Garza County Underground Water Conservation District

Revised

Water Management Plan

2014-2019

Index

TIME PERIOD FOR THIS PLAN 2014-2019

This plan becomes effective upon approval by the Texas Water Development Board after Adoption by the District Board of Directors and remains in effect until 2019, or for a period of five years, whichever is later. The plan may be revised at any time, or after five years when the plan will be reviewed to insure that it is consistent with the applicable Regional Water Plan and the State Water Plan.

Garza County Underground Water Conservation District
District Mission

The overall objective of the district is the conservation, preservation, recharge and enhancement of the ground water supplies within the boundaries of the District; also to make wise and beneficial use of the resource for the benefit of the citizens and economy of the District. To accomplish these goals, the District plans to implement a program to monitor both the quantity & quality of these water supplies and also to promote a brush control program for the District.

Statement of Guiding Principles

The Garza County Underground Water Conservation District is created and organized under the term and provisions of Section 59, Article XVI, Texas Constitution, and Chapter 188 of the House Bill 846, including all amendments and additions, of the 74th Legislature. The District has all the rights, powers, privileges, authority, functions, and duties provided by the general law of the state, including Chapter 36 (formerly Chapter 52) of the Texas Water Code, Vernon's Texas Codes Annotated, applicable to underground water conservation districts created under Section 59, Article XVI, Texas Constitution.

The District recognizes that the groundwater resources of the region are vital importance to the residents of the District and that this resource must be managed and protected from contamination and waste. The rules and regulations of the District will be implemented and enforced to accomplish these objectives.

Location and Extent

The boundaries of the Garza County UWCD are coextensive with the boundaries of Garza County, Texas, which lies in the southern part of the High Plains of Texas. About ¼ of the District lies above the Caprock escarpment while the rest of the District, including the principal city of Post, lies below the Caprock.

Ground Water Resource

The Ogallala Aquifer is located in the western part of the District, extending from the northwestern corner to the southwest corner, mainly being in the area above the Caprock. Water from the aquifer is principally used for irrigation and rural domestic and livestock needs.

The Dockum Aquifer is located in the northern and northeastern parts of the District and extends along the eastern edge to the southeast corner. Water from the aquifer is used for mining, irrigation, livestock and household use.

The Edwards-Trinity High Plans Aquifer lies along the western edge of the District, extending from the northwest corner to the southwest corner. Water from the aquifer is used mainly for irrigation and domestic household needs.

Surface Water Resources of Garza County UWCD

There are no surface water impoundments in the District, except for livestock consumption, which could possibly require conjunctive management. At the present time, Garza County UWCD has no jurisdiction over any surface water projects. Likewise, no agency which regulates surface water, has the authority to manage groundwater within the territory of this District.

Lake Alan Henry and proposed Post Reservoir are within the boundaries of Garza County UWCD, but the District has no jurisdiction over these lakes.

Lake Alan Henry Water District was formed during the Texas 78th Legislature to manage the surface water of Lake Alan Henry.

Estimate of Modeled available groundwater based on Desired Future Conditions.

Refer to: GAM Run – 10-030 MAG   Table 7   Appendix C

Estimate of amount of groundwater being used annually.

Refer to: Estimated Historical Water Use 2012 State Water Plan Datasets   Appendix A

Estimated annual of amount of recharge from precipitation to groundwater resource.

Refer to: GAM Run 13-021   Table 1   Appendix B

<u>Estimated annual volume of water that discharges from the aquifer to springs and any surface water bodies.</u>

Estimate of annual volume of flow:

a) Into the District within each aquifer

b) out of the District within each aquifer

c) between aquifers in the District

Refer to: GAM Run 13-021 Table 1 Appendix B

<u>Estimate of projected surface water supplies within the District according to the most recently adopted state water plan.</u>

Refer to: Estimate Historical Water Use 2012 State Water Plan Datasets Appendix A

<u>Estimate of the projected total demand for water within the District according to the most recently adopted state water plan.</u>

Refer to: Estimated Historical Water Use 2012 State Water Plan Datasets Appendix A

<u>Water supply needs for the adopted state water plan.</u>

Refer to: Estimated Historical Water Use 2012 State Water Plan Datasets Appendix A

<u>Water management strategies from the adopted state water plan.</u>

Refer to: Estimated Historical Water Use 2012 State Water Plan Datasets Appendix A

Enhancement of Recharge and Availability

The District supports brush control as a management practice to maintain and improve ground water supplies in the District and region. Recharge of aquifers is achieved through rainfall and can be enhanced by the control of brush, mainly mesquite and juniper, which would decrease the demand of groundwater in the District and region. Benefits would include more groundwater availability, increase productivity of rangeland, increased spring flow, and increased amount of moisture available to infiltrate as recharge.

Mesquite

There are approximately 450,000 acres in GARZA County which are infested with mesquite. There are a total of 450,000 acres of rangeland in this county. Researchers estimate that a mesquite tree uses up to 15 gallons/day/tree during the growing season. This rate will vary based on the size of tree. Our counts have ranged from approximately 50 trees to 450 trees per acre where producers have signed up to control mesquite.

Redberry Juniper

There are approximately 73,000 acres in GARZA County which are infested with juniper. This estimate is based on the acres of Rough Breaks and Mobeeti-Potter (very shallow) soil types. Researchers estimate that a large redberry juniper uses up to 32 gallons of water per day. This also will vary based on the size of tree.

Salt Cedar

There are approximately 3800 acres in GARZA County which are infested with salt cedar. This estimate is based on measuring the lengths of the five major streams in the county and 100 feet on each side of the streams. Researchers estimate that a large salt cedar uses up to 200 gallons of water per day during the growing season.

Source of this data: National Resources Conservation Services (NRCS)

Desired Future Conditions

In a joint planning session with other members of the Groundwater Management Area #2, the Garza County UWCD adopted Desired Future Conditions for the District for relevant aquifers: Ogallala, Edwards, Trinity (High Plans) and the Dockum. Based on the 50 year planning horizon, the average allowable drawdown for Garza County UWCD would be 40 feet. This would be an average of .8 feet per year. The District proposes to calculate the cumulative drawdown every 5 years and make any changes necessary to conform to allowable drawdown of DFC'S

Refer to: GAM Run 10-030 MAG Table 1 Appendix C

MANAGEMENT OF GROUND WATER SUPPLIES

The District will manage the supply of groundwater within the District in order to conserve the resource while seeking to maintain the economic viability of all resource user groups, public and private. 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 a reduction of groundwater use. The District will make a regular assessment of water supply and groundwater storage conditions and will report those conditions to the Board and to the Public. The District will undertake, as necessary and co-operate with investigations of the groundwater resources within the District and will make the results of investigations available to the public upon adoption by the Board.

The District will adopt rules to regulate groundwater withdrawals by means of well spacing and production limits. The District may deny a well construction permit or limit groundwater withdrawals in accordance with the guidelines stated in the rules of the District. In making a determination to deny a permit or limit groundwater withdrawals, the District will consider the public benefit against individual hardship after considering all appropriate testimony.

The relevant factors to be considered in making a determination to deny a permit or limit groundwater withdrawals will include:

(1) The purpose of the rules of the District
(2) The equitable distribution of the resource
(3) The economic hardship resulting from grant or denial of a permit or the terms prescribed by the permit

ACTIONS, PROCEDURES, PERFORMANCE AND AVOIDANCE FOR PLAN IMPLEMENTATION

The District will implement the provisions of this plan and will utilize the provisions of this plan as a guidepost for determining the direction or priority for all District activities. All operations of the District, all agreements entered into by the District and any additional planning efforts in which the District may participate will be consistent with the provision of this plan.

The District will adopt and amend as necessary rules relating to the permitting of wells and the production of groundwater. The rules adopted by the District shall be pursuant to Texas Water Code (TWC) Chapter 36 and the provisions of this plan. All rules will be adhered to and enforced. The promulgation and enforcement of the rules will be based on the best technical evidence available.

The District shall treat all citizens with equality. Citizens may apply to the District for discretion in enforcement of the rules on grounds of adverse economic effect or unique local character. In granting of discretion to any rules, the Board shall consider the potential for adverse effect on adjacent landowners. The exercise of said discretion by the Board, shall not be construed as limiting the power of the Board.

The District will seek cooperation in the implementation of this plan and the management of groundwater supplies within the District. All activities of the District will be undertaken in cooperation and coordination with the appropriate state, regional or local water management entity.

COORDINATION WITH REGIONAL WATER PLAN

The GARZA County Underground Water Conservation District Water Management Plan will coordinate with both the Regional and State Water Plans.

TRACKING METHODOLOGY

The District manager will prepare an annual report on District performance to insure that management goals and objectives are being achieved. This report will be presented yearly, to the Board of Directors during their regular business meeting in October and this report will be maintained on file at the District office.

GOALS, MANAGEMENT OBJECTIVES AND PERFORMANCE STANDARDS

Goal 1.0 - Providing for the most efficient use of groundwater within the District

Management Objective: Each year, the District will provide available educational information on water conservation to the public within the District by at least one of the following methods: articles in the District newsletter, local newspaper articles, NRCS and FSA newsletters Extension Service newsletters or any other publications available.

Performance Standard: Number of articles, newsletters or other publications on the efficient use of groundwater in various publications within the District, as information becomes available, will be reported in the annual report to the District Board.

Goal 2.0 - Controlling and Preventing the Waste of Groundwater within the District

Management Objective: Each year, the District will investigate 100 percent of reported wasteful irrigation practices within the District. The District will seek remediation on 100 Percent of sites deemed a wasteful practice. The District will make diligent searches to identify wasteful irrigation practice within the district annually.

Performance Standards:

(A) The District will investigate 100 percent of reported wasteful irrigation practices and seek remediation on 100 percent of wasteful practice sites occurring within the district.

(B) The number of wasteful irrigation practice reported to the District and the number of investigation by the District will be included in the annual report to the District Board.

(C) The number of diligent searches for wasteful irrigation practice in the District that were carried out by District personnel will be reported in the annual report to the District Board.

Goal 3.0 - Addressing Drought Conditions

Management Objective: Addressing the effects of drought due to climatic or other conditions upon all water resource user groups.

Performance Standards:

(A) The District will check water table levels in twenty (20) wells in January of each year, and monitor pumping rates to determine water supply availability.

(B) Publish change in water levels in at least one newsletter or at least one newspaper each year.

(C) Inform the public about water shortages and stress water saving techniques during peak water usage periods each year through at least one newspaper article or at least one newsletter.

For more information on Drought Conditions click on
http://waterdatafortexas.org/drought/

Goal 4.0 - Addressing Conservation

Management Objective: Each year, at the beginning of the irrigation season and during the heavy irrigation period, we will provide information to the producers through (NRCS) newsletters and local media. The District will publish at least one article each year about water conservation techniques.

Performance Standard: The number of water conservation techniques articles published each year.

Goal 5.0 – Addressing Rainwater Harvesting

Management Objective: The District will publish at least one article each year about rainwater harvesting.

Performance Standard: The number of rainwater harvesting information articles published each year.

Goal 6.0 – Brush Control

Management Objective: The District will publish at least one article each year on the benefits of brush control.

Performance Standard: The number of brush control information articles published each year.

Goal 7.0 – Addressing in a quantitative manner the Desired Future Conditions of the Groundwater Resources in the District.

DFC's were adopted for the District on August, 2010. Based on the 50 year planning horizon, the allowable drawdown for the district would be 40 feet, or an average of .8 feet per year.

Management Objective: The district will publish at least one article each year on the status of Desired Future conditions.

Performance Standards:

a) The District will check water table levels in 20 wells in January of each year and monitor pumping rates to determine water supply availability. In addition the District will check water table levels every five years for cumulative drawdown to determine if DFC's are met.

b) Publish results of water table level checks in at least one newsletter or one newspaper each year on the results.

MANAGEMENT GOALS DETERMINED NOT APPLICABLE

Goal 1.0- Controlling and preventing subsidence within the District.

This management goal is not applicable to the operations of the District.

Goal 2.0 - Conjunctive surface water management issues within the District.

This management goal is not applicable to the operations of the District.

Goal 3.0 - Addressing natural resource issues which impact the use and availability of groundwater and which are impacted by the use of groundwater in the District.

This goal is not applicable to the operation of the District.

Goal 4.0 – Recharge Enhancement

This management is not cost effective to the District.

This goal is not applicable to the operations of the District.

Goal 5.0 – Precipitation Enhancement

This management is not cost effective to the District.

This goal is not applicable to the operation of the District.

SUMMARY DEFINITIONS:

<u>"Abandoned Well" shall mean:</u>

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 the applicable law, including the Rules and Regulations of the District, the Texas Water Driller's Act, Texas Commission on Environmental Quality or any other state or federal agency or political subdivision having jurisdiction, if presumed to be an abandoned or deteriorated well.

<u>"Board"</u> - The Board of Directors of the GARZA County U WCD

<u>"District"</u> - The GARZA County UWCD

<u>“TCEQ"</u> - Texas Commission on Environmental Quality

<u>“TWDB"</u> - Texas Water Development Board

<u>“Waste"</u> - as defined by Chapter 36 of the Texas Water Code means any one or more of the following:

(1) withdrawal of ground water from a ground water reservoir at a rate and in an amount that causes or threatens to cause intrusion into the reservoir of water unsuitable for agricultural, gardening, domestic, or stock 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 groundwater reservoir to any other reservoir or geologic strata that does not contain groundwater;

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

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

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

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

Appendix A

Estimated Historical Water Use And 2012 State Water Plan Datasets:

Garza County Underground Water Conservation District

by Stephen Allen
Texas Water Development Board
Groundwater Resources Division
Groundwater Technical Assistance Section
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February 14, 2014

GROUNDWATER MANAGEMENT PLAN DATA:

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

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

The five reports included in 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 Texas 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 up-to-date WUS and 2012 SWP data available as of 2/14/2014. Although it does not happen frequently, neither of these datasets are static so they are subject to change pending the availability of more accurate WUS data or an amendment to the 2012 SWP. District personnel must review these datasets and correct any discrepancies in order to ensure approval of their groundwater management plan.

The WUS dataset can be verified at this web address:

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

The 2012 SWP dataset can be verified by contacting Sabrina Anderson (sabrina.anderson@twdb.texas.gov or 512-936-0886).

For additional questions regarding this data, please contact Stephen Allen (stephen.allen@twdb.texas.gov or 512-463-7317) 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 year 2012. TWDB staff anticipates the calculation and posting of these estimates at a later date.

GARZA COUNTY

All values are in acre-fee/year

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2011	GW	185	0	39	0	11,535	63	11,822
	SW	767	2	9	0	0	252	1,030
2010	GW	149	0	95	0	7,354	60	7,658
	SW	599	2	22	0	0	242	865
2009	GW	145	0	138	0	15,028	60	15,371
	SW	589	2	32	0	0	238	861
2008	GW	142	0	181	0	8,883	53	9,259
	SW	588	2	42	0	0	210	842
2007	GW	127	0	0	0	14,502	53	14,682
	SW	559	2	0	0	0	210	771
2006	GW	140	0	0	0	11,515	49	11,704
	SW	614	2	0	0	0	197	813
2005	GW	129	0	0	0	11,784	43	11,956
	SW	874	2	0	0	0	170	1,046
2004	GW	123	0	0	0	13,257	22	13,402
	SW	664	2	0	0	0	198	864
2003	GW	140	0	0	0	13,329	20	13,489
	SW	792	2	0	0	0	183	977
2002	GW	141	0	0	0	19,768	28	19,937
	SW	752	1	0	0	200	258	1,211
2001	GW	129	0	0	0	14,502	30	14,661
	SW	808	2	0	0	146	273	1,229
2000	GW	127	0	0	0	12,105	32	12,264
	SW	652	2	0	0	60	287	1,001

Projected Surface Water Supplies
TWDB 2012 State Water Plan Data

GARZA COUNTY

All values are in acre-feet/year

RWPG	WUG	WUG Basin	Source Name	2010	2020	2030	2040	2050	2060
O	LIVESTOCK	BRAZOS	LIVESTOCK LOCAL SUPPLY	363	423	432	442	453	465
O	POST	BRAZOS	MEREDITH LAKE/RESERVOIR	306	306	306	306	306	306
O	POST	BRAZOS	WHITE RIVER LAKE/RESERVOIR	1,021	973	493	12	0	0
	Sum of Projected Surface Water Supplies (acre-feet/year)			**1,690**	**1,702**	**1,231**	**760**	**759**	**771**

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.

GARZA COUNTY

All values are in acre-feet/year

RWPG	WUG	WUG Basin	2010	2020	2030	2040	2050	2060
O	POST	BRAZOS	631	642	616	579	549	512
O	IRRIGATION	BRAZOS	11,451	10,783	10,148	9,556	8,997	8,471
O	COUNTY-OTHER	BRAZOS	156	156	150	141	132	123
O	MANUFACTURING	BRAZOS	2	2	2	2	2	2
O	LIVESTOCK	BRAZOS	363	423	432	442	453	465
O	MINING	BRAZOS	752	361	211	90	0	0
		Sum of Projected Water Demands (acre-feet/year)	**13,355**	**12,367**	**11,559**	**10,810**	**10,133**	**9,573**

Projected Water Supply Needs
TWDB 2012 State Water Plan Data

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

GARZA COUNTY

All values are in acre-feet/year

RWPG	WUG	WUG Basin	2010	2020	2030	2040	2050	2060
O	COUNTY-OTHER	BRAZOS	14	14	14	14	14	14
O	IRRIGATION	BRAZOS	-4,712	-4,301	-3,995	-3,721	-3,455	-3,212
O	LIVESTOCK	BRAZOS	0	0	0	0	0	0
O	MANUFACTURING	BRAZOS	0	0	0	0	0	0
O	MINING	BRAZOS	0	0	0	0	0	0
O	POST	BRAZOS	696	637	183	-261	-243	-206
	Sum of Projected Water Supply Needs (acre-feet/year)		**-4,712**	**-4,301**	**-3,995**	**-3,982**	**-3,698**	**-3,418**

Projected Water Management Strategies
TWDB 2012 State Water Plan Data

GARZA COUNTY

WUG, Basin (RWPG)

All values are in acre-feet/year

Water Management Strategy	Source Name [Origin]	2010	2020	2030	2040	2050	2060
COUNTY-OTHER, BRAZOS (O)							
LAKE ALAN HENRY SUPPLY FOR LAKE ALAN HENRY WSC	ALAN HENRY LAKE/RESERVOIR [RESERVOIR]	270	270	270	270	270	270
IRRIGATION, BRAZOS (O)							
IRRIGATION WATER CONSERVATION	CONSERVATION [GARZA]	4,428	3,985	3,587	3,228	2,905	2,615
POST, BRAZOS (O)							
LOCAL GROUNDWATER DEVELOPMENT	OGALLALA AQUIFER [CROSBY]	400	400	400	400	400	400
Sum of Projected Water Management Strategies (acre-feet/year)		**5,098**	**4,655**	**4,257**	**3,898**	**3,575**	**3,285**

Appendix B

GAM RUN 13-021: GARZA COUNTY UNDERGROUND WATER CONSERVATION DISTRICT MANAGEMENT PLAN

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

August 28, 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 seal appearing on this document was authorized by Cynthia K. Ridgeway, P.G. 471 on August 28, 2013.

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GAM RUN 13-021: GARZA COUNTY UNDERGROUND WATER CONSERVATION DISTRICT MANAGEMENT PLAN

by William Kohlrenken
Texas Water Development Board
Groundwater Resources Division
Groundwater Availability Modeling Section
(512) 463-8279
August 28, 2013

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 before being used in the plan. Information derived from groundwater availability models that shall be included in the groundwater management plan includes:

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

This report—Part 2 of a two-part package of information from the TWDB to Garza County Underground Water Conservation District—fulfills the requirements noted above. Part 1 of the two-part package is the Historical Water Use/State Water Plan data report. The District should have received, or will receive, this data report from the TWDB Groundwater Technical Assistance Section. Questions about the data report can be directed to Mr. Stephen Allen, stephen.allen@twdb.texas.gov, (512) 463-7317.

The groundwater management plan for Garza County Underground Water Conservation District should be adopted by the district on or before April 8, 2014 and submitted to the executive administrator of the TWDB on or before May 8, 2014. The current management plan for Garza County Underground Water Conservation District expires on July 7, 2014.

This report discusses the methods, assumptions, and results from model runs using the groundwater availability models for the Ogallala, the Edwards-Trinity (High Plains), and the Dockum aquifers. This model run replaces the results of GAM Run 09-07 (Oliver, 2009). GAM Run 13-021 meets current standards set after the release of GAM Run 09-07 including use of the extent of the official aquifer boundaries within the district rather than the entire active area of the model within the district. 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. If after review of the figures, Garza County Underground Water Conservation District determines that the district boundaries used in the assessment do not reflect current conditions, please notify the Texas Water Development Board immediately.

METHODS:

In accordance with the provisions of the Texas State Water Code, Section 36.1071, Subsection (h), the groundwater availability model for the southern portion of the Ogallala Aquifer and the Edwards-Trinity (High Plains) Aquifer and the groundwater availability model for the Dockum Aquifer were run for this analysis. Garza County Underground Water Conservation District water budgets were extracted for the historical model periods (1980-2000 for southern portion of Ogallala Aquifer and Edwards-Trinity (High Plains) Aquifer and 1980-1997 for the Dockum Aquifer) using ZONEBUDGET Version 3.01 (Harbaugh, 2009). The average annual water budget values for recharge, surface water outflow, inflow to the district, outflow from the district, net inter-aquifer flow (upper), and net inter-aquifer flow (lower) for the portion of the aquifer located within the district is summarized in this report.

PARAMETERS AND ASSUMPTIONS:

Southern portion of the Ogallala Aquifer and Edwards-Trinity (High Plains) Aquifer

- Version 2.01 of the groundwater availability model for the southern portion of the Ogallala Aquifer and the Edwards-Trinity (High Plains) Aquifer was used for this analysis. This model is an expansion on and update to the previously developed 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 model.

- The model includes four layers representing the southern portion of the Ogallala Aquifer and the Edwards-Trinity (High Plains) Aquifer. The units comprising the Edwards-Trinity (High Plains) Aquifer (primarily Edwards, Comanche Peak, and Antlers Sand formations) are separated from the overlying Ogallala Aquifer by a layer of Cretaceous shale, where present. Water budgets for the district have been determined for the Ogallala Aquifer (Layer 1), as well as the Edwards-Trinity (High Plains) Aquifer (Layer 2 through Layer 4, collectively).

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

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 for the Dockum Aquifer.

- This groundwater availability model includes three layers which generally represent the Ogallala, Edwards-Trinity (High Plains), Edwards-Trinity (Plateau), Pecos Valley, and Rita Blanca aquifers (Layer 1), the upper portion of the Dockum Aquifer (Layer2), and the lower portion of the Dockum Aquifer (Layer 3).

- The geologic units 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 MODFLOW Drain package was used to simulate both evapotranspiration and springs. Only drain flow from model grid cells representing springs within the district were incorporated into the surface water outflow values shown in Table 3.

- 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 35,000 milligrams per liter are considered brines.

- 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 run in the district, as shown in Tables 1 through 3.

- 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 net vertical 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. “Inflow” to an aquifer from an overlying or underlying aquifer will always equal the “Outflow” from the other aquifer.

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

TABLE 1: SUMMARIZED INFORMATION FOR THE OGALLALA AQUIFER THAT IS NEEDED FOR GARZA 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	Ogallala Aquifer	8,872
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Ogallala Aquifer	2,005
Estimated annual volume of flow into the district within each aquifer in the district	Ogallala Aquifer	2,457
Estimated annual volume of flow out of the district within each aquifer in the district	Ogallala Aquifer	9
Estimated net annual volume of flow between each aquifer in the district	Net flow from the Edwards-Trinity (High Plains) Aquifer, the Duck Creek Formation, and the Kiamichi Formation into the Ogallala Aquifer	435

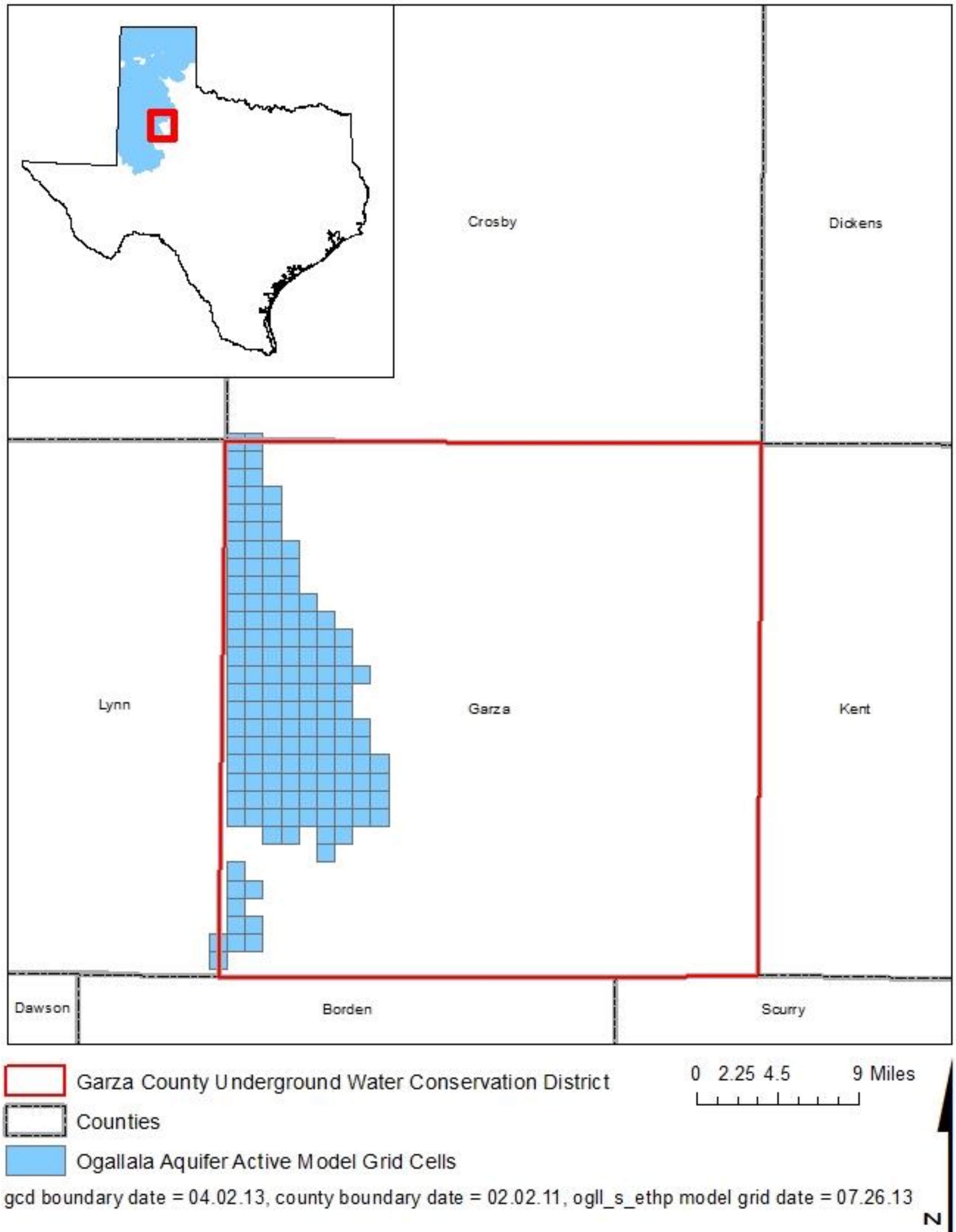

FIGURE 1: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE OGALLALA AQUIFER FROM WHICH THE INFORMATION IN TABLE 1 WAS EXTRACTED (THE OGALLALA AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).

TABLE 2: SUMMARIZED INFORMATION FOR THE EDWARDS-TRINITY (HIGH PLAINS) AQUIFER THAT IS NEEDED FOR GARZA 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 (High Plains) Aquifer	0
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Edwards-Trinity (High Plains) Aquifer	55
Estimated annual volume of flow into the district within each aquifer in the district	Edwards-Trinity (High Plains) Aquifer	481
Estimated annual volume of flow out of the district within each aquifer in the district	Edwards-Trinity (High Plains) Aquifer	1
Estimated net annual volume of flow between each aquifer in the district	Net flow from Edwards-Trinity (High Plains) Aquifer to the Ogallala Aquifer, Duck Creek Formation, and Kiamichi Formation.	347
	Net lateral flow from the Duck Creek and Kiamichi Formations to the Edwards-Trinity (High Plains) Aquifer	64

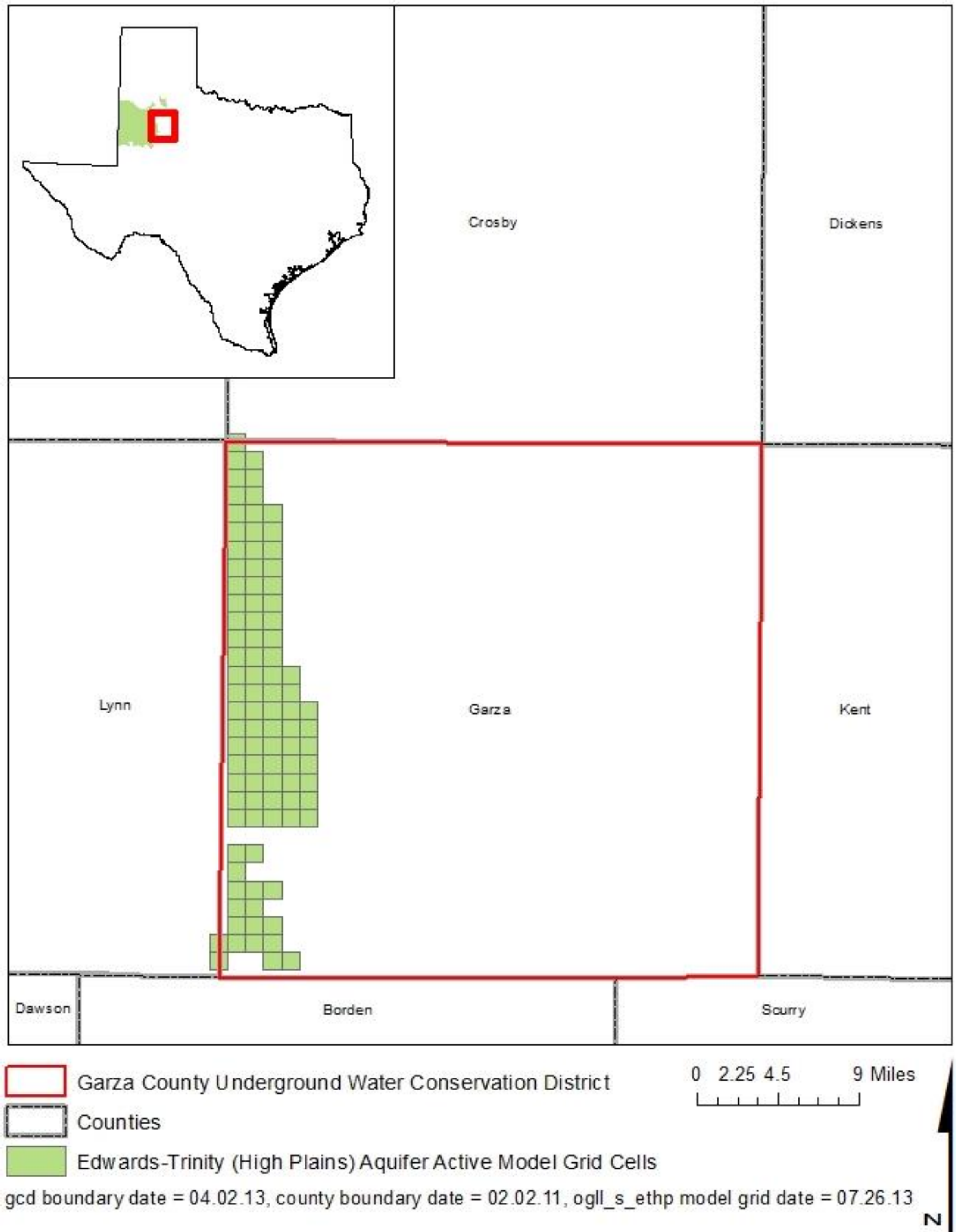

FIGURE 2: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE EDWARDS-TRINITY (HIGH PLAINS) AQUIFER FROM WHICH THE INFORMATION IN TABLE 2 WAS EXTRACTED (THE EDWARDS-TRINTIY (HIGH PLAINS) AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).

TABLE 3: SUMMARIZED INFORMATION FOR THE DOCKUM AQUIFER THAT IS NEEDED FOR GARZA 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	3,761
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Dockum Aquifer	2,800
Estimated annual volume of flow into the district within each aquifer in the district	Dockum Aquifer	0
Estimated annual volume of flow out of the district within each aquifer in the district	Dockum Aquifer	0
Estimated net annual volume of flow between each aquifer in the district	Net lateral flow from the brackish portion of the Dockum Aquifer into the official aquifer boundary	909

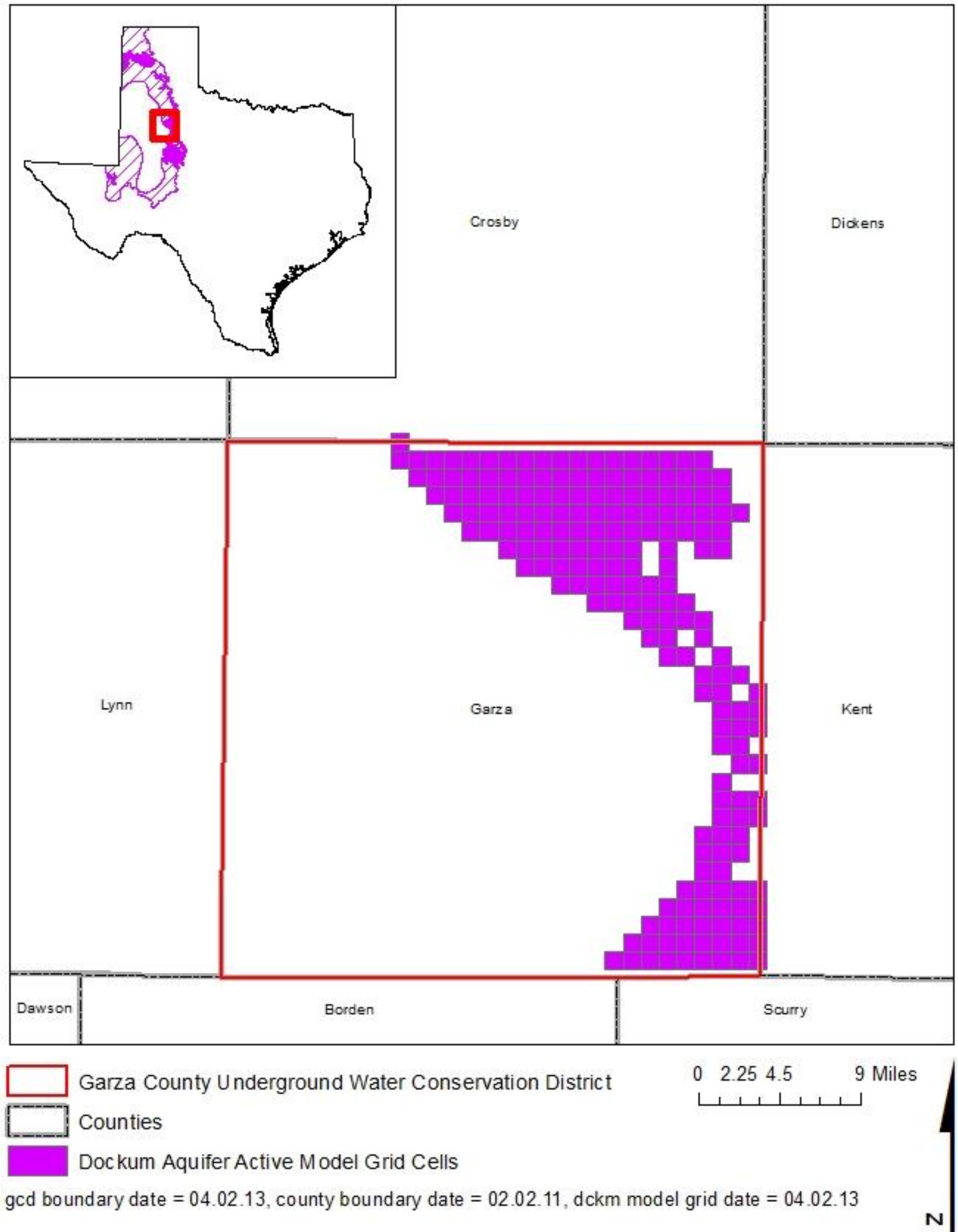

FIGURE 3: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE DOCKUM AQUIFER FROM WHICH THE INFORMATION IN TABLE 3 WAS EXTRACTED (THE DOKCUM AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).

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 interaction with streams are specific to particular historic time periods.

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

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

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Blandford, T.N., Blazer, D.J., Calhoun, K.C., Dutton, A.R., Naing, T., Reedy, R.C., and Scanlon, B.R., 2003, Groundwater availability of the southern Ogallala aquifer in Texas and New Mexico—Numerical simulations through 2050: Final report prepared for the Texas Water Development Board by Daniel B. Stephens & Associates, Inc., 158 p., http://www.twdb.texas.gov/groundwater/models/gam/ogll_s/OGLL_S_Full_Report.pdf.

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Appendix C

GAM Run 10-030 MAG

by Mr. Wade Oliver

Texas Water Development Board
Groundwater Availability Modeling Section
(512) 463-3132
June 22, 2011

Cynthia K. Ridgeway is the Manager of the Groundwater Availability Modeling Section and 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, 2011.

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EXECUTIVE SUMMARY:

The estimated total pumping from the Ogallala Aquifer that achieves the desired future conditions adopted by the members of Groundwater Management Area 2 declines from approximately 2,367,000 acre-feet per year to 1,307,000 acre-feet per year between 2010 and 2060. This is summarized by county, regional water planning area, and river basin as shown in Table 2. The corresponding total pumping from the Edwards-Trinity (High Plains) Aquifer declines from approximately 96,000 acre-feet per year to 23,000 acre-feet per year over the same time period (Table 3). The estimated managed available groundwater, the amount available for permitting, for the groundwater conservation districts within Groundwater Management Area 2 for the Ogallala and Edwards-Trinity (High Plains) aquifers declines from approximately 2,368,000 acre-feet per year to 1,266,000 acre-feet per year between 2010 and 2060 (Table 9). The pumping estimates were extracted from Groundwater Availability Modeling Task 10-023, Scenario 3, which Groundwater Management Area 2 used as the basis for developing their desired future conditions.

REQUESTOR:

Mr. Jason Coleman of South Plains Underground Water Conservation District on behalf of Groundwater Management Area 2

DESCRIPTION OF REQUEST:

In a letter dated August 10, 2010 and received August 13, 2010, Mr. Jason Coleman provided the Texas Water Development Board (TWDB) with the desired future conditions of the Ogallala and Edwards-Trinity (High Plains) aquifers adopted by the members of Groundwater Management Area 2. Below are the desired future conditions for the Ogallala and Edwards-Trinity (High Plains) aquifers in the northern portion of the management area as described in Resolution No. 2010-01 and adopted August 5, 2010:

> [T]he *members of* [Groundwater Management Area] *#2 adopt the desired future condition of 50 percent of the saturated thickness remaining after 50 years for the Northern Portion of* [Groundwater Management Area] *#2, based on GAM Run 10-023, Scenario 3…*

As described in Resolution No. 2010-01, the northern portion of Groundwater Management Area 2 consists of Bailey, Briscoe, Castro, Cochran, Crosby, Deaf Smith, Floyd, Hale, Hockley, Lamb, Lubbock, Lynn, Parmer, and Swisher counties.

For the southern portion of Groundwater Management Area 2, desired future conditions for the Ogallala and Edwards-Trinity (High Plains) aquifers were stated as average water-level declines (drawdowns) over the same time period. The average drawdowns specified as desired future conditions for the southern portion of Groundwater Management Area 2 are: Andrews–6 feet, Bordon–3 feet, Dawson–74 feet, Gaines–70 feet, Garza–40 feet, Howard–1 foot, Martin–8 feet, Terry–42 feet, and Yoakum–18 feet.

In response to receiving the adopted desired future conditions, the Texas Water Development Board has estimated the managed available groundwater for each of the groundwater conservation districts within Groundwater Management Area 2 for the Ogallala and Edwards-Trinity (High Plains) aquifers.

Although not explicitly stated in the adopted desired future conditions statement, drawdown estimates for the Edwards-Trinity (High Plains) Aquifer associated with Scenario 3 of GAM Task 10-023 are shown in Table 1 below.

Table 1. Average drawdown in feet in the Edwards-Trinity (High Plains) Aquifer by county in Scenario 3 of GAM Task 10-023.

County	Average drawdown (feet)					
	2010	2020	2030	2040	2050	2060
Bailey	0	1	2	4	4	5
Borden	0	1	1	2	3	4
Cochran	-1	0	3	6	9	11
Dawson	3	21	37	50	60	67
Floyd	3	16	29	41	52	61
Gaines	6	28	42	53	61	67
Garza	2	10	18	26	33	40
Hale	1	8	15	22	29	36
Hockley	1	7	13	19	24	28
Lamb	0	1	1	2	3	3
Lubbock	1	8	14	20	25	29
Lynn	0	7	14	21	27	32
Terry	2	14	25	32	37	40
Yoakum	1	6	10	13	15	17

For purposes of developing total pumping and managed available groundwater numbers, it was assumed that by referencing Scenario 3 of GAM Task 10-023, the groundwater conservation districts in Groundwater Management Area 2 intended to fully incorporate the drawdown and pumping estimates of the Edwards-Trinity (High Plains) Aquifer. Thus, this analysis included those pumping numbers.

METHODS:

Groundwater Management Area 2, located in the Texas Panhandle, contains a portion of the Ogallala Aquifer and the entire Edwards-Trinity (High Plains) Aquifer. The location of Groundwater Management Area 2, the Ogallala and Edwards-Trinity (High Plains) aquifers, and the groundwater availability model cells that represent the aquifers are shown in Figure 1.

The Texas Water Development Board previously completed several predictive groundwater availability model simulations of the Ogallala and Edwards-Trinity (High Plains) aquifers to assist the members of Groundwater Management Area 2 in developing desired future conditions.

As stated in Resolution No. 2010-01 and the narrative of the methods used for developing desired future conditions provided by Groundwater Management Area 2, the simulation on which the desired future conditions above are based is Scenario 3 of GAM Task 10-023 (Oliver, 2010). The estimated pumping for Groundwater Management Area 2 presented here, taken directly from the above scenario, has been divided by county, regional water planning area, river basin, and groundwater conservation district. These areas are shown in Figure 2.

PARAMETERS AND ASSUMPTIONS:

The parameters and assumptions for the model run using the groundwater availability model for the southern portion of the Ogallala Aquifer and the Edwards-Trinity (High Plains) Aquifer are described below:

- The results presented in this report are based on “Scenario 3” in GAM Task 10-023 (Oliver, 2010). See GAM Task 10-023 for a full description of the methods, assumptions, and results for the groundwater availability model run.

- Version 2.01 of the groundwater availability model for the southern portion of the Ogallala Aquifer and the Edwards-Trinity (High Plains) Aquifer (Blandford and others, 2008) was used for this analysis. 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.

- The model includes four layers representing the southern portion of the Ogallala and Edwards-Trinity (High Plains) aquifers. The units comprising the Edwards-Trinity (High Plains) Aquifer (primarily Edwards, Comanche Peak, and Antlers Sand formations) are separated from the overlying Ogallala Aquifer by a layer of Cretaceous shale, where present.

- The mean absolute error (a measure of the difference between simulated and measured water levels during model calibration) for the Ogallala Aquifer in 2000 is 33 feet. The mean absolute error for the Edwards-Trinity (High Plains) Aquifer in 1997 is 25 feet (Blandford and others, 2008).

- Cells were assigned to individual counties, river basins, regional water planning areas, and groundwater conservation districts as shown in the August 3, 2010 version of the file that associates the model grid to political and natural boundaries for the southern portion of the Ogallala Aquifer and the Edwards-Trinity (High Plains) Aquifer. Note that some minor corrections were made to the file to better reflect the relationship of model cells to political boundaries.

- The recharge used for the model run represents average recharge as described in Blandford and others (2003).

Determining Managed Available Groundwater

As defined in Chapter 36 of the Texas Water Code, "managed available groundwater" is the amount of water that may be permitted. The pumping output from groundwater availability models, however, represents the total amount of pumping from the aquifer. The total pumping includes uses of water both subject to permitting and exempt from permitting. Examples of exempt uses include domestic, livestock, and oil and gas exploration. Each district may also exempt additional uses as defined by its rules or enabling legislation.

Since exempt uses are not available for permitting, it is necessary to account for them when determining managed available groundwater. To do this, the Texas Water Development Board developed a standardized method for estimating exempt use for domestic and livestock purposes based on projected changes in population and the distribution of domestic and livestock wells in the area. Because other exempt uses can vary significantly from district to district, and there is much higher uncertainty associated with estimating use due to oil and gas exploration, estimates of exempt pumping outside domestic and livestock uses have not been included. The districts were also encouraged to evaluate the estimates of exempt pumping and, if desired, provide updated estimates. Once established, the estimates of exempt pumping were subtracted from the total pumping output from the groundwater availability model to yield the estimated managed available groundwater for permitting purposes.

RESULTS:

The estimated total pumping from the Ogallala Aquifer in Groundwater Management Area 2 that achieves the above desired future conditions declines from approximately 2,367,000 acre-feet per year in 2010 to 1,307,000 acre-feet per year in 2060. 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 2). The corresponding estimated total pumping from the Edwards-Trinity (High Plains) Aquifer declines from approximately 96,000 acre-feet per year to 23,000 acre-feet per year over the same time period (Table 3).

The total pumping estimates for the combined Ogallala and Edwards-Trinity (High Plains) aquifers are also summarized by county, regional water planning area, river basin, and groundwater conservation district as shown in tables 4, 5, 6, and 7, respectively. In Table 7, the total pumping both excluding and including areas outside of a groundwater conservation district is shown. Table 8 contains the estimates of exempt pumping for the Ogallala and Edwards-Trinity (High Plains) aquifers by groundwater conservation district. The managed available groundwater, the difference between the total pumping in the districts (Table 7, excluding areas outside of a district) and the estimated exempt use (Table 8) is shown in Table 9. The total managed available groundwater for the Ogallala and Edwards-Trinity (High Plains) aquifers in Groundwater Management Area 2 declines from approximately 2,368,000 acre-feet per year to 1,266,000 acre-feet per year between 2010 and 2060.

LIMITATIONS:

Managed available groundwater numbers included in this report are the result of subtracting the estimated future exempt use from the estimated total pumping that would achieve the desired future condition adopted by the groundwater conservation districts in the groundwater management area. These numbers, therefore, are the result of (1) running the groundwater model to estimate the total pumping required to achieve the desired future condition and (2) estimating the future exempt use in the area.

The groundwater model used in developing estimates of total pumping is the best available scientific tool that can be used to estimate the pumping that will achieve the desired future condition. 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 total pumping 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.

In addition, certain assumptions have been made regarding future precipitation, recharge, and streamflow in developing these total pumping estimates. Those assumptions also need to be considered and compared to actual future data when evaluating compliance with the desired future condition.

In the case of TWDB's estimates of future exempt use, key assumptions were made as to the pattern of population growth relative to the need for domestic wells or supplied water, per capita use from domestic wells, and livestock uses of water. In the case of district estimates of future exempt use, including exempt use associated with the exploration of oil and gas, the assumptions are specific to that district. In either case, these assumptions need to be considered when reviewing future data related to exempt use.

Given these limitations, users of this information are cautioned that the total pumping 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 groundwater model and the assumptions in this analysis, it is important that the groundwater conservation districts work with the TWDB to refine these managed available groundwater numbers given the reality of how the aquifer responds to the actual amount and location of pumping now and in the future.

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Table 2. Estimated total annual pumping for the Ogallala Aquifer in Groundwater Management Area 2. Results are in acre-feet per year and are divided by county, regional water planning area, and river basin.

County	Region	Basin	Year					
			2010	2020	2030	2040	2050	2060
Andrews	F	Colorado	17,584	15,085	13,678	12,014	10,016	7,377
		Rio Grande	54	50	41	41	41	41
Bailey	O	Brazos	62,538	41,283	34,907	30,064	24,021	21,429
Borden	F	Brazos	292	292	292	292	292	292
		Colorado	107	107	107	107	107	107
Briscoe	O	Red	33,622	26,457	19,722	14,220	13,037	11,933
Castro	O	Brazos	90,367	90,367	90,367	90,367	88,630	84,458
		Red	37,055	36,936	36,141	35,449	34,650	33,540
Cochran	O	Brazos	16,324	7,707	6,556	4,770	4,410	4,179
		Colorado	32,021	28,501	27,085	25,926	23,674	21,192
Crosby	O	Brazos	133,239	133,058	133,058	133,058	133,058	133,058
		Red	1,624	1,624	1,624	1,624	1,624	1,624
Dawson	O	Brazos	5,350	5,350	5,350	5,138	4,075	1,099
		Colorado	196,260	192,758	180,531	156,477	131,379	92,681
Deaf Smith	O	Red	129,167	118,166	106,868	97,057	80,382	65,931
Floyd	O	Brazos	95,488	93,749	92,041	90,930	86,458	84,300
		Red	59,482	55,617	53,320	47,453	43,351	40,061
Gaines	O	Colorado	350,369	240,110	175,175	130,951	97,498	71,544
Garza	O	Brazos	19,203	19,073	18,942	18,812	18,032	17,121
Hale	O	Brazos	130,097	129,291	127,492	125,488	119,612	111,734
		Red	525	525	525	525	525	525
Hockley	O	Brazos	87,712	84,378	80,285	76,847	69,445	60,771
		Colorado	8,256	8,004	8,004	7,571	7,324	7,009
Howard	F	Colorado	3,075	3,075	2,731	2,731	2,731	2,703
Lamb	O	Brazos	147,368	137,304	125,466	111,509	95,696	85,190
Lubbock	O	Brazos	124,519	120,044	115,348	108,699	100,762	91,073
Lynn	O	Brazos	98,003	97,740	96,954	94,600	86,945	78,543
		Colorado	6,020	6,020	6,020	6,020	6,020	5,925
Martin	F	Colorado	13,570	13,570	13,570	13,140	12,299	12,277
Parmer	O	Brazos	50,258	45,572	39,624	35,624	29,978	27,692
		Red	18,436	17,493	16,960	16,525	15,642	13,289
Swisher	O	Brazos	28,248	28,248	26,603	19,889	14,084	8,304
		Red	82,677	79,158	74,399	64,929	59,764	55,994
Terry	O	Brazos	13,342	13,342	13,342	9,793	5,348	4,092
		Colorado	192,317	182,880	121,267	77,305	48,557	29,555
Yoakum	O	Colorado	82,297	59,745	43,575	33,882	26,717	20,040
Total			**2,366,866**	**2,132,679**	**1,907,970**	**1,699,827**	**1,496,184**	**1,306,683**

Table 3. Estimated total annual pumping for the Edwards-Trinity (High Plains) Aquifer in Groundwater Management Area 2. Results are in acre-feet per year and are divided by county, regional water planning area, and river basin.

County	Region	Basin	Year					
			2010	2020	2030	2040	2050	2060
Bailey	O	Brazos	279	279	279	279	279	279
Borden	F	Brazos	65	65	65	65	65	65
		Colorado	41	41	41	41	41	41
Cochran	O	Brazos	137	137	137	137	137	137
		Colorado	127	127	127	127	127	127
Dawson	O	Brazos	0	0	0	0	0	0
		Colorado	1,103	1,103	1,103	1,103	1,103	1,103
Floyd	O	Brazos	521	521	521	518	505	499
		Red	695	695	695	695	695	683
Gaines	O	Colorado	85,058	46,202	30,316	22,997	16,523	12,904
Garza	O	Brazos	18	18	18	18	18	18
		Colorado	0	0	0	0	0	0
Hale	O	Brazos	3,523	3,523	3,523	3,523	3,523	3,419
Hockley	O	Brazos	96	96	96	96	96	96
		Colorado	0	0	0	0	0	0
Lamb	O	Brazos	164	164	164	164	164	164
Lubbock	O	Brazos	690	690	690	690	690	690
Lynn	O	Brazos	221	221	221	221	221	221
		Colorado	9	9	9	9	9	9
Terry	O	Brazos	23	23	23	23	23	23
		Colorado	959	959	922	922	922	922
Yoakum	O	Colorado	2,532	1,893	1,757	1,642	1,642	1,524
Total			**96,261**	**56,766**	**40,707**	**33,270**	**26,783**	**22,924**

Table 4. Estimated total annual pumping for the Ogallala and Edwards-Trinity (High Plains) aquifers summarized by county in Groundwater Management Area 2 for each decade between 2010 and 2060. Results are in acre-feet per year.

County	Year					
	2010	2020	2030	2040	2050	2060
Andrews	17,638	15,135	13,719	12,055	10,057	7,418
Bailey	62,817	41,562	35,186	30,343	24,300	21,708
Borden	505	505	505	505	505	505
Briscoe	33,622	26,457	19,722	14,220	13,037	11,933
Castro	127,422	127,303	126,508	125,816	123,280	117,998
Cochran	48,609	36,472	33,905	30,960	28,348	25,635
Crosby	134,863	134,682	134,682	134,682	134,682	134,682
Dawson	202,713	199,211	186,984	162,718	136,557	94,883
Deaf Smith	129,167	118,166	106,868	97,057	80,382	65,931
Floyd	156,186	150,582	146,577	139,596	131,009	125,543
Gaines	435,427	286,312	205,491	153,948	114,021	84,448
Garza	19,221	19,091	18,960	18,830	18,050	17,139
Hale	134,145	133,339	131,540	129,536	123,660	115,678
Hockley	96,064	92,478	88,385	84,514	76,865	67,876
Howard	3,075	3,075	2,731	2,731	2,731	2,703
Lamb	147,532	137,468	125,630	111,673	95,860	85,354
Lubbock	125,209	120,734	116,038	109,389	101,452	91,763
Lynn	104,253	103,990	103,204	100,850	93,195	84,698
Martin	13,570	13,570	13,570	13,140	12,299	12,277
Parmer	68,694	63,065	56,584	52,149	45,620	40,981
Swisher	110,925	107,406	101,002	84,818	73,848	64,298
Terry	206,641	197,204	135,554	88,043	54,850	34,592
Yoakum	84,829	61,638	45,332	35,524	28,359	21,564
Total	**2,463,127**	**2,189,445**	**1,948,677**	**1,733,097**	**1,522,967**	**1,329,607**

Table 5. Estimated total annual pumping for the Ogallala and Edwards-Trinity (High Plains) aquifers summarized by regional water planning area in Groundwater Management Area 2 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	34,788	32,285	30,525	28,431	25,592	22,903
O	2,428,339	2,157,160	1,918,152	1,704,666	1,497,375	1,306,704
Total	**2,463,127**	**2,189,445**	**1,948,677**	**1,733,097**	**1,522,967**	**1,329,607**

Table 6. Estimated total annual pumping for the Ogallala and Edwards-Trinity (High Plains) aquifers summarized by river basin in Groundwater Management Area 2 for each decade between 2010 and 2060. Results are in acre-feet per year.

Basin	Year					
	2010	2020	2030	2040	2050	2060
Brazos	1,108,085	1,052,535	1,012,364	961,614	886,567	818,946
Colorado	991,705	800,189	626,018	492,965	386,689	287,040
Red	363,283	336,671	310,254	278,477	249,670	223,580
Rio Grande	54	50	41	41	41	41
Total	**2,463,127**	**2,189,445**	**1,948,677**	**1,733,097**	**1,522,967**	**1,329,607**

Table 7. Estimated total annual pumping for the Ogallala and Edwards-Trinity (High Plains) aquifers summarized by groundwater conservation district (GCD) in Groundwater Management Area 2 for each decade between 2010 and 2060. Results are in acre-feet per year. UWCD refers to Underground Water Conservation District.

Groundwater Conservation District	Year					
	2010	2020	2030	2040	2050	2060
Garza County UWCD	19,221	19,091	18,960	18,830	18,050	17,139
High Plains UWCD No. 1	1,421,975	1,343,554	1,282,656	1,208,126	1,109,582	1,019,597
Llano Estacado UWCD	435,427	286,312	205,491	153,948	114,021	84,448
Mesa UWCD	202,713	199,211	186,984	162,718	136,557	94,883
Permian Basin UWCD	16,403	16,403	16,099	15,669	14,828	14,795
Sandy Land UWCD	84,829	61,638	45,332	35,524	28,359	21,564
South Plains UWCD	207,257	197,820	136,170	88,659	55,466	35,208
Total (excluding non-district areas)	**2,387,825**	**2,124,029**	**1,891,692**	**1,683,474**	**1,476,863**	**1,287,634**
No District	75,302	65,416	56,985	49,623	46,104	41,973
Total (including non-district areas)	**2,463,127**	**2,189,445**	**1,948,677**	**1,733,097**	**1,522,967**	**1,329,607**

Table 8. Estimates of annual exempt use for the Ogallala and Edwards-Trinity (High Plains) aquifers in Groundwater Management Area 2 by groundwater conservation district (GCD) for each decade between 2010 and 2060. Results are in acre-feet per year. UWCD refers to Underground Water Conservation District.

Groundwater Conservation District	Source	Year					
		2010	2020	2030	2040	2050	2060
Garza County UWCD	TA	68	71	69	67	64	59
High Plains UWCD No. 1	D	15,482	16,253	16,712	16,925	17,087	17,043
Llano Estacado UWCD	D	2,242	2,332	2,397	2,443	2,435	2,420
Mesa UWCD	TA	542	558	573	582	566	545
Permian Basin UWCD	TA	575	596	605	608	605	599
Sandy Land UWCD	TA	366	402	424	448	436	422
South Plains UWCD	TA	502	537	569	601	603	599
Total		**19,777**	**20,749**	**21,349**	**21,674**	**21,796**	**21,687**

TA = Estimated exempt use calculated by TWDB and accepted by the district

D = Estimated exempt use calculated by the district

Table 9. Estimates of managed available groundwater for the Ogallala and Edwards-Trinity (High Plains) aquifers in Groundwater Management Area 2 by groundwater conservation district (GCD) for each decade between 2010 and 2060. Results are in acre-feet per year. UWCD refers to Underground Water Conservation District.

Groundwater Conservation District	Year					
	2010	2020	2030	2040	2050	2060
Garza County UWCD	19,153	19,020	18,891	18,763	17,986	17,080
High Plains UWCD No. 1	1,406,493	1,327,301	1,265,944	1,191,201	1,092,495	1,002,554
Llano Estacado UWCD	433,185	283,980	203,094	151,505	111,586	82,028
Mesa UWCD	202,171	198,653	186,411	162,136	135,991	94,338
Permian Basin UWCD	15,828	15,807	15,494	15,061	14,223	14,196
Sandy Land UWCD	84,463	61,236	44,908	35,076	27,923	21,142
South Plains UWCD	206,755	197,283	135,601	88,058	54,863	34,609
Total	**2,368,048**	**2,103,280**	**1,870,343**	**1,661,800**	**1,455,067**	**1,265,947**

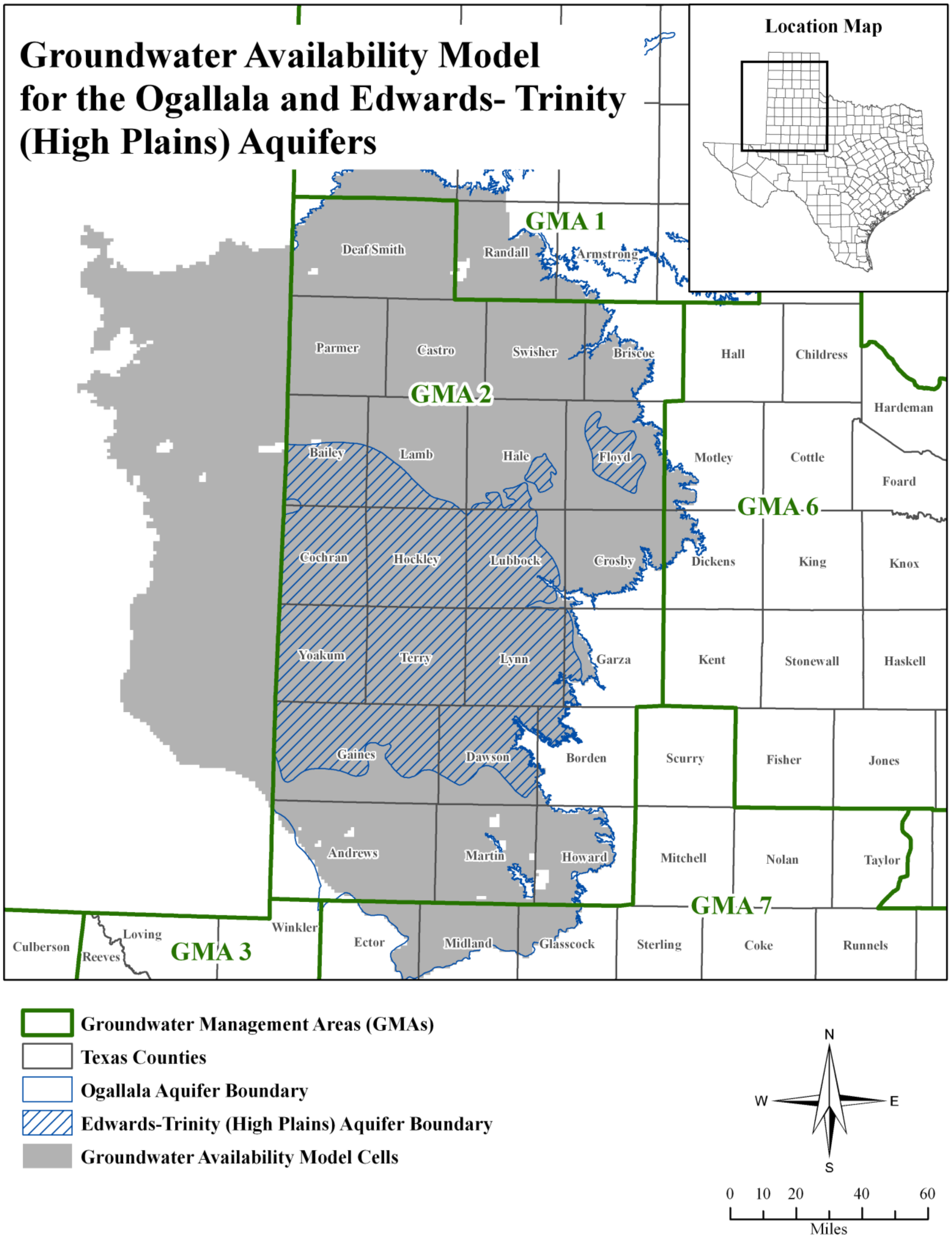

Figure 1. Map showing the areas covered by the groundwater availability model for the southern portion of the Ogallala Aquifer and the Edwards-Trinity (High Plains) Aquifer.

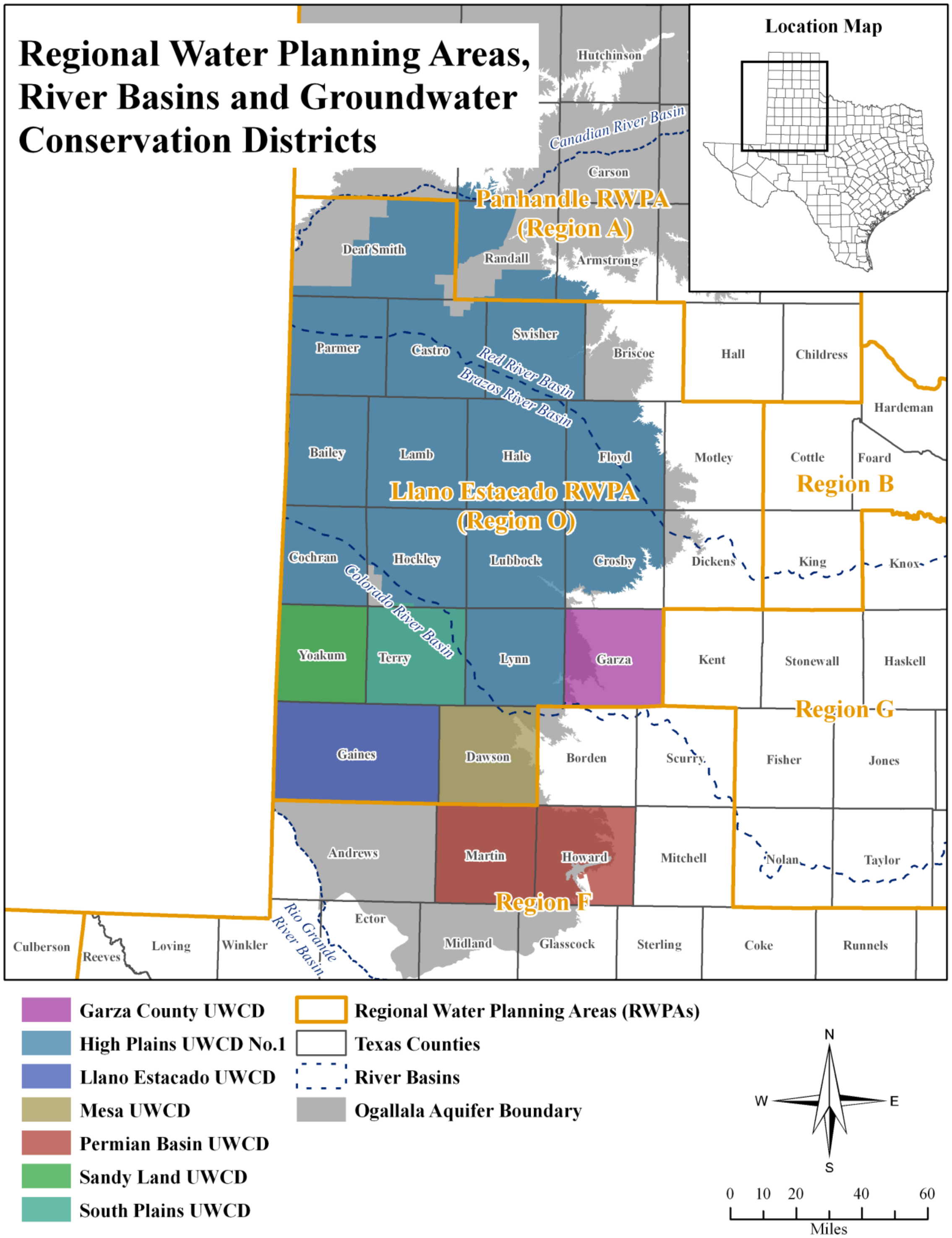

Figure 2. Map showing regional water planning areas (RWPAs), groundwater conservation districts (GCDs), counties, and river basins in Groundwater Management Area 2. UWCD refers to Underground Water Conservation District.