Coke		Comal		Concho		Crane		Crockett		Culberson	
	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out
Model Layer 1												
Reservoirs (Constant Head Cells)	--	--	--	--	0	0	0	0	0	0	0	0
Storage	--	--	--	--	124	0	3,670	0	4,305	0	1,188	0
Springs and Seeps (Drain Package)	--	--	--	--	0	566	0	0	0	0	0	0
Inter-aquifer Flow (GHB Package)	--	--	--	--	0	0	89	1,749	0	43	65	439
Wells	--	--	--	--	0	6,729	0	2,603	0	22,222	0	55
Streams and Rivers (Stream Package)	--	--	--	--	0	0	100	6,762	11,891	3,693	0	0
Recharge	--	--	--	--	5,205	0	5,465	0	43,957	0	2,183	0
Lateral Inflow	--	--	--	--	2,125	635	3,998	2,208	12,215	28,515	548	3,490
Vertical Leakage Downward	--	--	--	--	519	41	--	--	162	18,056	--	--
Model Layer 2												
Reservoirs (Constant Head Cells)	0	0	6,276	7,129	0	0	0	0	0	0	--	--
Storage	2	0	0	1	1,901	0	48	0	809	0	--	--
Springs and Seeps (Drain Package)	0	3,343	0	0	0	0	0	0	0	0	--	--
Inter-aquifer Flow (GHB Package)	0	50	2,437	12,111	48	0	8	1	10	2,830	--	--
Wells	0	3,243	0	3,059	0	5,548	0	51	0	3,229	--	--
Streams and Rivers (Stream Package)	0	0	471	27,570	0	0	0	0	336	8,018	--	--
Recharge	5,916	0	30,369	0	3,274	0	138	0	2,301	0	--	--
Vertical Leakage Upward	--	--	--	--	41	519	--	--	18,056	162	--	--
Lateral Inflow	1,164	446	20,169	9,854	976	174	658	800	6,782	14,055	--	--
Total Pumpage		3,243		3,059		12,278		2,654		25,451		55

Table A-1. (continued)

	Ector		Edwards		Gillespie		Glasscock		Hays		Howard	
	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out
Model Layer 1												
Reservoirs (Constant Head Cells)	0	0	0	0	0	0	0	0	--	--	--	--
Storage	3,848	0	32	0	0	0	0	0	--	--	--	--
Springs and Seeps (Drain Package)	0	0	0	4,149	0	9,298	0	1,615	--	--	--	--
Inter-aquifer Flow (GHB Package)	0	405	0	0	0	0	0	0	--	--	--	--
Wells	0	3,143	0	7,835	0	619	0	54	--	--	--	--
Streams and Rivers (Stream Package)	0	0	13,089	25,346	1,043	1,323	0	0	--	--	--	--
Recharge	788	0	74,639	0	10,113	0	11,144	0	--	--	--	--
Lateral Inflow	103	1,161	6,278	51,894	3,493	2,040	509	2,118	--	--	--	--
Vertical Leakage Downward	0	32	5	4,821	362	1,732	137	8,002	--	--	--	--
Model Layer 2												
Reservoirs (Constant Head Cells)	0	0	0	0	0	0	0	0	0	0	0	0
Storage	2,304	0	1,456	0	105	21	7,655	0	0	454	25	0
Springs and Seeps (Drain Package)	0	0	0	0	0	7,430	0	0	0	0	0	0
Inter-aquifer Flow (GHB Package)	117	1,057	0	0	0	7	16,893	59	0	17,804	1,335	22
Wells	0	11,324	0	860	0	4,280	0	59,226	0	3,715	0	1,700
Streams and Rivers (Stream Package)	0	0	3,417	166	3,485	20,920	0	0	0	3,239	0	0
Recharge	11,774	0	3,185	0	36,773	0	5,156	0	32,522	0	1,517	0
Vertical Leakage Upward	32	0	4,821	5	1,732	362	8,002	137	--	--	--	--
Lateral Inflow	4,596	6,441	12,673	24,522	716	9,790	32,705	10,989	7,255	14,566	311	1,466
Total Pumpage		14,467		8,695		4,899		59,280		3,715		1,700

Table A-1. (continued)

	Irion		Jeff Davis		Kendall		Kerr		Kimble		Kinney	
	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out
Model Layer 1												
Reservoirs (Constant Head Cells)	0	0	0	0	--	--	0	0	0	0	0	0
Storage	119	0	1,633	0	--	--	0	0	9	0	1,881	0
Springs and Seeps (Drain Package)	0	4,654	0	0	--	--	0	7,371	0	18,322	0	5,069
Inter-aquifer Flow (GHB Package)	0	0	11	12	--	--	0	0	0	0	1,859	8,195
Wells	0	5,068	0	201	--	--	0	5,208	0	7,135	0	35,983
Streams and Rivers (Stream Package)	1,042	3,352	0	0	--	--	8,297	5,221	1,192	3,726	1,908	11,445
Recharge	14,334	0	5,294	0	--	--	19,184	0	25,672	0	42,401	0
Lateral Inflow	6,244	1,881	1,364	8,088	--	--	3,566	12,008	15,516	6,344	24,616	10,872
Vertical Leakage Downward	106	6,891	--	--	--	--	10	1,248	148	7,009	2	1,127
Model Layer 2												
Reservoirs (Constant Head Cells)	0	0	--	--	0	0	0	0	0	0	0	0
Storage	448	0	--	--	6	346	952	1	659	0	193	0
Springs and Seeps (Drain Package)	0	171	--	--	0	0	0	0	0	2,175	0	0
Inter-aquifer Flow (GHB Package)	969	277	--	--	0	0	0	0	0	0	3,345	2,169
Wells	0	4,375	--	--	0	4,842	0	28,524	0	16,830	0	23,268
Streams and Rivers (Stream Package)	0	0	--	--	246	38,587	6,394	5,260	10,568	11,224	0	0
Recharge	2,287	0	--	--	51,352	0	27,329	0	7,256	0	1,163	0
Vertical Leakage Upward	6,891	106	--	--	--	--	1,248	10	7,009	148	1,127	2
Lateral Inflow	3,120	8,786	--	--	9,152	16,981	10,907	13,035	9,629	4,745	20,291	681
Total Pumpage		9,444		201		4,842		33,732		23,985		59,231

Table A-1. (continued)

	Loving		Martin		Mason		McCulloch		Medina		Menard	
	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out
Model Layer 1												
Reservoirs (Constant Head Cells)	0	0	--	--	0	0	0	0	--	--	0	0
Storage	2,421	0	--	--	0	0	0	0	--	--	229	0
Springs and Seeps (Drain Package)	0	0	--	--	0	344	0	9	--	--	0	3,193
Inter-aquifer Flow (GHB Package)	2	161	--	--	0	0	0	0	--	--	0	0
Wells	0	4,363	--	--	0	967	0	942	--	--	0	12,518
Streams and Rivers (Stream Package)	1,799	1,098	--	--	0	0	0	0	--	--	253	5,718
Recharge	604	0	--	--	829	0	677	0	--	--	20,304	0
Lateral Inflow	2,254	1,458	--	--	533	61	230	39	--	--	5,883	3,685
Vertical Leakage Downward	--	--	--	--	80	69	117	34	--	--	256	1,811
Model Layer 2												
Reservoirs (Constant Head Cells)	--	--	0	0	0	0	0	0	541	599	0	0
Storage	--	--	633	0	43	0	1,078	0	265	0	639	0
Springs and Seeps (Drain Package)	--	--	0	0	0	277	0	0	0	0	0	0
Inter-aquifer Flow (GHB Package)	--	--	2,480	41	0	0	171	13	0	24,180	0	0
Wells	--	--	0	3,398	0	2,861	0	7,308	0	860	0	6,482
Streams and Rivers (Stream Package)	--	--	0	0	0	0	0	0	0	0	3,795	99
Recharge	--	--	2,833	0	1,477	0	5,073	0	8,448	0	3,142	0
Vertical Leakage Upward	--	--	--	--	69	80	34	117	--	--	1,811	256
Lateral Inflow	--	--	6,205	8,713	2,126	497	1,089	9	21,445	5,061	750	3,304
Total Pumpage		4,363		3,398		3,828		8,248		860		19,000

Table A-1. (continued)

	Midland		Nolan		Pecos		Reagan		Real		Reeves	
	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out
Model Layer 1												
Reservoirs (Constant Head Cells)	0	0	--	--	0	0	0	0	0	0	0	0
Storage	0	0	--	--	49,618	0	61	0	0	0	85,455	0
Springs and Seeps (Drain Package)	0	0	--	--	0	0	0	651	0	7,762	0	0
Inter-aquifer Flow (GHB Package)	0	0	--	--	57	4,871	0	0	0	0	209	4,156
Wells	0	3	--	--	0	138,264	0	1,001	0	2,844	0	114,361
Streams and Rivers (Stream Package)	0	0	--	--	302	14,674	0	0	259	4,604	1,083	33,048
Recharge	2,691	0	--	--	148,323	0	21,100	0	12,474	0	67,867	0
Lateral Inflow	226	789	--	--	20,063	43,519	3,380	5,111	5,857	2,802	11,712	14,741
Vertical Leakage Downward	10	2,135	--	--	1,881	18,918	277	18,056	41	619	--	--
Model Layer 2												
Reservoirs (Constant Head Cells)	0	0	0	0	0	0	0	0	0	0	--	--
Storage	21,775	0	0	0	11,543	0	4,764	0	749	0	--	--
Springs and Seeps (Drain Package)	0	0	0	9,932	0	0	0	0	0	0	--	--
Inter-aquifer Flow (GHB Package)	3,214	423	0	0	0	0	15,009	98	0	0	--	--
Wells	0	21,137	0	1,001	0	35,171	0	60,815	0	8,680	--	--
Streams and Rivers (Stream Package)	0	0	0	0	1,859	5,428	0	0	9,511	112	--	--
Recharge	15,283	0	11,947	0	7,165	0	21	0	8,759	0	--	--
Vertical Leakage Upward	2,135	10	--	--	18,918	1,881	18,056	277	619	41	--	--
Lateral Inflow	16,939	37,775	167	1,180	8,356	5,363	36,585	13,244	5,845	16,649	--	--
Total Pumpage		21,140		1,001		173,435		61,816		11,525		114,361

Table A-1. (continued)

	Schleicher		Sterling		Sutton		Taylor		Terrell		Tom Green	
	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out
Model Layer 1												
Reservoirs (Constant Head Cells)	0	0	0	0	0	0	--	--	0	0	0	0
Storage	1,335	0	0	0	782	0	--	--	2,156	0	168	0
Springs and Seeps (Drain Package)	0	0	0	2,061	0	0	--	--	0	4,298	0	3,530
Inter-aquifer Flow (GHB Package)	0	0	0	0	0	0	--	--	0	0	0	0
Wells	0	16,124	0	1,563	0	20,652	--	--	0	698	0	7,390
Streams and Rivers (Stream Package)	12,162	2,484	0	0	6,918	13,582	--	--	170	33,633	198	423
Recharge	24,018	0	4,546	0	29,044	0	--	--	43,448	0	8,029	0
Lateral Inflow	4,135	17,666	1,329	1,289	16,390	12,217	--	--	42,829	34,323	6,462	1,960
Vertical Leakage Downward	1	5,378	172	1,134	272	6,955	--	--	267	15,920	47	1,601
Model Layer 2												
Reservoirs (Constant Head Cells)	0	0	0	0	0	0	0	0	0	0	0	0
Storage	23	0	100	0	274	0	0	0	6,214	0	423	0
Springs and Seeps (Drain Package)	0	0	0	740	0	0	0	4,490	0	0	0	1,013
Inter-aquifer Flow (GHB Package)	0	0	1,064	1,102	0	0	0	0	0	0	273	18
Wells	0	43	0	3,604	0	122	0	500	0	1,395	0	7,647
Streams and Rivers (Stream Package)	0	0	0	0	327	0	0	0	185	15,959	573	1,741
Recharge	0	0	5,992	0	0	0	4,595	0	682	0	3,601	0
Vertical Leakage Upward	5,378	1	1,134	172	6,955	272	--	--	15,920	267	1,601	47
Lateral Inflow	1,879	7,236	2,189	4,861	5,483	12,644	495	100	6,903	12,283	7,114	3,120
Total Pumpage		16,167		5,167		20,774		500		2,093		15,037

Table A-1. (continued)

	Travis		Upton		Uvalde		Val Verde		Ward		Winkler	
	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out
Model Layer 1												
Reservoirs (Constant Head Cells)	--	--	0	0	0	0	18,105	47,386	0	0	0	0
Storage	--	--	495	0	0	0	367	0	13,519	0	46,206	0
Springs and Seeps (Drain Package)	--	--	0	0	0	2,592	0	574	0	0	0	0
Inter-aquifer Flow (GHB Package)	--	--	4	902	5	5,857	0	0	2	4,645	0	3,083
Wells	--	--	0	337	0	1,433	0	49,078	0	17,290	0	51,996
Streams and Rivers (Stream Package)	--	--	0	0	0	0	29,574	104,264	739	10,649	0	0
Recharge	--	--	15,277	0	7,422	0	90,068	0	6,575	0	5,300	0
Lateral Inflow	--	--	1,007	5,665	3,116	1,464	72,312	10,465	15,412	3,662	7,936	4,363
Vertical Leakage Downward	--	--	105	9,983	840	37	2,468	1,128	--	--	--	--
Reservoirs (Constant Head Cells)	3,563	31,081	0	0	0	0	0	0	--	--	0	0
Storage	0	81	4,611	0	272	0	1,435	0	--	--	26	0
Springs and Seeps (Drain Package)	0	0	0	0	0	0	0	0	--	--	0	0
Inter-aquifer Flow (GHB Package)	13,129	346	7,831	16	984	19,660	0	0	--	--	0	5
Wells	0	3,900	0	20,266	0	2,332	0	534	--	--	0	517
Streams and Rivers (Stream Package)	19	6,704	0	0	2,566	14,394	93	1,370	--	--	0	0
Recharge	16,098	0	2,632	0	19,757	0	152	0	--	--	119	0
Vertical Leakage Upward	--	--	9,983	105	37	840	1,128	2,468	--	--	--	--
Lateral Inflow	9,364	60	16,320	20,989	18,930	5,301	12,010	10,445	--	--	377	0
Total Pumpage		3,900		20,604		3,765		49,612		17,290		52,513

APPENDIX F

NOT RELEVANT TO

COKE COUNTY UNDERGROUND

WATER CONSERVATION DISTRICT

Texas Water Development Board

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

July 2, 2012

Mr. Winton Milliff
General Manager
Coke County Underground Water Conservation District
P.O. Box 1110
Robert Lee, TX 76945

Re: Revised modeled available groundwater estimates for the Dockum and Lipan aquifers in Groundwater Management Area 7

Dear Mr. Milliff:

The Texas Water Code, Section 36.1084, Subsection (b), states that the Texas Water Development Board's (TWDB) executive administrator shall provide each groundwater conservation district and regional water planning group located wholly or partly in the groundwater management area with the modeled available groundwater in the management area based upon the desired future conditions adopted by the districts. This letter and the attached reports (GAM Run 10-040 MAG Version 2 and GAM Run 10-062 MAG Version 2) are in response to this directive.

Modeled available groundwater is defined in the Texas Water Code, Section 36.001, Subsection (25), 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 first version of GAM Run 10-040 MAG and GAM Run 10-062 MAG included modeled available groundwater values for counties that were declared "not-relevant" for joint planning purposes by Groundwater Management Area 7. Since modeled available groundwater only applies to areas with a specified desired future condition, these reports have been updated to depict modeled available groundwater in relevant counties only.

For use in the regional water planning process, modeled available groundwater estimates have been reported by aquifer, county, river basin, regional water planning area, groundwater conservation district, and any other subdivision of the aquifer designated by the management area (if applicable).

We encourage open communication and coordination between groundwater conservation districts, regional water planning groups, and the TWDB to ensure that the modeled available groundwater reported in regional water plans and groundwater management plans are not in conflict. We estimated modeled available groundwater that would have to occur to achieve the desired future conditions using the best available scientific tools. However, these estimates are based on assumptions of the magnitude and distribution of projected pumping in the aquifer. It is, therefore, important for groundwater conservation districts to monitor whether their management of pumping is achieving their desired future conditions. Districts are encouraged to continue to work with the TWDB to better define available groundwater as additional information may help better assess responses of the aquifer to pumping and its distribution now and in the future.

If you have any questions, please contact Ms. Rima Petrossian of my staff at 512-936-2420 or rima.petrossian@twdb.texas.gov for further information.

Sincerely,

Melanie Callahan

Melanie Callahan
Executive Administrator

Attachments: GAM Run 10-040 MAG Version 2
GAM Run 10-062 MAG Version 2

c w/atts.: L'Oreal Stepney, Texas Commission of Environmental Quality
Kellye Rila, Texas Commission of Environmental Quality
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David Dunn, HDR Engineering
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Raymond Buck, Upper Guadalupe River Authority
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Dan Hardin, Water Resources Planning
Matt Nelson, Water Resources Planning
Temple McKinnon, Water Resources Planning
Doug Shaw, Water Resources Planning
Connie Townsend, Water Resources Planning
Lann, Bookout, Water Resources Planning
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GAM Run 10-040 MAG Version 2

By Mohammad Masud Hassan, P.E.

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

Updated to Version 2 by Shirley Wade to reflect refined modeled available groundwater estimates

Texas Water Development Board
Groundwater Availability Modeling Section
(512) 936-0883
June 22, 2012

Cynthia K. Ridgeway, the Manager of the Groundwater Availability Modeling Section, is responsible for oversight of work performed by employees under her direct supervision. The seal appearing on this document was authorized by Cynthia K. Ridgeway, P.G. 471 on June 22, 2012.

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EXECUTIVE SUMMARY:

The modeled available groundwater for the Dockum Aquifer as a result of the desired future conditions adopted by the districts of Groundwater Management Area 7 is approximately 21,700 acre-feet per year. The estimates were extracted from the "base" scenario in Groundwater Availability Model Run 10-001, which meets the desired future conditions adopted by the districts of Groundwater Management Area 7. These desired future conditions are drawdown limits set for the upper and lower portions of the Dockum Aquifer in Ector, Midland, Mitchell, Nolan, Pecos, Scurry, and Upton counties. The Dockum Aquifer is deemed not relevant in the remaining counties in Groundwater Management Area 7.

The first version of this report showed modeled available groundwater for areas declared not relevant for joint planning purposes. In this report version we show modeled available groundwater only in areas specified as relevant by Groundwater Management Area 7 in their resolution.

REQUESTOR:

Mr. Allan J. Lange of the Lipan-Kickapoo Water Conservation District on behalf of Groundwater Management Area 7.

DESCRIPTION OF REQUEST:

In a letter dated August 13, 2010, Mr. Allan J. Lange provided the Texas Water Development Board (TWDB) with the desired future conditions of the Dockum Aquifer adopted by the districts of Groundwater Management Area 7. The desired future conditions for the Dockum Aquifer in Groundwater Management Area 7, as described in Resolution No. 07-29-10-1, are:

> *"Upper Dockum, as delineated in Figure 1 of TWDB GAM Run 10-001: net total drawdown not to exceed 29 feet in Midland County; and*
>
> *Lower Dockum Aquifer, as delineated in Figure 1 of TWDB GAM Run 10-001: net total drawdown not to exceed 4 feet in Ector, Mitchell, Pecos, Scurry, and Upton Counties (Lone Wolf GCD, Middle Pecos GCD); and*
>
> *Lower Dockum Aquifer as delineated in Figure 1 of TWDB GAM Run 10-001: Drawdown not to exceed a net total of 39 feet in Nolan County (West-Tex GCD); and*
>
> *The Dockum Aquifer is not relevant for joint planning purposes in all other areas of GMA 7."*

In response to receiving the adopted desired future conditions, the TWDB has estimated the modeled available groundwater for the Dockum Aquifer in Groundwater Management Area 7.

METHODS:

The TWDB previously completed several predictive groundwater availability model simulations of the Dockum Aquifer to assist the districts of Groundwater Management Area 7 in defining desired future conditions. The location of Groundwater Management Area 7, the Dockum Aquifer, and the groundwater availability model cells that represent the aquifer are shown in Figure 1. As stated in Resolution No. 07-29-10-1, the groundwater management area considered Groundwater Availability Model (GAM) Run 10-001 (Oliver, 2010) when defining desired future conditions. Since each of the desired future conditions above is met in the "base" scenario in GAM Run 10-001, the estimated pumping for Groundwater Management Area 7 presented here was taken directly from that simulation. The pumping was then divided by county, regional water planning area, river basin, and groundwater conservation district.

PARAMETERS AND ASSUMPTIONS:

The parameters and assumptions for the model run using the groundwater availability model for the Dockum Aquifer are described below:

- The results presented in this report are taken from the "base" scenario in GAM Run 10-001 (Oliver, 2010). See GAM Run 10-001 for a full description of the methods, assumptions, and results for the groundwater availability model run.

- The modified groundwater availability model for the Dockum Aquifer described in Oliver and Hutchison (2008) was used for this analysis. This model is a modification of the previously developed groundwater availability model for the Dockum Aquifer described in Ewing and others (2008). This model was modified in order to more effectively simulate predictive conditions. See Oliver and Hutchison (2010) and Ewing and others (2008) for assumptions and limitations of the model.

- Layers 2 and 3 of the model represent the upper and lower portions of the Dockum Aquifer, respectively. Layer 1, which is active in version 1.01 of the model documented in Ewing and others (2008), was inactivated in the modified model as described in Oliver and Hutchison (2010).

- Cells were assigned to individual counties and groundwater conservation districts as shown in the September 14, 2009, version of the model grid for the Dockum Aquifer. Because this model grid predates the development of the modified model, care was taken to ensure that only those fields in the model grid that were valid for the modified model were used for analyzing model results.

Modeled Available Groundwater and Permitting

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

RESULTS:

The modeled available groundwater for the Dockum Aquifer in Groundwater Management Area 7 consistent with the desired future conditions is approximately 21,700 acre-feet per year. This has been divided by county, regional water planning area, and river basin for each decade between 2010 and 2060 for use in the regional water planning process (Table 1).

The modeled available groundwater is also summarized by county, regional water planning area, river basin, and groundwater conservation district as shown in tables 2, 3, 4, and 5, respectively.

LIMITATIONS:

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

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

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

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

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

REFERENCES:

Ewing, J.E., Jones, T.L., Yan, T., Vreugdenhil, A.M., Fryar, D.G., Pickens, J.F., Gordon, K., Nicot, J.P., Scanlon, B.R., Ashworth, J.B., Beach, J., 2008, Groundwater Availability Model for the Dockum Aquifer – Final Report: contract report to the Texas Water Development Board, 510 p.

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

Oliver, W., 2010, GAM Run 10-001: Texas Water Development Board, GAM Run 10-001 Report, 36 p.

Oliver, W., Hutchison, W.R., 2010, Modification and recalibration of the Groundwater Availability Model of the Dockum Aquifer: Texas Water Development Board, 114 p.

Smith, R., 2009, GAM Run 09-001: Texas Water Development Board, GAM Run 09-001 Draft Report, 28 p.

Table 1: Modeled available groundwater for the Dockum Aquifer in Groundwater Management Area 7. Results are in acre-feet per year and are divided by county, regional water planning area, and river basin.

County	Regional Water Planning	River Basin	Year					
			2010	2020	2030	2040	2050	2060
Ector	F	Colorado	13	13	13	13	13	13
		Rio Grande	515	515	515	515	515	515
Midland	F	Colorado	0	0	0	0	0	0
Mitchell	F	Colorado	14,018	14,018	14,018	14,018	14,018	14,018
Nolan	G	Brazos	2,824	2,824	2,824	2,824	2,824	2,824
		Colorado	2,926	2,926	2,926	2,926	2,926	2,926
Pecos	F	Rio Grande	3	3	3	3	3	3
Scurry	F	Brazos	306	306	306	306	306	306
		Colorado	903	903	903	903	903	903
Upton	F	Colorado	0	0	0	0	0	0
		Rio Grande	219	219	219	219	219	219
Total			21,727	21,727	21,727	21,727	21,727	21,727

Table 2: Modeled available groundwater for the Dockum Aquifer summarized by county in Groundwater Management Area 7 for each decade between 2010 and 2060. Results are in acre-feet per year.

County	Year					
	2010	2020	2030	2040	2050	2060
Ector	528	528	528	528	528	528
Midland	0	0	0	0	0	0
Mitchell	14,018	14,018	14,018	14,018	14,018	14,018
Nolan	5,750	5,750	5,750	5,750	5,750	5,750
Pecos	3	3	3	3	3	3
Scurry	1,209	1,209	1,209	1,209	1,209	1,209
Upton	219	219	219	219	219	219
Total	**21,727**	**21,727**	**21,727**	**21,727**	**21,727**	**21,727**

Table 3: Modeled available groundwater for the Dockum Aquifer summarized by regional water planning area in Groundwater Management Area 7 for each decade between 2010 and 2060. Results are in acre-feet per year.

Regional Water Planning Area	Year					
	2010	2020	2030	2040	2050	2060
F	15,977	15,977	15,977	15,977	15,977	15,977
G	5,750	5,750	5,750	5,750	5,750	5,750
Total	**21,727**	**21,727**	**21,727**	**21,727**	**21,727**	**21,727**

Table 4: Modeled available groundwater for the Dockum Aquifer summarized by river basin in Groundwater Management Area 7 for each decade between 2010 and 2060. Results are in acre-feet per year.

Basin	Year					
	2010	2020	2030	2040	2050	2060
Brazos	3,130	3,130	3,130	3,130	3,130	3,130
Colorade	17,860	17,860	17,860	17,860	17,860	17,860
Rio Grande	737	737	737	737	737	737
Total	**21,727**	**21,727**	**21,727**	**21,727**	**21,727**	**21,727**

Table 5: Modeled available groundwater for the Dockum Aquifer summarized by groundwater conservation district in Groundwater Management Area 7 for each decade between 2010 and 2060. Results are in acre-feet per year.

Groundwater Conservation District	Year					
	2010	2020	2030	2040	2050	2060
Lone Wolf	14,018	14,018	14,018	14,018	14,018	14,018
Middle Pecos	3	3	3	3	3	3
Wes-Tex	5,750	5,750	5,750	5,750	5,750	5,750
No District	1,956	1,956	1,956	1,956	1,956	1,956
Total	**21,727**	**21,727**	**21,727**	**21,727**	**21,727**	**21,727**

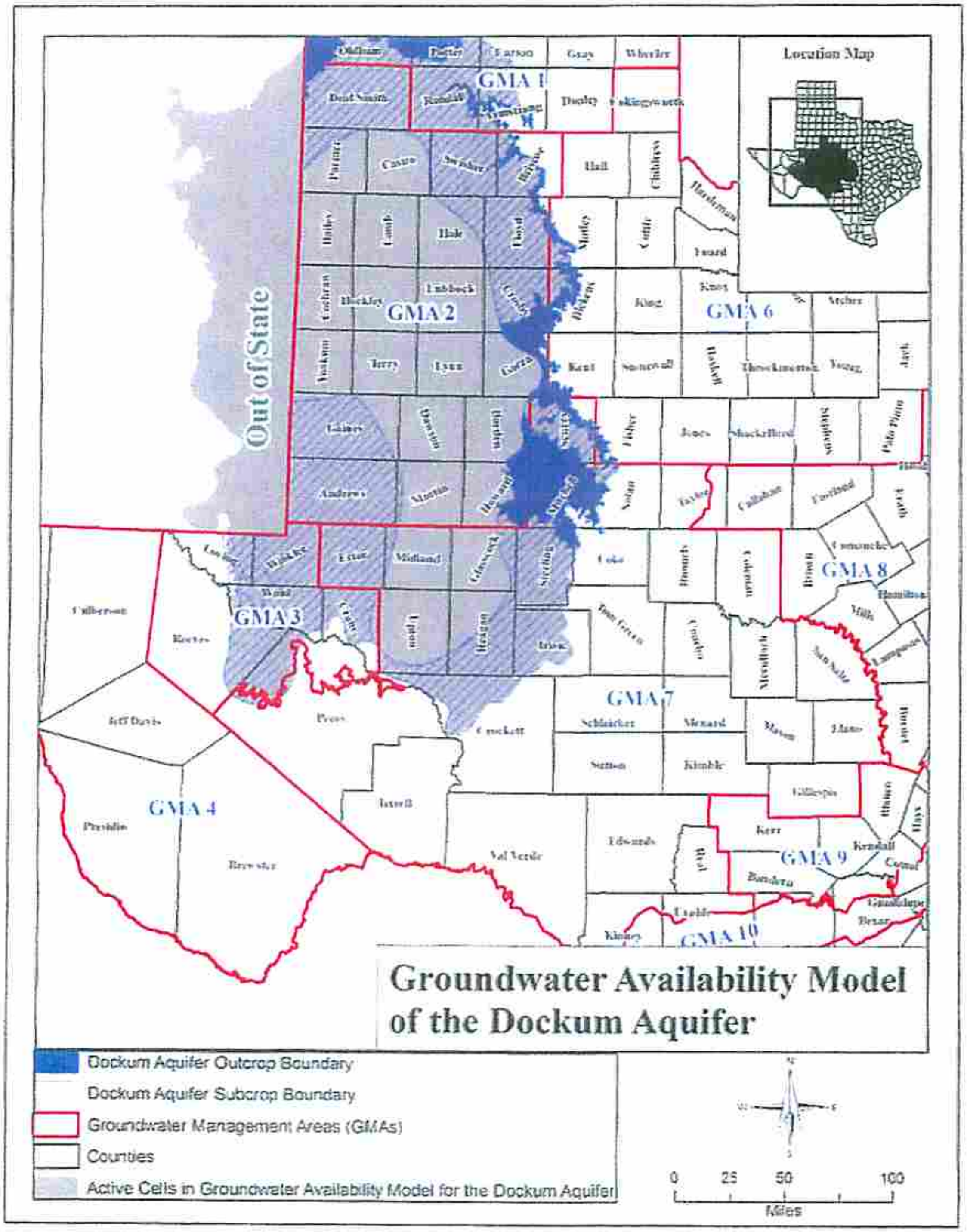

Figure 1: Map showing the areas covered by the groundwater model for the Dockum Aquifer.

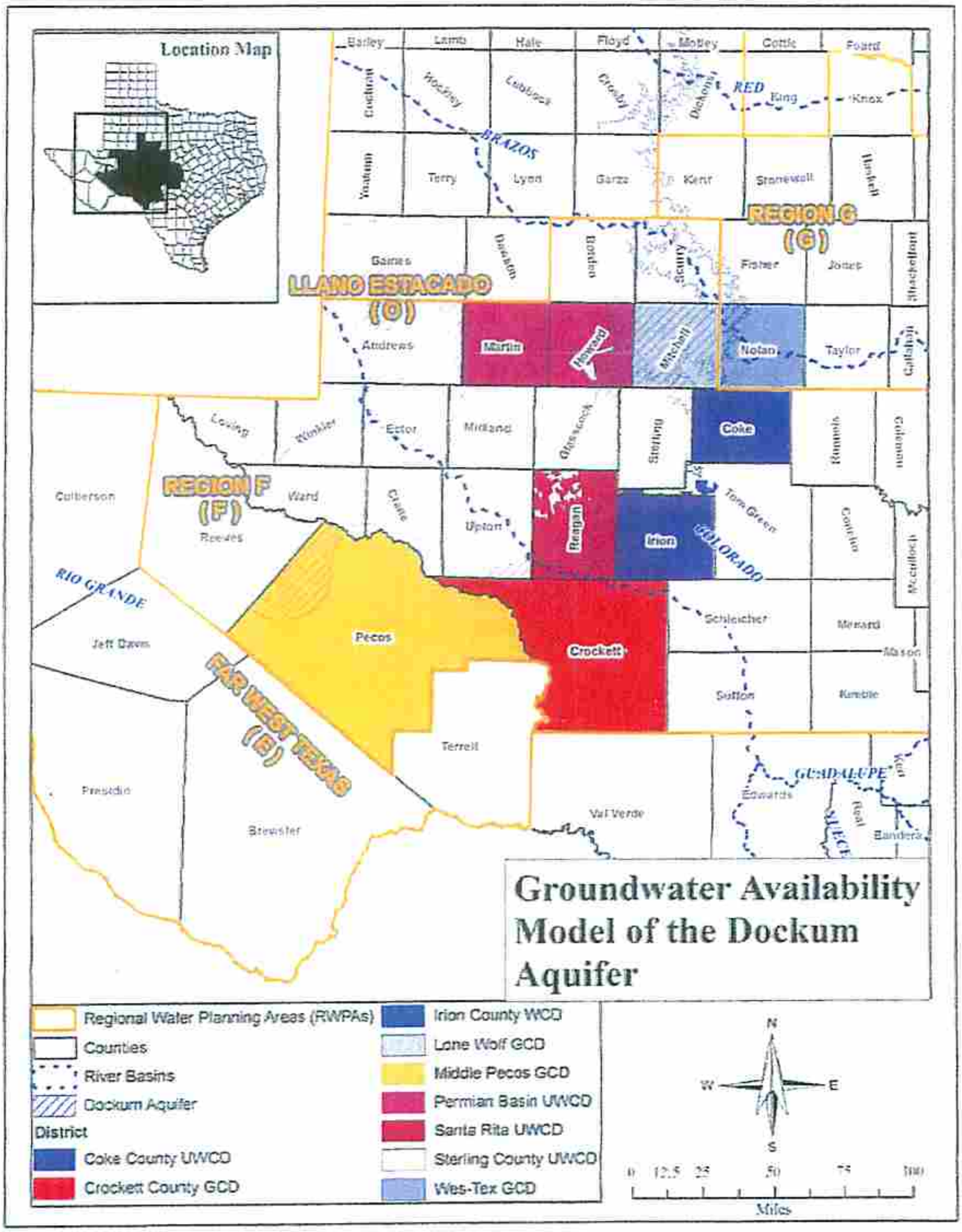

Figure 2: Map showing regional water planning areas (RWPAs), groundwater conservation districts (GCDs), counties, and river basins in Groundwater Management Area 7.

GAM Run 10-062 MAG Version 2

by Mr. Wade Oliver

Updated to version 2 by Shirley Wade to reflect refined modeled available groundwater estimates

Texas Water Development Board
Groundwater Availability Modeling Section
(512) 936-0883
June 29, 2012

Cynthia K. Ridgeway, the Manager of the Groundwater Availability Modeling Section, is responsible for oversight of work performed by employees under her direct supervision. The seal appearing on this document was authorized by Cynthia K. Ridgeway, P.G. 471 on June 29, 2012.

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EXECUTIVE SUMMARY:

The modeled available groundwater for the Lipan Aquifer as a result of the desired future condition adopted by the districts of Groundwater Management Area 7 is, on average, approximately 41,000 acre-feet per year. We have divided the modeled available groundwater by county, regional water planning area, and river basin (Table 1) for use in the regional water planning process. We have also summarized the modeled available groundwater by county (Table 2) and groundwater conservation district (Table 3). The results presented in this report are based on Groundwater Availability Model (GAM) Run 10-002, which the districts of Groundwater Management Area 7 considered when developing the desired future condition for the Lipan Aquifer. The original version of the GAM Run 10-062 MAG report included estimates of modeled available groundwater which were considered non-relevant by the groundwater conservation districts within Groundwater Management Area 7. This report only includes estimates of modeled available groundwater within the Lipan-Kickapoo Water Conservation District.

REQUESTOR:

Mr. Allan Lange of Lipan-Kickapoo Water Conservation District on behalf of Groundwater Management Area 7

DESCRIPTION OF REQUEST:

In a letter dated August 13, 2010, Mr. Allan Lange provided the Texas Water Development Board (TWDB) with the desired future condition of the Lipan Aquifer adopted by the members of Groundwater Management Area 7. The desired future condition for the Lipan Aquifer, as presented in Resolution # 07-29-10-4 and adopted July 29, 2010 by the groundwater conservation districts within Groundwater Management Area 7, is shown below:

1) *within the boundaries of the Lipan-Kickapoo* [Water Conservation District] *in Concho, Runnels, and Tom Green Counties: continue to use 100% of all available groundwater annually with annual fluctuations of water levels and zero (0) net draw down in water levels over the next 50 years; and*
2) *the Lipan aquifer is not relevant for joint planning purposes outside the boundaries of Lipan-Kickapoo* [Water Conservation District].

In response to receiving the adopted desired future condition, the TWDB has estimated the modeled available groundwater for the Lipan Aquifer in Groundwater Management Area 7.

METHODS:

Groundwater Management Area 7 contains the Lipan Aquifer, a minor aquifer as defined in the 2007 State Water Plan (TWDB, 2007). The location of the Lipan Aquifer and the groundwater availability model cells that represent the aquifer, are shown in Figure 1.

The TWDB previously completed a model simulation that meets the above desired future condition. This is documented in Groundwater Availability Model (GAM) Run 10-002

(Hutchison, 2010). As described in Hutchison (2010), historical annual pumping from the Lipan Aquifer has been based largely on the water levels in the aquifer at the beginning of the irrigation season. Each year, pumping depletes the aquifer to the point that it is no longer economical to continue. Thus, when water levels are high, higher pumping can occur than when water levels are lower. After the irrigation season, water-levels recover as the aquifer is recharged from precipitation, inflow from the neighboring Edwards-Trinity (Plateau) Aquifer, and interaction with surface water. The amount of water available for pumping, therefore, varies depending on the amount of winter recharge.

Because of this, the simulations in GAM Run 10-002 used to evaluate the pumping required to meet the desired future condition were set up to determine the average and range of pumping that would occur under a variety of recharge conditions. The results below show the minimum and maximum pumping for any single year, as well as the average pumping among all years of the simulations.

PARAMETERS AND ASSUMPTIONS:

The parameters and assumptions for the model run using the groundwater availability model for the Lipan Aquifer are described below:

- The results presented here are based on GAM Run 10-002 (Hutchison, 2010). See Hutchison (2010) for a full description of the methods, assumptions, and results of the groundwater availability model run.
- Version 1.01 of the groundwater availability model for the Lipan Aquifer was used for all simulations. See Beach and others (2004) for assumptions and limitations of the groundwater availability model.
- The model includes one layer representing the Quaternary Leona Formation, the underlying Permian Formations, and the Edwards-Trinity (Plateau) Aquifer to the west, south, and north. It should be noted that extent of the Lipan Aquifer in the model predates the updated footprint noted in the 2007 State Water Plan and does not include all of the aquifer as it is currently delineated.
- The mean error (a measure of the difference between simulated and measured water levels during model calibration) in the groundwater availability model is 4.7 feet for the calibration period (1980-1989) and 1.8 feet for the verification period (1990-1999. Beach and others, 2004).

Modeled Available Groundwater and Permitting

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

RESULTS:

The modeled available groundwater for the Lipan Aquifer in Groundwater Management Area 7 as a result of the desired future condition is, on average, approximately 41,000 acre-feet per year. We have divided this pumping by county, regional water planning area, and river basin for each decade between 2010 and 2060 for use in the regional water planning process (Table 1). Notice that the Lipan Aquifer is located entirely within Region F Regional Water Planning Area and the Colorado River Basin.

We have also summarized the minimum, average, and maximum modeled available groundwater by county and groundwater conservation district (Tables 2 and 3, respectively) based on the seasonal considerations explained earlier.

LIMITATIONS:

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

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

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

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

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

REFERENCES:

Beach, J.A., Burton, S. and Kolarik, B., 2004, Groundwater availability model for the Lipan Aquifer in Texas: contract report to the Texas Water Development Board.

Hutchison, W.R., 2010, GAM Run 10-002: Texas Water Development Board, GAM Run 10-002 Report, 8 p.

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

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

Table 1. Modeled available groundwater in acre-feet for the Lipan Aquifer in Groundwater Management Area 7 by county, regional water planning area, and river basin. Pumping volumes are included for only portions of the counties included in the Lipan-Kickapoo Groundwater Conservation District. Note this table reflects the results assuming average pumping and climatic conditions. For drier climatic conditions, please see Table 2 (Minimum Modeled Available Groundwater).

County	Regional Water Planning Area	Basin	Year					
			2010	2020	2030	2040	2050	2060
Concho	F	Colorado	1,834	1,834	1,834	1,834	1,834	1,834
Runnels	F	Colorado	15	15	15	15	15	15
Tom Green	F	Colorado	39,361	39,361	39,361	39,361	39,361	39,361
Total			**41,209**	**41,209**	**41,209**	**41,209**	**41,209**	**41,209**

Table 2. Estimated minimum, average, and maximum modeled available groundwater for the Lipan Aquifer summarized by county in Groundwater Management Area 7. Results are in acre-feet per year. Pumping volumes are included for only portions of the counties included in the Lipan-Kickapoo Groundwater Conservation District.

County	Modeled Available Groundwater		
	Minimum	Average	Maximum
Concho	1,403	1,834	2,311
Runnels	11	15	19
Tom Green	30,131	39,361	49,602
Total	**31,545**	**41,209**	**51,932**

Table 3. Estimated minimum, average, and maximum modeled available groundwater for the Lipan Aquifer summarized by groundwater conservation district (GCD) in Groundwater Management Area 7. Results are in acre-feet per year. WCD refers to Water Conservation District.

Groundwater Conservation District	Modeled Available Groundwater		
	Minimum	Average	Maximum
Lipan-Kickapoo WCD	31,545	41,209	51,932

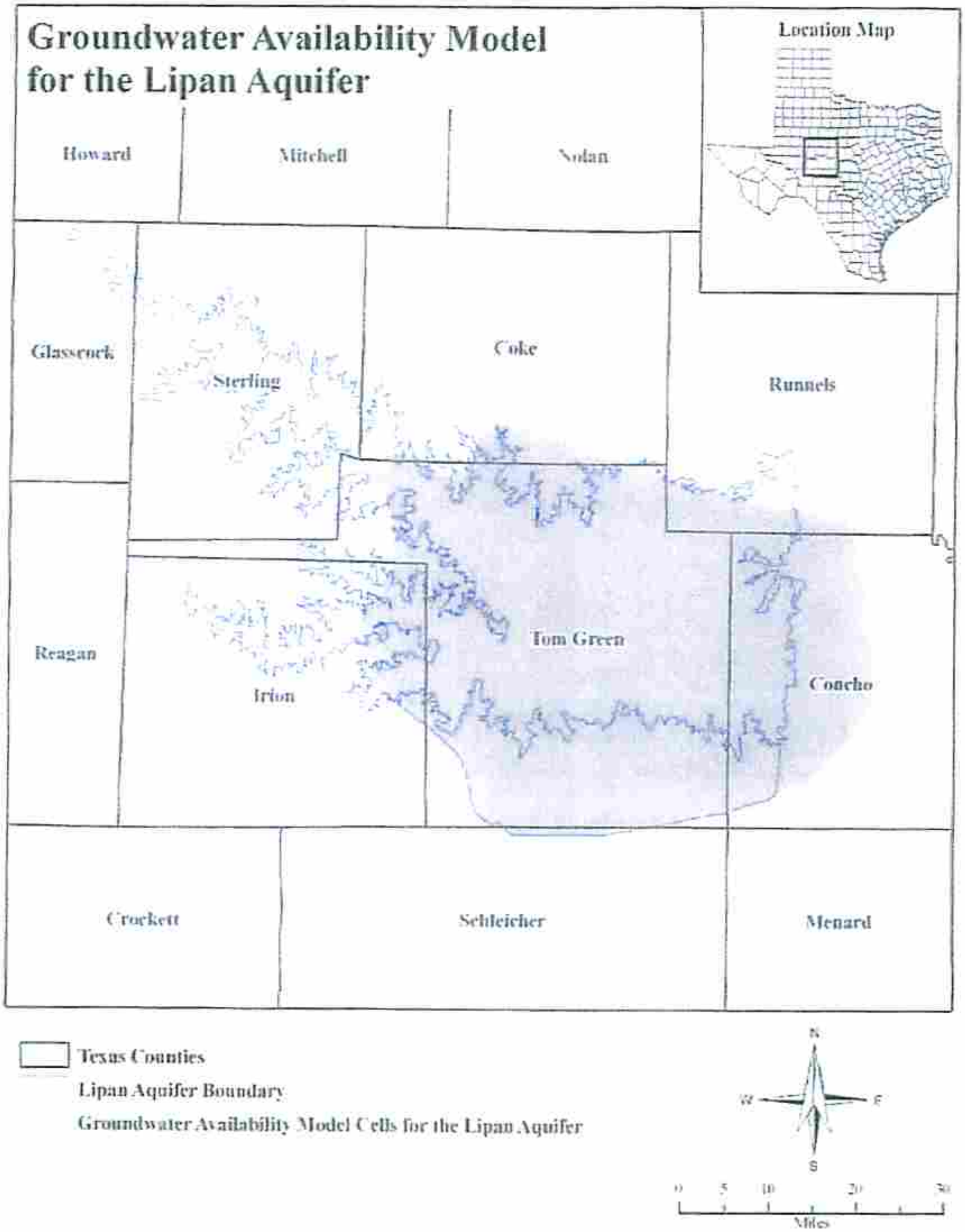

Figure 1. Map showing the areas covered by the groundwater availability model for the Lipan Aquifer.

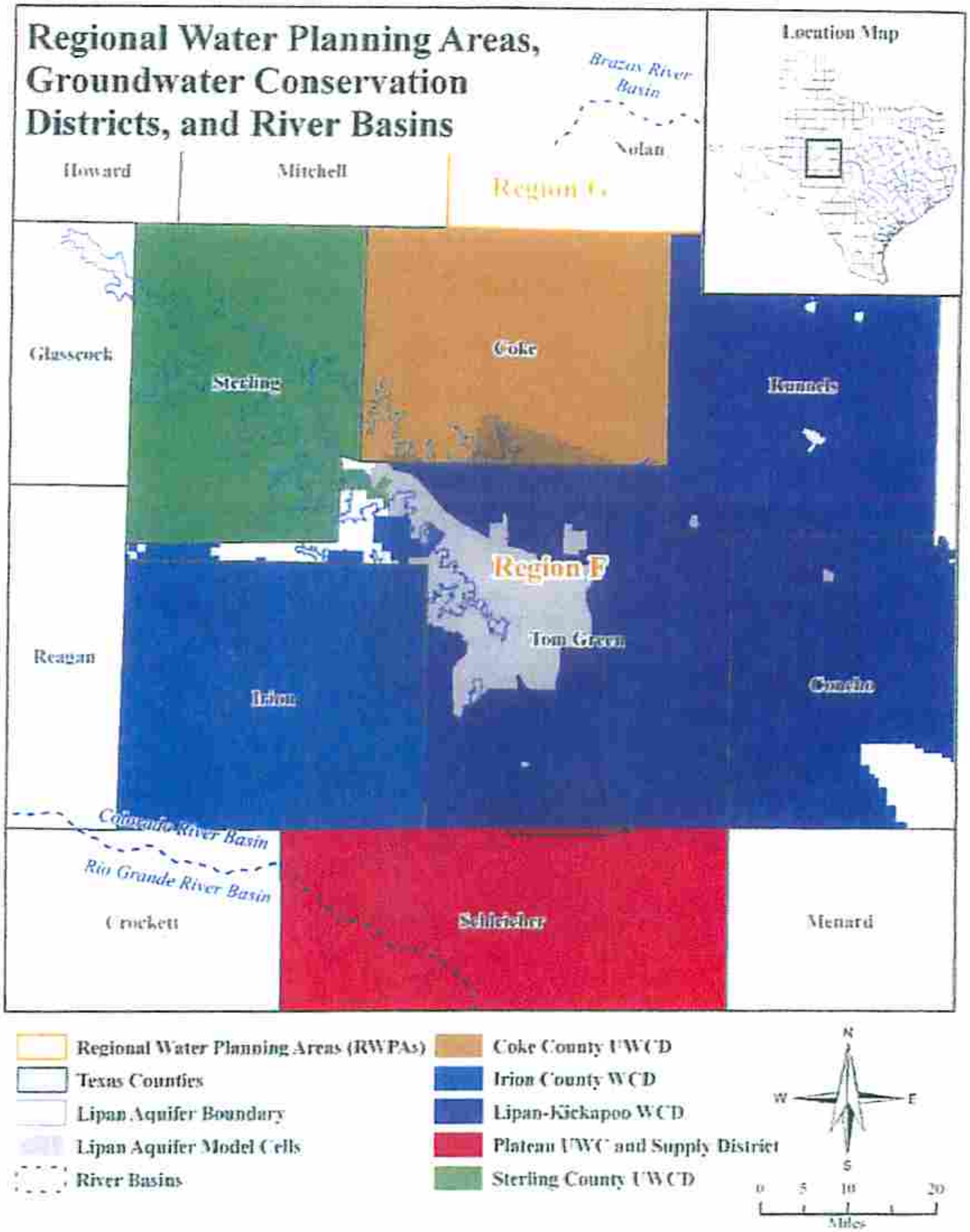

Figure 2. Map showing regional water planning areas (RWPAs), groundwater conservation districts (GCDs), counties, and river basins in the vicinity of the Lipan Aquifer in Groundwater Management Area 7.