Middle Pecos Groundwater Conservation District
Minutes of July 21, 2015

On this the 21st of July, 2015, a regular board meeting and public hearings and workshop were held by the Middle Pecos Groundwater Conservation District in the office located at 405 North Spring Drive, Fort Stockton, Texas, with the following members present, to-wit:

Jerry McGuairt	President, Precinct 1
M. R. Gonzalez	Secretary/Treasurer, Precinct 2
John Dorris	Vice President, Precinct 3
Janet Groth	Precinct 1
Weldon Blackwelder	Precinct 3
Vanessa Cardwell	City of Fort Stockton

Quorum Present.
Board members absent: Jeffery McMahon, Ronald Cooper, Terry Whigham Merrell Daggett and Alvaro Mandujano, Jr.

Others present: Paul Weatherby, Mike Gershon, Raymond Straub, Vince Clause, Gail Reeves, Ty Edwards, Harvey Gray, Melissa Mills, Rod Ponton, Darrell Peckham, Brock Thompson, Jeff Williams, Ed McCarthy, Jr., Mike Thornhill, Morgan Johnson, Homer Mills, James Cravens, Gil Van Deventer, Gerald D. Lyda, Steve Finch, Frank Urias, Tommy Ervin, Mr. and Mrs. David Mitchell, Glenn Honaker, Jim Perkins, Don Burns, Stanley Weiner, Stan Weiner, Alan Murphy, Chance Murphy, Adam Friedman, Doug May, Alyson McDonald, Joe Shuster, Chris Alexander, Santiago Cantu, Gladys Dorris, and Bob Beal/Fort Stockton Pioneer.

CONTINUATION of SHOW CAUSE HEARING ON ALLEGED VIOLATION OF DISTRICT'S RULES BY BUGINGTON ENERGY, LLC

I Call to Order at 10:04 a.m. by President Jerry McGuairt

II Show Cause Hearing on alleged violations of District's Rules 14.1(d), 14.2(a) and (c), and 14.3(a)-(c) pertaining to waste, pollution and degradation of quality of groundwater by **BUGINGTON ENERGY, LLC and Bugington Energy, LLC's compliance with District's May 2015 enforcement order.**

Bugington Energy, LLC, did not have any of their company officers or employees in attendance at the hearing.

Bugington Energy, LLC, was represented by Morgan Johnson of McGinnis Lochridge law firm. She stated that she is not making a formal appearance – only observing.

On July 2, 2015, the law firm of McGinnis Lockridge sent a letter contending that the District does not have jurisdiction over these matters; rather the Railroad Commission has exclusive jurisdiction. While Bugington intends to be cooperative, Bugington denies the District's allegations and will not waive its position that the hearing and enforcement action are unlawful.

Bugington's letter also stated that the Railroad Commission is reviewing a work plan with an estimated time of approval to be in August.

On May 19, 2015 an Order was issued to Bugington Energy, LLC as follows: Bugington Energy, LLC must submit to the District by July 3, 2015, a work plan prepared by a competent person licensed by the Texas Board of Professional Geoscientists and experienced with oil field spills that meets the following requirements: (A) identifies constituents of concern that could degrade groundwater quality; (B) determines the lateral and vertical extent of those constituents of concern by evaluation including excavation, soil borings or otherwise; (C) incorporates findings from this evaluation into the work plan; and (D) proposes an appropriate action plan for remediation to be considered and approved by the District's Board President and General Manager. There has been no communication from/with Bugington or their representatives and no compliance with the May 19, 2015 order. Today the penalty phase will begin.

Order #2, July 21, 2015:

(1) Having failed to comply with the May 19, 2015 District Order to submit a proper work plan to outline all possible groundwater contamination sources, the extent of the migration of that contamination, and an ultimate plan for remediation, Bugington must submit to the District by September 4, 2015, a revised work plan, using the same enunciated standards as previously ordered by the District in its May 19, 2015 order, to properly identify and remediate all pollution to groundwater as a result of Bugington's violation of District rules.

(2) Bugington shall remit to the District the penalty amount of $30,000.00 (thirty thousand and no/100 dollars) no later than August 17, 2015.

(3) Bugington may be responsible for remitting to the District the additional penalty amount of $100,000.00 (one hundred thousand and no/100 dollars), subject to reduction by the Board depending upon Bugington's compliance with this order and any future order of the Board.

(4) The Show Cause Hearing is continued again until August 18, 2015, at 10:00 a.m., during which the Board will receive a status report on Bugington's compliance with this order, take any additional necessary enforcement action.

The District's General Manager is directed to communicate with the RRC Director of Enforcement to make him aware of this order and to request that the RRC accelerate the deadlines imposed on Bugington, including a specific requirement that Bugington immediately commence its assessment of groundwater pollution and appropriate remediation.

The District's General Manager, Mr. Paul Weatherby; Assistant General Manager, Ty Edwards; and consultant, Raymond L. Straub, Jr., P.E., presented sworn testimony and evidence during the Hearing regarding the alleged violations, including among other things the District's Bugington enforcement file; photographs of the relevant sites and Bugington's equipment, discharge pipe, and discharges; hydrogeological information including water table depth, and groundwater flow measurements; soil properties data; and the written evaluation of potential contamination prepared by consultant Allan R. Standen, P.G., which indicated that Bugington's discharges would reach the underlying water table in an estimated 12 to 26 days, depending on saturated conditions.

Mr. Raymond L. Straub Jr., a professional geoscientist with the Straub Corporation, who was engaged to assess possible impacts, horizontally and vertically, to groundwater and the recharge zone at and around the spill sites caused by Bugington's apparent discharges, and to offer expert opinion through the investigation process, recommended the continued use of industry standards employed from time to time by the Railroad Commission of Texas ("RRC") to further assess such impacts;

Mr. Raymond L. Straub Jr., presented a proposal to the Board of Directors that would support enforcement proceedings against Bugington Energy for two sites located in pasture areas on the WT Shear Lease near Imperial, TX. The proposal is for 3 monitor wells approximately 70 feet in depth or approximately 15 feet below static water level and would be 2" sch. 40 pvc. The total cost estimate is $56,477.50.

An Executive Session was called at 10:53 a.m. by President Jerry McGuairt pursuant to the Texas Open Meetings Act, Sections 551.071 of the Texas Government Code, to consult with attorney.

The executive session continued through lunch and ended at 1:20 p.m. The Board reconvened into open session. President McGuairt stated that no decisions or votes were made in executive session.

III Consider and act on **alleged violations by BUGINGTON ENERGY, LLC**, and consider and act on appropriate penalty or other enforcement remedy to be imposed and/or pursued in court.

Board Member Janet Groth:
I would like to make a motion and as a preface to the motion, I would like to reiterate that in our authorizing legislation that we are in charge of preserving and protecting groundwater and that I am making this motion in that spirit. We do have the directive to preserve the water quality and quantity. We do have clear evidence from our expert testimony today that there is clear indication that groundwater contamination issues exist.

I (Janet Groth) make a motion that we fine Bugington Energy, LLC, a total of $130,000.00. $30,000.00 is to be payable immediately. The $100,000.00 we can review, and if Bugington Energy, LLC, come across and starts coming into compliance with what we are doing – then we can review the extra $100,000.00 to see where we are, and possibly reduce that. I would also like to order them to complete the work order and get it to us in 45 days and the work order has to be prepared by a professional as specified in our May 19th Order. I would also like to make sure that Paul Weatherby stay in contact with the Railroad Commission and that we make it clear that we are working with them to try and fill a void that they may have – or to help them get this taken care of. Our issue is the expediency – this has gone on way too long and we feel a sense of urgency that they may not feel.

After discussion, Janet Groth rescinded her previous motion.

Janet Groth made a motion to fine Bugington Energy, LLC, $130,000.00. $30,000.00 is to be payable within 30 days. The additional $100,000.00 to be reviewed each month as we have reports of them making progress. The motion was seconded by John Dorris. Motion carried unanimously.

Janet Groth made a motion to authorize/direct Paul Weatherby to be in communication with the Railroad Commission over this issue, along with others that want to attend, to share the findings from these hearings, the sworn testimony and any enforcement order. We hope the Railroad Commission will switch gears and require the assessment of groundwater pollution on a parallel track on an expedited basis. Motion seconded by Vanessa Cardwell. Motion carried unanimously.

Janet Groth made a motion to require Bugington Energy, LLC, to submit a work plan developed by a competent person licensed by the Texas Board of Professional Geoscientist and experienced with oilfield related spills that provides for an investigation of groundwater pollution. The work plan is to be submitted to the MPGCD within 45 days. And, to instruct Bugington Energy, LLC, to implement said plan and produce a second work plan providing for remediation as necessary and expeditiously. Motion seconded by John Dorris. Motion carried unanimously.

Janet Groth reiterated that the basis for the motions is our rule 15.3.3 for the fines.

IV Adjourn. President Jerry McGuairt continued the hearing until August 18, 2015, at 10 a.m. at the MPGCD office; with the exception that the $30,000.00 fine is to be paid in 30 days and that is a final decision.

Bugington Hearing reopened:

John Dorris made a motion to have Manager Paul Weatherby make an Executive Decision, based on the conversation with the Railroad Commission, whether or not to have Straub Corporation to begin work on drilling 3 monitor wells in support of enforcement proceedings against Bugington Energy, LLC. Motion seconded by M. R. Gonzalez. Motion carried unanimously.

Bugington Hearing re-continued until August 18, 2015, at 10 a.m. at the MPGCD office.

PUBLIC HEARING ON MANAGEMENT PLAN

Item skipped.

PRODUCTION PERMIT HEARING for EAST PECOS SOLAR, LLC.

I Call to order at 1:56 p.m. on Public Hearing on **Production Permit for East Pecos Solar, LLC.**

The application requests 250 acre feet/year from the Edwards Trinity and Pecos Valley Aquifer for 1 well located on H and GN RR CO Block 12 Section 6 approximately 1.6 miles North West of Nevill Road and RR 1901 Intersection, in Pecos County, Texas. The purpose of this well is for Industrial and Domestic Use.

Party representing application: John Lichtenberger was unable to attend, and has asked to be on the August 18th meeting if necessary.

Protestant to application: None

Ty Edwards presented the application to the Board. The application requests 250 acre feet/year from the Edwards Trinity and Pecos Valley Aquifer for 1 well located on H and GN RR CO Block 12 Section 6 approximately 1.6 miles North West of Nevill Road and RR 1901 Intersection, in Pecos County, Texas. The purpose of this well is for Industrial and Domestic Use. The property is owned by Larry Drgac and has a historical and existing use permit for 862 acre feet for agricultural purposes. Larry Drgac submitted a letter giving permission to John Lichtenberger to file this application. The well was drilled in 1957 to 170' deep. We granted a tax abatement to East Pecos Solar, LLC for the solar facility. This application is requesting 249 acre feet for industrial use, and 1 acre foot for domestic use for the buildings and facilities. The application is administratively complete.

II Adjourn hearing and consider and/or act on **Production Permit for East Pecos Solar, LLC.**

President Jerry McGuairt continued the hearing until August 18, 2015, at 10:30 a.m. at the MPGCD office

Workshop on Proposed Budget and Tax Rate Call to Order following Public Hearings.

Item skipped.

REGULAR BOARD MEETING

I Call to order at 2 P.M. by President McGuairt.

II Comments from **public and media** - No comments from the public or media.

III Consider and/or act upon **Minutes of May 19, 2015**.
Janet Groth made a motion to approve all minutes as presented for May 19, 2015. Motion seconded by M. R. Gonzalez. Motion carried unanimously.

IV Consider and/or act upon **Minutes of July 9, 2015**
Meeting was cancelled due to lack of quorum.

V Consider and/or act upon **Accounts Payable and Treasurer's Report and Line Item Transfers for the Month Ending May 31, 2015**.
Janet Groth made a motion to accept the Accounts Payable and Treasurer's Report and Line Item Transfers for the Month Ending May 31, 2015. Motion seconded by John Dorris. Motion carried unanimously.

VI Consider and/or act upon **Accounts Payable and Treasurer's Report and Line Item Transfers for the Month Ending June 30, 2015**.
Vanessa Cardwell made a motion to accept the Accounts Payable and Treasurer's Report and Line Item Transfers for the Month Ending June 30, 2015. Motion seconded by John Dorris. Motion carried unanimously.

VII Consider and/or act upon Management Plan
Item skipped.

VIII General Managers' 3rd Quarter Report
Item Tabled

IX **Progress Reports: Well Registrations, Production Permits, Drilling Permits, Data Loggers, ongoing Water Quality Analysis.**

General Manager Paul Weatherby reported that there is no new additional information.

X Consider and/or act upon **Power Point presentation given by Gil Van Deventer, PG, indentifying the San Andres wells in northern Pecos County or to propose and advise a path forward in addressing the San Andres wells.**

Gil Van Deventer, PG, Hydrogeologist with Trident Environmental presented a work plan for assessment of San Andres Artesian wells in northern Pecos County with a power point presentation.

- The San Andres is an artesian aquifer allowing for groundwater to travel up the borehole and potentially up to the surface where flows as much as 4,000 gallons per minute have been reported.
- Published records indicate that at least 36 San Andres wells were drilled in northern Pecos County between 1926 through 1957, with most drilled in the 1940's according to TBWE Bulletin #6106 which was published in 1961.
- Wells may have TDS concentrations exceeding 5,000 mg/L.
- The base flow of the impacted water table travels towards the Pecos River watershed. Base flow from the shallow alluvium contributes to the discharge of the Pecos River.
- There is a potential for incipient subsidence and sinkholes
- The presence of entrained hydrogen sulfide (H_2S) in San Andres water allows conditions for potentially unsafe air exposure.

Scope of Proposed Assessment Work Plan:

- Gather available records and information on the San Andres wells.
- Develop priority ranking criteria to assess a level of risk imposed by the wells by assigning weighted values, compile all data. Photo document well site area with digital camera.

Mr. Van Deventer will prepare a proposal of the scope of work to the August 18, 2015 meeting.

No action taken.

XI Power Point **Presentation on Capitan Reef Complex Aquifer as it pertains to La Escalera Ranch**

Gerald D. Lyda/La Escalera Ranch and Steve Finch, Jr./John Shomaker & Assoc, Inc. presented a power point presentation called "Evaluation of Fresh Groundwater in the Capitan Reef Complex Aquifer Beneath La Escalera Ranch and Surrounding Area.

- La Escalera Capitan Reef Complex Aquifer Summary:
- Calculated recharge is 25,000 to 35,000 acre feet/year
- Predominately fresh groundwater with TDS ranging from 300 to 1,000 mg/L
- La Escalera Ranch contains 175,000 acres of Capitan Reef Complex Aquifer with average 1,500 ft. thickness.
- Transmissivity will support large capacity wells

XII Update on **STW Water Process & Technologies' Capitan Reef Complex Aquifer Project**

Alan Murphy, President of STW Water Process & Technologies, updated the Board on the projects they have going in Pecos County.

- Working with Pecos County Commissioners' Court on a feasibility study regarding the San Andreas water formations. They would like to use the water for municipal and industrial use.
- The Capitan Reef Complex Aquifer project on the City of Fort Stockton's section 112 has had Test well #1 and its replacement well plugged. The monitor well that was drilled into the Capitan Reef Complex is providing the water for the drilling of the test wells and 7 million gallons has been used within the last 4 1/2 months – and tests show the quality and quantity unaffected.
- Currently drilled test well#2 to 120'
- Pursuing a production permit for the artesian wells near Imperial in the San Andreas formation
- Working on a project for a Reverse Osmosis plant
- Will pursue a production permit for the Capitan Reef Complex Aquifer wells and follow the guidelines for that permit including a hydrogeological study.
- Working with the City of Fort Stockton to order equipment to get their well #1 up and running and also get the downtown plant up and running.
- We can run water into the City's pipeline and start using Test Well 2 once we get a production permit for the City of Fort Stockton.

XIII Consider and possibly take action on **STW Water Process & Technologies' request for Rehearing on Capitan Reef Complex Aquifer Moratorium Resolution dated June 8, 2015**

Attachment 1: 06-08-2015 STW's Request for Rehearing

Adam Friedman, representing STW Water Process & Technologies'(STW), took the floor. For the record – the Board and Mr. Friedman discussed possible conflict-of-interest issues, and both the Board and Mr. Friedman declared there is no conflict-of-interest issues.

Mr. Friedman said STW would like to clarify their project and ease the Board's concern with their project in hopes of having the moratorium lifted and allowing them to move forward with the application process and to demonstrate their hydrogeological report studies in support of their future production permit application. Today STW is request for a rehearing is asking for the Board to hold a public hearing with a 20 day hearing notice and allow stakeholders to comment. The 20 day notice because they feel the moratorium equates to a rule making. He stated that ultimately the MPGCD Management Plan adopted a Modeled Available Groundwater of 9,761 acre feet for the Capitan Reef Complex Aquifer.

Mr. Friedman offered items into the record:

- Attachment #2 GAM Task 13-030 Total Estimated Recoverable Storage for Aquifers in GMA 7.
- Attachment #3 Resolution #07-29-10-6 Designation of Desired Future Conditions for the Capitan Reef Aquifer in GMA 7.
- Attachment #4 GTA Aquifer Assessment 10-09 MAG Capitan Reef Complex Aquifer-Modeled Available Groundwater Estimates in GMA 7.

Alan Murphy stated that they would like to drill test well#2, which will make between 2,000 – 2,400 gallons per minute (2,880,000 per day); Tie into the City of Fort Stockton's existing infrastructure and start running the water through their treatment system. Once there is a decision on the hearing – drilling the well should take about 60 days, and then another 35 – 40 to complete the hydrological report.

An Executive Session was called at 4:10 p.m. by President Jerry McGuairt pursuant to the Texas Open Meetings Act, Sections 551.071 of the Texas Government Code, to consult with attorney.

The executive session ended at 4:25 p.m. The Board reconvened the open session. President McGuairt stated that no decisions or votes were made in executive session.

President McGuairt announced that no action will be taken at this time.

XIV Consider and/or act upon **General Manager's Correspondence.**

- 07-17-2015: Summary of GCD-Related Legislation Enacted during Regular Session of 84th Texas Legislature.
- 07-17-2015: Update on recent legal developments at Texas Legislature, Texas Supreme Court and U. S. Federal Court (Western District).
- Order from case 5:14-cv-00848-RP filed 06-02-2015 GG Ranch, LTD. Horton Ranches, Inc. Lloyd and Dancy Tschirhart, Eakin Ranches, LTD, and Rusty Ulbrich versus The Edwards Aquifer Authority
- Order from case P-7047-83-CV filed 06-08-2015 Fort Stockton Holdings, L.P. versus Middle Pecos GCD. The order resets the hearing date before the Honorable Stephen Ables to September 21, 2015 at 10:30 A.M.
- 07-16-2015: The Bastrop Advertiser, article titled Forestar, Landowners may contest requests.
- 07-09-2015: Environmental Awareness seminar agenda.
- Stephen Robertson PBPA correspondence, 07-06-2015.
- Resolution authorizing outside counsel to represent Ector County in cases alleging violation of the Texas Water Code.

XV **Directors' comments**. No Directors' comments

XVI Consider and/or act upon **agenda for next** meeting.
Bugington Energy, LLC, hearing. East Pecos Solar production permit hearing. Trident Environmental/Gil Van Deventer. 2015 Management Plan. 2016 Proposed Budget. Temporary Production Permit for the City of Fort Stockton. Larry Drgac production permit.

XVII **Adjourn**.
M. R. Gonzalez made a motion to adjourn the meeting at 4:45 p.m. Motion seconded by John Dorris. Motion carried unanimously.

M. R. Gonzalez, Secretary/Treasurer

Jerry McGuairt, President

Date Approved 8/18/15

Minutes prepared by Melissa Mills

Minutes of July 21, 2015
Attachment 1
Rehearing Request

STW Water Process & Technologies
A Division of STW Resources Holding Corp.
3424 South County Road 1192 Midland, Texas 79706
Phone: (432) 687-1811

June 8, 2015

Board of Directors
Paul Weatherby, General Manager
Middle Pecos Groundwater Conservation District
PO Box 1644
Fort Stockton, Texas 79735

FILED VIA U.S. MAIL
& HAND-DELIVERY

Dear Board of Directors and Mr. Weatherby:

It has come to the attention of STW Water Process & Technologies ("STW") that the District recently instituted a temporary moratorium on permitting in the Capitan Reef Aquifer within the District. STW hereby requests a rehearing of the Board's May 19, 2015, decision to issue the temporary moratorium in order to preserve its rights according to District Rule 4.9. STW would like the opportunity to meet with the District, County and City officials in order to discuss the implications of the moratorium and effects on the community before the decision is considered to be final under Rule 4.9.

STW is supportive of all opportunities to preserve private property rights and the logic behind the other justifications set forth the District's resolution adopting the temporary moratorium. However, there are other considerations not set forth in the resolution, including but not limited to whether existing statutory and case law support such a moratorium and whether a permit could/should be issued for current demand if a person/entity were to have a current demand for use in the Capitan Reef that would not impair the DFC because it would fall within the current MAG numbers.

Again, STW is a champion for the District and its mission. We are simply filing this request for rehearing in an effort to make sure we preserve our rights given the short window of time to internally process the Board's decision under Rule 4.9 and to request the opportunity to meet with District, County and City officials in order to better understand the effects of the decision.

Thank you for your consideration of this request, and we look forward to working with you on the issues discussed in this letter. Please let me know if I can provide you with any other information.

Regards,

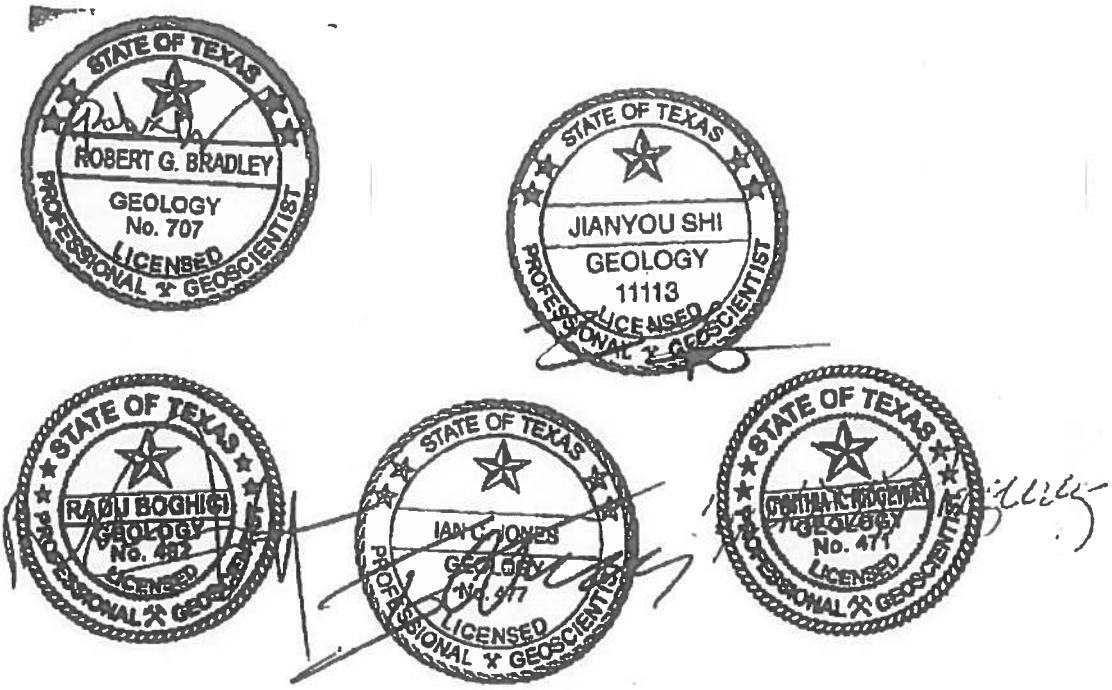
Stanley T. Weiner
Chief Executive Officer

cc: The Honorable Judge Joe Shuster, Pecos County Judge
The Honorable City Council, City of Fort Stockton
Raul Rodriguez, City Manager, City of Fort Stockton

Minutes of July 21, 2015
Attachment 2
GAM TASK 13-030
53 PAGES

GAM TASK 13-030: TOTAL ESTIMATED RECOVERABLE STORAGE FOR AQUIFERS IN GROUNDWATER MANAGEMENT AREA 7

by Ian C. Jones, Ph.D., P.G., Robert Bradley, P.G., Radu Boghici, P.G., William Kohlrenken, and Jerry Shi, Ph.D., P.G.
Texas Water Development Board
Groundwater Resources Division
(512) 463-6641[1]
October 2, 2013



The seals appearing on this document were authorized by Ian C. Jones, P.G. 477, Robert Bradley, P.G. 707, Radu Boghici, P.G. 482, Jerry Shi, P.G. 11113, and Cynthia K. Ridgeway, P.G. 471 on October 2, 2013. 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 total estimated recoverable storage in this report was calculated as follows: the Capitan Reef Complex, Edwards-Trinity (Plateau), Trinity, and Pecos Valley aquifers (Ian Jones); the Hickory, Ellenburger-San Saba, and Marble Falls aquifers (Robert Bradley); the Blaine, Igneous, and Seymour aquifers (Radu Boghici); the Dockum, Lipan, and Ogallala aquifers (William Kohlrenken); and the Rustler Aquifer and the Edwards-Trinity (Plateau) Aquifer in Kinney County (Jerry Shi).

[1] This is the office telephone number for Ian Jones

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GAM TASK 13-030: TOTAL ESTIMATED RECOVERABLE STORAGE FOR AQUIFERS IN GROUNDWATER MANAGEMENT AREA 7

by Ian C. Jones, Ph.D., P.G., Robert Bradley, P.G., Radu Boghici, P.G.,
William Kohlrenken, and Jerry Shi, Ph.D., P.G.
Texas Water Development Board
Groundwater Resources Division
(512) 463-6641[2]
October 2, 2013

EXECUTIVE SUMMARY:

Texas Water Code, §36.108 (d) (Texas Water Code, 2011) states that, before voting on their proposed desired future conditions for a relevant aquifer within a groundwater management area, the groundwater conservation districts shall consider the total estimated recoverable storage as provided by the executive administrator of the Texas Water Development Board (TWDB) along with other factors listed in §36.108 (d). Texas Administrative Code Rule §356.10 (Texas Administrative Code, 2011) defines the total estimated recoverable storage as the estimated amount of groundwater within an aquifer that accounts for recovery scenarios that range between 25 percent and 75 percent of the porosity-adjusted aquifer volume.

This report discusses the methods, assumptions, and results of an analysis to estimate the total recoverable storage for the Hickory, Ellenburger-San Saba, Marble Falls, Blaine, Capitan Reef Complex, Rustler, Dockum, Trinity, Edwards-Trinity (Plateau), Igneous, Ogallala, Pecos Valley, Lipan, and Seymour aquifers within Groundwater Management Area 7. Tables 1 through 28 summarize the total estimated recoverable storage required by the statute. Figures 4 through 17 indicate the official extent of the aquifers in Groundwater Management Area 7 used to estimate the total recoverable storage.

DEFINITION OF TOTAL ESTIMATED RECOVERABLE STORAGE:

The total estimated recoverable storage is defined as the estimated amount of groundwater within an aquifer that accounts for recovery scenarios that range between 25 percent and 75

[2] This is the office telephone number for Ian Jones

percent of the porosity-adjusted aquifer volume. In other words, we assume that between 25 and 75 percent of groundwater held within an aquifer can be removed by pumping.

The total recoverable storage was estimated for each aquifer within Groundwater Management Area 7 for the portion that lies within the official lateral aquifer boundaries as delineated by George and others (2011). Total estimated recoverable storage values may include a mixture of water quality types, including fresh, brackish, and saline groundwater, because the available data and the existing groundwater availability models do not permit the differentiation between different water quality types. The total estimated recoverable storage values also do not take into account the effects of land surface subsidence, degradation of water quality, or any changes to surface water-groundwater interaction that may occur due to pumping.

METHODS:

To estimate the total recoverable storage of an aquifer, we first calculated the total storage in an aquifer within the official aquifer boundary in the groundwater management area. The total storage is the volume of groundwater that can be removed by completely draining the aquifer.

Aquifers can be either unconfined or confined (Figure 1). A well screened in an unconfined aquifer will have a water level equal to the water level outside the well—in the aquifer. Thus, an unconfined aquifer has water levels within the aquifer. A confined aquifer is bounded by low permeable geologic units at the top and bottom, and the aquifer is under hydraulic pressure above the ambient atmospheric pressure. The water level in a well screened in a confined aquifer will be above the top of the aquifer. As a result, calculation of total storage is different for unconfined and confined aquifers. For an unconfined aquifer, the total storage is equal to the volume of groundwater removed to make the water level fall to the aquifer bottom. For a confined aquifer, the total storage contains two parts. The first part is the groundwater released from the aquifer when the water level falls from above the top of the aquifer to the top of the aquifer. The reduction of hydraulic pressure in the aquifer by pumping causes expansion of groundwater and deformation of aquifer solids. The aquifer is still fully saturated to this point. The second part—just like unconfined aquifer—is the

groundwater released from the aquifer when the water level falls from the top to the bottom of the aquifer. Given the same aquifer area and water level drop, the amount of water released in the second part is much greater than the first part. The difference is quantified by two parameters: storativity or specific storage related to confined aquifer and specific yield related to unconfined aquifer. For example, storativity values range from 10^{-5} to 10^{-3} for most confined aquifers, while the specific yield values can be 0.01 to 0.3 for most unconfined aquifers. The equations for calculating the total storage are presented below:

- for unconfined aquifers

$$Total\ Storage\ = V_{drained} = Area \times S_y \times (Water\ Level - Bottom)$$

- for confined aquifers

$$Total\ Storage\ = V_{confined} + V_{drained}$$

  - confined part

$$V_{confined} = Area \times [S \times (Water\ Level - Top)]$$

or

$$V_{confined} = Area \times [S_s \times (\text{Top} - \text{Bottom}) \times (Water\ Level - Top)]$$

  - unconfined part

$$V_{drained} = Area \times [S_y \times (Top - Bottom)]$$

where:

- $V_{drained}$ = storage volume due to water draining from the formation (acre-feet)
- $V_{confined}$ = storage volume due to elastic properties of the aquifer and water(acre-feet)
- *Area* = area of aquifer (acre)
- *Water Level* = groundwater elevation (feet above mean sea level)
- *Top* = elevation of aquifer top (feet above mean sea level)
- *Bottom* = elevation of aquifer bottom (feet above mean sea level)
- S_y = specific yield (no units)
- S_s = specific storage (1/feet)
- S = storativity or storage coefficient (no units)

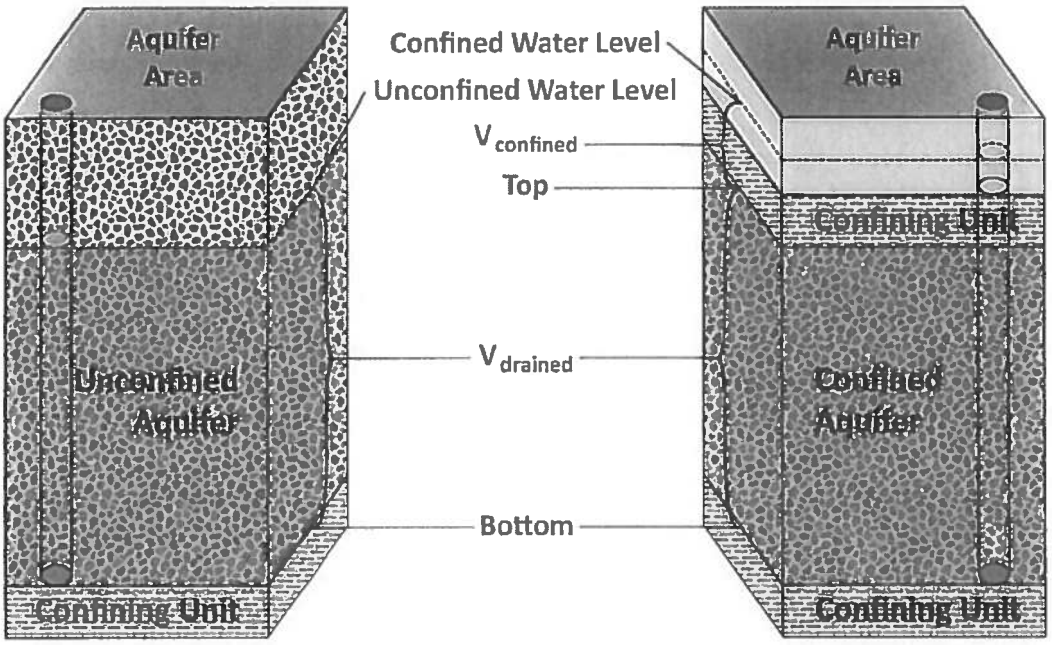

FIGURE 1. SCHEMATIC SHOWING THE DIFFERENCE BETWEEN UNCONFINED AND CONFINED AQUIFERS.

As presented in the equations, calculation of the total storage requires data, such as aquifer top, aquifer bottom, aquifer storage properties, and water level. For the Blaine, Rustler, Dockum, Trinity, Edwards-Trinity (Plateau), Ogallala, Pecos Valley, Lipan, and Seymour aquifers in Groundwater Management Area 7, we extracted this information from existing groundwater availability model input and output files on a cell-by-cell basis. For aquifers without groundwater availability model(s), analogous approaches were used.

For the Capitan Reef Complex Aquifer in Groundwater Management Area 7, we used surfaces for the aquifer top and base constructed by Standen and others (2009). Due to insufficient water-level data to construct a water-level map we calculated total storage for the Capitan Reef Complex Aquifer assuming that $V_{confined}$ is very small relative to $V_{drained}$ and therefore insignificant. We extracted the aquifer top and base data using a grid with 1 square mile cells (Figure 2) and calculated total storage for each cells using the above equations. Finally, the total estimated recoverable storage was calculated as the product of the total storage and an estimated factor ranging from 25 percent to 75 percent.

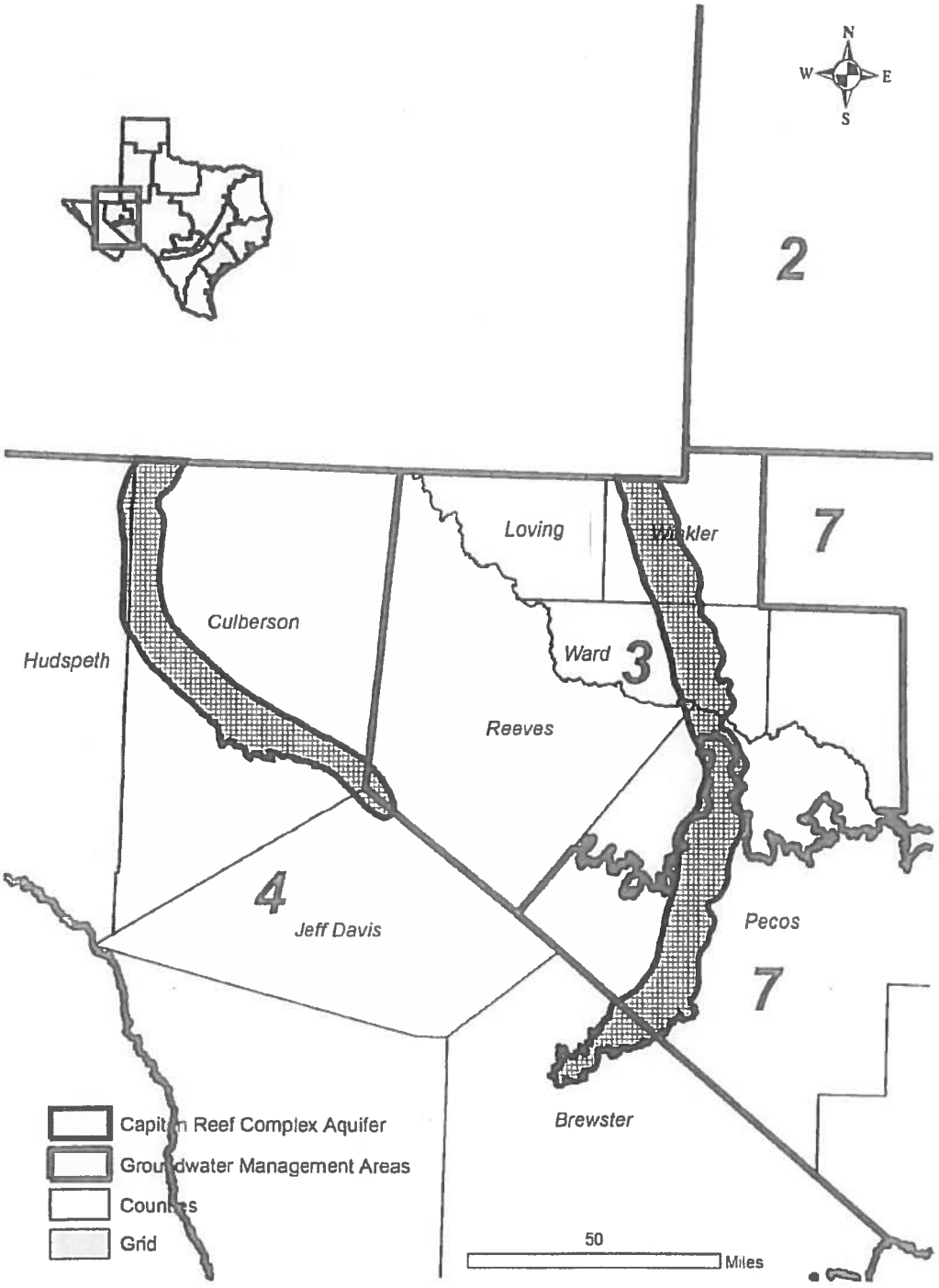

FIGURE 2. THE GRID CELLS USED TO CALCULATE TOTAL STORAGE FOR THE CAPITAN REEF COMPLEX AQUIFER IN GMA 7.

The following methodology was used to estimate total recoverable storage for parts of the Pecos Valley, Trinity, and Edwards-Trinity (Plateau) aquifers in Groundwater Management Area 7 that were not included in the 1-layer alternative groundwater flow model covering these aquifers (Hutchison and others, 2011a). The excluded parts of the respective aquifers are relatively thin and mostly located along the margins of the respective aquifers in the western part of the model.

Recoverable storage in areas outside of the model but within the official aquifer boundaries was estimated by first establishing a relationship between aquifer thickness and saturated thickness. Where aquifer thickness is the difference between the elevations of the aquifer top and base, and saturated thickness is the difference between the water table and aquifer base elevations. In each of the three aquifers included in this model there is a generally linear relationship between aquifer thickness and saturated thickness. In the Pecos Valley Aquifer, the ratio between saturated thickness and aquifer thickness is approximately 0.8, while in the Edwards-Trinity (Plateau) and Trinity aquifers, it is 0.9 and 0.6, respectively. Saturated thickness in the non-modeled areas was estimated using these ratios.

The three aquifers—Pecos Valley and Edwards-Trinity (Plateau) aquifers, and the Hill Country portion of the Trinity Aquifer—were assumed to be unconfined. Consequently, storage in each model cell representing parts of the respective aquifers excluded from the groundwater flow model was estimated using the following equation:

$$Total\ Storage = V_{drained} = Area \times S_y \times H_{sat}$$

where:

- $V_{drained}$ = storage volume due to water draining from the formation (acre-feet)
- $Area$ = area of aquifer (acre)
- S_y = specific yield (no units)
- H_{sat} = estimated saturated thickness (feet)

Storage volumes estimated using this method were added to the storage volumes from the modeled area to estimate the total recoverable storage for the entire aquifer.

The "Method of the Wedges" was used to calculate total storage for the Igneous Aquifer in Groundwater Management Area 7 which was excluded from the groundwater availability model for the Igneous Aquifer (Beach and others, 2004a). This area occurs along the margins of the Igneous Aquifer where the aquifer pinches out and is difficult to model. Total storage in this part of the aquifer was calculated based on the assumption that it takes the form of a right-wedge (Figure 3). Total storage was calculated by multiplying the volume of the assumed right-wedge by an assumed specific yield.

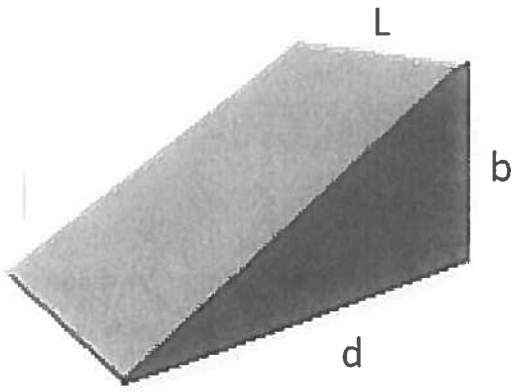

FIGURE 3. A SCHEMATIC OF THE RIGHT-WEDGE USED TO CALCULATE TOTAL STORAGE IN THE IGNEOUS AQUIFER IN GROUNDWATER MANAGEMENT AREA 7.

The volume of the right-edge was calculated using the formula:

$$V = 0.5 \times b \times L \times d$$

Where:

- b = the average saturated thickness of the last row of active model cells bordering the "wedge";
- L = the length of the last row of active model cells bordering the "wedge"; and
- d = the average distance between the last row of active model cells and the aquifer boundary.

In the case of the Edwards-Trinity (Plateau) Aquifer in Kinney County, aquifer bottom, area, storativity, and water levels were extracted from the input and output files of the alternative groundwater flow model for Kinney County (Hutchison and others, 2011b) on a cell-by-cell basis. Specific yield was not included in the model Layer-Property Flow package in this model because the Kinney County groundwater flow model simulated all hydrostratigraphic units as confined aquifers. The specific yield values for the Edwards-Trinity (Plateau) Aquifer were derived from the groundwater availability model by Anaya and Jones (2009), where a specific yield value of 0.014 was assigned for the Edwards Group and a specific yield value of 0.003 Trinity Group in the Edwards-Trinity (Plateau) Aquifer. A FORTRAN-90 program was developed and used to expedite the storage calculation. The total recoverable storage was calculated as the product of the total storage and an estimated factor ranging from 25 percent to 75 percent.

The water-level data from the TWDB Groundwater Database were used to develop the potentiometric surface and the total storage estimate for the Hickory, Ellenburger-San Saba, and Marble Falls aquifers. These water-level measurements were used to construct a potentiometric surface grid using Surfer® software. The base of the Hickory and Ellenburger-San Saba aquifers outcrop were derived from the Source Water Assessment Project (SWAP) data created by the United States Geological Survey (2002a; 2002b). These surfaces were re-created as grids in Surfer® software and used to calculate aquifer volumes. For the subcrop area, we used the top and bottom of the Hickory and Ellenburger-San Saba aquifers from Standen and others (2007). The confined volumes were calculated by first taking the difference in the potentiometric surface and tops of the respective aquifers in subcrop. This value was multiplied by a storage coefficient of 10-5 for the Hickory Aquifer and 0.0022 for the Ellenburger-San Saba aquifers, resulting in the total storage volume for the portion above the top of the aquifer. The unconfined volumes were calculated by multiplying the aquifer thickness by an assumed specific yield value of 0.03. Zonal statistics in ArcMap 10.1 software summed the data from grid calculations by county and groundwater conservation district. To calculate the estimated total estimated aquifer storage for the Marble Falls aquifer, the average saturated thickness was multiplied by the specific yield and aquifer area.

PARAMETERS AND ASSUMPTIONS:

Hickory and Ellenburger-San Saba Aquifers

- The Hickory and Ellenburger-San Saba aquifers within Groundwater Management Area 7 are unconfined in outcrop and confined in the subcrop areas.
- Limited storage data is available, but because the calculations include all of the Hickory and Ellenburger-San Saba aquifers, we used a storage coefficient of 10^{-4} and a specific yield of 0.03 (Bluntzer, 1992).

Marble Falls Aquifer

- The Marble Falls Aquifer—which only occurs in outcrop—is assumed to be unconfined.
- The saturated thickness is estimated at 60 feet based on available data (Texas Water Development Board Groundwater Database; Texas Department of Licensing and Regulation, 2013). No storage data was located for the area, but the specific yield is estimated to be 3 percent (American Society of Civil Engineers, 1996).

Blaine and Seymour Aquifers

- We used version 1.01 of the groundwater availability model for the Seymour and Blaine aquifers. See Ewing and others (2004) for assumptions and limitations of the groundwater availability model.
- This groundwater availability model includes two layers, representing the Seymour (Layer 1) and Blaine (Layer 2) aquifers. In areas where the Blaine Aquifer does not exist the model roughly replicates the various Permian units located in the study area.
- Of the two layers, total estimated recoverable storage was determined using the cells in the model that represent the Blaine Aquifer in layer 2.

Capitan Reef Complex Aquifer

- The Capitan Reef Complex Aquifer within Groundwater Management Area 7 is under confined conditions throughout the area.

- The potentiometric surface was not constructed due to insufficient water-level data. Instead, we assumed that confined part of total storage is much smaller than the unconfined part and is therefore insignificant. The justification for this assumption is that the aquifer thickness and specific yield used to calculate the unconfined part of the total storage are much larger than the confined head—difference between the water level and aquifer top elevations—and the storativity or specific storage used to calculate the confined part of the total storage.
- We used the base and top of the Capitan Reef Complex Aquifer constructed by Standen and others (2009). These surfaces were used to calculate aquifer thickness.
- No storage data were discovered for the area. We used a conservative estimate for the specific yield of 0.05 based on borehole geophysics data for the Capitan Reef Complex Aquifer (Garber and others, 1989).
- The total storage was calculated for each cell by multiplying cell area, aquifer thickness and a specific yield of 0.05.

Rustler Aquifer

- We used version 1.01 of the groundwater availability model for the Rustler Aquifer to estimate the total recoverable storage for the Rustler Aquifer. See Ewing and Others (2012) for assumptions and limitations of the groundwater availability model.
- This groundwater availability model includes two numerical layers which represent Dockum Aquifer/Dewey Lake Formation (Layer 1) and Rustler Aquifer (Layer 2).
- Model Layer 2 was used to calculate the total estimated recoverable storage for the Rustler Aquifer.

Dockum Aquifer

- We used version 1.01 of the groundwater availability model for the Dockum Aquifer to estimate the total recoverable storage for the aquifer. See Ewing and other (2008) for assumptions and limitations of the groundwater availability model.
- This 3-layer groundwater availability model includes two layers—layers 2 and 3—which represent the Dockum Aquifer.
- The groundwater availability model for the Dockum Aquifer includes down-dip portions of the Dockum Group that are not included in the official aquifer boundaries (Ewing and other, 2008). The down-dip boundary of the Dockum Aquifer is based on the 5,000 milligrams per liter (mg/L) total dissolved solids concentration line while the model extends beyond the 5,000 mg/L total dissolved solids line incorporating highly saline parts of the Dockum Group.

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

- We used the alternative groundwater flow model for the Edwards-Trinity (Plateau) Aquifer. See Hutchison and others (2011a) for assumptions and limitations of the alternative numerical groundwater flow model.
- We used the alternative groundwater flow model for the Edwards-Trinity (Plateau) Aquifer instead of the 2-layer official groundwater availability model (Anaya and Jones, 2009) because the alternative groundwater flow model has better water-level calibration statistics.
- This 1-layer groundwater flow model simulates groundwater flow through the Pecos Valley and Edwards-Trinity (Plateau) aquifers, and the Hill Country portion of the Trinity Aquifer.
- In this model, where the Pecos Valley and Edwards-Trinity (Plateau) aquifer overlap, total storage is assigned to the Pecos Valley Aquifer.

Edwards-Trinity (Plateau) Aquifer in Kinney County

- We used version 1.01 of the alternative groundwater flow model for the Kinney County area to estimate the total recoverable storage for the Edwards (Balcones Fault Zone)

and Edwards-Trinity (Plateau) aquifers in Kinney County. See Hutchison and Others (2011b) for assumptions and limitations of the numerical groundwater flow model.

- This groundwater flow model includes four numerical layers which represent the Carrizo-Wilcox Aquifer (Layer 1), Upper Cretaceous units (Layer 2), the Edwards (Balcones Fault Zone) and Edwards Unit of the Edwards-Trinity (Plateau) Aquifer (Layer 3), and the Trinity Unit of the Edwards-Trinity (Plateau) Aquifer (Layer 4).
- Model Layers 3 and 4 were used to calculate the total estimated recoverable storage for the Edwards-Trinity (Plateau) Aquifer in the Groundwater Management Area 7 in Kinney County.

Igneous Aquifer

- The part of the Igneous Aquifer in Groundwater Management Area 7 is not included in version 1.01 of the Igneous Aquifer and parts of the West Texas Bolsons—Wild Horse, Michigan, Ryan, and Lobo flats (Beach and others,2004a).
- Total storage was calculated based on aquifer thickness and length data obtained from the groundwater availability model by Beach and others (2004a) and an assumed specific yield value of 0.01. Please see the Methods Section for the approach used.

Ogallala Aquifer

- We used version 2.01 of the groundwater availability model for the southern portion of the Ogallala Aquifer and the Edwards-Trinity (High Plains) Aquifer to estimate the total recoverable storage for the southern portion of the Ogallala Aquifer. This model is an expansion on and update to the previously developed groundwater availability model for the southern portion of the Ogallala Aquifer described in Blandford and others (2003). See Blandford and others (2008) and Blandford and others (2003) for assumptions and limitations of the groundwater availability model.
- This groundwater availability model includes 4 layers which represent the southern portion of the Ogallala Aquifer (Layer 1) and the Edwards-Trinity (High Plains) Aquifer (primarily Edwards, Comanche Peak, and Antlers Sand formations; Layers 2-4).
- Of the four layers, total estimated recoverable storage was determined for the Ogallala Aquifer (Layer 1) in Groundwater Management Area 7.

Lipan Aquifer

- We used version 1.01 of the groundwater availability model for the Lipan Aquifer to estimate the total recoverable storage (Beach and others, 2004b).
- This groundwater availability model includes one layer that represents the Quaternary Leona Formation, the underlying Permian Formations, and the Edwards-Trinity (Plateau) Aquifer to the west, south, and north. The basis for the extent of the model boundaries for the Lipan Aquifer was developed using the boundaries recognized by TWDB prior to the boundary changes discussed in the 2007—Water For Texas state water plan.
- We used the version 1.01 of the groundwater availability model for the Dockum Aquifer to estimate total storage values for parts of the Lipan Aquifer that were not included in the groundwater availability model for the Lipan Aquifer and overlapped with the Dockum Aquifer. Layer 1 of the model represents overlying stratigraphic units, where the overlying stratigraphic units are within the Lipan Aquifer boundary, we assume the volumes represent the Lipan Aquifer.

RESULTS:

Tables 1 through 28 summarize the total estimated recoverable storage required by statute. The county and groundwater conservation district total estimates are rounded within two significant figures. Figures 4 through 17 indicates the extents of the Hickory, Ellenburger-San Saba, Marble Falls, Blaine, Capitan Reef Complex, Rustler, Dockum, Trinity, Edwards-Trinity (Plateau), Igneous, Ogallala, Pecos Valley, Lipan, and Seymour aquifers in Groundwater Management Area 7 used to estimate the total recoverable storage volume.

TABLE 1. TOTAL ESTIMATED RECOVERABLE STORAGE BY COUNTY FOR THE HICKORY AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 7. COUNTY TOTAL ESTIMATES ARE ROUNDED TO TWO SIGNIFICANT FIGURES.

County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Coleman	1,500,000	375,000	1,125,000
Concho	2,800,000	700,000	2,100,000
Gillespie	7,200,000	1,800,000	5,400,000
Kimble	5,900,000	1,475,000	4,425,000
Llano	1,000,000	250,000	750,000
Mason	5,400,000	1,350,000	4,050,000
McCulloch	8,500,000	2,125,000	6,375,000
Menard	4,500,000	1,125,000	3,375,000
San Saba	7,500,000	1,875,000	5,625,000
Total	44,300,000	11,075,000	33,225,000

TABLE 2. TOTAL ESTIMATED RECOVERABLE STORAGE BY GROUNDWATER CONSERVATION DISTRICT[3] FOR THE HICKORY AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 7. GROUNDWATER CONSERVATION DISTRICT TOTAL ESTIMATES ARE ROUNDED TO TWO SIGNIFICANT FIGURES.

Groundwater Conservation District (GCD)	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
No District	8,400,000	2,100,000	6,300,000
Hickory UWCD[4] No. 1	18,000,000	4,500,000	13,500,000
Hill Country UWCD	7,200,000	1,800,000	5,400,000
Kimble County GCD	5,500,000	1,375,000	4,125,000
Lipan-Kickapoo GCD	1,900,000	475,000	1,425,000
Menard County UWD[5]	3,300,000	825,000	2,475,000
Total	44,300,000	11,075,000	33,225,000

[3] The total estimated recoverable storage values by groundwater conservation district and county for an aquifer may not be the same because the numbers have been rounded to within two significant figures.
[4] UWCD is the abbreviation for Underground Water Conservation District.
[5] UWD is the abbreviation for Underground Water District.

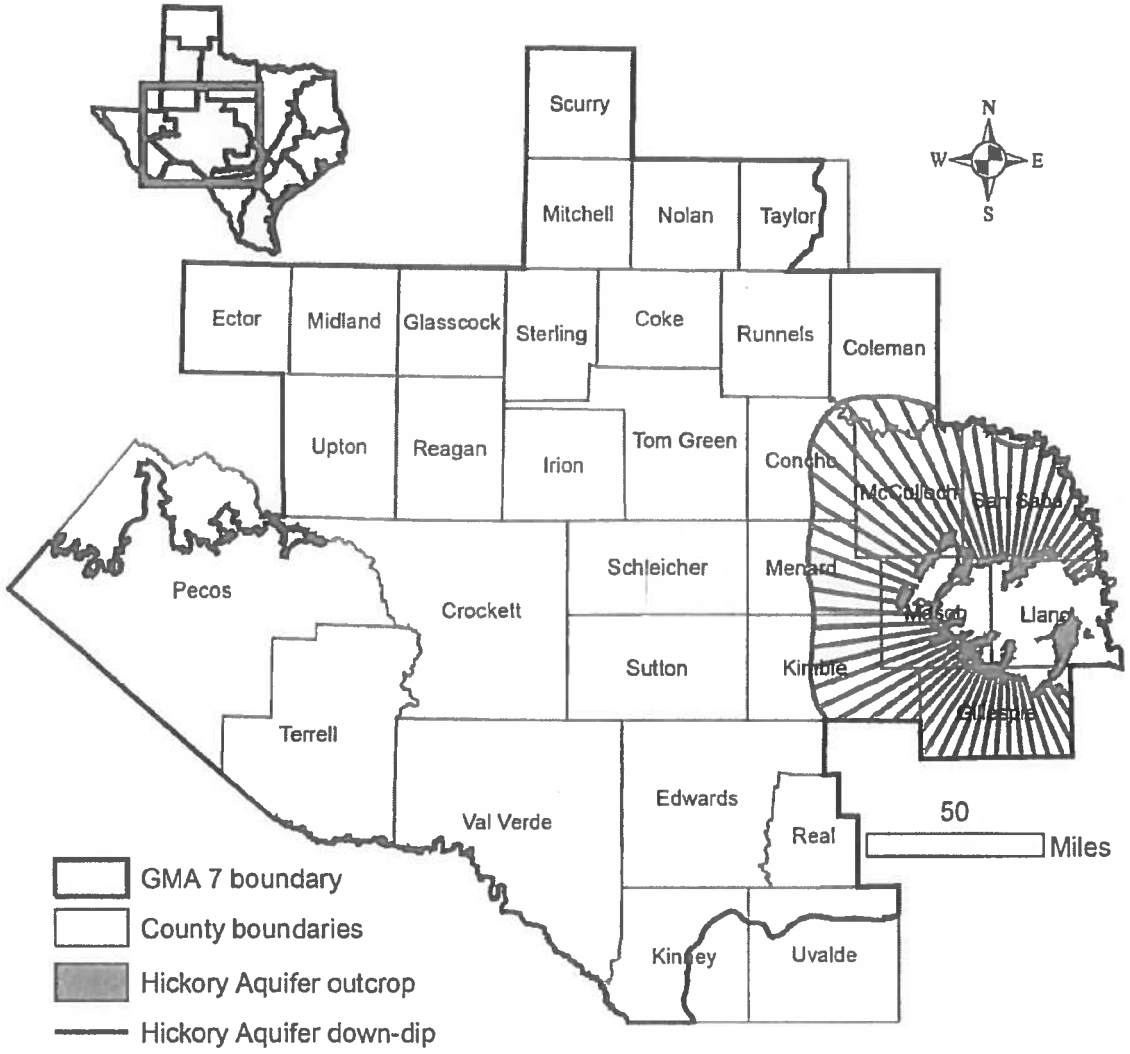

FIGURE 4. AREA OF THE HICKORY AQUIFER USED TO ESTIMATE TOTAL RECOVERABLE STORAGE WITHIN GROUNDWATER MANAGEMENT AREA (GMA) 7.

TABLE 3. TOTAL ESTIMATED RECOVERABLE STORAGE BY COUNTY FOR THE ELLENBURGER-SAN SABA AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 7. COUNTY TOTAL ESTIMATES ARE ROUNDED WITHIN TWO SIGNIFICANT FIGURES.

County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Coleman	1,400,000	350,000	1,050,000
Concho	62,000	15,500	46,500
Gillespie	6,500,000	1,625,000	4,875,000
Kimble	6,000,000	1,500,000	4,500,000
Llano	350,000	87,500	262,500
Mason	1,900,000	475,000	1,425,000
McCulloch	16,000,000	4,000,000	12,000,000
Menard	1,600,000	400,000	1,200,000
San Saba	20,000,000	5,000,000	15,000,000
Total	53,812,000	13,453,000	40,359,000

TABLE 4. TOTAL ESTIMATED RECOVERABLE STORAGE BY GROUNDWATER CONSERVATION DISTRICT[6] FOR THE ELLENBURGER-SAN SABA AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 7. GROUNDWATER CONSERVATION DISTRICT TOTAL ESTIMATES ARE ROUNDED WITHIN TWO SIGNIFICANT FIGURES.

Groundwater Conservation District (GCD)	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
No District	17,850,000	4,462,500	13,387,500
Hickory UWCD[7] No. 1	23,019,000	5,754,750	17,264,250
Hill Country UWCD	6,500,000	1,625,000	4,875,000
Kimble County GCD	5,300,000	1,325,000	3,975,000
Lipan-Kickapoo GCD	43,000	10,750	32,250
Menard County UWD[8]	1,100,000	275,000	825,000
Total	53,812,000	13,453,000	40,359,000

[6] The total estimated recoverable storage values by groundwater conservation district and county for an aquifer may not be the same because the numbers have been rounded to within two significant figures.
[7] UWCD is the abbreviation for Underground Water Conservation District.
[8] UWD is the abbreviation for Underground Water District.

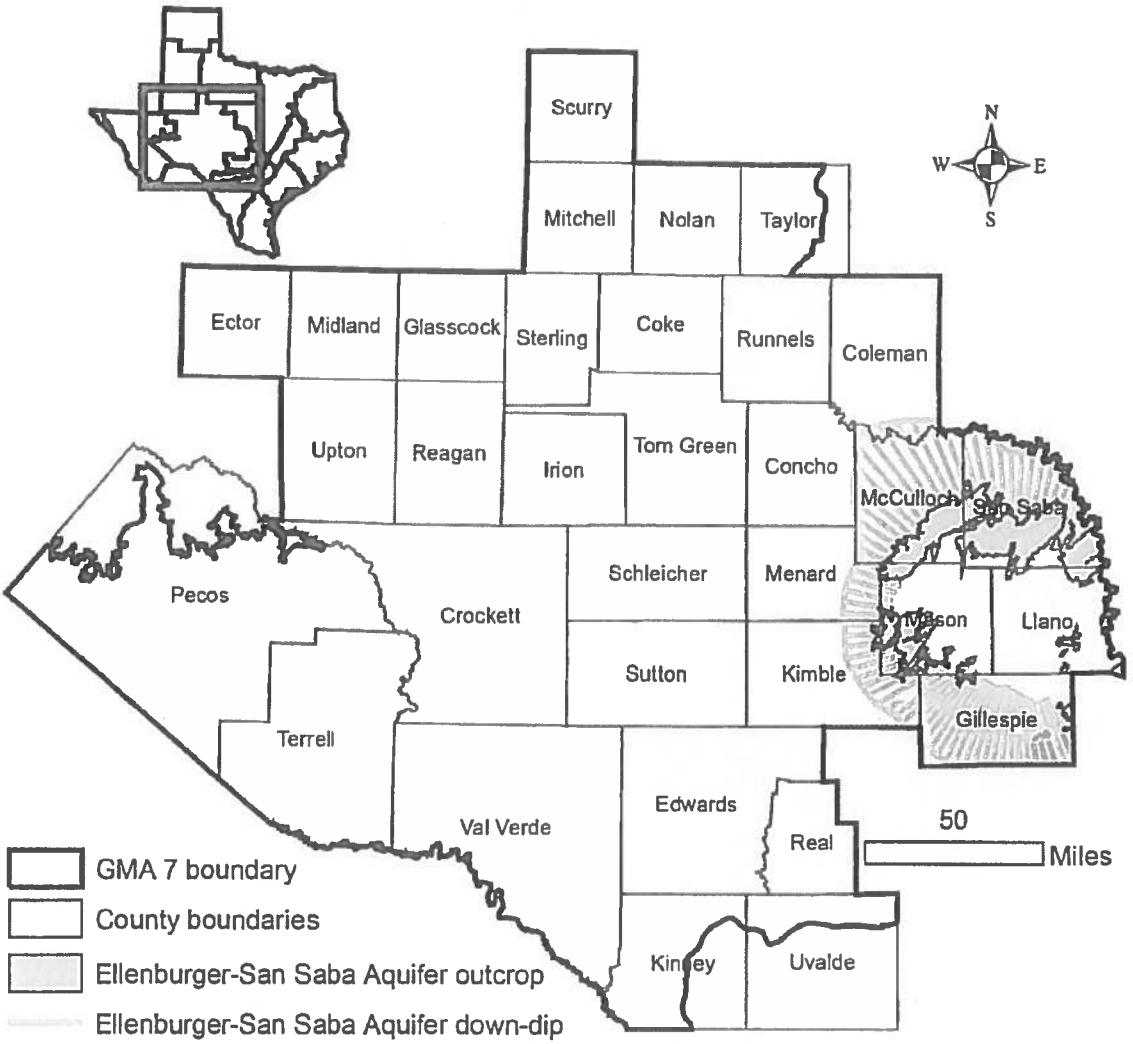

FIGURE 5. AREA OF THE ELLENBURGER-SAN SABA AQUIFER USED TO ESTIMATE TOTAL RECOVERABLE STORAGE WITHIN GROUNDWATER MANAGEMENT AREA (GMA) 7.

TABLE 5. TOTAL ESTIMATED RECOVERABLE STORAGE BY COUNTY FOR THE MARBLE FALLS AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 7. COUNTY TOTAL ESTIMATES ARE ROUNDED TO TWO SIGNIFICANT FIGURES.

County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Kimble	2,400	600	1,800
Llano	2,100	525	1,575
Mason	5,300	1,325	3,975
McCulloch	33,000	8,250	24,750
San Saba	144,000	36,000	108,000
Total	186,800	46,693	140,078

TABLE 6. TOTAL ESTIMATED RECOVERABLE STORAGE BY GROUNDWATER CONSERVATION DISTRICT[9] FOR THE MARBLE FALLS AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 7. GROUNDWATER CONSERVATION DISTRICT TOTAL ESTIMATES ARE ROUNDED TO TWO SIGNIFICANT FIGURES.

Groundwater Conservation District (GCD)	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
No District	55,000	13,750	41,250
Hickory UWCD[10] No. 1	130,000	32,500	97,500
Kimble County GCD	970	243	728
Total	130,970	32,743	98,228

[9] The total estimated recoverable storage values by groundwater conservation district and county for an aquifer may not be the same because the numbers have been rounded to within two significant figures.
[10] UWCD is the abbreviation for Underground Water Conservation District.

FIGURE 6. AREA OF THE MARBLE FALLS AQUIFER USED TO ESTIMATE TOTAL RECOVERABLE STORAGE FOR WITHIN GROUNDWATER MANAGEMENT AREA (GMA) 7.

TABLE 7. TOTAL ESTIMATED RECOVERABLE STORAGE BY COUNTY FOR THE BLAINE AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 7. COUNTY TOTAL ESTIMATES ARE ROUNDED WITHIN TWO SIGNIFICANT FIGURES.

County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Nolan	260,000	65,000	195,000
Total	260,000	65,000	195,000

TABLE 8. TOTAL ESTIMATED RECOVERABLE STORAGE BY GROUNDWATER CONSERVATION DISTRICT[11] FOR THE BLAINE AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 7. GROUNDWATER CONSERVATION DISTRICT TOTAL ESTIMATES ARE ROUNDED WITHIN TWO SIGNIFICANT FIGURES.

Groundwater Conservation District (GCD)	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Wes-Tex GCD	260,000	65,000	195,000
Total	260,000	65,000	195,000

[11] The total estimated recoverable storage values by groundwater conservation district and county for an aquifer may not be the same because the numbers have been rounded to within two significant figures.

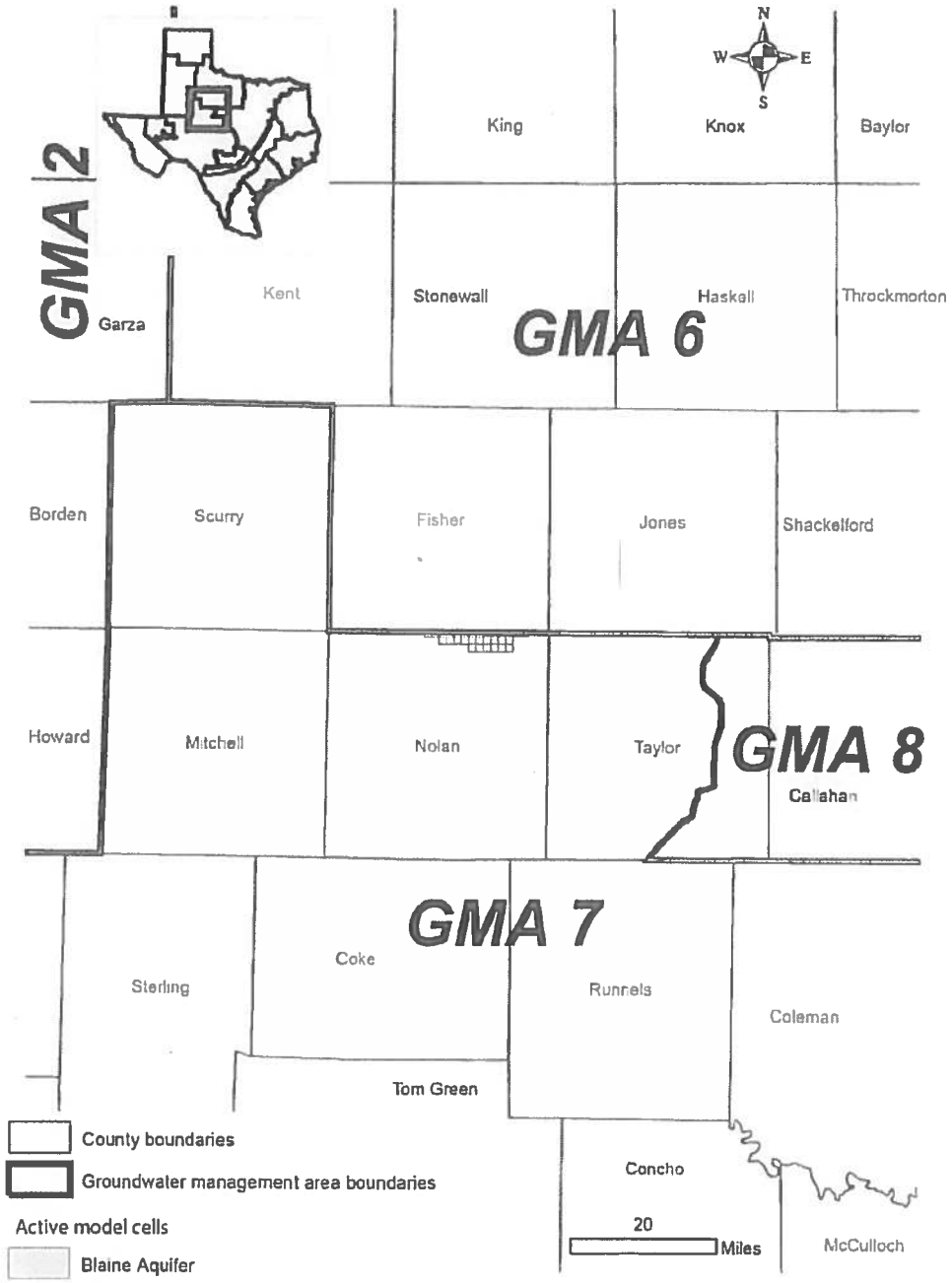

FIGURE 7. EXTENT OF THE GROUNDWATER AVAILABILITY MODEL FOR THE SEYMOUR AND BLAINE AQUIFERS USED TO ESTIMATE TOTAL RECOVERABLE STORAGE FOR THE BLAINE AQUIFER IN GROUNDWATER MANAGEMENT AREA (GMA) 7.

TABLE 9. TOTAL ESTIMATED RECOVERABLE STORAGE BY COUNTY FOR THE CAPITAN REEF COMPLEX AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 7. COUNTY TOTAL ESTIMATES ARE ROUNDED WITHIN TWO SIGNIFICANT FIGURES.

County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Pecos	14,000,000	3,500,000	10,500,000
Total	14,000,000	3,500,000	10,500,000

TABLE 10. TOTAL ESTIMATED RECOVERABLE STORAGE BY GROUNDWATER CONSERVATION DISTRICT[12] FOR THE CAPITAN REEF COMPLEX AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 7. GROUNDWATER CONSERVATION DISTRICT TOTAL ESTIMATES ARE ROUNDED WITHIN TWO SIGNIFICANT FIGURES.

Groundwater Conservation District (GCD)	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Middle Pecos GCD	14,000,000	3,500,000	10,500,000
Total	14,000,000	3,500,000	10,500,000

[12] The total estimated recoverable storage values by groundwater conservation district and county for an aquifer may not be the same because the numbers have been rounded to within two significant figures.

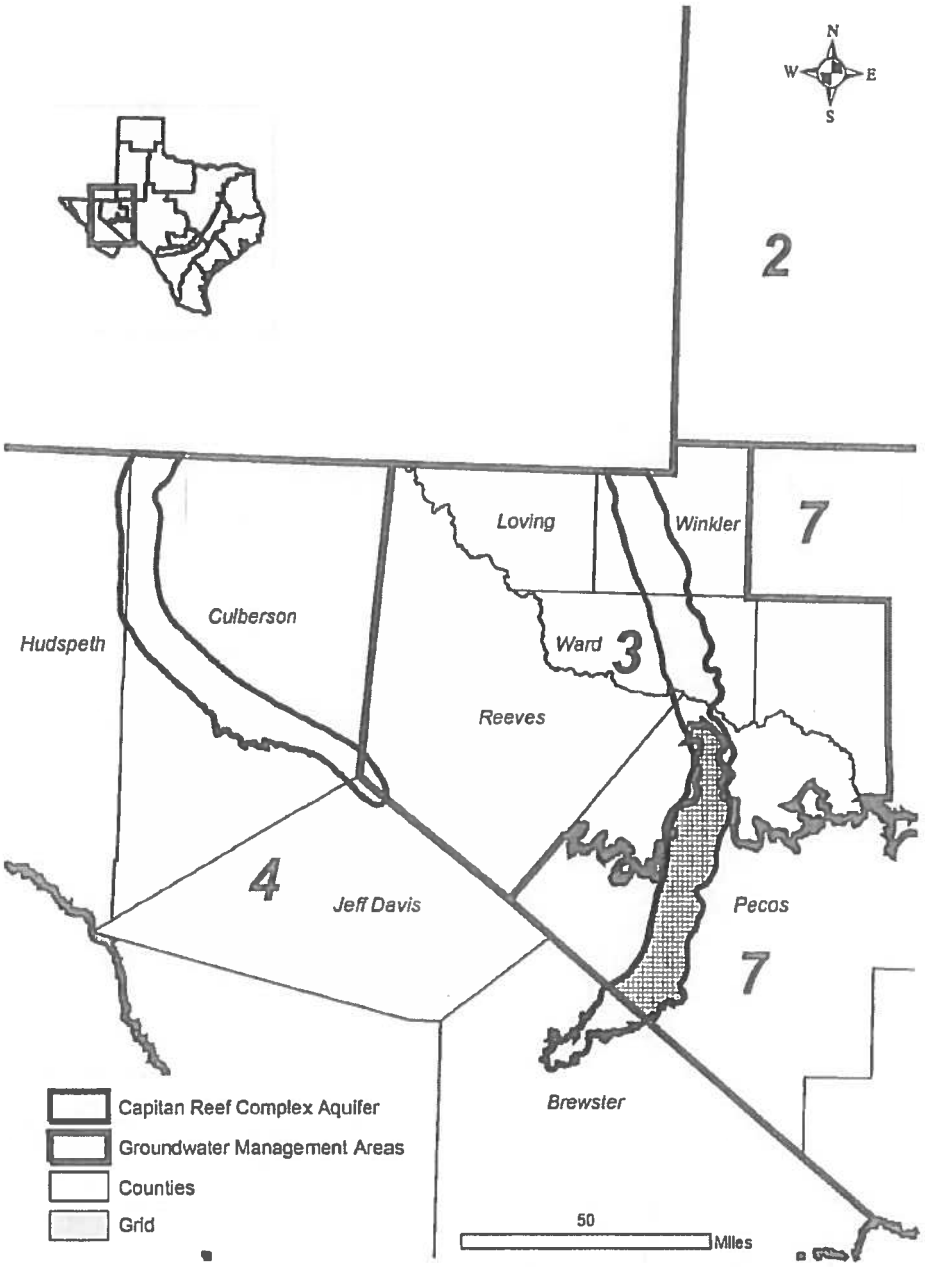

FIGURE 8. AREA OF THE CAPITAN REEF COMPLEX AQUIFER USED TO ESTIMATE TOTAL RECOVERABLE STORAGE WITHIN GROUNDWATER MANAGEMENT AREA 7.

TABLE 11. TOTAL ESTIMATED RECOVERABLE STORAGE BY COUNTY FOR THE RUSTLER AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 7. COUNTY TOTAL ESTIMATES ARE ROUNDED WITHIN TWO SIGNIFICANT FIGURES.

County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Pecos	5,000,000	1,250,000	3,750,000
Total	5,000,000	1,250,000	3,750,000

TABLE 12. TOTAL ESTIMATED RECOVERABLE STORAGE BY GROUNDWATER CONSERVATION DISTRICT[13] FOR THE RUSTLER AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 7. GROUNDWATER CONSERVATION DISTRICT TOTAL ESTIMATES ARE ROUNDED WITHIN TWO SIGNIFICANT FIGURES.

Groundwater Conservation District (GCD)	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Middle Pecos GCD	5,000,000	1,250,000	3,750,000
Total	5,000,000	1,250,000	3,750,000

[13] The total estimated recoverable storage values by groundwater conservation district and county for an aquifer may not be the same because the numbers have been rounded to within two significant figures.

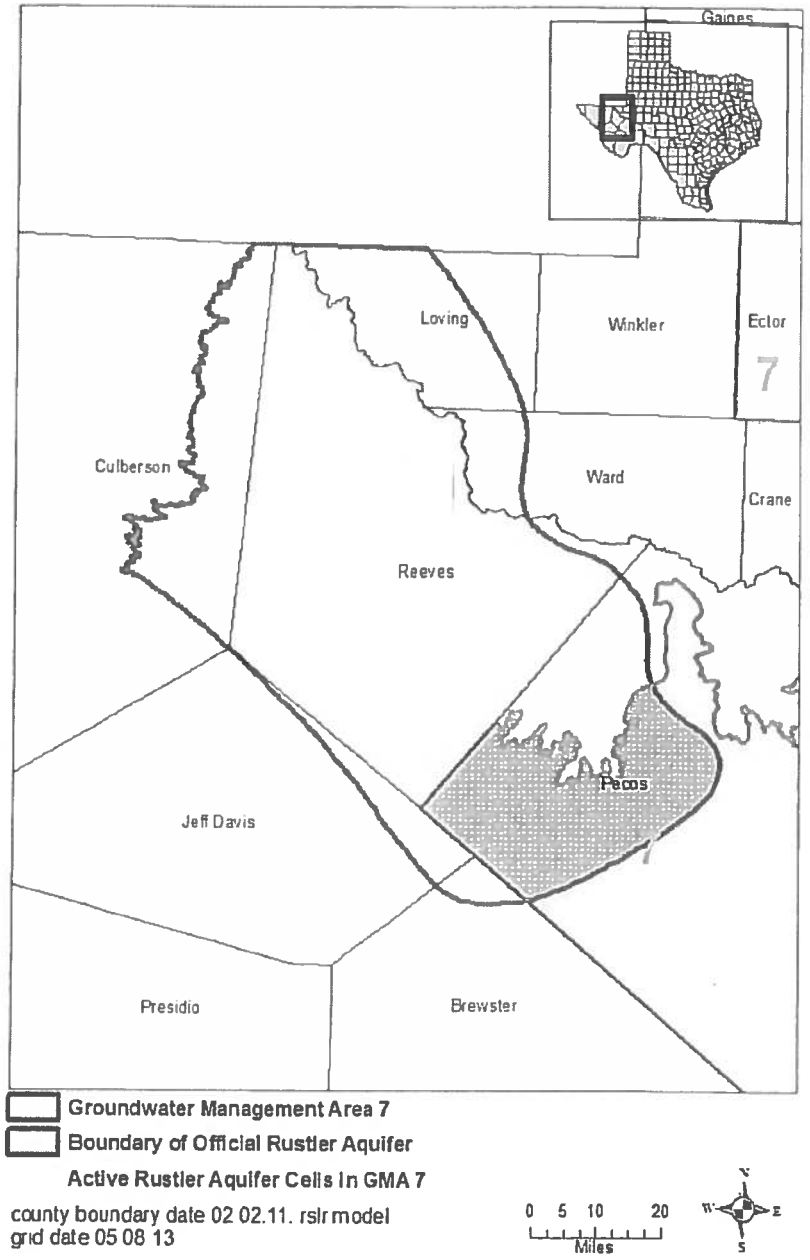

FIGURE 9. EXTENT OF THE GROUNDWATER AVAILABILITY MODEL FOR THE RUSTLER AQUIFER USED TO ESTIMATE TOTAL RECOVERABLE STORAGE FOR THE RUSTLER AQUIFER IN GROUNDWATER MANAGEMENT AREA 7.

TABLE 13. TOTAL ESTIMATED RECOVERABLE STORAGE BY COUNTY FOR THE DOCKUM AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 7. COUNTY TOTAL ESTIMATES ARE ROUNDED WITHIN TWO SIGNIFICANT FIGURES.

County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Coke	520,000	130,000	390,000
Crockett	14,000,000	3,500,000	10,500,000
Ector	100,000,000	25,000,000	75,000,000
Glasscock	11,000,000	2,750,000	8,250,000
Irion	9,100,000	2,275,000	6,825,000
Midland	10,000,000	2,500,000	7,500,000
Mitchell	27,000,000	6,750,000	20,250,000
Nolan	2,100,000	525,000	1,575,000
Pecos	2,500,000	625,000	1,875,000
Reagan	17,000,000	4,250,000	12,750,000
Scurry	32,000,000	8,000,000	24,000,000
Sterling	33,000,000	8,250,000	24,750,000
Tom Green	1,100,000	275,000	825,000
Upton	9,300,000	2,325,000	6,975,000
Total	268,620,000	67,155,000	201,465,000

TABLE 14. TOTAL ESTIMATED RECOVERABLE STORAGE BY GROUNDWATER CONSERVATION DISTRICT[14] FOR THE DOCKUM AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 7. GROUNDWATER CONSERVATION DISTRICT TOTAL ESTIMATES ARE ROUNDED WITHIN TWO SIGNIFICANT FIGURES.

Groundwater Conservation District (GCD)	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
No District	160,000,000	40,000,000	120,000,000
Coke County UWCD[15]	520,000	130,000	390,000
Crockett County GCD	14,000,000	3,500,000	10,500,000
Glasscock GCD	11,000,000	2,750,000	8,250,000
Irion County WCD[16]	9,600,000	2,400,000	7,200,000
Lone Wolf GCD	27,000,000	6,750,000	20,250,000
Middle Pecos GCD	2,500,000	625,000	1,875,000
Santa Rita UWCD	17,000,000	4,250,000	12,750,000
Sterling County UWCD	33,000,000	8,250,000	24,750,000
Wes-Tex GCD	2,100,000	525,000	1,575,000
Total	276,720,000	69,180,000	207,540,000

[14] The total estimated recoverable storage values by groundwater conservation district and county for an aquifer may not be the same because the numbers have been rounded to within two significant figures.
[15] UWCD is the abbreviation for Underground Water Conservation District.
[16] WCD is the abbreviation for Water Conservation District.

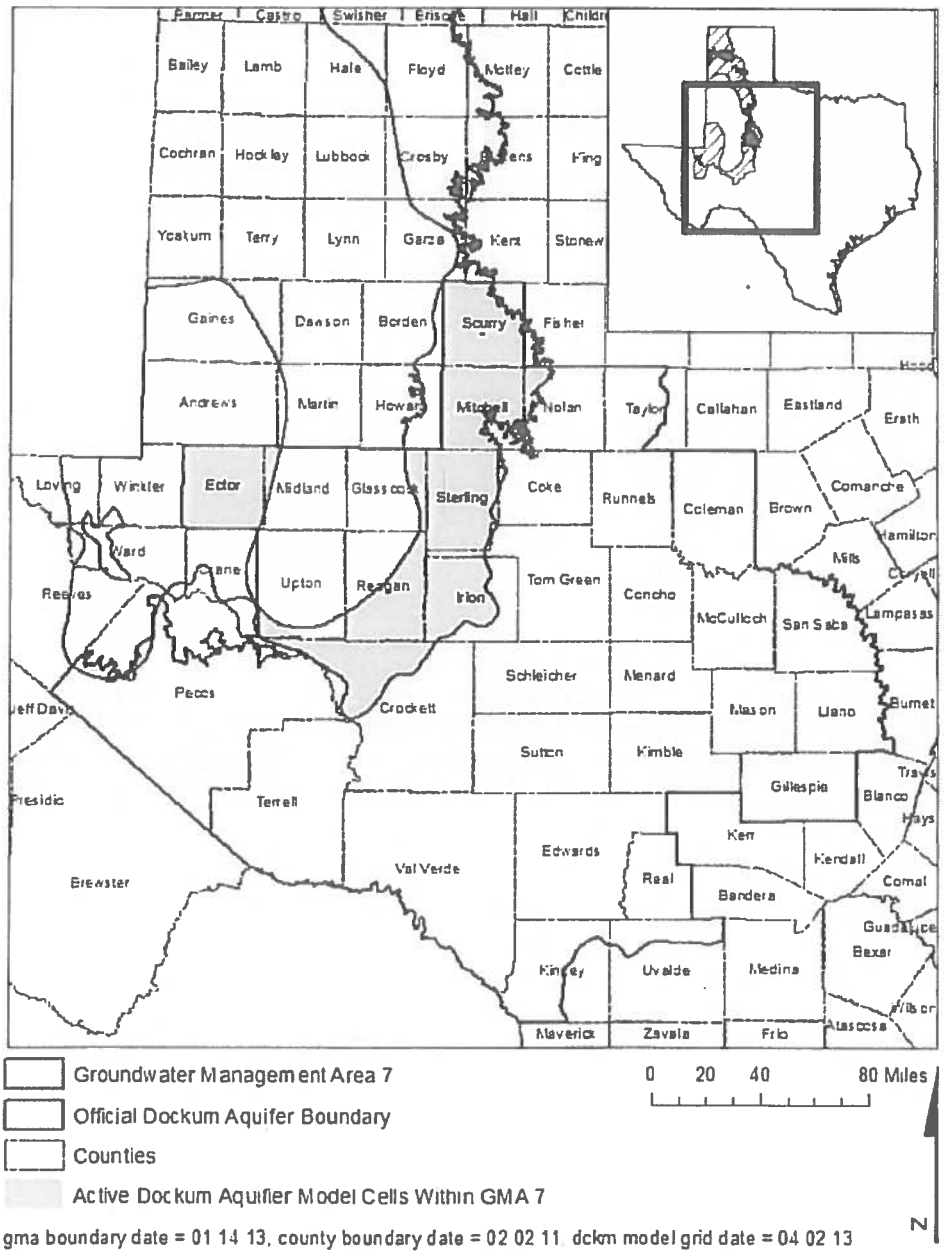

FIGURE 10. EXTENT OF THE GROUNDWATER AVAILABILITY MODEL FOR THE DOCKUM AQUIFER USED TO ESTIMATE TOTAL RECOVERABLE STORAGE FOR THE DOCKUM AQUIFER IN GROUNDWATER MANAGEMENT AREA (GMA) 7.

TABLE 15. TOTAL ESTIMATED RECOVERABLE STORAGE BY COUNTY FOR THE TRINITY AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 7. COUNTY TOTAL ESTIMATES ARE ROUNDED TO TWO SIGNIFICANT FIGURES.

County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Gillespie	270,000	67,500	202,500
Real	23,000	5,750	17,250
Uvalde	230,000	57,500	172,500
Total	523,000	130,750	392,250

TABLE 16. TOTAL ESTIMATED RECOVERABLE STORAGE BY GROUNDWATER CONSERVATION DISTRICT[17] FOR THE TRINITY AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 7. GROUNDWATER CONSERVATION DISTRICT TOTAL ESTIMATES ARE ROUNDED TO TWO SIGNIFICANT FIGURES.

Groundwater Conservation District (GCD)	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Hill Country UWCD[18]	270,000	67,500	202,500
Real-Edwards C & R[19] District	23,000	5,750	17,250
Uvalde County UWCD	230,000	57,500	172,500
Total	523,000	130,750	392,250

[17] The total estimated recoverable storage values by groundwater conservation district and county for an aquifer may not be the same because the numbers have been rounded to within two significant figures.
[18] UWCD is the abbreviation for Underground Water Conservation District.
[19] C &R is the abbreviation for Conservation and Reclamation

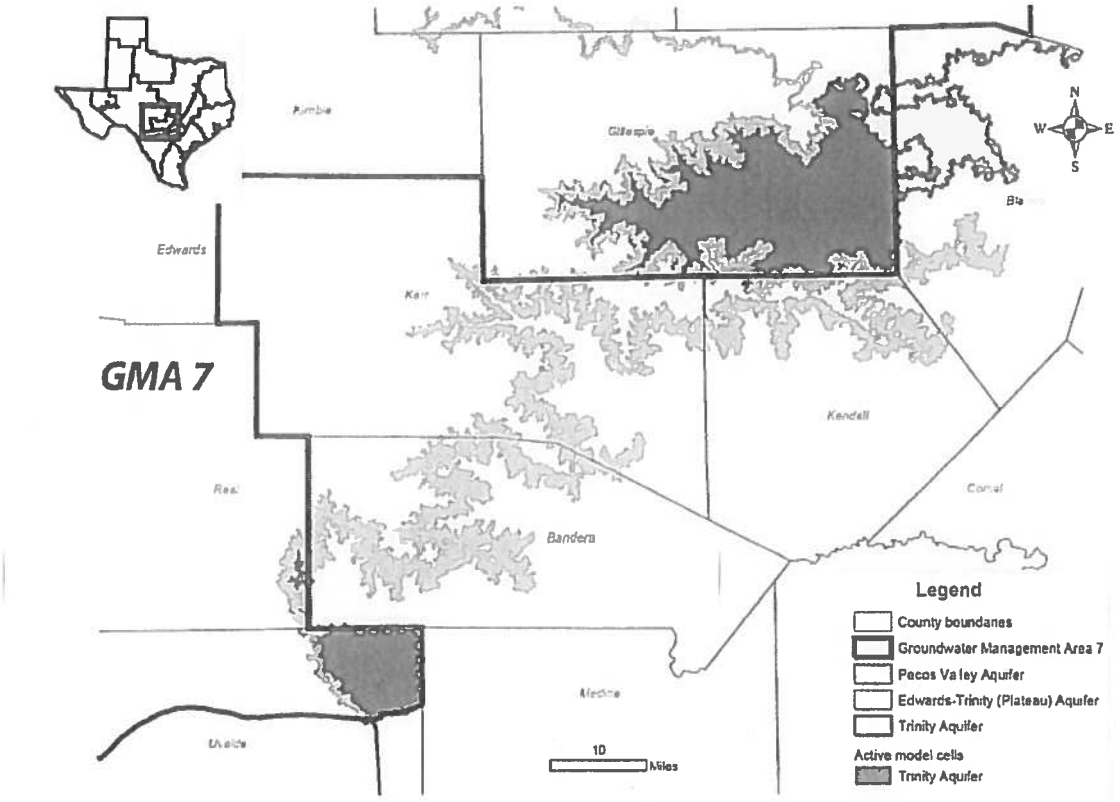

FIGURE 11. AREA OF THE TRINITY AQUIFER USED TO ESTIMATE TOTAL RECOVERABLE STORAGE WITHIN GROUNDWATER MANAGEMENT AREA (GMA) 7.

TABLE 17. TOTAL ESTIMATED RECOVERABLE STORAGE BY COUNTY FOR THE EDWARDS-TRINITY (PLATEAU) AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 7. COUNTY TOTAL ESTIMATES ARE ROUNDED WITHIN TWO SIGNIFICANT FIGURES.

County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Coke	120,000	30,000	90,000
Concho	79,000	19,750	59,250
Crockett	1,500,000	375,000	1,125,000
Ector	220,000	55,000	165,000
Edwards	5,000,000	1,250,000	3,750,000
Gillespie	430,000	107,500	322,500
Glasscock	270,000	67,500	202,500
Irion	420,000	105,000	315,000
Kimble	1,100,000	275,000	825,000
Kinney[20]	4,400,000	1,100,000	3,300,000
Mason	51,000	12,750	38,250
McCulloch	93,000	23,250	69,750
Menard	250,000	62,500	187,500
Midland	240,000	60,000	180,000
Nolan	170,000	42,500	127,500
Pecos	3,100,000	775,000	2,325,000
Reagan	560,000	140,000	420,000
Real	1,600,000	400,000	1,200,000

[20] Total storage values for Kinney County are based on the alternative model by Hutchison and others (2011), the other total storage values were based on the groundwater availability model by Anaya and Jones (2009).

County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Schleicher	890,000	222,500	667,500
Sterling	150,000	37,500	112,500
Sutton	1,800,000	450,000	1,350,000
Taylor	78,000	19,500	58,500
Terrell	4,500,000	1,125,000	3,375,000
Tom Green	250,000	62,500	187,500
Upton	550,000	137,500	412,500
Uvalde	1,000,000	250,000	750,000
Val Verde	10,000,000	2,500,000	7,500,000
Total	38,821,000	9,705,250	29,115,750

TABLE 18. TOTAL ESTIMATED RECOVERABLE STORAGE BY GROUNDWATER CONSERVATION DISTRICT[21] FOR THE EDWARDS-TRINITY (PLATEAU) AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 7. GROUNDWATER CONSERVATION DISTRICT TOTAL ESTIMATES ARE ROUNDED WITHIN TWO SIGNIFICANT FIGURES.

Groundwater Conservation District (GCD)	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
No District	11,000,000	2,750,000	8,250,000
Coke County UWCD[22]	120,000	30,000	90,000
Crockett County GCD	1,500,000	375,000	1,125,000
Glasscock GCD	320,000	80,000	240,000
Hickory UWCD No. 1	210,000	52,500	157,500
Hill Country UWCD	430,000	107,500	322,500
Irion County WCD[23]	450,000	112,500	337,500
Kimble County GCD	1,100,000	275,000	825,000
Kinney County GCD[24]	4,400,000	1,100,000	3,300,000
Lipan-Kickapoo WCD	220,000	55,000	165,000
Menard County UWD[25]	210,000	52,500	157,500
Middle Pecos GCD	3,100,000	775,000	2,325,000
Plateau UWC[26] and Supply District	890,000	222,500	667,500

[21] The total estimated recoverable storage values by groundwater conservation district and county for an aquifer may not be the same because the numbers have been rounded to within two significant figures.
[22] UWCD is the abbreviation for Underground Water Conservation District.
[23] WCD is the abbreviation for Water Conservation District.
[24] Total storage values for Kinney County GCD are based on the alternative model by Hutchison and others (2011), the other total storage values were based on the groundwater availability model by Anaya and Jones (2009).
[25] UWD is the abbreviation for Underground Water District.
[26] UWC is the abbreviation for Underground Water Conservation.

Groundwater Conservation District (GCD)	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Real-Edwards C & R[27] District	6,600,000	1,650,000	4,950,000
Santa Rita UWCD	520,000	130,000	390,000
Sterling County UWCD	160,000	40,000	120,000
Sutton County UWCD	1,800,000	450,000	1,350,000
Terrell County GCD	4,500,000	1,125,000	3,375,000
Uvalde County UWCD	1,000,000	250,000	750,000
Wes-Tex GCD	170,000	42,500	127,500
Total	38,700,000	9,675,000	29,025,000

[27] C & R is the abbreviation for Conservation and Reclamation.

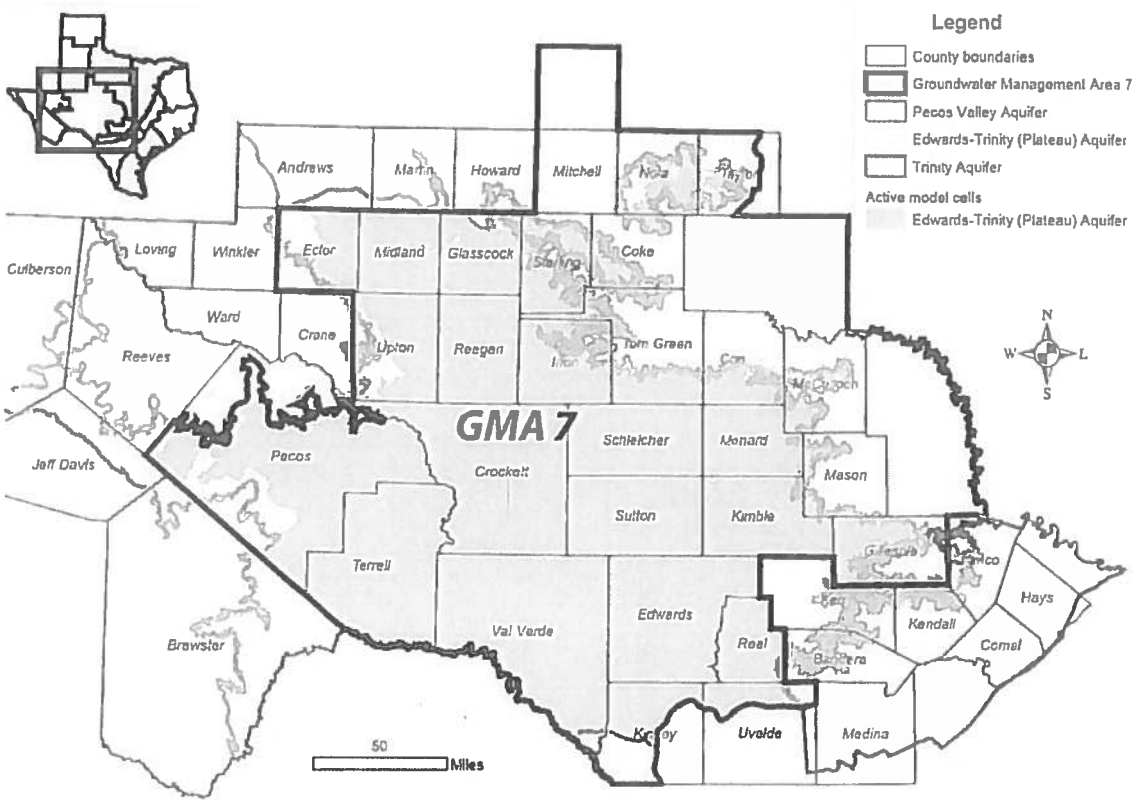

FIGURE 12. EXTENT OF THE GROUNDWATER AVAILABILITY MODEL FOR THE EDWARDS-TRINITY (PLATEAU) AQUIFER AND THE ALTERNATIVE GROUNDWATER FLOW MODEL FOR KINNEY COUNTY USED TO ESTIMATE TOTAL RECOVERABLE STORAGE FOR THE EDWARDS-TRINITY (PLATEAU) AQUIFER IN GROUNDWATER MANAGEMENT AREA (GMA) 7.

TABLE 19. TOTAL ESTIMATED RECOVERABLE STORAGE BY COUNTY FOR THE IGNEOUS AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 7. COUNTY TOTAL ESTIMATES ARE ROUNDED TO TWO SIGNIFICANT FIGURES.

County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Pecos	350	88	263
Total	350	88	263

TABLE 20. TOTAL ESTIMATED RECOVERABLE STORAGE BY GROUNDWATER CONSERVATION DISTRICT[28] FOR THE IGNEOUS AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 7. GROUNDWATER CONSERVATION DISTRICT TOTAL ESTIMATES ARE ROUNDED TO TWO SIGNIFICANT FIGURES.

Groundwater Conservation District (GCD)	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Middle Pecos GCD	350	88	263
Total	350	88	263

[28] The total estimated recoverable storage values by groundwater conservation district and county for an aquifer may not be the same because the numbers have been rounded to within two significant figures.

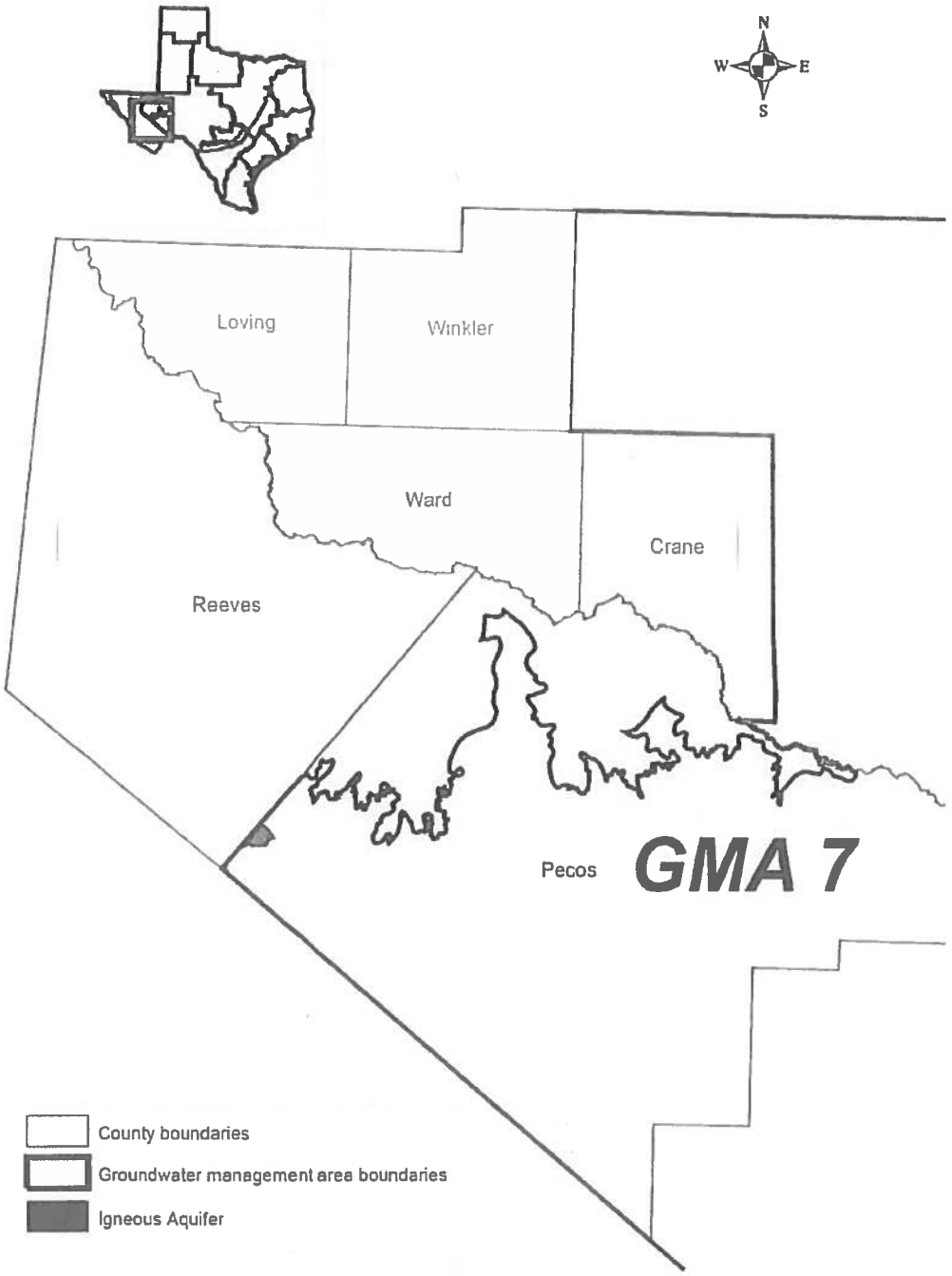

FIGURE 13. EXTENT OF THE GROUNDWATER AVAILABILITY MODEL FOR THE IGNEOUS AQUIFER USED TO ESTIMATE TOTAL RECOVERABLE STORAGE FOR THE IGNEOUS AQUIFER IN GROUNDWATER MANAGEMENT AREA (GMA) 7.

TABLE 21. TOTAL ESTIMATED RECOVERABLE STORAGE BY COUNTY FOR THE OGALLALA AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 7. COUNTY TOTAL ESTIMATES ARE ROUNDED WITHIN TWO SIGNIFICANT FIGURES.

County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Ector	840,000	210,000	630,000
Glasscock	2,000,000	500,000	1,500,000
Midland	3,500,000	875,000	2,625,000
Total	6,340,000	1,585,000	4,755,000

TABLE 22. TOTAL ESTIMATED RECOVERABLE STORAGE BY GROUNDWATER CONSERVATION DISTRICT[29] FOR THE OGALLALA AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 7. GROUNDWATER CONSERVATION DISTRICT TOTAL ESTIMATES ARE ROUNDED WITHIN TWO SIGNIFICANT FIGURES.

Groundwater Conservation District (GCD)	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
No District	4,400,000	1,100,000	3,300,000
Glasscock GCD	2,000,000	500,000	1,500,000
Total	6,400,000	1,600,000	4,800,000

[29] The total estimated recoverable storage values by groundwater conservation district and county for an aquifer may not be the same because the numbers have been rounded to within two significant figures.

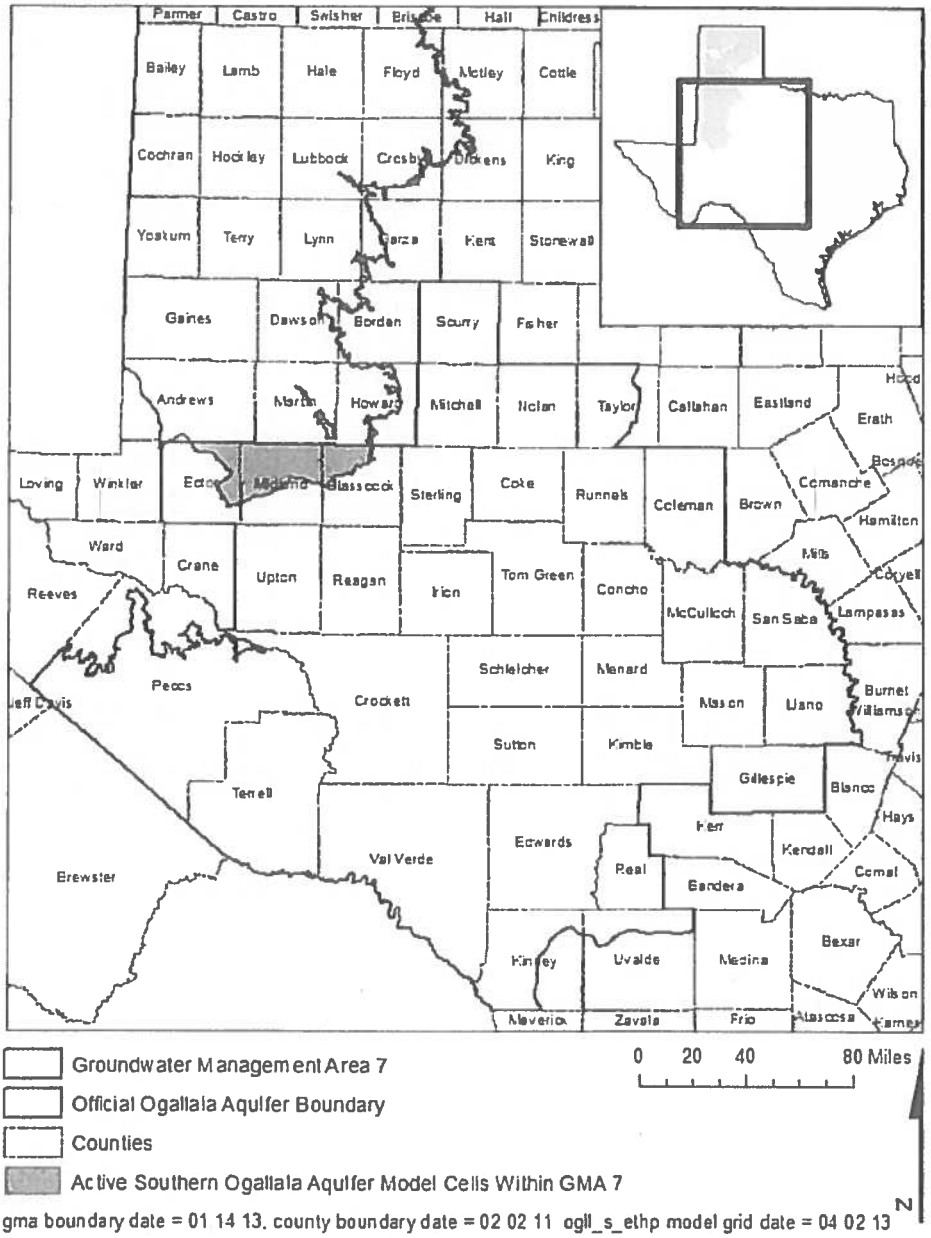

FIGURE 14. EXTENT OF THE GROUNDWATER AVAILABILITY MODEL FOR THE EDWARDS-TRINITY (HIGH PLAINS) AQUIFER AND THE SOUTHERN PORTION OF THE OGALLALA AQUIFER USED TO ESTIMATE TOTAL RECOVERABLE STORAGE FOR THE OGALLALA AQUIFER IN GROUNDWATER MANAGEMENT AREA (GMA) 7.

TABLE 23. TOTAL ESTIMATED RECOVERABLE STORAGE BY COUNTY FOR THE PECOS VALLEY AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 7. COUNTY TOTAL ESTIMATES ARE ROUNDED WITHIN TWO SIGNIFICANT FIGURES.

County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Crockett	160,000	40,000	120,000
Ector	5,900,000	1,475,000	4,425,000
Pecos	910,000	227,500	682,500
Upton	4,400,000	1,100,000	3,300,000
Total	11,370,000	2,842,500	8,527,500

TABLE 24. TOTAL ESTIMATED RECOVERABLE STORAGE BY GROUNDWATER CONSERVATION DISTRICT[30] FOR THE PECOS VALLEY AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 7. GROUNDWATER CONSERVATION DISTRICT TOTAL ESTIMATES ARE ROUNDED WITHIN TWO SIGNIFICANT FIGURES.

Groundwater Conservation District (GCD)	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
No District	10,000,000	2,500,000	7,500,000
Crockett County GCD	160,000	40,000	120,000
Middle Pecos GCD	910,000	227,500	682,500
Total	11,070,000	2,767,500	8,302,500

[30] The total estimated recoverable storage values by groundwater conservation district and county for an aquifer may not be the same because the numbers have been rounded to within two significant figures.

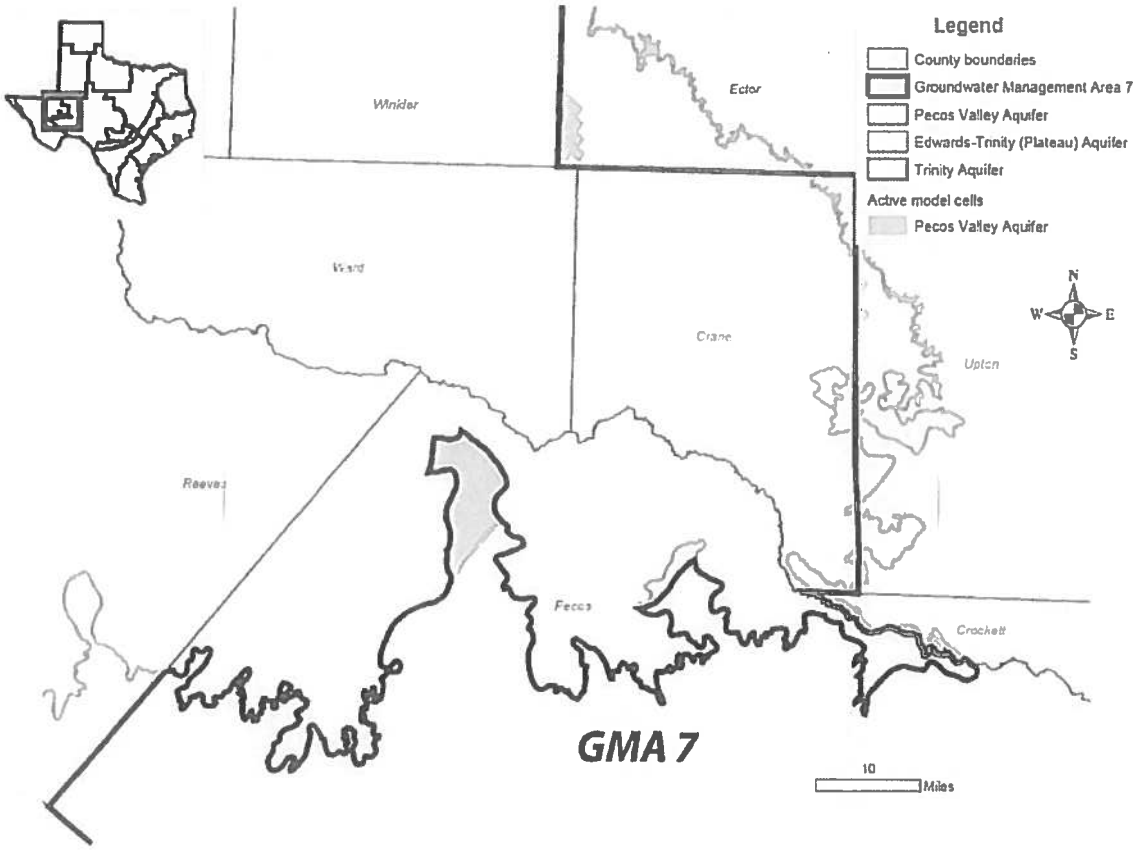

FIGURE 15. EXTENT OF THE GROUNDWATER AVAILABILITY MODEL FOR THE EDWARDS-TRINITY (PLATEAU) AND PECOS VALLEY AQUIFERS USED TO ESTIMATE TOTAL RECOVERABLE STORAGE FOR THE PECOS VALLEY AQUIFER IN GROUNDWATER MANAGEMENT AREA (GMA) 7.

TABLE 25. TOTAL ESTIMATED RECOVERABLE STORAGE BY COUNTY FOR THE LIPAN AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 7. COUNTY TOTAL ESTIMATES ARE ROUNDED WITHIN TWO SIGNIFICANT FIGURES.

County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Coke	13,000	3,250	9,750
Concho	720,000	180,000	540,000
Glasscock	6,000	1,500	4,500
Irion	100,000	25,000	75,000
Runnels	400,000	100,000	300,000
Sterling	41,000	10,250	30,750
Schleicher	7,500	1,875	5,625
Tom Green	2,900,000	725,000	2,175,000
Total	4,200,000	1,046,875	3,140,625

TABLE 26. TOTAL ESTIMATED RECOVERABLE STORAGE BY GROUNDWATER CONSERVATION DISTRICT[31] FOR THE LIPAN AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 7. GROUNDWATER CONSERVATION DISTRICT TOTAL ESTIMATES ARE ROUNDED WITHIN TWO SIGNIFICANT FIGURES.

Groundwater Conservation District (GCD)	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
No District	330,000	82,500	247,500
Coke County UWCD[32]	13,000	3,250	9,750
Glasscock GCD	6,000	1,500	4,500
Irion County WCD[33]	110,000	27,500	82,500
Lipan-Kickapoo WCD	3,600,000	900,000	2,700,000
Plateau UWC[34] and Supply District	7,500	1,875	5,625
Sterling County UWCD	45,000	11,250	33,750
Total	4,100,000	1,027,875	3,083,625

[31] The total estimated recoverable storage values by groundwater conservation district and county for an aquifer may not be the same because the numbers have been rounded to within two significant figures.
[32] UWCD is the abbreviation for Underground Water Conservation District.
[33] WCD is the abbreviation for Water Conservation District.
[34] UWC is the abbreviation for Underground Water Conservation.

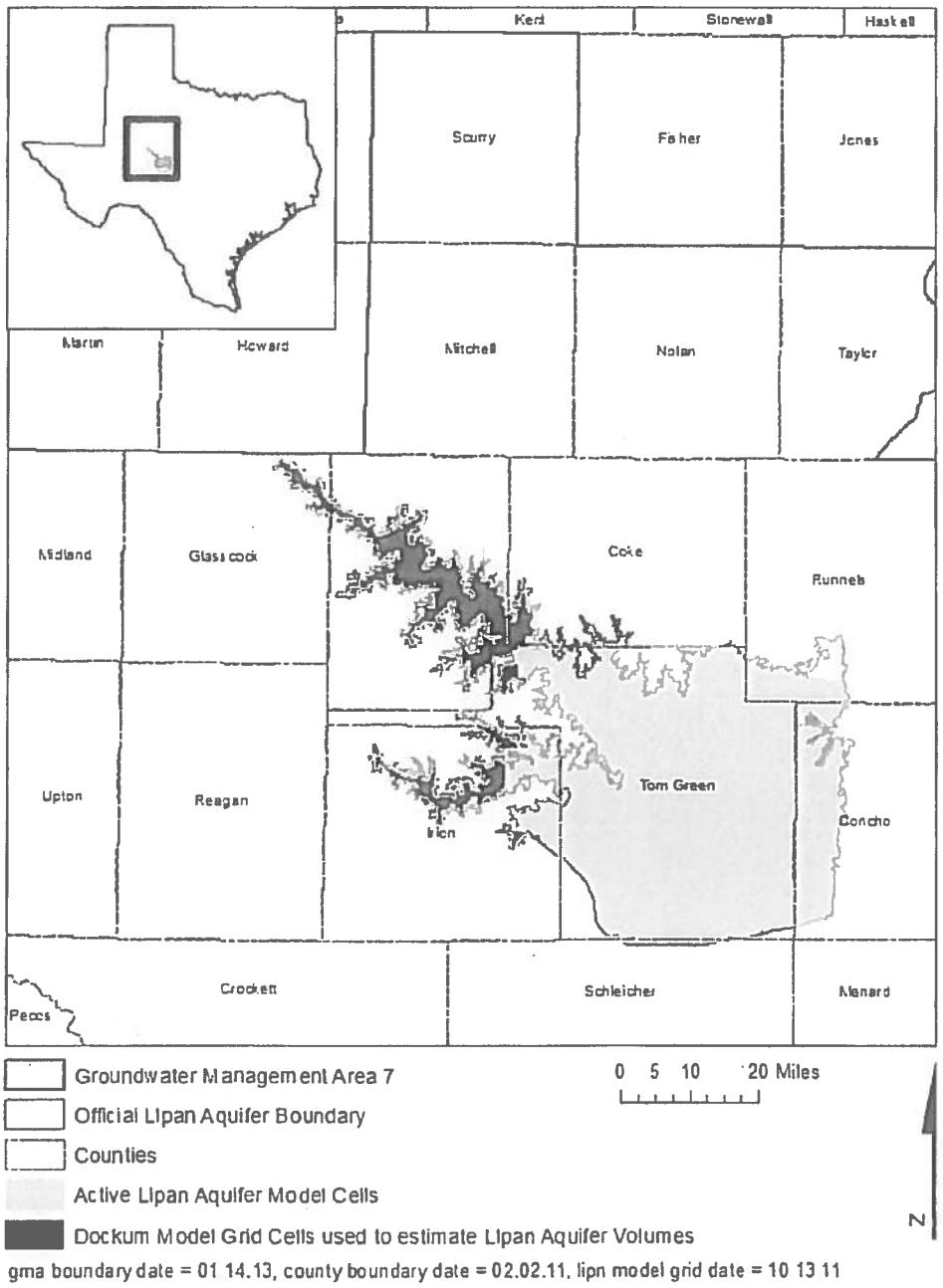

FIGURE 16. EXTENT OF THE GROUNDWATER AVAILABILITY MODELS FOR THE DOCKUM AND LIPAN AQUIFERS USED TO ESTIMATE TOTAL RECOVERABLE STORAGE FOR THE LIPAN AQUIFER IN GROUNDWATER MANAGEMENT AREA 7.

TABLE 27. TOTAL ESTIMATED RECOVERABLE STORAGE BY COUNTY FOR THE SEYMOUR AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 7. COUNTY TOTAL ESTIMATES ARE ROUNDED WITHIN TWO SIGNIFICANT FIGURES.

County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Taylor	610	153	458
Total	610	153	458

TABLE 28. TOTAL ESTIMATED RECOVERABLE STORAGE BY GROUNDWATER CONSERVATION DISTRICT[35] FOR THE SEYMOUR AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 7. GROUNDWATER CONSERVATION DISTRICT TOTAL ESTIMATES ARE ROUNDED WITHIN TWO SIGNIFICANT FIGURES.

Groundwater Conservation District (GCD)	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
No District	610	153	458
Total	610	153	458

[35] The total estimated recoverable storage values by groundwater conservation district and county for an aquifer may not be the same because the numbers have been rounded to within two significant figures.

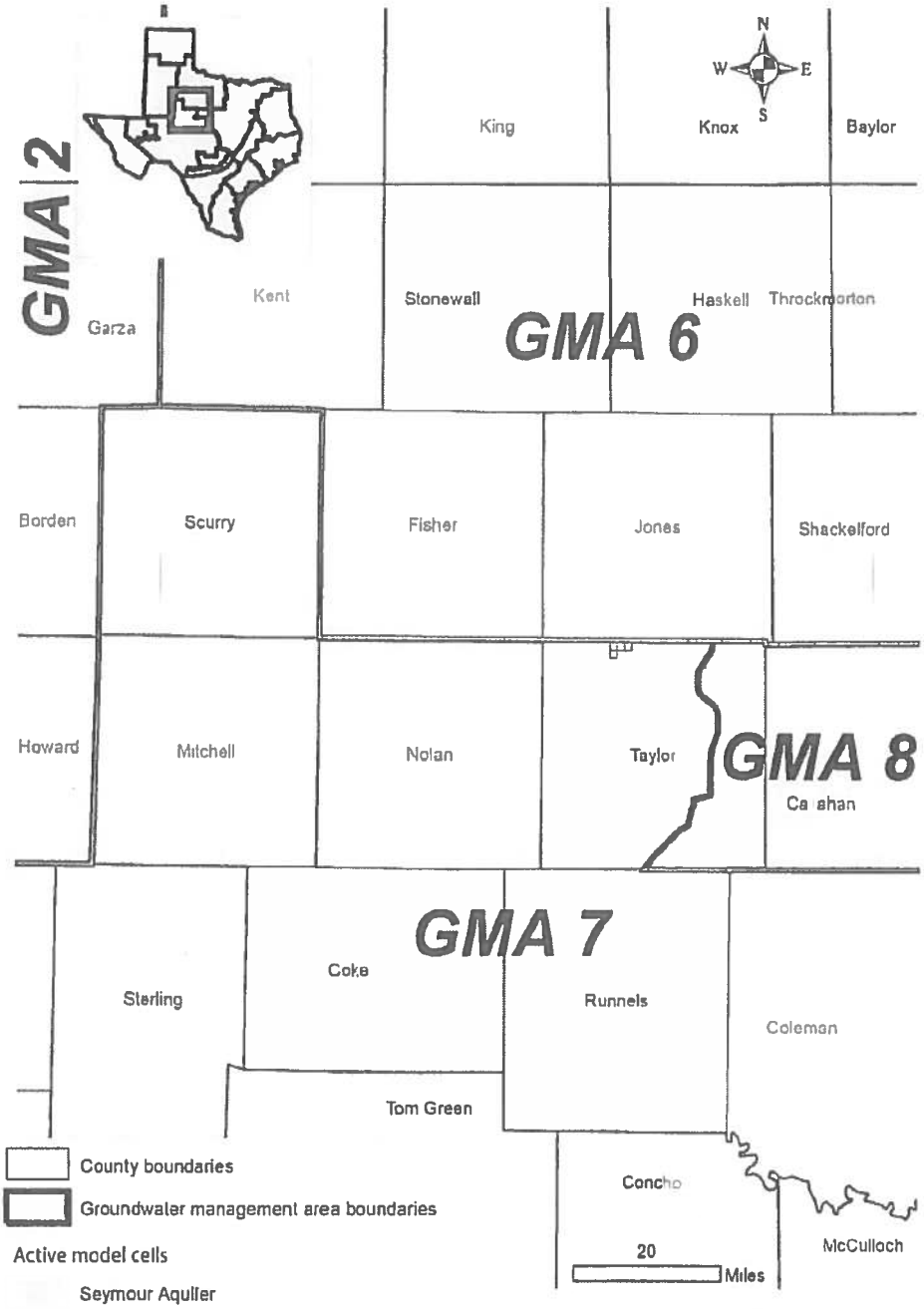

FIGURE 17. EXTENT OF THE GROUNDWATER AVAILABILITY MODEL FOR THE SEYMOUR AND BLAINE AQUIFERS USED TO ESTIMATE TOTAL RECOVERABLE STORAGE FOR THE SEYMOUR AQUIFER IN GROUNDWATER MANAGEMENT AREA (GMA) 7.

LIMITATIONS

The groundwater models used in completing this analysis are the best available scientific tools 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."*

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.

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STATE OF TEXAS §
§ **RESOLUTION # 07-29-10-6**
GROUNDWATER §
MANAGEMENT AREA 7 §

Designation of Desired Future Conditions For the Capitan Reef 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 Aquifer Assessments and/or other technical advice with input and comment from stakeholders within GMA7; and

WHEREAS, the GMA 7 designated representatives have received and considered technical advice and, herein, designate the following Desired Future Conditions for the Capitan Reef Aquifer located within GMA 7 through the year 2060:

1) total net decline in water levels within the Middle Pecos GCD at the end of the fifty-year period shall not exceed fifteen (15) feet below water levels in the unconfined portion of the aquifer in the year 2010; and

2) total net decline in water levels at the end of the fifty-year period shall not exceed two hundred (200) feet below water levels in the confined portion of the aquifer in the year 2010; and

3) the aquifer is not relevant for joint planning purposes outside the boundaries of the Middle Pecos GCD.

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 Capitan Reef 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- LLANO-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:

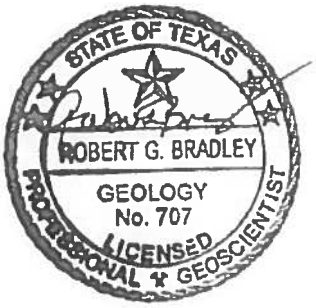
DESIGNATED REPRESENTATIVE -

DESIGNATED REPRESENTATIVE -

GTA Aquifer Assessment 10-09 MAG
Groundwater Management Area 7
Capitan Reef Complex Aquifer
Modeled Available Groundwater estimates
November 18, 2011

GTA Aquifer Assessment 10-09 MAG

by Robert G. Bradley, P.G.
Texas Water Development Board
Groundwater Technical Assistance Section
(512) 936-0870



Robert G. Bradley, P.G. 707, authorized the seal appearing on this document on November 18, 2011.

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Groundwater Management Area 7
Capitan Reef Complex Aquifer
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EXECUTIVE SUMMARY:

The estimated modeled available groundwater from the Capitan Reef Complex Aquifer that achieves the desired future condition adopted by members of Groundwater Management Area 7 is approximately 9,761 acre-feet per year and is summarized by county, regional water planning area, and river basin as shown in Table 1. The estimated modeled available groundwater for the Middle Pecos Groundwater Conservation District in Groundwater Management Area 7 for the aquifer is approximately 9,761 acre feet per year between 2010 and 2060 and is shown in Table 2. The modeled available groundwater estimates were extracted from Williams 2010, which Groundwater Management Area 7 used as the basis for developing a desired future condition.

REQUESTOR:

Mr. Allan Lange of the Lipan-Kickapoo Water Conservation District acting on behalf of the member groundwater conservation districts of Groundwater Management Area 7.

DESCRIPTION OF REQUEST:

In a letter received August 16, 2010, Mr. Allan Lange provided the Texas Water Development Board (TWDB) with the desired future condition of the Capitan Reef Complex Aquifer adopted by the members of Groundwater Management Area 7. The desired future condition for the Capitan Reef Complex Aquifer, as described in Resolution No. 07-29-10-6 and adopted July 29, 2010 by the groundwater conservation districts in Groundwater Management Area 7 is described below:

> *Desired Future Conditions for the Capitan Reef [Complex] Aquifer located within GMA 7 through the year 2060:*
>
> 1. *total net decline in water levels within the Middle Pecos GCD at the end of the fifty-year period shall not exceed fifteen (15) feet below water levels in the unconfined portion of the aquifer in the year 2010;*
> 2. *and total net decline in water levels at the end of the fifty-year period shall not exceed two hundred (200) feet below water levels in the confined portion of the aquifer in the year 2010; and*
> 3. *the aquifer is not relevant for joint planning purposes outside the boundaries of the Middle Pecos GCD.*

In response to receiving the adopted desired future condition, TWDB has estimated the modeled available groundwater that achieves the above desired future condition for Groundwater Management Area 7.

METHODS:

Groundwater Management Area 7, located in West Texas, includes the Capitan Reef Complex Aquifer (Figure 1). The Middle Pecos Groundwater Conservation District hired a consultant to compile district specific information on the aquifer for the establishment of desired future conditions within the district (Williams, 2010). This information was evaluated and verified, and it was incorporated within the final modeled available groundwater numbers issued in this report. The extent of the aquifer in Groundwater Management Area 3 is shown in Figure 2.

PARAMETERS AND ASSUMPTIONS:

- "Managed available groundwater" estimates from Williams (2010) were used in this report as modeled available groundwater volumes, because exempt use was not factored into the calculations.

MODELED AVAILABLE GROUNDWATER AND PERMITTING:

As defined in Chapter 36 of the Texas Water Code, "modeled available groundwater" is the estimated average amount of water that may be produced annually to achieve a desired future condition. This is distinct from "managed available groundwater," shown in the draft version of this report dated January 5, 2011, which was a permitting value and accounted for the estimated use of the aquifer exempt from permitting. This change was made to reflect changes in statute by the 82nd Texas Legislature, effective September 1, 2011.

Groundwater conservation districts are required to consider modeled available groundwater, along with several other factors, when issuing permits in order to manage groundwater production to achieve the desired future condition(s). The other factors districts must consider include annual precipitation and production patterns, the estimated amount of pumping exempt from permitting, existing permits, and a reasonable estimate of actual groundwater production under existing permits.

The estimated amount of pumping exempt from permitting, which the Texas Water Development Board is now required to develop after soliciting input from applicable groundwater conservation districts, will be provided in a separate report.

RESULTS:

The estimated modeled available groundwater from the Capitan Reef Complex Aquifer in Groundwater Management Area 7 that achieves the adopted desired future condition is approximately 9,761 acre-feet per year. This pumping 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 shown in Table 2.

Table 1. Estimated modeled available groundwater by decade for the Capitan Reef Complex Aquifer in Groundwater Management Area 7. Results are in acre-feet per year and are shown by county, regional water planning area, and river basin.

County	Regional Water Planning Area	River Basin	Year					
			2010	2020	2030	2040	2050	2060
Pecos	F	Rio Grande	9,761	9,761	9,761	9,761	9,761	9,761

Table 2. Estimates of modeled available groundwater for the Capitan Reef Complex Aquifer 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
Middle Pecos Groundwater Conservation District	9,761	9,761	9,761	9,761	9,761	9,761

LIMITATIONS:

The water budget this analysis (Williams 2010) is the same method used by TWDB staff, which was determined to be the best method to calculate estimates of modeled available groundwater, however this method has limitations and should be replaced with better tools, including groundwater models and additional data that are not currently available, whenever possible.

This analysis assumes homogeneous and isotropic aquifers; however, aquifer conditions may not be uniform. The analysis further assumes that precipitation is the only source of aquifer recharge that lateral inflow to the aquifer is equal to lateral outflow from the aquifer, and that future pumping will not alter this balance. In addition, certain assumptions have been made regarding future precipitation, recharge, and streamflow in developing modeled available groundwater estimates. These assumptions need to be considered and compared to actual future data when evaluating achievement of the 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. 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 and water levels to know if they are achieving their desired future conditions. Because of the limitations and assumptions in this analysis, it is important that the groundwater conservation districts work with the TWDB 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:

Williams, C.R., 2010, Desired Future Condition of the Capitan Reef Aquifer in GMA-7: memorandum to Paul Weatherby, General Manager, Middle Pecos Groundwater Conservation District, 5 p.

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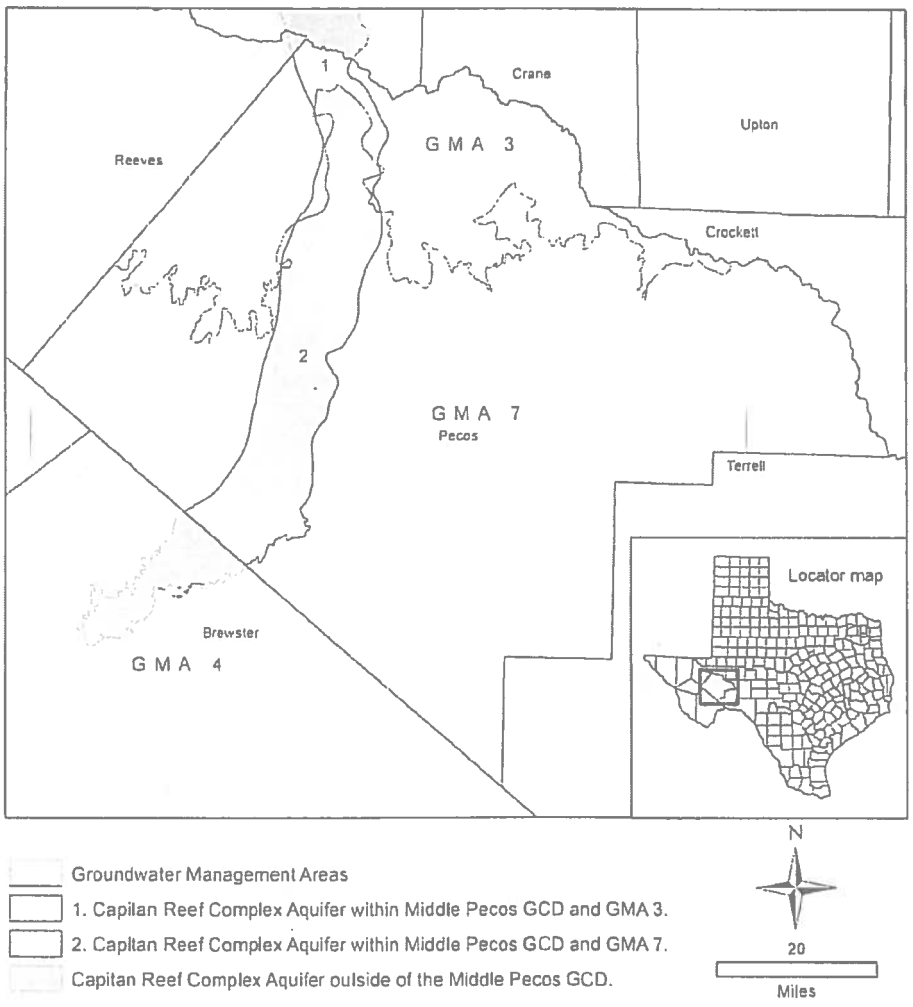

Figure 1. Map showing the area covered by the Capitan Reef Complex Aquifer in Groundwater Management Area 7. GCD = Groundwater Conservation District.

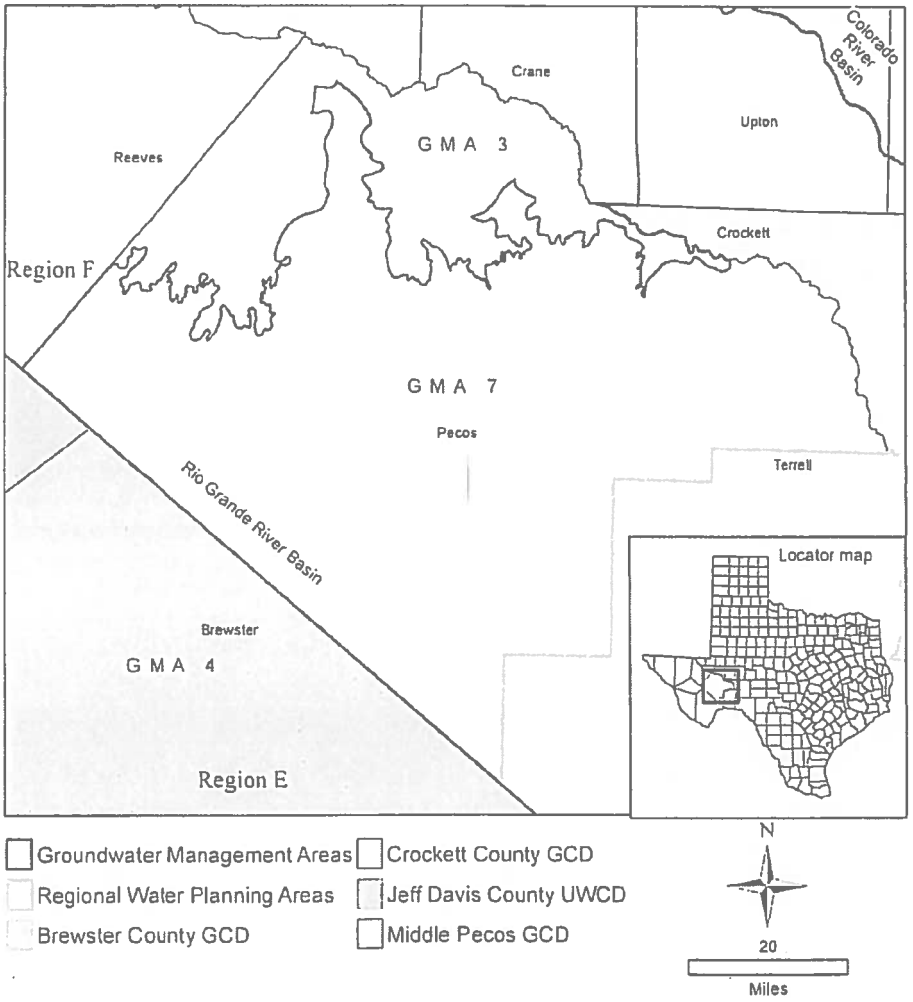

Figure 2. Map showing regional water planning areas, river basins, groundwater conservation districts, and counties in Groundwater Management Area 7. GCD = Groundwater Conservation District, UWCD = Underground Water Conservation District