HEMPHILL COUNTY
Underground Water Conservation District
Conserving a Texas Oasis

DISTRICT MANAGEMENT PLAN

Adopted July 17, 2007
Certified by TWDB Sept. 17, 2007
Repealed and New Plan Adopted July 10, 2012
(Certified by TWDB_____)

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I. DISTRICT MISSION

The mission of the Hemphill County Underground Water Conservation District is to conserve and protect the groundwater resources of Hemphill County, by ensuring sustainable development through local management and the best available science.

II. PURPOSE OF THE MANAGEMENT PLAN

Senate Bill 1 (SB 1), enacted by the 75th Texas Legislature in 1997, and Senate Bill 2 (SB2), enacted by the 77th Texas Legislature in 2001, established a comprehensive statewide planning process and the actions necessary for districts to manage and conserve the groundwater resources of the state of Texas. These bills required all underground water conservation districts to develop a management plan which defines the water needs and supply within each district and the goals each district will use to manage the underground water in order to meet their needs. In addition, the 79th Texas Legislature enacted HB 1763 in 2005 that requires joint planning among districts that are in the same Groundwater Management Area (GMA). These districts must establish the desired future conditions of the aquifers within their respective GMAs every five years. Through this process, the districts are to consider the varying uses and conditions of the aquifer within the management area that differ substantially from one geographic area to another. The Districts will then submit the established desired future conditions to the executive administrator of the Texas Water Development Board (TWDB) who will provide each district with the modeled available groundwater in the management area based on the desired future conditions of the aquifer in the area. Technical information, such as the desired future conditions of the aquifers within the District's jurisdiction and the amount of the modeled available groundwater from such aquifers is required to be included in the District's management plan.

The District's management plan satisfies the requirements of SB 1, SB2, HB 1763, the statutory requirements of Texas Water Code (TWC) Chapter 36, and the rules and requirements of TWDB.

This plan further addresses the process established by the District to monitor changes in the aquifer, communicate to the public the findings made by the District, and ensure that the plan can adapt through time to meet the needs of the stakeholders of Hemphill County.

III. DISTRICT INFORMATION

A. Creation

The Texas State Legislature in 1949 authorized the creation of Underground Water Conservation Districts to perform certain prescribed duties, functions, and hold specific powers as set forth in Article 7880-3c, Texas Civil Statutes, now codified in Chapter 36 of the Texas Water Code. In 1994 a committee appointed by the Hemphill County Commissioners' Court reviewed the need for Hemphill County to either join an existing water district or in accordance with statute, form

a single county district. After investigating other districts and discussions within the county, the committee recommended that a single county district be formed. The Hemphill County Underground Water Conservation District was created the following year by the Hemphill County Underground Water Conservation District Act (Act of May 19, 1995, 74th Leg., R.S., ch. 157, 1995 Tex. Gen. Laws 1007). (See Appendix A) The District was confirmed by a local election held in Hemphill County on November 4, 1997 with 88% of the voters in favor of the District.

B. Directors

The District's Board of Directors is composed of five members elected to serve staggered four year terms. All directors are elected to serve as directors at-large. All elections are held in May of even numbered years. The Board of Directors hold regular meetings at the Commissioner's Courtroom located on the 2nd floor of the Hemphill County Courthouse located at 400 Main Street, Canadian, Texas on the second Tuesday of each month unless otherwise posted. All meetings of the Board of Directors are public meetings noticed and held in accordance with applicable public meeting requirements.

C. Authority

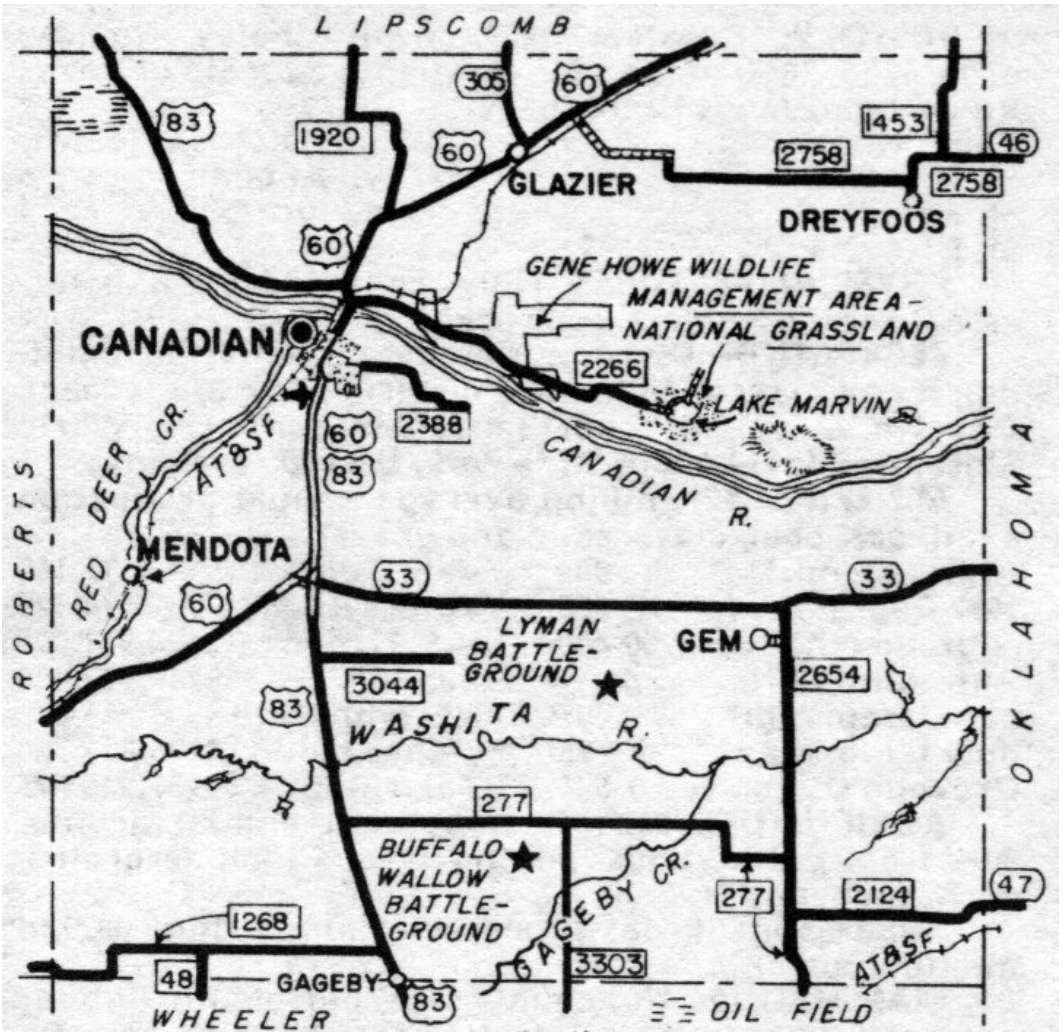
The District derives its authority to manage groundwater within the District by virtue of the powers granted and authorized pursuant to Section 59, Article XVI, Texas Constitution, Chapter 36, Texas Water Code, and the District's enabling act, the Act of May 19, 1995, 74th Leg., R.S., ch. 157, 1995 Tex. Gen. Laws 1007 (See Appendix A). The District, acting under such authority, assumes all the rights and responsibilities of a groundwater conservation district specified in Chapter 36 of the Texas Water Code. With the adoption of the Districts rules by the Board of Directors in a public meeting on June 8, 2004, and amended November 14, 2006, January 10, 2007 and August 10, 2010; the authority to manage the use of groundwater in the District will be governed at all times as specified in the District rules.

D. Location and Extent

The District (see Exhibit A) is located in Hemphill County and its boundaries are coterminous with the boundaries of the County. This area encompasses approximately 900 square miles and contains approximately 594,560 acres and has a current population of 3,807 according to the 2010 US Census. The District lies in the rolling plains on the eastern edge of the Texas Panhandle. It is bordered on the east by Oklahoma, on the south by Wheeler County, on the west by Roberts County and on the north by Lipscomb County. Industries within the county include agricultural, petroleum, tourism and hunting.

EXHIBIT A

HEMPHILL COUNTY UNDERGROUND WATER CONSERVATION DISTRICT BOUNDARY



E. Topography and Drainage

Total elevation relief in the county is approximately 835 feet. The maximum elevation, approximately 3005 feet above sea level, is in the southwest corner of the county. The minimum elevation, approximately 2170 feet above mean sea level, is in the Canadian River bottoms at the Oklahoma state line. A small portion of the county in the southwest is located in the generally level Llano Estacado (Staked plains) portion of the Texas Panhandle. The remainder of the county is located in eroded areas surrounding the rivers. The southwest and west portions of the county contain flat topped mesas surrounded by tributary creeks

and arroyos. A significant escarpment is present between the plains areas and the Canadian River drainages. A similar escarpment is present along portions of Red Deer Creek. Generally, the terrain is rougher in the west and smoother in the east. Areas of sand dunes are located in the area north of the Canadian River. Several river terraces are present along the Canadian River.

Two of the main drainage systems flow from west to east through the county. These are the Canadian and Washita Rivers. These Rivers originate outside the county boundaries. Red Deer Creek, located in the western part of the county, also originates outside the county and flows in a northerly direction in the western part of the county. The three main drainage systems are described below.

The Canadian River originates in New Mexico, flows across the Texas Panhandle from west to east, and continues into Oklahoma, joining the Arkansas River near the Oklahoma-Arkansas border. The Canadian River and the feeder creeks drain approximately 50% of the county land area.

The headwaters for Red Deer Creek are located in Gray County although annual flow is not typically present until you reach Hemphill County near the southwest corner before joining the Canadian River just west of the town of Canadian. Red Deer Creek drains approximately 10% of the county area.

The Washita River originates outside Hemphill County between Red Deer Creek and the southwest corner of the county. The river flows east across the county, into Oklahoma, and into Lake Texoma on the Red River between Texas and Oklahoma. The Washita River and associated feeder creeks drain roughly the southern 40% of Hemphill County. Gageby Creek, originating in Wheeler County to the south, is a major tributary.

Streams feeding into the two rivers generally flow north or south for a short distance into the main stream. The rivers and creeks are fed by stream flow from outside the county, surface runoff within the county and from groundwater discharges to springs and seeps located near the stream heads or along the stream courses. The discharging groundwater is from the Ogallala aquifer.

F. Groundwater Resources in Hemphill County

The primary aquifer in the District (see Exhibit B) is the Ogallala Aquifer. Water-saturated sediments of the Ogallala formation form the aquifer. The Ogallala sediments rest on Permian age “Red Beds”. Limited exposures of the red beds are found at several locations on the south side of the Canadian River channel. These red bed exposures contain fine grained sands with gypsum streaks. There are additional red bed exposures in the Washita River channel just east of the county line in Oklahoma.

The general geologic section in Hemphill County has Permian Red Beds at the base; with coarse sand and gravel lenses near the base of the Ogallala formation.

Above the base of the Ogallala, the formation contains sands, sandstone, gravels and clays with occasional caliche. In the western part of the county at higher elevations there are fine sand and clay with interbedded caliche.

There are extensive sand hills and sand dune deposits overlying the Ogallala formation north of the Canadian River. Additional sand areas are located in the southeast corner of the county along and southeast of Hackberry Creek, and just north of the Washita River.

Saturated zones (see Exhibit C) are found in most of the Ogallala section in Hemphill County. Saturated thickness varies from at least 400 feet in the southwest and northern parts of the county to less than 20 feet in the east central area along the county and state boundary. There are two areas in the far eastern part of the County where there is little or no Ogallala Formation or aquifer present. Water produced from the Ogallala sediments is generally good quality. In the areas where the Ogallala sediments are thin, water may be produced from the underlying Red Beds as well as the overlying Ogallala sediments. Water from such wells may be of lesser quality. The incised Canadian River channel also contains saturated sediments; water quality in these sediments may not be as good as that produced from the Ogallala.

Exhibit B—Major Aquifers Hemphill County

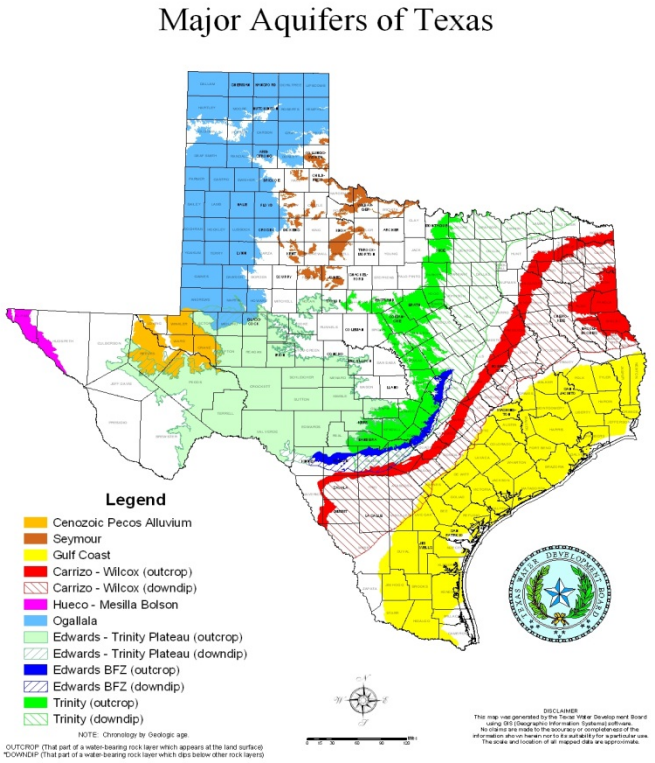
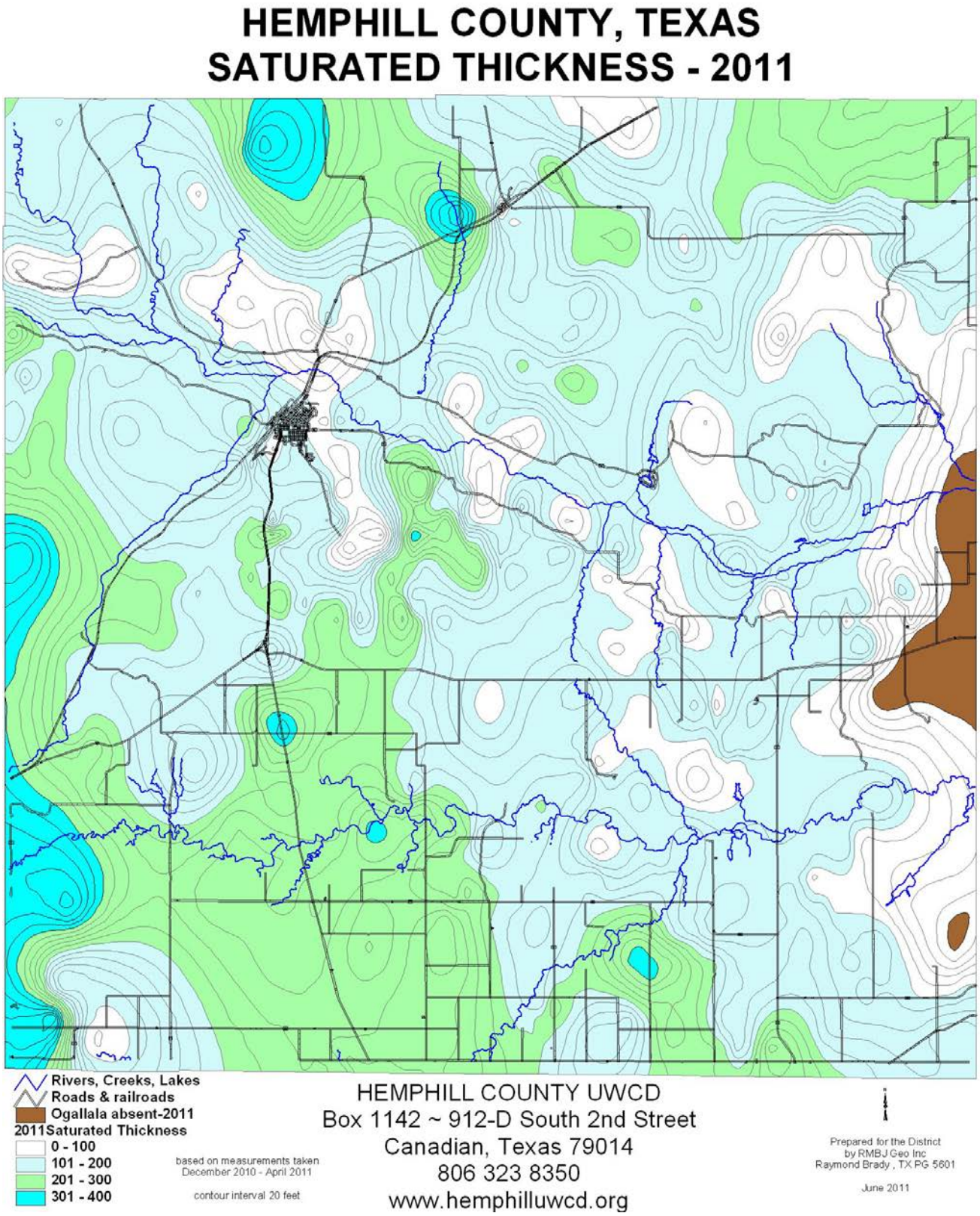


Exhibit C Saturated Thickness in Hemphill County



IV. STATEMENT OF GUIDING PRINCIPLES

The District recognizes the importance of the groundwater resources in Hemphill County to our industries, our community and our heritage. This plan further addresses the process established by the District to monitor changes in the aquifer, educate the public the findings made by the District, and ensure that the plan can adapt through time to meet the needs of the citizens of Hemphill County.

V. CRITERIA FOR PLAN APPROVAL

A. Planning Horizon

The time period for this plan is five years from the date of approval by the executive administrator or, if appealed, on approval by the TWDB. The original management plan was certified by TWDB on January 7, 2000. The District's Board of Directors repealed and replaced that plan with a plan adopted on July 17, 2007 and it was certified by TWDB September 17, 2007. This plan is being submitted as part of the five-year review and re-adoption process as required by TWDB 36.1072(e). This management plan will remain in effect until a revised management plan is approved by the executive administrator or the TWDB. The plan may be reviewed annually and will be updated and readopted in accordance with the requirements of the Texas Water Code at least once every five years.

B. Board Resolution

Certified copy of the Hemphill County Underground Water Conservation District resolution adopting the plan 31 TAC §356.6(a)(2)

A certified copy of the Hemphill County Underground Water Conservation District resolution adopting the plan is located in Appendix B – District Resolution.

C. Plan Adoption

Evidence that the plan was adopted after notice and hearing 31 TAC §356.6(a)(5); §36.1071(a);

Public notices documenting that the plan was adopted following appropriate public meetings and hearings are located in Appendix C – Notice of Meetings.

D. Coordination with Surface Water Management Entities

Evidence that following notice and hearing the District coordinated in the development of its management plan with surface water management entities. TWC §36.1071(a); §356.6(a)(4);

A letter transmitting a copy of this plan to surface water management entities is located in Appendix D – Letter to Surface Water Management Entities.

VI. ESTIMATES OF TECHNICAL INFORMATION REQUIRED BY TWC § 36.1071 / 31 TAC 356.5

A. Modeled available groundwater in the district based on the desired future condition established under TWC § 36.1071(e)(3)(A)

Modeled available groundwater is defined in TWC § 36.001 (25) as meaning "the amount of water that the executive administrator determines may be produced on an average annual basis to achieve a desired future condition established under Section 36.108." The desired future condition of the aquifer may only be determined through joint planning with other groundwater conservation districts (GCDs) in the same groundwater management area (GMA) as required by the 79th legislature with the passage of HB 1763 into law. The District is located in GMA 1. The GCDs of GMA 1 have completed the joint planning process to determine the desired future conditions of the aquifers in the GMA. See Appendix E for map of GMA boundaries.

The Ogallala Aquifer is the primary aquifer available to producers in Hemphill County and it is therefore the only aquifer in which we will address in this Plan. To determine the desired future condition for the Ogallala Aquifer, the member Districts held 19 GMA 1 meetings, and assessed nine Groundwater Availability Model runs (GAM Runs) depicting varying future conditions of the Aquifer. A copy of the DFC submittal package can be found here: http://www.twdb.texas.gov/groundwater/docs/DFC/GMA1_DFC_Adopted_2009-0707.pdf

1. Ogallala Aquifer

a. Desired Future Conditions:
On July 7, 2009, the adopted desired future condition for the portion of the Ogallala Aquifer that lies within the jurisdiction of the Hemphill County Underground Water Conservation District is to have 80% of the volume in storage remaining in 50 years.

b. Modeled Available Groundwater:

The modeled available groundwater value for the Ogallala Aquifer in Hemphill County, as given in TWDB GAM Run 09-026 MAG can be seen in Appendix F.

"Total Pumping" in the following table is synonymous with Modeled Available Groundwater. Due to changes in statute by the 82nd Legislature, modeled available groundwater is defined as "the amount of water that the executive administrator determines may be produced on an average annual

basis to achieve a desired future condition established under Section 36.108." This is different from managed available groundwater, a permitting value that accounted for use exempt from permitting, which TWDB provided prior to Sept. 1, 2011. A summary for each decade between 2010 and 2060 is as follows: (results are in acre feet per year).

Modeled Available Groundwater for the Ogallala Aquifer

Hemphill Co.	Year					
	2010	2020	2030	2040	2050	2060
Total Pumping	54,998	54,998	54,998	54,998	54,938	54,938
Exempt Use	9,121	9,132	8,371	7,063	6,050	5,174
Managed Available Groundwater	45,877	45,866	46,627	47,935	48,888	49,764

Source TWDB GAM Run 09-026 MAG (See Appendix F)

On May 4, 2012, TWDB issued Draft GAM Run 12-005 MAG report using the updated Groundwater Availability Model (GAM) developed by INTERA, Inc. (Kelley and others, 2010) for the northern portion of the Ogallala Aquifer. This report incorporates the legislatively revised definition and meaning of "Managed Available Groundwater" to "Modeled Available Groundwater." The draft GAM Run Report 12-005 MAG can be seen in its entirety in Appendix K.

Modeled Available Groundwater for the Ogallala Aquifer

Hemphill Co.	Year					
	2010	2020	2030	2040	2050	2060
Managed Available Groundwater	45,170	41,759	42,398	42,777	42,989	43,159

Source TWDB Draft GAM Run 12-005 MAG (See Appendix K)

B. Amount of groundwater being used within the District on an annual basis – 31 TAC 356 (a)(5)(B), 356.2 (2) Implementing TWC §36.1071(e)(3)(B)

The amount of groundwater being used within the District on an annual basis as provided by the Texas Water Development Board from their Water Use Survey database is shown in Appendix G Estimated Historical Water Use and 2012 State Water Plan Data Set Pages 3 and 4. All values are in acre feet per year.

The District's estimates for groundwater being used within the District on an annual basis for years 2003-2010 is provided in the table below as Exhibit D District's Estimate of Groundwater Used in Hemphill County in Acre Feet per Year. The sources for the District's estimates are found in Appendix H.

Exhibit D District's Estimates of the Annual Amount of Groundwater Used in Hemphill County in Acre Feet per Year

User Group/Year	2003	2004	2005	2006	2007	2008	2009	2010
Municipal								
City of Canadian	554	566	539	613	528	571	605	628
County Other	150	151	153	153	153	158	160	157
Total	**704**	**717**	**692**	**766**	**681**	**729**	**765**	**785**
Industrial								
Mining	2,773	3,612	2,882	4,406	5,062	7,068	2,236	4,482
Manufacturing	6	2	2	2	3	3	2	1
Steam Electric	0	0	0	0	0	0	0	0
Total	**2,773**	**3,612**	**2,882**	**4,406**	**5,062**	**7,068**	**2,236**	**4,482**
Agricultural								
Irrigation	1,626	1,451	6,824	7,187	5,769	9,140	3,820	4,549
Livestock	1,238	1,292	1,223	1,237	1,294	1,082	1,191	1,276
Total	**2,864**	**2,743**	**8,047**	**8,424**	**7,063**	**10,222**	**5,011**	**5,825**
TOTAL	6,341	7,072	11,621	13,596	12,806	18,019	8,012	11,092
Estimate Source: Hemphill County UWCD (See Appendix H)								

C. Annual amount of recharge from precipitation to the groundwater resources within the district – 31 TAC §356.5(a)(5)(C) Implementing TWC §36.1071(e)(3)(C)

The estimate of the annual volume of recharge to the Ogallala Aquifer in Hemphill County is based on the GAM simulations provided by TWDB to the District for use in this plan. (See Appendix I page 7)

Ogallala Aquifer Recharge
31,881 acre feet per year

Estimate Source: TWDB GAM Run 11-014; October 4, 2011 Appendix I

D. For each aquifer, annual volume of water that discharges from the aquifer to springs and any surface water bodies, including lakes, streams, and rivers – 31 TAC §356.5(a)(5)(D) Implementing TWC §36.1071(e)(3)(D)

The estimate of the annual volume of water discharged from the Ogallala Aquifer in Hemphill County to surface water systems is based on the GAM simulations provided by TWDB to the District for use in this plan. (See Appendix I page 7)

Ogallala Aquifer Discharges
45,187 acre feet per year

Estimate Source: TWDB GAM Run 11-014; October 4, 2011 Appendix I

E. Annual volume of flow into and out of the District within each aquifer and between aquifers in the District, if a groundwater availability model is available – 31 TAC §356.5(a)(5)(E) Implementing TWC §36.1071(e)(3)(E)

The Northern Ogallala Aquifer Groundwater Availability Model is available for the portion of the Ogallala Aquifer in Hemphill County. The estimates of the volume of water flowing into and out of the District within each aquifer and between aquifers in the District are based on the GAM simulations provided by TWDB to the District for use in this plan. (See Appendix I page 7)

Ogallala Aquifer:

1. Flow into the aquifer within the District:
   14,932 acre feet per year

2. Flow out of the aquifer within the District
   1,600 acre feet per year

3. Net flow between aquifers within the District
   The exchange of water with the underlying formations is considered negligible.
   Estimate Source: TWDB GAM Run 11-014; October 4, 2011 Appendix I

F. Projected surface water supply in the District, according to the most recently adopted state water plan - 31 TAC §356.5(a)(5)(F) Implementing TWC §36.1071(e)(3)(F)

The most recently adopted state water plan is the 2012 State Water Plan. The 2012 State Water Plan indicates a projected surface water supply for Hemphill County of 888 acre feet/year. See Appendix G Estimated Historical Water Use and 2012 State Water Plan Data Set Pages 5 Projected Surface Water Supplies.

G. Projected total demand for water in the district according to the most recently adopted state water plan - 31 TAC §356.5(a)(5)(G) Implementing TWC §36.1071(e)(3)(G)

The projected water demands for Hemphill County in the 2012 State Water Plan are found in Appendix G Estimated Historical Water Use and 2012 State Water Plan Datasets Page 6.

The District's estimate of projected total demand for Hemphill County in 2010 is 13,660 acre feet per year. The District's projected water demands for Hemphill County by decade 2010-2060 are shown below in Exhibit E. All projected water demands are from the 2012 State Water Plan with the exception of mining. Estimates are in acre feet per year. The source of these estimates is found in Appendix J.

Exhibit E – District's Estimate of Total Projected Water Demand

RWPG	WUG	Groundwater	2010	2020	2030	2040	2050	2060
A	Canadian	Ogallala	475	477	461	444	432	411
A	County-Other	Ogallala	158	159	153	148	143	137
A	Irrigation	Ogallala	5,049	5,049	5,049	5,049	5,049	5,049
A	Livestock	Ogallala	1,276	1,281	1,285	1,290	1,296	1,301
A	Manufacturing	Ogallala	1	1	1	1	1	1
A	Mining	Ogallala	6,701	6,701	5,361	4,289	3,431	2,745
		TOTAL	13,660	13,668	12,310	11,221	10,352	9,644

Estimate Source: Hemphill County UWCD estimates Appendix J

VII. CONSIDER THE WATER SUPPLY NEEDS AND WATER MANAGEMENT STATEGIES INCLUDED IN THE ADOPTED STATE WATER PLAN - 31 TAC §356.5(a)(7) Implementing TWC §36.1071(e)(4)

The most recent state water plan is the 2012 State Water Plan. In Hemphill County, there are no water needs identified for any user group in any decade. Water needs are identified when the projected water demand of a Water User Group (WUG) exceeds the projected water supplies of the WUG. See Appendix G Page 7.

While no shortages were identified in the 2012 State Water Plan, it is recommended that irrigation conservation be implemented. See Appendix G Page 8.

VIII. MANAGEMENT OF GROUNDWATER SUPPLIES – The District will manage the supply of groundwater within the District in order to both 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 more efficient use of groundwater.

The District shall implement a management program based on actual aquifer conditions, measured annually by the District in conjunction with the water level measuring program, and production allocation rates modified over time to insure the conservation goals are not exceeded. The District may designate multiple management areas and sub-management areas. Initially, management Area North will be that portion of the District North of the Canadian River and Management Area South will be that portion of the District South of the Canadian River. The District's management criteria is: 1) a decline rate of no more than 1% reduction in the saturated thickness per year; and 2) an average minimum aquifer storage level of 80% of the calculated 2010 volume in storage remaining in 50 years. The District will amend the District rules as necessary to implement the changes to Chapter 36 of the Texas Water Code and to implement any future groundwater management strategies as well as the goals and objectives of this plan.

It is recognized by the District that the long-term sustainable storage goal of the aquifer is dependent upon long-term use characteristics of the District and adjoining areas of the

Ogallala that communicate with the boundaries of the District. The District will continue to participate in long-term studies of the aquifer with the GMA 1 Joint Planning Group, Region A Water Planning Area, and other entities when available.

Management will be accomplished thru the use of well spacing, production limits, production reporting, and monitoring aquifer conditions.

The District will continue to measure an adequate number of water levels distributed throughout the county on an annual basis. The District will work with new Permittees and existing users to add or delete additional monitor wells to ensure an adequate monitoring network is maintained.

IX. ACTION, PROCEDURES, PERFORMANCE AND AVOIDANCE FOR PLAN IMPLEMENTATION - 31 TAC §356.5(a)(4), 356.6(a)(3) Implementing TWC §36.1071(e)(2)

The District will implement the goals and provisions of this management plan and will utilize the objectives of this management plan as a guideline in its decision-making. The District will ensure that it's planning efforts, operations, and activities will be consistent with the provisions of this plan.

The District has adopted rules in accordance with Chapter 36 of the Texas Water Code, and the District may amend the District rules as necessary to comply with changes to Chapter 36 of the Texas Water Code, revised Management Plans and to insure the best management of the groundwater within the District according to present and projected aquifer conditions. The development and enforcement of the rules of the District will be based on the best scientific and technical evidence available to the District. A copy of the District's Rules is available for download on the District's Website: www.hemphilluwcd.org.

The District will encourage cooperation and coordination in the implementation of this plan. All operations and activities of the District will be performed in a manner that encourages cooperation with the appropriate state, regional or local water entities.

X. METHODOLOGY FOR TRACKING DISTRICT PROGRESS IN ACHIEVING MANAGEMENT GOALS - 31 TAC §356.5(a)(6)

The General Manager of the District shall prepare and submit an Annual Report to the Board of Directors (Board) of the District. The Annual Report will include an update on the District's performance in regards to achieving management goals and objectives based on the fiscal year ending September 30th. The general manager of the District will present the Annual Report prior to the end of the next fiscal year. The Board will maintain a copy of the Annual Report on file for public inspection at the District's offices upon adoption by the Board.

XI. GOALS, MANAGEMENT OBJECTIVES AND PERFORMANCE STANDARDS

The management goals, objectives and performance standards of the District in the areas specified in 31 TAC §356.5 are addressed below:

Management Goals

A. Providing the Most Efficient Use of Groundwater – 31 TAC §356.5(a)(1)(A) Implementing TWC §36.1071(a)(1)

A.1 **Objective –** Each year, the District will require all new exempt or non exempt wells that are constructed within the boundaries of the District to be registered or permitted with the District in accordance with the District Rules.

A.1 **Performance Standard –** The number of exempt and non exempt wells registered or permitted by the District for the year will be incorporated into the Annual Report.

A.2 **Objective –** Each year, the District will regulate the production of groundwater by maintaining a permitting system within the boundaries of the District in accordance with the District Rules.

A.2 **Performance Standard –**Each year, a summary of the number and type of applications for the permitted use of groundwater in the District, and the disposition of the applications will be included in the Annual Report.

B. Controlling and Preventing Waste of Groundwater – 31 TAC §356.5(a)(1)(B) Implementing TWC §36.1071(a)(2)

B.1. **Objective –** Each year, the District will make evaluation of the District rules to determine whether any amendments are recommended that would decrease the amount of waste of groundwater within the District.

B.1. **Performance Standard –** The District will include a discussion of the annual evaluation of the District Rules and the determination of whether any amendments to the rules are recommended to prevent the waste of groundwater in the Annual Report.

B.2. **Objective –**The District will monitor the Texas Railroad Commission website to identify the location and status of all salt water or waste disposal wells permitted to operate within the District.

B.2. **Performance Standard –** Each year a summary of the information collected from the Texas Railroad Commission website regarding the location and status of all salt water or waste disposal wells permitted to operate within the District will be included in the Annual Report.

B.3. **Objective –** Each year the District will track the results of all mechanical integrity tests performed on salt water or waste disposal injection wells permitted by the Texas Railroad Commission to operate within the District.

B.3. **Performance Standard** -Each year a summary of the results of all mechanical integrity tests performed on the salt water or waste disposal wells permitted to operate within the District will be included in the Annual Report.

B.4. **Objective –** Each year the District will monitor newspapers of general circulation in Hemphill County for the notice of the drilling and operation of salt water disposal wells to be located within the District and attempt to obtain a benchmark for BTEX and Total Chlorides from samples of selected wells within 1 mile of the disposal well activity.

B.4. **Performance Standard –** Each year the District will subscribe to newspapers of general circulation in Hemphill County and prepare a report to be included in the Annual Report which describes the number and location of new water quality benchmark sites.

C. Controlling and Preventing Subsidence - 31 TAC §356.5(a)(1)(C) Implementing TWC §36.1071(a)(3)

This goal is not applicable to the Hemphill County Underground Water Conservation District.

D. Conjunctive Surface Water Management Issues - 31 TAC §356.5(a)(1)(D) Implementing TWC §36.1071(a)(4)

D.1. **Objective –** Each year, the District will participate in the regional planning process by attending the Region A – Panhandle Water Planning Group meetings to encourage the development of surface water supplies as alternatives to groundwater usage to meet the needs of appropriate water user groups in the Region.

D.1. **Performance Standard –** Each year, the attendance of a District representative at a minimum of 50 percent of the Region A Panhandle Water Planning Group meetings will be reflected in the District's Annual Report and will include the number of meetings attended, the dates and the name of the District representative who attended.

E. Natural Resource Issues Which Impact the Use and Availability of Groundwater and Which are Impacted by the Use of Groundwater - 31 TAC §356.5(a)(1)(E) Implementing TWC §36.1071(a)(5)

E.1. **Objective** - The District will establish a point source contamination monitoring network.

E.1. **Performance Standard** - Each year the District will collect water quality samples from at least 80% of the monitoring wells designated in the point source monitoring network and provide a status report on the number of wells tested and a summary of the testing results in the Annual Report.

E.2. **Objective** - The District will establish a non point source groundwater contamination network of monitoring wells.

E.2. **Performance Standard** - Each year the District will collect water quality samples from at least 80% of the monitoring wells designated in the non point source monitoring network and include a status report on the number of wells tested and a summary of the testing results.

F. Drought Conditions - 31 TAC §356.5(a)(1)(F) Implementing TWC §36.1071(a)(6)

F.1. **Objective –** Each quarter, the District will monitor the drought conditions for the High Plains Region and prepare a letter briefing the City Manager of the City of Canadian as to the Palmer Drought Severity Index (PDSI) Level for Hemphill County. The source of the drought information may include information provided by the Texas Water Development Board drought information page found at http://www.twdb.state.tx.us/DATA/drought/

F.1. **Performance Standard –** A summary of the District's briefings provided to the City Manager will be included in the Annual Report.

G. Conservation, Recharge Enhancement, Rainwater Harvesting, Precipitation Enhancement, and Brush Control, Where Appropriate and Cost Effective - 31 TAC §356.5(a)(1)(G) Implementing TWC §36.1071(a)(7)

G.1. **Objective (Conservation)** - Each year the District will promote conservation by distributing conservation brochures/literature to the public.

G.1. **Performance Standard (Conservation) –** Each year, the annual report will include a summary of the District activity during the year to promote conservation.

G.2. **Objective (Conservation) –** Annually, the District will submit an article or advertisement regarding water conservation for publication to at least one newspaper of general circulation in Hemphill County.

G.2. **Performance Standard (Conservation) –** A copy of the article or advertisement submitted by the District for publication to a newspaper or general circulation in the District regarding water conservation will be included in the Annual Report.

G.3. **Objective (Conservation) –** The District will develop or implement a pre-existing educational program for use on at least one public school campus located in the District to educate students on the importance of water as a natural resource, water conservation or the prevention of contamination.

G.3. **Performance Standard (Conservation) –** A summary of the educational program developed or implemented by the District for use in public or

private schools located in the District will be included in the Annual Report.

G.4. **Objective (Rainwater Harvesting) -** Each year the District will promote rainwater harvesting by distributing brochures/literature to the public.

G.4. **Performance Standard (Rainwater Harvesting) –** Each year, the annual report will include a summary of the District activity during the year to promote rainwater harvesting

G.5. **Objective (Brush Control) –** Each year the District will promote brush control by distributing brochures/literature to the public.

G.5. **Performance Standard (Brush Control) –** Each year, the annual report will include a summary of the District activity during the year to promote brush control.

H. Addressing, in a Quantitative Manner, the Desired Future Conditions of the Groundwater Resources Adopted Under 36.108 TWC §36.1071(a)(8)

H.1. **Objective –** Each year the District will evaluate the status of the Ogallala Aquifer utilizing a water level monitoring network within the District boundaries.

H.1. **Performance Standard –** Each year the District will obtain water level measurements from at least 80% of the wells designated in the water level monitoring network and a report of the number of water level measurements obtained will be included in the Annual Report.

H.2. **Objective -** Each year the District will monitor the status of attaining the Desired Future Condition.

H.2. **Performance Standard –** Each year the District will calculate the volume of water in place using the annual water level measurements, compare this volume to the initial 2010 volume of water, and include the results in the Annual Report.

XII. MANAGEMENT GOALS DETERMINED NOT APPLICABLE TO THE DISTRICT

A. Controlling and Preventing Subsidence – 31 TAC§356.5(a)(1)(C)

The rigid geologic framework of the region precludes significant subsidence from occurring due to groundwater pumping.

B. Recharge Enhancement and Precipitation Enhancement 31 TAC§356.5(a)(1)(G)

At this time, goals relating to recharge enhancement and precipitation enhancement are not considered to be cost effective and would cause the District to increase taxes.

APPENDIX A

HEMPHILL COUNTY
Underground Water Conservation District
Conserving a Texas Oasis

HEMPHILL COUNTY UNDERGROUND WATER CONSERVATION DISTRICT ACT

Act of May 19, 1995, 74th Leg., R.S., ch. 157, 1995 Tex. Gen. Laws 1007.

HEMPHILL COUNTY UNDERGROUND WATER CONSERVATION DISTRICT ACT

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CHAPTER 157

H.B. No. 1493

AN ACT

relating to the creation, administration, powers, duties, operation, and financing of the Hemphill County Underground Water Conservation District.

Be it enacted by the Legislature of the State of Texas:

SECTION 1. CREATION. (a) An underground water conservation district, to be known as the Hemphill County Underground Water Conservation District, is created in Hemphill County, subject to approval at a confirmation election under Section 8 of this Act. The district is a governmental agency and a body politic and corporate.

(b) The district is created under and is essential to accomplish the purposes of Section 59, Article XVI, Texas Constitution.

Act of May 19, 1995, 74th Leg., R.S., ch. 157, 1995 Tex. Gen. Law 1007.

SECTION 2. DEFINITION. In this Act, "district" means the Hemphill County Underground Water Conservation District.

Act of May 19, 1995, 74th Leg., R.S., ch. 157, 1995 Tex. Gen. Law 1007.

SECTION 3. BOUNDARIES. The boundaries of the district are coextensive with the boundaries of Hemphill County.

Act of May 19, 1995, 74th Leg., R.S., ch. 157, 1995 Tex. Gen. Law 1007.

SECTION 4. FINDING OF BENEFIT. All of the land and other property included within the boundaries of the district will be benefited by the works and projects that are to be accomplished by the district under powers conferred by Section 59, Article XVI, Texas Constitution. The district is created to serve a public use and benefit.

Act of May 19, 1995, 74th Leg., R.S., ch. 157, 1995 Tex. Gen. Law 1007.

SECTION 5. POWERS. (a) The district has all of the rights, powers, privileges, authority, functions, and duties provided by the general law of this state, including Chapters 50 and 52, Water Code, applicable to underground water conservation districts created under Section 59, Article XVI, Texas Constitution, except the district may not exercise the power of eminent domain for any purpose. This Act prevails over any provision of general law that is in conflict or inconsistent with this Act.

(b) The rights, powers, privileges, authority, functions, and duties of the district are subject to the continuing right of supervision of the state to be exercised by and through the Texas Natural Resource Conservation Commission.

Act of May 19, 1995, 74th Leg., R.S., ch. 157, 1995 Tex. Gen. Law 1007.

SECTION 6. BOARD OF DIRECTORS. (a) The district is governed by a board of five directors.

(b) Temporary directors serve until initial permanent directors are elected under Section 8 of this Act.

(c) Initial permanent directors serve until permanent directors are elected under Section 9 of this Act.

(d) Permanent directors other than initial permanent directors serve staggered four-year terms.

(e) Each director must qualify to serve as director in the manner provided by Sections 51.078 and 51.079, Water Code.

(f) A director serves until the director's successor has qualified.

Act of May 19, 1995, 74th Leg., R.S., ch. 157, 1995 Tex. Gen. Law 1007.

SECTION 7. TEMPORARY DIRECTORS. (a) The Commissioners Court of Hemphill County shall appoint five temporary directors.

(b) If a temporary director fails to qualify for office, the temporary directors who have qualified shall appoint a person to fill the vacancy. If at any time there are fewer than three qualified temporary directors, the Commissioners Court of Hemphill County shall appoint the necessary number of persons to fill all vacancies on the board.

Act of May 19, 1995, 74th Leg., R.S., ch. 157, 1995 Tex. Gen. Law 1007.

SECTION 8. CONFIRMATION AND INITIAL DIRECTORS' ELECTION. (a) The temporary board of directors shall call and hold an election to confirm establishment of the district and to elect five initial directors.

(b) A person who desires to be a candidate for the office of initial director may file an application with the temporary board to have the candidate's name printed on the ballot as provided by Section 52.107, Water Code.

(c) At the confirmation and initial directors' election, the temporary board of directors shall have the names of the five persons serving as temporary directors placed on the ballot together with the name of any candidate filing for the office of director as provided by

Subsection (b) of this section and blank spaces to write in the names of other persons. If the district is created at the election, the temporary board of directors, at the time the vote is canvassed, shall declare the five persons who receive the most votes to be elected as the initial directors and shall include the results of the directors' election in its election report to the Texas Natural Resource Conservation Commission.

(d) Section 41.001(a), Election Code, does not apply to a confirmation and initial directors' election held as provided by this section.

(e) Except as provided by this section, a confirmation and initial directors' election must be conducted as provided by Sections 52.059(b)-(g), Water Code, and the Election Code.

Act of May 19, 1995, 74th Leg., R.S., ch. 157, 1995 Tex. Gen. Law 1007.

SECTION 9. ELECTION OF DIRECTORS. (a) On the first Saturday in May of the second year after the year in which the district is authorized to be created at a confirmation election, an election shall be held in the district for the election of two directors, each of whom shall serve a two-year term, and three directors, each of whom shall serve a four-year term.

(b) On the first Saturday in May of each subsequent second year following the election, the appropriate number of directors shall be elected to the board.

Act of May 19, 1995, 74th Leg., R.S., ch. 157, 1995 Tex. Gen. Law 1007.

SECTION 10. FINDINGS RELATED TO PROCEDURAL REQUIREMENTS. (a) The proper and legal notice of the intention to introduce this Act, setting forth the general substance of this Act, has been published as provided by law, and the notice and a copy of this Act have been furnished to all persons, agencies, officials, or entities to which they are required to be furnished by the constitution and other laws of this state, including the governor, who has submitted the notice and Act to the Texas Natural Resource Conservation Commission.

(b) The Texas Natural Resource Conservation Commission has filed its recommendations relating to this Act with the governor, lieutenant governor, and speaker of the house of representatives within the required time.

(c) All requirements of the constitution and laws of this state and the rules and procedures of the legislature with respect to the notice, introduction, and passage of this Act are fulfilled and accomplished.

Act of May 19, 1995, 74th Leg., R.S., ch. 157, 1995 Tex. Gen. Law 1007.

SECTION 11. EMERGENCY. The importance of this legislation and the crowded condition of the calendars in both houses create an emergency and an imperative public necessity that the constitutional rule requiring bills to be read on three several days in each house

be suspended, and this rule is hereby suspended, and that this Act take effect and be in force from and after its passage, and it is so enacted.

Act of May 19, 1995, 74th Leg., R.S., ch. 157, 1995 Tex. Gen. Law 1007.

APPENDIX B

STATE OF TEXAS §
§
COUNTY OF HEMPHILL §

CERTIFICATE OF JANET GUTHRIE

As official custodian of files and records of the Hemphill County Underground Water Conservation District, I hereby certify that the attached is a true and correct copy of Resolution and Order No. 2012-02 of the Board of Directors of the Hemphill County Underground Water Conservation District: (1) Repealing the District's Existing Management Plan; (2) Adopting, in its place, a New Management Plan.

ISSUED UNDER MY HAND AND SEAL OF OFFICE THIS 16th day of AUGUST, 2012.

Janet Guthrie
General Manager

NOTARY PUBLIC
CAROLYN K. PRICE
Notary Public, State of Texas
My Commission Expires 10-02-2012

Sworn to and subscribed before me this the
_16___ day of ___August____, 2012.

Notary Public, State of Texas

RESOLUTION AND ORDER NO. 2012-02

OF THE BOARD OF DIRECTORS OF THE HEMPHILL COUNTY UNDERGROUND WATER CONSERVATION DISTRICT: (1) REPEALING THE DISTRICT'S EXISTING MANAGEMENT PLAN; AND (2) ADOPTING, IN ITS PLACE, A NEW MANAGEMENT PLAN

WHEREAS, the Hemphill County Underground Water Conservation District ("District") was created in 1995 by the Texas Legislature, Hemphill County Underground Water Conservation District Act of May 19, 1995, 74th Leg., R.S., ch. 157, 1995 Tex. Gen. Laws 1007 ("Act");

WHEREAS, the District has "all of the rights, powers, privileges, authority, functions, and duties," provided by Chapter 36, TEX. WATER CODE ANN. Act § 5;[1]

WHEREAS, the District was created "to provide for the conservation, preservation, protection, recharging, and prevention of waste of groundwater . . ." TEX. WATER CODE ANN. § 36.0015;

WHEREAS, pursuant to the Texas Water Code, the District must periodically develop and adopt a "comprehensive management plan" (hereinafter "Management Plan"). TEX. WATER CODE ANN. § 36.1071;

WHEREAS, the last Management Plan adopted by the District was adopted on July 17, 2007 (the "existing Management Plan");

WHEREAS, pursuant to the Texas Water Code, the District must review and readopt its Management Plan, "with or without revisions" at least every five years. TEX. WATER CODE ANN. § 36.1072(e);

WHEREAS, on May 15, 2012, the Board approved a draft new Management Plan for consideration for adoption by the Board (the "new Management Plan"), and authorized the General Manager to continue to make revisions to the new Management Plan based on directives from the Texas Water Development Board and the District's legal counsel;

WHEREAS, the new Management Plan is intended to achieve compliance with various revised mandates of Chapter 36, to reorganize and re-format the District's Management Plan, and to revise and expand the District's management goals and objectives;

WHEREAS, the District may only adopt the new Management Plan "[f]ollowing notice and hearing." TEX. WATER CODE ANN. § 36.1071(a);

WHEREAS, on June 12, 2012, and July 10, 2012, the District held public hearings for the purpose of providing interested members of the public the opportunity to appear and provide oral or written comments to the District related to the proposed repeal of the existing Management

[1] Section 5 actually refers to, among other things, Chapter 52, Texas Water Code. Chapter 52 has been repealed and recodified in Chapter 36 of the Texas Water Code. *See* Act of May 29, 1995, 74th Leg., R.S., ch. 933, sec. 6, 1995 Tex. Gen. Laws 4673, 4679, 4701.

Plan and the proposed adoption of the proposed new Management Plan;

WHEREAS, the District provided advance notice of the public hearings through newspaper publication, posting at the Hemphill County Courthouse and the District's office, and the District website;

WHEREAS, the Texas Private Real Property Rights Preservation Act Assessment, as set out in Exhibit A, is attached hereto and incorporated for all purposes;

WHEREAS, in light of the consideration of public comments, and review by the Texas Water Development Board and the District's legal counsel, the District has prepared the new Management Plan as set out in Exhibit B (clean version) and Exhibit C (redlined version), which are attached hereto and incorporated for all purposes; and

WHEREAS, the Board has reviewed the new Management Plan and finds that it is consistent with the District's statutory authority and should be adopted.

NOW, THEREFORE, BE IT RESOLVED AND ORDERED BY THE BOARD OF DIRECTORS OF THE HEMPHILL COUNTY UNDERGROUND WATER CONSERVATION DISTRICT THAT:

Section 1. The Texas Private Real Property Rights Preservation Act Assessment, which is attached hereto as Exhibit A, and all of the statements, findings, and conclusions contained therein, are hereby approved and adopted by the Board and are incorporated into this Resolution and Order for all purposes.

Section 2. The existing Management Plan, which was adopted by the Board on July 17, 2007, is hereby repealed.

Section 3. The new Management Plan, which is attached to this Resolution and Order as Exhibit B, is hereby adopted as the District's Management Plan.

PASSED AND APPROVED BY THE BOARD OF DIRECTORS OF THE HEMPHILL COUNTY UNDERGROUND WATER CONSERVATION DISTRICT THIS 10th DAY OF July, 2012.

~~JIM HALEY~~ MARY ALICE HUGHES
Vice-Chairman, Board of Directors

ATTEST:

~~BETH~~ STURGEON
Secretary, Board of Directors

APPROVED AS TO FORM:

ANDREW S. (DREW) MILLER
General Counsel

HEMPHILL COUNTY UNDERGROUND WATER CONSERVATION DISTRICT

MANAGEMENT PLAN

Document Title:	**TEXAS PRIVATE REAL PROPERTY RIGHTS PRESERVATION ACT ASSESSMENT**
Type:	Repeal of Existing Management Plan and Adoption of New Management Plan
Prepared By:	Andrew S. "Drew" Miller, General Counsel Sarah B. Faust
Approved By:	Janet Guthrie, General Manager
Date:	July 10, 2012

I. DUTY OF CERTAIN GOVERNMENTAL ENTITIES TO CONDUCT A TAKINGS IMPACT ASSESSMENT UNDER CERTAIN CIRCUMSTANCES

Chapter 2007 of the Texas Government Code,[1] requires governmental entities, under certain circumstances, to prepare a takings impact assessment ("TIA") in connection with certain covered categories of proposed governmental actions.[2]

II. APPLICABILITY OF TPRPRPA TO THE HEMPHILL COUNTY UWCD

The requirement to prepare a TIA generally applies to a "governmental entity."[3] The term "governmental entity" is defined by TPRPRPA to include "a political subdivision of this state."[4] The express language of the enabling statute for the Hemphill County Underground Water Conservation District (the "District")[5] establishes the District as a "conservation and reclamation district" under Article XVI, Section 59 of the Texas Constitution.[6] Conservation and reclamation districts created under Article XVI, Section 59 of the Texas Constitution are "political subdivisions" of the State of Texas.[7] The District, therefore, is a "governmental entity."

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[1] TEX. GOV'T CODE ANN. §§ 2007.001-.045 (West 2008) (the "Texas Private Real Property Rights Preservation Act" or "TPRPRPA").

[2] *See id.* §§ 2007.043(a); 2007.003(a)(1)-(3).

[3] *Id.* § 2007.043(a).

[4] *Id.* § 2007.002(1)(B).

[5] Act of May 19, 1995, 74th Leg., R.S., ch. 157, 1995 Tex. Gen. Laws 1007 ("Act").

[6] *See id.* § 1(b).

[7] *See e.g., Guaranty Petroleum Corp. v. Armstrong*, 609 S.W.2d 529, 530 (Tex. 1980).

III. APPLICABILITY OF TPRPRPA TO ADOPTION/REPEAL OF MANAGEMENT PLANS GENERALLY

Although TPRPRPA does not apply to the repeal of a Management Plan by a governmental entity, it could apply to the adoption of a Management Plan.[8] Section 2007.003(a) of TPRPRPA states that "[t]his chapter applies only to the following governmental actions: (1) the *adoption or issuance* of . . . [a] resolution, policy, guideline, or similar measure."[9] A Management Plan is clearly meant to be a policy-setting document for a groundwater conservation district. A Management Plan must address the District's "management goals"[10] and identify "performance standards and management objectives" to achieve those goals.[11] The District must then adopt rules necessary to "implement" the Management Plan.[12] As such, TPRPRPA could apply to the adoption of a Management Plan.

IV. THE DISTRICT'S ADOPTION OF A NEW MANAGEMENT PLAN IS EXCLUDED FROM TPRPRPA UNDER TPRPRPA'S STATUTORY EXCLUSIONS

TEX. GOV'T CODE ANN. § 2007.003(b) sets forth statutory exclusions that exempt certain governmental actions from TPRPRPA's coverage. The District's adoption of a new Management Plan falls within at least two of these exclusions.

A. THE DISTRICT'S ADOPTION OF A MANAGEMENT PLAN IS EXCLUDED FROM TPRPRPA UNDER TEX. GOV'T CODE ANN. § 2007.003(b)(11)(C).

TEX. GOV'T CODE ANN. § 2007.003(b)(11)(C) excludes from TPRPRPA's applicability "an action taken by a political subdivision . . . under the political subdivision's statutory authority to prevent waste or protect rights of owners of interest in groundwater."[13] Because the District's adoption of a Management Plan is an action taken by the District under its statutory authority to protect the rights of owners of interests in groundwater and to prevent the waste of groundwater, that action is excluded from the requirements of TPRPRPA.

The Texas Legislature created the District under the Hemphill County Underground Water Conservation District Act (the "Act") for the express purpose of serving a "public use and benefit."[14] Section 5 of the Act provides that the District has all of the rights and powers provided under Chapter 36, Texas Water Code, with the exception of the power of eminent

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[8] *See* TEX. GOV'T CODE ANN. § 2007.003(a)(1).

[9] *Id.* § 2007.003(a)(1)(emphasis added).

[10] TEX. WATER CODE ANN. § 36.1071(a).

[11] *Id.* § 36.1071(e)(1).

[12] *Id.* § 36.1071(f).

[13] TEX. GOV'T CODE ANN. § 2007.003(b)(11)(C).

[14] Act § 4.

domain.[15] The District is also a "district" under § 36.001(1) of the Texas Water Code.[16] Therefore, the District has all of the powers and authority provided for in Chapter 36 of the Texas Water Code, to prevent the waste of groundwater and to protect interests in groundwater.

Groundwater conservation districts, such as the District, are the "state's preferred method of groundwater management."[17] Accordingly, Chapter 36 of the Texas Water Code provides for the creation of districts for the express purpose of preventing the waste of groundwater, and indirectly the interests therein, through conservation, preservation, protection, and recharge.[18] Section 36.1071 of the Texas Water Code authorizes districts, such as the District, to "develop a comprehensive management plan" to carry out this purpose.[19] The rules of the District are then to be modeled in such a way as to "implement" the management plan.[20] In other words, Districts are to adopt management plans as part of an overall effort to prevent the waste of groundwater and to generally protect ownership interests through conservation and preservation.[21]

Chapter 36 of the Texas Water Code also sets forth the details of the significant elements of a permit program.[22] Such a program must consider the prevention of the waste of groundwater. Specifically, § 36.1071 requires the development of a comprehensive management plan which considers controlling and preventing the waste of groundwater as a management goal.[23] Section 36.113 stipulates that before the granting or denying of a permit, the district must consider whether "the applicant has agreed to avoid waste and achieve water conservation."[24] As applied to the regulation of spacing and production, § 36.116(a) provides that "[i]n order to . . . prevent waste, a district by rule may regulate . . . [spacing and production]."[25] As these provisions demonstrate, the District is clearly authorized to take action under the statutory authority provided by the Legislature to prevent the waste of groundwater.[26] The Texas Supreme Court in *Bragg v. Edwards Aquifer Authority* noted that the authority to prevent waste under the Property

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[15] Section 5 actually refers to, among other things, Chapter 52, Texas Water Code. Chapter 52 has been repealed and recodified in Chapter 36 of the Texas Water Code. *See* Act of May 29, 1995, 74th Leg., R.S., ch. 933, sec. 6, 1995 Tex. Gen. Laws 4673, 4679, 4701.

[16] TEX. WATER CODE ANN. § 36.001(1) (West 2008).

[17] *Id.* § 36.0015 (West 2008).

[18] *See id.* "In order to provide for the conservation, preservation, protection, recharging, and prevention of *waste* of groundwater, and of groundwater reservoirs or their subdivisions . . . groundwater conservation districts may be created as provided by this chapter." *Id.* (emphasis added).

[19] *Id.* § 36.1071(a).

[20] *Id.* § 36.1071(f).

[21] *See Bragg v. Edwards Aquifer Auth.*, 71 S.W.2d 729, 736 (Tex. 2002).

[22] *See* TEX. WATER CODE ANN. § 36.113(a)(requiring a district to issue permits); *see also* § 36.102 (providing for enforcement); § 36.116 (providing for well spacing).

[23] *Id.* § 36.1071(a)(2).

[24] *Id.* § 36.113 (d)(6). This rule also provides that "permits may be issued subject to the rules promulgated by the district." *Id.* § 36.113 (f)

[25] *Id.* § 36.116(a).

[26] *See Bragg*, 71 S.W.2d at 736.

Rights Act's exclusion refers to the broader concept of preventing waste through a permit system that is designated by the Legislature,[27] such as the permitting scheme authorized by Chapter 36 of the Texas Water Code.

Through the implementation of a permitting program, ownership interests in groundwater are also protected under Chapter 36 of the Texas Water Code. By providing for the enactment of rules to implement a permitting scheme designed to protect and conserve groundwater, the District ensures that all ownership interests in groundwater are protected and that water is available for beneficial use by multiple users.[28] Before granting or denying a permit, a district is required to consider whether "the proposed use of water unreasonably affects . . . existing permit holders."[29] The District's management plan is an initial ingredient to allow the District to regulate groundwater, manage withdrawals, conserve groundwater, protect the water quality of the aquifer, and protect the rights of the owners of interest in groundwater and to prevent waste.

That the District's adoption of a new Management Plan is exempt from the Property Rights Act under § 2007.003(b)(11)(C) of the Texas Government Code is supported by the Supreme Court's decision in *Bragg*.[30] Accordingly, the District's adoption of a new Management Plan is exempt from the Property Rights Act's requirement to prepare a TIA.

B. THE DISTRICT'S ADOPTION OF A NEW MANAGEMENT PLAN IS EXCLUDED FROM TPRPRPA UNDER TEX. GOV'T CODE ANN. § 2007.003(B)(4)

The District's adoption of a new Management Plan is also exempted from TPRPRPA under § 2007.003(b)(4) of the Texas Government Code. This provision excludes from TPRPRPA's coverage: "an action . . . of a political subdivision, that is . . . reasonably taken to fulfill an obligation mandated by state law."[31] The District is expressly mandated by state law to adopt a new Management Plan.[32] That action is, therefore, excluded from the requirements of TPRPRPA.

V. COVERED GOVERNMENTAL ACTION DETERMINATION

The District's adoption of a new Management Plan is excluded from the requirements of TPRPRPA under both § 2007.003(b)(11)(C) and § 2007.003(b)(4) of the Texas Government Code and, therefore, no takings impact assessment is required.

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[27] *See id.*

[28] *See* TEX. WATER CODE ANN. § 36.0015 (providing that the purpose of a District is to conserve and protect groundwater); *see also* §§ 36.101(a), 36.113(d)(2), 36.1131(b), 36.115, 36.116(a) (relating to permitting a permitting program that protects and conserves groundwater); § 36.118 (relating to the capping of open or uncovered wells), § 36.119 (providing remedies for illegal drilling), and § 36.123 (providing authority for inspections).

[29] *Id.* § 36.113(d)(2).

[30] 71 S.W.2d at 736.

[31] TEX. GOV'T CODE ANN. § 2007.003(b)(4).

[32] TEX. WATER CODE ANN. § 36.1072(e).

HEMPHILL COUNTY UNDERGROUND WATER CONSERVATION DISTRICT

CANADIAN, TEXAS

MANAGEMENT PLAN

COPY OF EXHIBIT

NOT INCLUDED

Redlined version of Management Plan

HEMPHILL COUNTY
Underground Water Conservation District
Conserving a Texas Oasis

DISTRICT MANAGEMENT PLAN

Adopted July 17, 2007
Certified by TWDB Sept. 17, 2007
Repealed and New Plan Adopted???, 2012
(Certified by TWDB_____)

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basis to achieve a desired future condition established under Section 36.108." This is different from managed available groundwater, a permitting value that accounted for use exempt from permitting, which TWDB provided prior to Sept. 1, 2011. A summary for each decade between 2010 and 2060 is as follows: (results are in acre feet per year).

Modeled Available Groundwater for the Ogallala Aquifer

Hemphill Co.	Year					
	2010	2020	2030	2040	2050	2060
Total Pumping	54,998	54,998	54,998	54,998	54,938	54,938
Exempt Use	9,121	9,132	8,371	7,063	6,050	5,174
Managed Available Groundwater	45,877	45,866	46,627	47,935	48,888	49,764

Source TWDB GAM Run 09-026 MAG (See Appendix F)

On May 4, 2012, TWDB issued Draft GAM Run 12-005 MAG report using the updated Groundwater Availability Model (GAM) developed by INTERA, Inc. (Kelley and others, 2010) for the northern portion of the Ogallala Aquifer. This report incorporates the legislatively revised definition and meaning of "Managed Available Groundwater" to "Modeled Available Groundwater." The draft GAM Run Report 12-005 MAG can be seen in its entirety in Appendix K.

Modeled Available Groundwater for the Ogallala Aquifer

Hemphill Co.	Year					
	2010	2020	2030	2040	2050	2060
Managed Available Groundwater	45,170	41,759	42,398	42,777	42,989	43,159

Source TWDB Draft GAM Run 12-005 MAG (See Appendix K)

B. Amount of groundwater being used within the District on an annual basis – 31 TAC 356 (a)(5)(B), 356.2 (2) Implementing TWC §36.1071(e)(3)(B)

The amount of groundwater being used within the District on an annual basis as provided by the Texas Water Development Board from their Water Use Survey database is shown in Appendix G Estimated Historical Water Use and 2012 State Water Plan Data Set Pages 3 and 4. All values are in acre feet per year.

The District's estimates for groundwater being used within the District on an annual basis for years 2003-2010 is provided in the table below as Exhibit D District's Estimate of Groundwater Used in Hemphill County in Acre Feet per Year. The sources for the District's estimates are found in Appendix H.

APPENDIX K

DRAFT GAM RUN 12-005 MAG: MODELED AVAILABLE GROUNDWATER FOR THE OGALLALA AQUIFER IN GROUNDWATER MANAGEMENT AREA 1

by Marius Jigmond
Texas Water Development Board
Groundwater Resources Division
Groundwater Availability Modeling Section
(512) 463-8499
May 4, 2012

Cynthia K. Ridgeway, the Manager of the Groundwater Availability Modeling Section, is responsible for oversight of work performed by employees under her direct supervision. The seal appearing on this document was authorized by Cynthia K. Ridgeway, P.G. 471 on May 4, 2012.

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DRAFT GAM RUN 12-005 MAG: MODELED AVAILABLE GROUNDWATER FOR THE OGALLALA AQUIFER IN GROUNDWATER MANAGEMENT AREA 1

by Marius Jigmond
Texas Water Development Board
Groundwater Resources Division
Groundwater Availability Modeling Section
(512) 463-8499
May 4, 2012

EXECUTIVE SUMMARY:

An updated Groundwater Availability Model (GAM) for the Ogallala Aquifer (northern portion) developed by INTERA, Inc. (Kelley and others, 2010) has been approved by the Texas Water Development Board (TWDB). Accordingly, the TWDB has conducted a GAM model run and is issuing updated modeled available groundwater numbers as requested by members of Groundwater Management Area 1. This model run supersedes model run 09-026 (Oliver, 2011) with respect to results extracted from the groundwater availability model for the northern portion of the Ogallala Aquifer. Estimates of modeled available groundwater extracted from the groundwater availability model for the southern portion of the Ogallala Aquifer remain unchanged.

In addition, legislation that became effective September 1, 2011 changed the definition and meaning of "Managed Available Groundwater" to "Modeled Available Groundwater." Modeled available groundwater represents estimates of total pumping as presented in the former "Managed Available Groundwater" report 09-026 (Oliver, 2011). The modeled available groundwater for the Ogallala Aquifer, as a result of the desired future conditions adopted by Groundwater Management Area 1, declines from 3,666,259 acre-feet per year in 2010 to 2,151,403 acre-feet per year in 2060. This report summarizes modeled available groundwater by county, groundwater conservation district, river basin, and geographic area for each decade between 2010 and 2060. The pumping estimates were extracted from the Groundwater Availability Model Run performed by INTERA, Inc. (Kelley and others, 2010) as part of the recalibration process.

REQUESTOR:

Mr. John R. Spearman, chairman of Groundwater Management Area 1.

DESCRIPTION OF REQUEST:

In a letter dated December 22, 2011, Mr. Spearman requested that the updated groundwater flow model for the Ogallala Aquifer (northern portion) be considered for adoption as an official GAM by TWDB. TWDB has adopted the updated model as the official GAM and is issuing revised modeled available groundwater estimates. The modeled available groundwater estimates are based on the desired future conditions for the Ogallala Aquifer as described in Resolution 2009-01 and adopted July 7, 2009:

- **"40 [percent] volume in storage remaining in 50 years in the following:**
    - **North Plains [Groundwater Conservation District] consisting of all or parts of the following counties: Dallam, Hartley, Moore and Sherman; and**
    - **Parts of the following counties that are not in a Groundwater Conservation District will also fall under the 40/50 [desired future condition], those counties being Dallam, Hartley and Moore**
- **50 [percent] volume in storage remaining in 50 years in the following:**
    - **High Plains Underground Water Conservation District consisting of parts of the following counties: Armstrong, Potter and Randall;**
    - **North Plains [Groundwater Conservation District] consisting of all or parts of the following counties: Hansford, Hutchinson, Lipscomb and Ochiltree;**
    - **Panhandle Groundwater Conservation District consisting of all or part of the following counties: Armstrong, Carson, Donley, Gray, Hutchinson, Potter, Roberts and Wheeler; and**
    - **All or parts of the following counties that are not in a Groundwater Conservation District will also fall under the 50/50 [desired future condition], those counties being Hutchinson, Oldham and Randall**
- **80 [percent] volume in storage remaining in 50 years in Hemphill County; provided that, in the event it is legally determined that the roughly 390-acre tract of land located in southwest Hemphill County and described more particularly in Attachment A (the "390-acre tract") lies within the jurisdiction of the Panhandle Groundwater Conservation District and not within the jurisdiction of the Hemphill County Underground Water Conservation District, then the Desired Future Condition for the 390-acre tract shall be 50 [percent] volume in storage remaining in 50 years and the Desired Future Condition for the remainder of Hemphill County shall be 80 [percent] volume in storage remaining in 50 years"**

The three geographic areas defined in the above desired future conditions statement are shown in Figure 1. Please note that the Attorney General of Texas, Opinion No. GA-0792, dated August 26, 2010, indicates the roughly 390-acre tract of land located in southwest Hemphill County lies within the jurisdiction of the Hemphill County

Underground Water Conservation District. As such the 80 percent volume in storage remaining in 50 years condition applies to the entire Hemphill County.

METHODS:

The Ogallala Aquifer within Groundwater Management Area 1 is covered by two GAMs. The GAM for the northern portion of the Ogallala Aquifer, documented in Dutton and others (2001), Dutton (2004), and Kelley and others (2010) covers the majority of Groundwater Management Area 1 and includes the Rita Blanca Aquifer. The GAM for the southern portion of the Ogallala Aquifer, documented in Blandford and others (2003) and Blandford and others (2008), covers the remaining areas of the Ogallala Aquifer within Groundwater Management Area 1. The area covered by each of the groundwater availability models is shown in Figure 2. Notice that there is an area in Potter and Randall counties where the two models overlap. Since the model for the northern portion of the Ogallala Aquifer is the primary model for Groundwater Management Area 1, results from the northern model were preferentially used over the results from the southern model in the overlap area.

The previously completed availability model run (Kelley and others, 2010) documents the model results reviewed by members of Groundwater Management Area 1. This new model run honors the above desired future conditions. The model run for the northern portion of the Ogallala Aquifer presented in this report divides the modeled available groundwater by county, groundwater conservation district, geographic area, and river basin within Groundwater Management Area 1. Note that Groundwater Management Area 1 is entirely contained within the Panhandle Regional Water Planning Area (Region A). The locations of these areas are shown in Figure 3.

For the southern portion of the Ogallala Aquifer, which covers portions of Oldham, Potter, Randall, and Armstrong counties, the Groundwater Availability Model Run 08-016 Supplement (Smith, 2008) was previously completed and meets the above request. Since completion of the model run, however, the groundwater availability model for the southern portion of the Ogallala Aquifer has been updated (Blandford and others, 2008). For this reason, the updated groundwater availability model was used to reassess these areas. This report documents the methods used in the updated groundwater availability model run for the southern portion of the Ogallala Aquifer in addition to reporting modeled available groundwater for Groundwater Management Area 1.

Modeled Available Groundwater and Permitting

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

PARAMETERS AND ASSUMPTIONS:

Northern Portion of the Ogallala Aquifer

The parameters and assumptions for the GAM run for the northern portion of the Ogallala Aquifer are described below:

- We used version 3.01 of the GAM for the northern portion of the Ogallala Aquifer. This model is an update to the previous versions documented in Dutton and others (2001) and Dutton (2004). See Kelley and others (2010), Dutton (2004), and Dutton and others (2001) for assumptions and limitations of the GAM.
- The GAM for the northern portion of the Ogallala Aquifer has only one layer which collectively represents the Ogallala and Rita Blanca aquifers. As described in the Resolution 2009-01 adopted by the members of Groundwater Management Area 1, the adopted desired future conditions apply to both the Ogallala and Rita Blanca aquifers. In both the desired future conditions statement and this report as a whole the Ogallala and Rita Blanca aquifers are referred to collectively as the "Ogallala Aquifer."
- The root mean squared error (a measure of the difference between simulated and measured water levels during model calibration) for the model for the northern portion of the Ogallala Aquifer is 45.7 feet. This represents 1.6 percent of the range of measured water levels across the model area.
- Cells were assigned to individual counties, groundwater conservation districts, and river basins as shown in the February 3, 2012 version of the file that associates the model grid to political and natural boundaries for the northern portion of the Ogallala. Note that some minor corrections were made to county

and groundwater conservation district grid cell assignments compared to the original Groundwater Availability Model Run 09-001 (Smith, 2009).

- See section 4.2 of Kelley and others (2010) for additional details about the pumping in the model run for the northern portion of the Ogallala Aquifer that meets the above desired future conditions.

Southern Portion of the Ogallala Aquifer

The parameters and assumptions for the GAM run for the southern portion of the Ogallala Aquifer are described below:

- We used version 2.01 of the GAM for the southern portion of the Ogallala Aquifer, which also includes the Edwards-Trinity (High Plains) 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 GAM.
- The model includes four layers representing the southern portion of the Ogallala Aquifer and the Edwards-Trinity (High Plains) Aquifer. However, only Layer 1 of the model, representing the Ogallala Aquifer, is active within Groundwater Management Area 1. For this reason, results are only presented for the Ogallala Aquifer from the GAM.
- 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. This represents 1.8 percent of the range of measured water levels across the model area.
- Cells were assigned to individual counties, groundwater conservation districts, and river basins as shown in the September 14, 2009 version of the file that associates the model grid to political and natural boundaries for the southern portion of the Ogallala Aquifer and Edwards-Trinity (High Plains) Aquifer.

The pumping for areas outside of Groundwater Management Area 1 is the same as described for the "base" scenario in GAM Run 09-023 (Oliver, 2010).

RESULTS:

Table 1 contains modeled available groundwater for the Ogallala Aquifer within Groundwater Management Area 1. It contains pumping totals from the groundwater availability models for the northern and southern portions of the Ogallala Aquifer subdivided by county, groundwater conservation district, and river basin. These areas are shown in figure 1. Note that all of Groundwater Management Area 1 is within the Panhandle Regional Water Planning Area (Region A). For this reason results have not been divided by Regional Water Planning Area.

Table 2 shows modeled available groundwater summarized by county and geographic area within Groundwater Management Area 1 and the total for the area as a whole. The modeled available groundwater for Groundwater Management Area 1 in 2010 is 3,666,259 acre-feet per year. This declines to 2,151,403 acre-feet of pumping per year by 2060 due to reductions in pumping necessary to minimize the occurrence of dry cells. A model cell becomes inactive when the water level in the cell drops below the base of the aquifer. In this situation, pumping cannot occur for the remainder of the model simulation.

Table 3 shows modeled available groundwater summarized by groundwater conservation district and geographic area. Geographic areas are shown in figure 3.

Table 4 shows modeled available groundwater summarized by geographic area. The decline in the volume of water stored in the Ogallala Aquifer over 50 years for each of these areas matches the desired future condition adopted by the members of Groundwater Management Area 1. For Area 1, which consists of Dallam, Sherman, Hartley, and Moore counties modeled available groundwater declines from 1,387,054 acre-feet per year to 691,874 acre-feet per year between 2010 and 2060. For Area 2, consisting of Hemphill County, pumping remains relatively constant between 42,000 and 45,000 acre-feet per year. For Area 3, which encompasses the remaining counties in Groundwater Management Area 1, modeled available groundwater declines from 2,234,035 to 1,416,370 acre-feet per year for the same time period.

Table 5 shows the results summarized by river basin. Between 2010 and 2060, the estimated total pumping declines from 3,027,060 to 1,739,871 acre-feet per year in the Canadian River basin. In the Red River basin for the same time period, modeled available groundwater declines from 639,199 to 411,532 acre-feet per year.

LIMITATIONS:

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

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

> for a particular regulatory application. These characteristics make evaluation of a regulatory model more complex than solely a comparison of measurement data with model results."

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

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

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

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Oliver, W., 2010, GAM Run 09-023: Texas Water Development Board, GAM Run 09-023 Draft Report, 30 p.

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TABLE 1: MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE OGALLALA AND RITA BLANCA AQUIFERS IN GROUNDWATER MANAGEMENT AREA 1. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE DIVIDED BY COUNTY, GROUNDWATER CONSERVATION DISTRICT (GCD), AND RIVER BASIN. UWCD REFERS TO UNDERGROUND WATER CONSERVATION DISTRICT.

County	District	Basin	Year					
			2010	2020	2030	2040	2050	2060
Armstrong	High Plains UWCD No. 1	Red	8,301	8,301	8,301	8,301	8,241	8,186
	Panhandle GCD	Red	44,587	37,066	32,778	29,115	25,920	23,142
Carson	Panhandle GCD	Canadian	96,113	81,718	73,958	66,324	59,324	53,120
		Red	93,885	89,424	80,108	71,529	63,665	56,289
Dallam	North Plains GCD	Canadian	314,814	277,174	245,338	216,215	188,745	163,943
	No District	Canadian	89,793	75,300	63,738	54,102	46,068	39,548
Donley	Panhandle GCD	Red	82,437	74,540	70,208	64,373	58,707	53,537
Gray	Panhandle GCD	Canadian	43,874	39,813	36,848	33,749	30,659	27,766
		Red	147,516	120,860	109,180	98,784	89,135	80,128
Hansford	North Plains GCD	Canadian	284,588	262,271	240,502	218,405	197,454	177,536
Hartley	North Plains GCD	Canadian	424,813	368,430	319,149	276,075	238,186	205,137
	No District	Canadian	27,646	21,118	17,852	15,019	12,780	10,961
Hemphill*	Hemphill County UWCD	Canadian	24,763	22,931	22,969	23,262	23,412	23,642
		Red	20,407	18,828	19,429	19,515	19,577	19,517
Hutchinson	North Plains GCD	Canadian	61,306	58,383	50,723	44,360	39,048	34,580
	Panhandle GCD	Canadian	14,798	13,968	14,414	14,293	13,865	13,194
	No District	Canadian	85,918	64,082	59,436	53,496	47,662	42,664
Lipscomb	North Plains GCD	Canadian	290,510	283,794	273,836	256,406	237,765	219,100
Moore	North Plains GCD	Canadian	193,001	186,154	162,142	137,321	114,658	95,490
	No District	Canadian	14,304	13,200	11,845	10,296	8,915	7,623
Ochiltree	North Plains GCD	Canadian	269,463	246,475	224,578	203,704	183,227	164,265
Oldham	No District	Canadian	20,553	19,360	18,722	17,694	16,406	15,198
		Red	3,952	3,122	2,885	2,772	2,306	2,269
Potter	High Plains UWCD No. 1	Canadian	1,731	1,118	1,041	1,041	1,041	740
		Red	3,521	2,664	1,147	326	326	326
	Panhandle GCD	Canadian	26,810	20,926	19,580	17,919	16,277	14,710
		Red	3,351	2,164	1,770	1,489	1,270	1,080
Randall	High Plains UWCD No. 1	Red	61,381	57,858	56,203	51,346	47,118	39,007
	No District	Red	28,773	27,756	26,195	24,352	21,763	19,377
Roberts	Panhandle GCD	Canadian	419,579	372,950	350,415	321,680	290,903	261,482
		Red	15,380	17,951	18,202	17,565	16,609	15,557
Sherman	North Plains GCD	Canadian	322,683	300,908	263,747	229,122	197,480	169,172
Wheeler	Panhandle GCD	Red	125,708	119,556	114,817	107,697	100,289	93,117
Total			**3,666,259**	**3,310,163**	**3,012,056**	**2,707,647**	**2,418,801**	**2,151,403**

*Hemphill county 2010 is taken from simulation year 2011

TABLE 2: MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE OGALLALA AND RITA BLANCA AQUIFERS IN GROUNDWATER MANAGEMENT AREA 1. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE DIVIDED BY COUNTY AND GEOGRAPHIC AREA.

County	Geographic Area	Year					
		2010	2020	2030	2040	2050	2060
Armstrong	3	52,888	45,367	41,079	37,416	34,161	31,328
Carson	3	189,998	171,142	154,066	137,853	122,989	109,409
Dallam	1	404,607	352,474	309,076	270,317	234,813	203,491
Donley	3	82,437	74,540	70,208	64,373	58,707	53,537
Gray	3	191,390	160,673	146,028	132,533	119,794	107,894
Hansford	3	284,588	262,271	240,502	218,405	197,454	177,536
Hartley	1	452,459	389,548	337,001	291,094	250,966	216,098
Hemphill*	2	45,170	41,759	42,398	42,777	42,989	43,159
Hutchinson	3	162,022	136,433	124,573	112,149	100,575	90,438
Lipscomb	3	290,510	283,794	273,836	256,406	237,765	219,100
Moore	1	207,305	199,354	173,987	147,617	123,573	103,113
Ochiltree	3	269,463	246,475	224,578	203,704	183,227	164,265
Oldham	3	24,505	22,482	21,607	20,466	18,712	17,467
Potter	3	35,413	26,872	23,538	20,775	18,914	16,856
Randall	3	90,154	85,614	82,398	75,698	68,881	58,384
Roberts	3	434,959	390,901	368,617	339,245	307,512	277,039
Sherman	1	322,683	300,908	263,747	229,122	197,480	169,172
Wheeler	3	125,708	119,556	114,817	107,697	100,289	93,117
Total		**3,666,259**	**3,310,163**	**3,012,056**	**2,707,647**	**2,418,801**	**2,151,403**

*Hemphill county 2010 is taken from simulation year 2011

TABLE 3: MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE OGALLALA AND RITA BLANCA AQUIFERS IN GROUNDWATER MANAGEMENT AREA 1. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE DIVIDED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND GEOGRAPHIC AREA. UWCD REFERS TO UNDERGROUND WATER CONSERVATION DISTRICT.

District	Geographic Area	Year					
		2010	2020	2030	2040	2050	2060
Hemphill County UWCD*	2	45,170	41,759	42,398	42,777	42,989	43,159
High Plains UWCD No. 1	3	74,934	69,941	66,692	61,014	56,726	48,259
North Plains GCD	1	1,255,311	1,132,666	990,376	858,733	739,069	633,742
	3	905,867	850,923	789,639	722,875	657,494	595,481
Panhandle GCD	3	1,114,038	990,936	922,278	844,517	766,623	693,122
No District	1	131,743	109,618	93,435	79,417	67,763	58,132
	3	139,196	114,320	107,238	98,314	88,137	79,508
Total		**3,666,259**	**3,310,163**	**3,012,056**	**2,707,647**	**2,418,801**	**2,151,403**

*Hemphill county 2010 is taken from simulation year 2011

TABLE 4: MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE OGALLALA AND RITA BLANCA AQUIFERS IN GROUNDWATER MANAGEMENT AREA 1. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE DIVIDED BY GEOGRAPHIC AREA.

Geographic Area	Year					
	2010	2020	2030	2040	2050	2060
1	1,387,054	1,242,284	1,083,811	938,150	806,832	691,874
2*	45,170	41,759	42,398	42,777	42,989	43,159
3	2,234,035	2,026,120	1,885,847	1,726,720	1,568,980	1,416,370
Total	**3,666,259**	**3,310,163**	**3,012,056**	**2,707,647**	**2,418,801**	**2,151,403**

*Hemphill county 2010 is taken from simulation year 2011

TABLE 5: MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE OGALLALA AND RITA BLANCA AQUIFERS IN GROUNDWATER MANAGEMENT AREA 1. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE DIVIDED BY RIVER BASIN.

Basin	Year					
	2010	2020	2030	2040	2050	2060
Canadian*	3,027,060	2,730,073	2,470,833	2,210,483	1,963,875	1,739,871
Red*	639,199	580,090	541,223	497,164	454,926	411,532
Total	**3,666,259**	**3,310,163**	**3,012,056**	**2,707,647**	**2,418,801**	**2,151,403**

*Hemphill county 2010 is taken from simulation year 2011

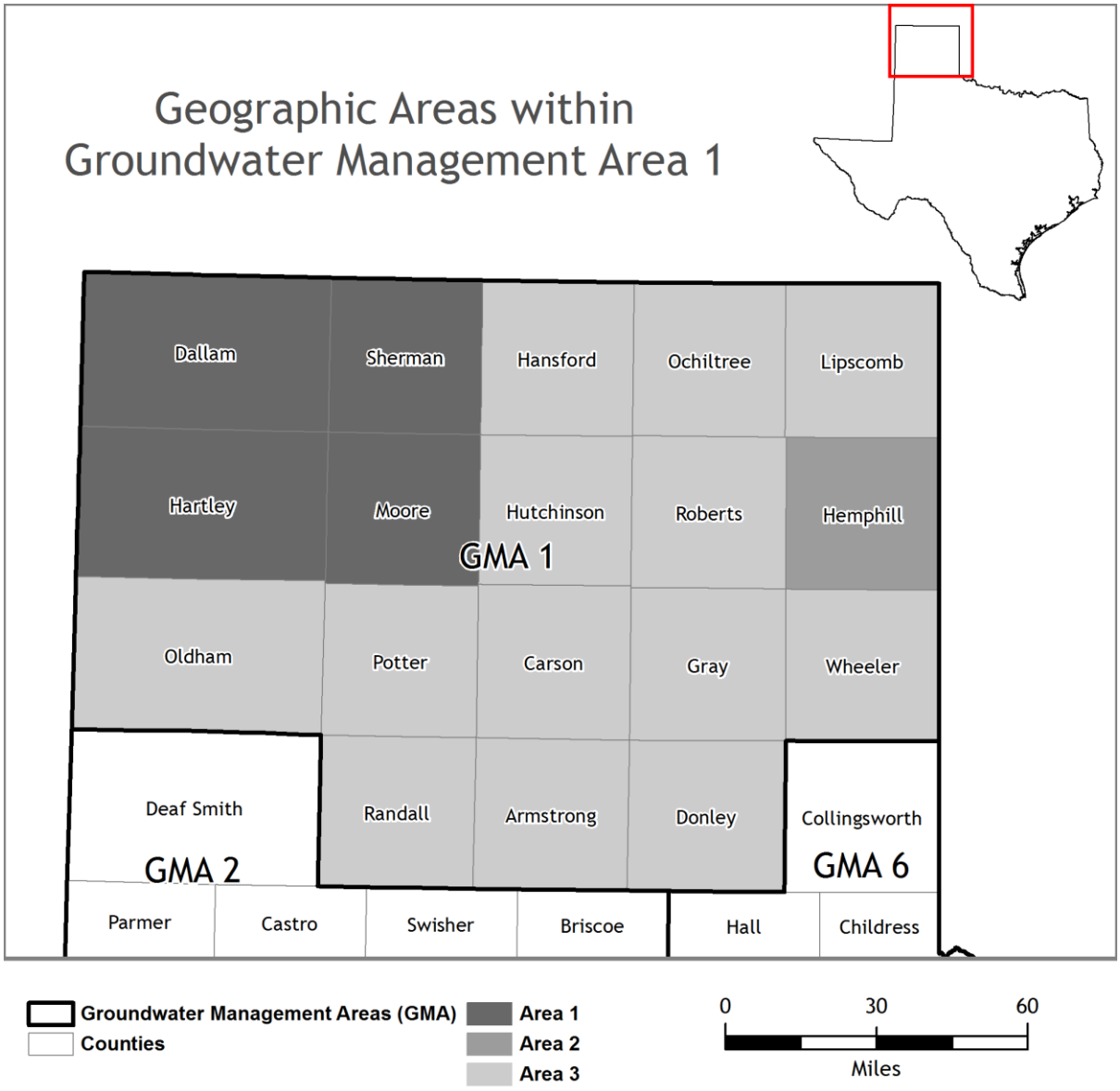

FIGURE 1: MAP SHOWING GEOGRAPHIC AREAS DEFINED BY GROUNDWATER MANAGEMENT AREA 1 IN THE DESIRED FUTURE CONDITIONS PROCESS FOR THE OGALLALA AQUIFER.

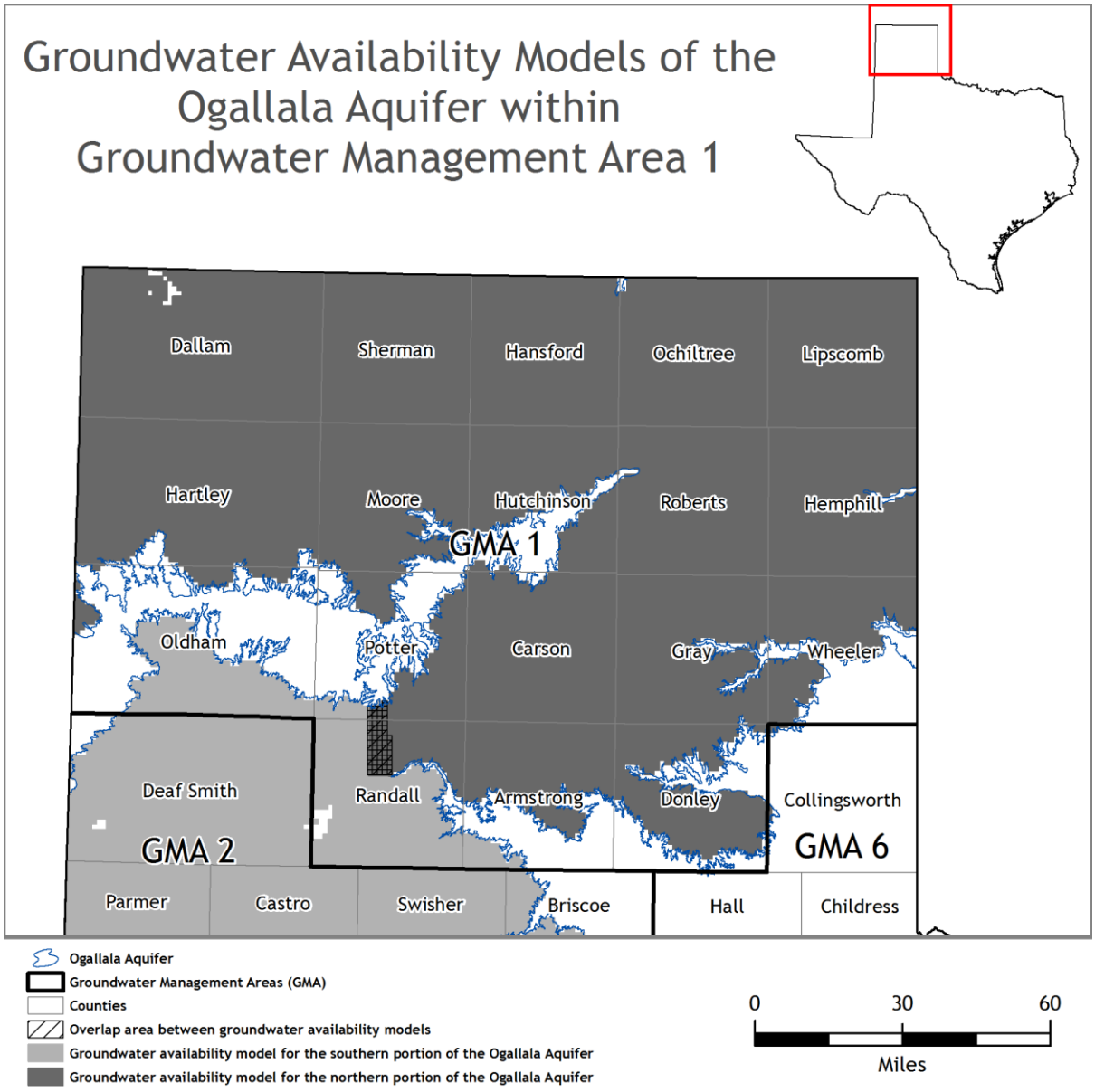

FIGURE 2: MAP SHOWING THE AREAS COVERED BY THE GROUNDWATER AVAILABILITY MODELS FOR THE NORTHERN AND SOUTHERN PORTIONS OF THE OGALLALA AQUIFER.

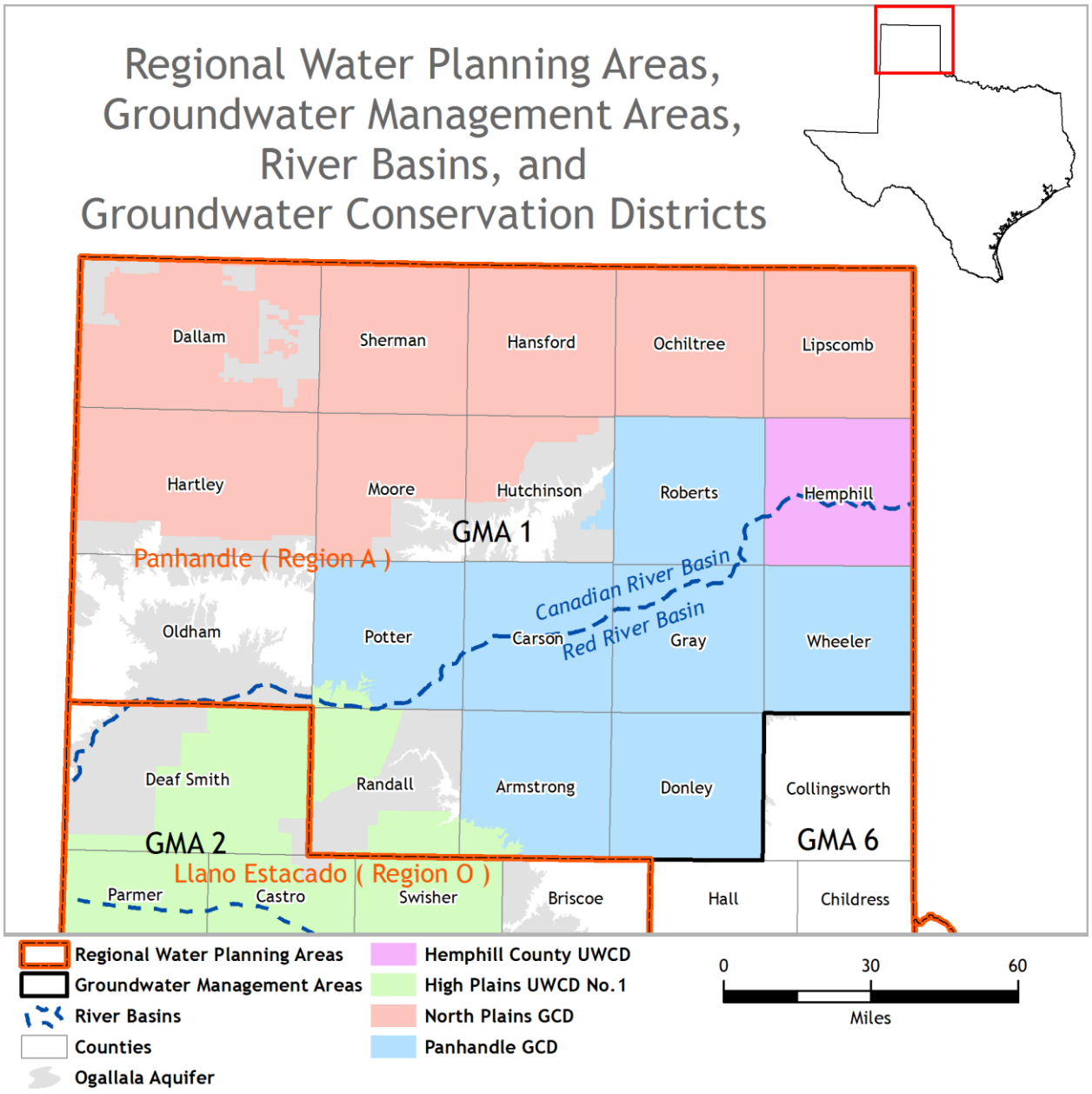

FIGURE 3: MAP SHOWING REGIONAL WATER PLANNING AREAS, GROUNDWATER MANAGEMENT AREAS, RIVER BASINS, AND GROUNDWATER CONSERVATION DISTRICTS.

APPENDIX C

Affidavit of Publication

STATE OF TEXAS

COUNTY OF Hemphill

Before me, the undersigned authority, on this day personally appeared

Mary L. Smithee, the Office Manager of
(Name) (Title)

the Canadian Record, a newspaper having general circulation in
(Name of Newspaper)

Canadian, Hemphill County, Texas, who being by me duly sworn, depoees and

saye that the foregoing attached notice was published in said newspaper on the following

date(s), to wit: May 24, 2012.

Mary L. Smithee
Signature

Subscribed and sworn to before me this the 4th day of

June, 2012, to certify which witness my hand and seal of office.

Charles L Kessie
Notary Public in and for

_____ County, Texas.

CHARLES L KESSIE
NOTARY PUBLIC
State of Texas
Comm. Exp. 04-09-2012

RECEIVED
BY CR DATE 6/7/12.

HCUWCD

$292.00

public hearing

NOTICE OF PUBLIC HEARING ON PROPOSED MANAGEMENT PLAN

The Hemphill County Underground Water Conservation District ("District") will conduct public hearings concerning the District's possible repeal of its existing Management Plan and adoption of proposed new, replacement Management Plan. The purpose of the public hearings is to provide interested members of the public the opportunity to appear and provide oral or written comments to the District related to the proposed new plan.

1.0 Date, Time, and Place of Public Hearing.

The date, time and place of the public hearings is as follows:

Date: Tuesday, June 12, 2012 and July 10, 2012
Time: 6:30 p.m.
Location: Commissioner's Courtroom,
Hemphill County Courthouse
400 Main Street
Canadian, Texas 79014

2.0 Brief Explanation of the Proposed New Management Plan.

The District is proposing to repeal its existing Management Plan and replace it with a proposed new Management Plan. Pursuant to Chapter 36 of the Texas Water Code, the District is obligated to periodically update its Management Plan. The District is proposing the new Plan in order to achieve compliance with the mandates of Chapter 36. The new Plan would reorganize and re-format the District's Management Plan, and would revise and expand the District's management goals and objectives. An exhaustive analysis of the differences between the District's current Management Plan and proposed new Management Plan is not attempted here. All interested persons are encouraged to review the proposed new Management Plan for themselves by obtaining a copy from the District, as provided below.

3.0 Procedures for Submitting Comments on the Proposed New Management Plan.

3.1 Oral Comments.

Any person may appear in person, or by authorized representative, at the public hearings on the proposed new Management Plan.

3.2 Written Comments.

Written comments on the proposed new Management Plan must be filed with the District by no later than the close of the public hearing on July 10, 2012. Written comments may be filed as follows:

(1) by hand delivery at the official address of the District, 912-D S. 2nd Street, Canadian, Texas 79014;

(2) by mail to PO Box 1142, Canadian, Texas 79014; or

(3) by hand delivery to the presiding officer at the public hearing.

Please note that while the District will consider written and oral comments, it will not prepare formal written responses to comments. Additionally, the public hearing on July 10, 2012 will be held immediately prior to the Board's consideration of adoption of the Management Plan.

4.0 Procedures for Obtaining the proposed new Management Plan.

A copy of the proposed new Management Plan may be obtained from the District as follows:

(1) calling 806.323.8350;

(2) visiting the offices of the District at 912--D S. 2nd Street, Canadian, Texas; or

(3) visiting the District's website at *www.hemphillucwd.org*

ISSUED THIS 15th DAY OF MAY, 2012.

JANET GUTHRIE, GENERAL MANAGER
HEMPHILL COUNTY UNDERGROUND
WATER CONSERVATION DISTRICT

21-1cH

public notice

LANDSCAPE IRRIGATION: INSTALLING WITHOUT A LICENSE

A new state law allows municipal and justice of the peace courts to penalize unlicensed irrigators who install irrigation systems with a Class C misdemeanor and a fine up to $500, plus related costs. Unlicensed irrigators installing irrigation systems risk contaminating the public water supply.

Licensed irrigators receive proper training to prevent contamination of the public water supply by ensuring that non-potable water from lawn-irrigation pipes does not flow into the water-supply.

The new bill (HB 2507), established to protect public health, went into effect September 1, 2011. You can file complaints against an unlicensed irrigator with the local municipality or water district, citing a violation of Texas Occupation Code, Sec. 1903.256. If the complaint is not resolved, or for more information, you can call the TCEQ Landscape Irrigation Program at 512.239.LAWN (5296), or visit *www.tceq.texas.gov/licensing/irrigation/landscape.html*

20-2cC

HEMPHILL COUNTY
Underground Water Conservation District
Conserving a Texas Oasis

NOTICE OF PUBLIC HEARING ON PROPOSED MANAGEMENT PLAN

The Hemphill County Underground Water Conservation District ("District") will conduct public hearings concerning the District's possible repeal of its existing Management Plan and adoption of proposed new, replacement Management Plan. The purpose of the public hearings is to provide interested members of the public the opportunity to appear and provide oral or written comments to the District related to the proposed new plan.

1.0 Date, Time, and Place of Public Hearings.

The date, time and place of the public hearings is as follows:

Date:	Tuesday, June 12, 2012 and July 10, 2012
Time:	6:30 p.m.
Location:	Commissioner's Courtroom, Hemphill County Courthouse 400 Main Street Canadian, Texas 79014

2.0 Brief Explanation of the Proposed New Management Plan.

The District is proposing to repeal its existing Management Plan and replace it with a proposed new Management Plan. Pursuant to Chapter 36 of the Texas Water Code, the District is obligated to periodically update its Management Plan. The District is proposing the new Plan in order to achieve compliance with the mandates of Chapter 36. The new Plan would reorganize and re-format the District's Management Plan, and would revise and expand the District's management goals and objectives. An exhaustive analysis of the differences between the District's current Management Plan and proposed new Management Plan is not attempted here. All interested persons are encouraged to review the proposed new Management Plan for themselves by obtaining a copy from the District, as provided below.

3.0 Procedures for Submitting Comments on the Proposed New Management Plan.

3.1 Oral Comments.

Any person may appear in person, or by authorized representative, at the public hearing on the proposed new Management Plan. Any person making an appearance must indicate their desire to make oral comments on the registration form provided by the District at the public hearing. A person must disclose any affiliation on the registration form and, if applicable, the

authority to speak for a person represented. Any other person attending the public hearing will be considered by the District to be an observer not desiring to make comment on the proposed new Management Plan. The District will not consider any comments of an observer in its proceedings.

The presiding officer will establish the order of oral comments of persons at the hearing. As appropriate, the presiding officer may limit:

(1) the number of times a person may speak;

(2) the time period for oral comments;

(3) cumulative, irrelevant, or unduly repetitious comments;

(4) general comments that are so vague, undeveloped, or immaterial as to be impracticable for the District to ascertain the intent or purpose of the person making the general oral comments and that are otherwise unhelpful to the District in analyzing the proposed new Management Plan;

(5) the time period for asking or responding to questions; and

(6) other matters that come to the attention of the presiding officer as requiring limitation.

3.2 Written Comments.

Written comments on the proposed new Management Plan must be filed with the District by no later than the close of the public hearing on July 10, 2012. Written comments may be filed as follows:

(1) by hand delivery at the official address of the District, 912-D S. 2nd Street, Canadian, Texas 79014;

(2) by mail to P.O. Box 1142, Canadian, Texas 79014; or

(3) by hand delivery to the presiding officer at the public hearing.

Please note that while the District will consider written and oral comments, it will not prepare formal written responses to comments for review and consideration by the Board of Directors of the District when it deliberates on whether to adopt the proposed new Management Plan.

4.0 Procedures for Obtaining the proposed new Management Plan.

A copy of the proposed new Management Plan may be obtained from the District as follows:

(1) calling (806) 323-8350;

(2) visiting the offices of the District at 912 –D S. 2nd Street, Canadian, Texas; or

(3) visiting the Distric website at www.hemphillucwd.org

5.0 Opportunity to Appear and Comment at Public Hearing Prior to Board Meeting at Which the Proposed New Management Plan May be Adopted.

The meeting of the District's Board of Directors at which the proposed new Management Plan will be considered for adoption is scheduled for July 10, 2012. The public hearing will be subject to the public hearing procedures described above, and will occur immediately prior to the Board's consideration of adoption of the Management Plan.

ISSUED THIS 15th DAY OF MAY, 2012.

Janet Guthrie
General Manager
Hemphill County Underground Water Conservation District

1150148v.2 14901/00100

Posted @ District Office May 23, 2012 @ 1:05 P.m
By: Carolyn Price

HEMPHILL COUNTY
Underground Water Conservation District
Conserving a Texas Oasis

NOTICE OF PUBLIC HEARING ON PROPOSED MANAGEMENT PLAN

The Hemphill County Underground Water Conservation District ("District") will conduct public hearings concerning the District's possible repeal of its existing Management Plan and adoption of proposed new, replacement Management Plan. The purpose of the public hearings is to provide interested members of the public the opportunity to appear and provide oral or written comments to the District related to the proposed new plan.

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Time:	6:30 p.m.
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authority to speak for a person represented. Any other person attending the public hearing will be considered by the District to be an observer not desiring to make comment on the proposed new Management Plan. The District will not consider any comments of an observer in its proceedings.

The presiding officer will establish the order of oral comments of persons at the hearing. As appropriate, the presiding officer may limit:

(1) the number of times a person may speak;

(2) the time period for oral comments;

(3) cumulative, irrelevant, or unduly repetitious comments;

(4) general comments that are so vague, undeveloped, or immaterial as to be impracticable for the District to ascertain the intent or purpose of the person making the general oral comments and that are otherwise unhelpful to the District in analyzing the proposed new Management Plan;

(5) the time period for asking or responding to questions; and

(6) other matters that come to the attention of the presiding officer as requiring limitation.

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5.0 Opportunity to Appear and Comment at Public Hearing Prior to Board Meeting at Which the Proposed New Management Plan May be Adopted.

The meeting of the District's Board of Directors at which the proposed new Management Plan will be considered for adoption is scheduled for July 10, 2012. The public hearing will be subject to the public hearing procedures described above, and will occur immediately prior to the Board's consideration of adoption of the Management Plan.

ISSUED THIS 15th DAY OF MAY, 2012.

Janet Guthrie
General Manager
Hemphill County Underground Water Conservation District

11501 8 14901/00100

18A 5

Posted @ 1:20 PM on 5/23/12. Lisa Johnson by Kyle & Bartlett

HEMPHILL COUNTY
Underground Water Conservation District
Conserving a Texas Oasis

August 2, 2012

Kent Satterwhite
Canadian River Municipal Water Authority
P.O. Box 9
Sanford, TX 79078

RE: Hemphill County UWCD
Adopted Management Plan

Dear Mr. Satterwhite:

Please find enclosed a copy of the Management Plan adopted by the Board of Directors of the Hemphill County Underground Water Conservation District on July 10, 2012. If you have any questions regarding the plan, please feel free to contact me.

Sincerely,

Janet Guthrie
General Manager

Encl. Copy of 2012 Adopted Mgmt Plan

CM # 7005 0390 0004 9394 0948

7005 0390 0004 9394 0948

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CERTIFIED MAIL™ RECEIPT
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SANFORD TX 79078 OFFICIAL USE

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Return Receipt Fee (Endorsement Required)	$2.35	Postmark Here
Restricted Delivery Fee (Endorsement Required)	$0.00	
Total Postage & Fees	$ $6.15	08/03/2012

Sent To
KENT SATTERWHITE CRMWA
Street, Apt. No.; or PO Box No. P.O. Box 9
City, State, ZIP+4 SANFORD, TX 79078

PS Form 3800, June 2002 See Reverse for Instructions

SENDER: *COMPLETE THIS SECTION*

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

KENT SATTERWHITE
CRMWA
P.O. Box 9
SANFORD, TX 79078

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X [signature] ☐ Agent ☐ Addressee

B. Received by (Printed Name) Kelly Tull C. Date of Delivery 8-6-12

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☑ No

3. Service Type
☑ Certified Mail ☐ Express Mail
☐ Registered ☑ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

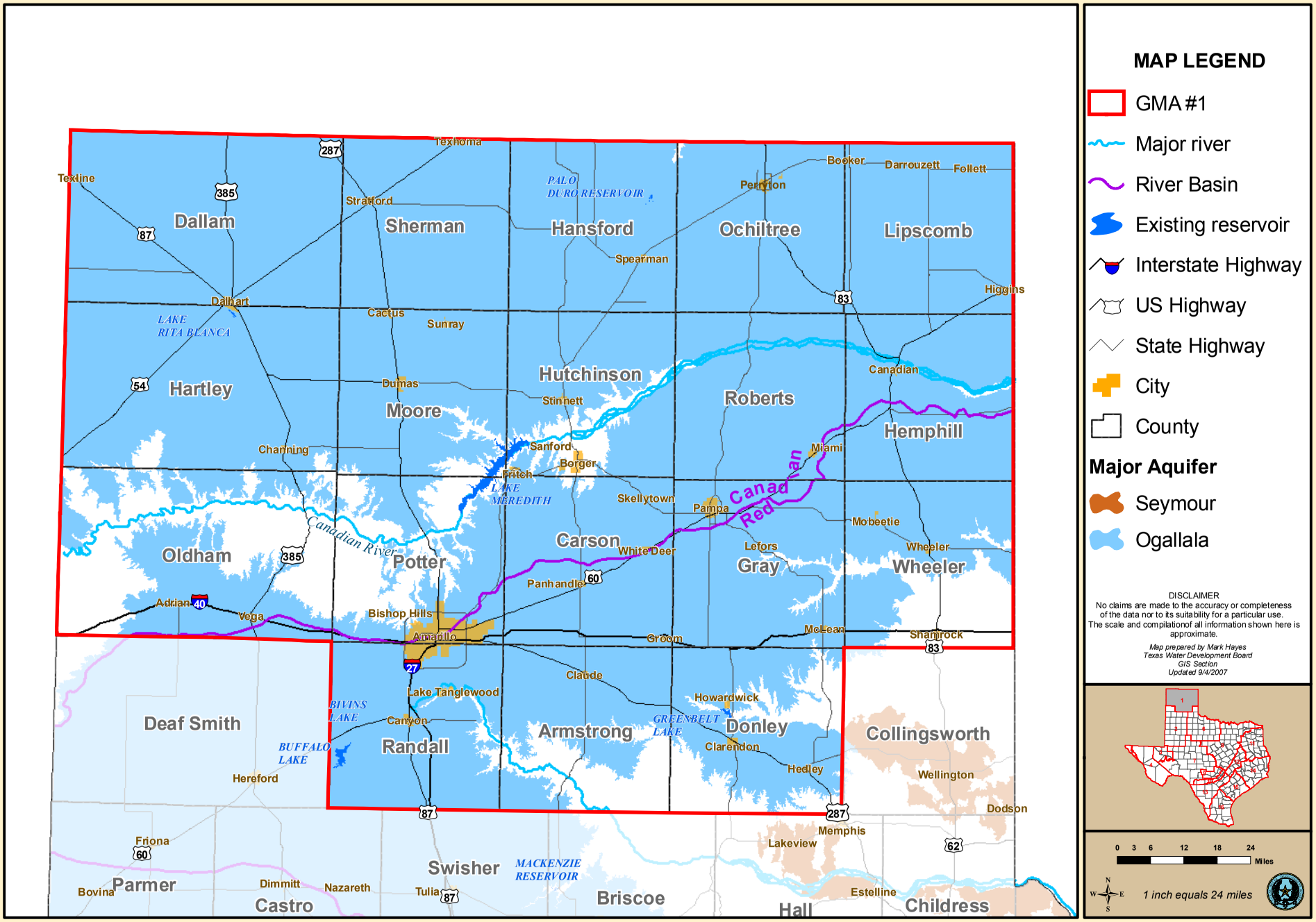
4. Restricted Delivery? *(Extra Fee)* ☐ Yes

2. Article Number
(Transfer from service label) 7005 0390 0004 9394 0948

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540

APPENDIX E

Groundwater Management Area #1



MAP LEGEND

- GMA #1
- Major river
- River Basin
- Existing reservoir
- Interstate Highway
- US Highway
- State Highway
- City
- County

Major Aquifer

- Seymour
- Ogallala

DISCLAIMER
No claims are made to the accuracy or completeness of the data nor to its suitability for a particular use. The scale and compilationof all information shown here is approximate.

Map prepared by Mark Hayes
Texas Water Development Board
GIS Section
Updated 9/4/2007

0 3 6 12 18 24 Miles

1 inch equals 24 miles

L:\Projects\Rio\Ts\GIS Projects and files\Groundwater_Management_Area_maps

GAM Run 09-026 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:

We ran the groundwater availability models for the northern and southern portions of the Ogallala Aquifer to estimate the managed available groundwater based on desired future conditions adopted by members of Groundwater Management Area 1. The model run for the northern portion of the Ogallala Aquifer is based on Groundwater Availability Model Run 09-001. For the southern portion of the Ogallala Aquifer, the most updated version of the groundwater availability model was run, which is documented in this report. This run included the most recent estimates of pumping in areas outside of Groundwater Management Area 1.

The estimated total pumping from the Ogallala Aquifer in Groundwater Management Area 1 necessary to achieve the requested desired future condition declines from 3,364,389 acre-feet per year in 2010 to 2,027,465 acre-feet per year in 2060. Of this, the estimated exempt use of the aquifer increases from 53,533 to 58,132 acre-feet per year over the same time period. Therefore, the total managed available groundwater within Groundwater Management Area 1 - the amount of water that may be permitted - declines from 3,310,856 acre-feet per year in 2010 to 1,969,333 acre-feet per year in 2060. Estimates for total pumping, exempt use, and managed available groundwater are presented and are divided by county, groundwater conservation district, geographic area, and river basin for each decade between 2010 and 2060.

REQUESTOR:

Mr. Kyle Ingham of the Panhandle Regional Planning Commission acting on behalf of Groundwater Management Area 1

DESCRIPTION OF REQUEST:

In a letter received July 30th, 2009, Mr. Kyle Ingham provided the Texas Water Development Board (TWDB) with the desired future conditions (DFCs) of the Ogallala and Rita Blanca aquifers within Groundwater Management Area 1 and requested that TWDB estimate managed available groundwater values. As described in the request, these aquifers are simulated as a single layer in the groundwater availability model and are referred to collectively as the "Ogallala Aquifer" in the desired future conditions statement (and throughout this report). The desired future conditions for the Ogallala Aquifer, as described in Resolution 2009-01 and adopted July 7, 2009 by the groundwater conservation districts (GCDs) within Groundwater Management Area 1, are described below:

- **"40 [percent] volume in storage remaining in 50 years in the following:**
  - **North Plains [Groundwater Conservation District] consisting of all or parts of the following counties: Dallam, Hartley, Moore and Sherman; and**
  - **Parts of the following counties that are not in a Groundwater Conservation District will also fall under the 40/50 [desired future condition], those counties being Dallam, Hartley and Moore**

- **50 [percent] volume in storage remaining in 50 years in the following:**

  - **High Plains Underground Water Conservation District consisting of parts of the following counties: Armstrong, Potter and Randall;**
  - **North Plains [Groundwater Conservation District] consisting of all or parts of the following counties: Hansford, Hutchinson, Lipscomb and Ochiltree;**
  - **Panhandle Groundwater Conservation District consisting of all or part of the following counties: Armstrong, Carson, Donley, Gray, Hutchinson, Potter, Roberts and Wheeler; and**
  - **All or parts of the following counties that are not in a Groundwater Conservation District will also fall under the 50/50 [desired future condition], those counties being Hutchinson, Oldham and Randall**

- **80 [percent] volume in storage remaining in 50 years in Hemphill County; provided that, in the event it is legally determined that the roughly 390-acre tract of land located in southwest Hemphill County and described more particularly in Attachment A (the "390-acre tract") lies within the jurisdiction of the Hemphill County Underground Water Conservation District, then the Desired Future Condition for the 390-acre tract shall be 50 [percent] volume in storage remaining in 50 years and the Desired Future Condition for the remainder of Hemphill County shall be 80 [percent] volume in storage remaining in 50 years"**

The three geographic areas defined in the above desired future conditions statement are shown in Figure 1.

METHODS:

The Ogallala Aquifer within Groundwater Management Area 1 is covered by two groundwater availability models. The groundwater availability model for the northern portion of the Ogallala Aquifer, documented in Dutton and others (2001) and Dutton (2004), covers the majority of Groundwater Management Area 1 and includes the Rita Blanca Aquifer. The groundwater availability model for the southern portion of the Ogallala Aquifer, documented in Blandford and others (2003) and Blandford and others (2008), covers the remaining areas of the Ogallala Aquifer within Groundwater Management Area 1. The area covered by each of the groundwater availability models is shown in Figure 2. Notice that there is an area in Potter and Randall counties where the two models overlap. Since the model for the northern portion of the Ogallala Aquifer is the primary model for Groundwater Management Area 1, results from the northern model were used over the results from the southern model in the overlap area.

The previously completed Groundwater Availability Model Run 09-001 (Smith, 2009) documents the model results reviewed by members of Groundwater Management Area 1 when developing the above desired future conditions. The model run for the northern portion of the Ogallala Aquifer presented in this report is based on the above referenced groundwater availability model run and are divided by county, groundwater conservation district, geographic area, and river basin within Groundwater Management Area 1. Note that Groundwater Management Area 1 is entirely contained within the Panhandle Regional Water Planning Area (Region A). The locations of these areas are shown in Figure 3.

It is important to note that a change was made to the year assigned to each stress period in the current model run compared with Groundwater Availability Model Run 09-001. In Smith (2009), the stress period in the model representing 2006 was used as the base year for the

model run. The first subsequent stress period was assumed to represent 2010 and the volume decline was calculated between 2010 and the end of 2059 (50 years). However, due to the nature of the Ogallala Aquifer with declining water levels through time, it was determined that it would be more appropriate to explicitly simulate the interim time-period from 2007 to 2009. The model run for the northern portion of the Ogallala Aquifer documented here uses 2006 as the base year as in Smith (2009). The first subsequent stress period, however, now represents 2007. The period over which the volume declines that match the desired future conditions were calculated is now from 2007 to 2056 (although the percent volume decline for each geographic area during the 50-year period from 2010 to 2059 is essentially the same). The consequence of this change is that the results presented in the tables below are offset by three years compared to Groundwater Availability Model Run 09-001. For example, the pumping for 2020 in the results section below corresponds to the results presented for 2023 in Smith (2009).

For the southern portion of the Ogallala Aquifer, which covers portions of Oldham, Potter, Randall, and Armstrong counties, the Groundwater Availability Model Run 08-016 Supplement (Smith, 2008) was previously completed and meets the above request. Since completion of the model run, however, the groundwater availability model for the southern portion of the Ogallala Aquifer has been updated (Blandford and others, 2008). For this reason, the updated groundwater availability model was used to reassess these areas. This report documents the methods used in the updated groundwater availability model run for the southern portion of the Ogallala Aquifer in addition to reporting managed available groundwater for Groundwater Management Area 1.

PARAMETERS AND ASSUMPTIONS:

Northern Portion of the Ogallala Aquifer

The parameters and assumptions for the groundwater availability model run for the northern portion of the Ogallala Aquifer are described below:

- We used version 2.01 of the groundwater availability model for the northern portion of the Ogallala Aquifer. This model is an update to the original version documented in Dutton and others (2001). See Dutton (2004) and Dutton and others (2001) for assumptions and limitations of the groundwater availability model

- The groundwater availability model for the northern portion of the Ogallala Aquifer has only one layer which collectively represents the Ogallala and Rita Blanca aquifers. As described in the Resolution 2009-01 adopted by the members of Groundwater Management Area 1, the adopted desired future conditions apply to both the Ogallala and Rita Blanca aquifers. In both the desired future conditions statement and this report as a whole the Ogallala and Rita Blanca aquifers are referred to collectively as the "Ogallala Aquifer."

- The root mean squared error (a measure of the difference between simulated and measured water levels during model calibration) for the model for the northern

portion of the Ogallala Aquifer is 53 feet. This represents 2.2 percent of the range of measured water levels across the model area.

- Cells were assigned to individual counties, groundwater conservation districts, and river basins as shown in the September 14, 2009 version of the file that associates the model grid to political and natural boundaries for the northern portion of the Ogallala. Note that some minor corrections were made to county and groundwater conservation district grid cell assignments compared to the original Groundwater Availability Model Run 09-001 (Smith, 2009).

- See the Pumping section below and Groundwater Availability Model Run 09-001 (Smith, 2009) for additional details about the pumping in the model run for the northern portion of the Ogallala Aquifer that meets the above desired future conditions.

Southern Portion of the Ogallala Aquifer

The parameters and assumptions for the groundwater availability model run for the southern portion of the Ogallala Aquifer are described below:

- We used version 2.01 of the groundwater availability model for the southern portion of the Ogallala Aquifer, which also includes the Edwards-Trinity (High Plains) 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.

- The model includes four layers representing the southern portion of the Ogallala Aquifer and the Edwards-Trinity (High Plains) Aquifer. However, only Layer 1 of the model, representing the Ogallala Aquifer, is active within Groundwater Management Area 1. For this reason, results are only presented for the Ogallala Aquifer from the groundwater availability model.

- 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. This represents 1.8 percent of the range of measured water levels across the model area.

- Cells were assigned to individual counties, groundwater conservation districts, and river basins as shown in the September 14, 2009 version of the file that associates the model grid to political and natural boundaries for the southern portion of the Ogallala Aquifer and Edwards-Trinity (High Plains) Aquifer.

- The pumping for areas outside of Groundwater Management Area 1 is the same as described for the “base” scenario in Groundwater Availability Model Run 09-023

(Oliver, 2010). Details on the pumping within Groundwater Management Area 1 are given below.

Pumping

Pumping within Groundwater Management Area 1 in the groundwater availability model for the northern portion of the Ogallala Aquifer is the same as described in Groundwater Availability Model Run 09-001 (Smith, 2009). For areas of the model outside of Texas, pumping during the predictive period (2007 through 2060) was held constant at the level estimated for 2007 in Dutton and others (2001).

For the southern portion of the Ogallala Aquifer, which covers parts of Oldham, Potter, Randall, and Armstrong counties (Figure 1), the updated version of the groundwater availability model for this area was run to match the above-specified desired future conditions. As described above, a previous model run that matched the above desired future conditions is documented in the supplement to Groundwater Availability Model Run 08-16 (Smith, 2008). This run, however, was performed prior to completion of the updated groundwater availability model for the southern portion of the Ogallala Aquifer and did not contain the most recent levels of pumping for areas outside of Groundwater Management Area 1.

The pumping in the groundwater availability model for the southern portion of the Ogallala Aquifer that matched the desired future conditions was determined using an iterative process. The pumping in the model for the year 2000 (the last year of the historical-calibration period) was held constant between 2001 and 2008. Beginning in 2009, this pumping distribution was increased and then held constant for each year through 2060. The amount of the increase over the pumping in the year 2000 was uniformly spread over all model cells that contained pumping in 2000. After running the model, the decline in the volume of the aquifer between 2009 and 2058 (50 years inclusive) was calculated and the level of pumping for the predictive period was adjusted accordingly. This process was repeated until the decline in aquifer volume in the southern portion of the Ogallala Aquifer in Groundwater Management Area 1 matched the requested decline (50 percent of the original volume after 50 years). It should be noted that the volume decline was also 50 percent for the inclusive 50-year periods 2010 to 2059 and 2011 to 2060. For areas outside of Groundwater Management Area 1, pumping was set to the same level as the "base" scenario documented in Groundwater Availability Model Run 09-023 (Oliver, 2010).

As described in Groundwater Availability Model Run 09-023 (Oliver, 2010), the initial volume of water in the Groundwater Management Area 2 portion of the Ogallala Aquifer, which constitutes the majority of the southern portion of the aquifer, was compared to the volume calculated from water level measurements. From this analysis it was found that the volume of water calculated from water level measurements was approximately 8.7 percent less than the volume calculated for the base year (2008) in the model. For this reason the model output pumping presented in this report for the southern portion of the Ogallala Aquifer has been reduced by 8.7 percent to correct for the initial volume difference. Note that Groundwater Management Area 2 was used for the volume comparison (as opposed to

Groundwater Management Area 1) because it covers the majority of the southern portion of the Ogallala Aquifer and contained a sufficient distribution of water level measurements to create a water level surface for 2008. This is the same process employed in Groundwater Availability Model Run 09-023 and is described in further detail in that report (Oliver, 2010).

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 were not included. Districts were encouraged to evaluated the estimates of exempt pumping and, if desired, provide updated estimates. Once established, the estimates of exempt pumping are subtracted from the total pumping output from the groundwater availability models to yield the estimated managed available groundwater for permitting purposes.

RESULTS:

Table 1 contains the total pumping estimates for the Ogallala Aquifer within Groundwater Management Area 1. It contains pumping totals from the groundwater availability models for the northern and southern portions of the Ogallala Aquifer subdivided by county, groundwater conservation district, geographic area, and river basin. These areas are shown in figures 1 and 3. Note that all of Groundwater Management Area 1 is within the Panhandle Regional Water Planning Area (Region A). For this reason results have not been divided by Regional Water Planning Area.

Table 2 shows the total pumping estimates summarized by county within Groundwater Management Area 1 and the total for the area as a whole. The geographic area within which each county is located is also shown. The total pumping for Groundwater Management Area 1 in 2010 is 3,364,389 acre-feet per year. This declines to 2,027,465 acre-feet of pumping per year by 2060 due to cells becoming inactive. A model cell becomes inactive when the water level in the cell drops below the base of the aquifer. In this situation, pumping cannot occur for the remainder of the model simulation.

Table 3 shows the total pumping estimates summarized by groundwater conservation district and geographic area. Between 2010 and 2060, total pumping declines from 54,998 to 54,938 acre-feet per year in Hemphill County Underground Water Conservation District, 72,832 to

48,934 acre-feet per year in High Plains Underground Water Conservation District No. 1 (limited to Groundwater Management Area 1), 1,905,700 to 1,067,874 acre-feet per year in North Plains Groundwater Conservation District, and 1,016,722 to 714,861 acre-feet per year in Panhandle Groundwater Conservation District. The total pumping for areas not covered by a groundwater conservation district within Groundwater Management Area 1 declines from 314,137 to 140,858 acre-feet per year between 2010 and 2060.

Table 4 shows the total pumping summarized by geographic area. The decline in the volume of water stored in the Ogallala Aquifer over 50 years for each of these areas matches the desired future condition adopted by the members of Groundwater Management Area 1. For Area 1, which consists of Dallam, Sherman, Hartley, and Moore counties, total pumping declines from 1,280,345 acre-feet per year to 511,161 acre-feet per year between 2010 and 2060. For Area 2, consisting of Hemphill County, pumping declines from 54,998 to 54,938 acre-feet per year. For Area 3, which encompasses the remaining counties in Groundwater Management Area 1, total pumping declines from 2,029,045 to 1,421,366 acre-feet per year for the same time period.

Table 5 shows the results summarized by river basin. Between 2010 and 2060, the estimated total pumping declines from 2,740,309 to 1,584,138 acre-feet per year for the Canadian River basin. In the Red River basin for the same time period, total pumping estimates decline from 624,080 to 443,327 acre-feet per year.

Tables 6 through 9 show the estimated exempt pumping for the same areas in tables 2 through 5, respectively. Note that the exempt pumping estimates for all areas within a groundwater conservation district were provided by the districts. Hemphill County Underground Water Conservation District provided estimates of additional exempt use above the estimates for domestic and livestock uses provided by the Texas Water Development Board. Each of the other districts provided alternative estimates of exempt use to replace the Texas Water Development Board estimates. Between 2010 and 2060, the estimated exempt pumping increases from 53,533 to 58,132 acre-feet per year.

Tables 10 through 13 contain the estimates of managed available groundwater for the Ogallala Aquifer. As described above, these reflect the difference between the total pumping (tables 2 through 5) and the estimated exempt use (tables 6 through 9). The managed available groundwater for the Ogallala Aquifer in Groundwater Management Area 1 declines from 3,310,856 acre-feet per year in 2010 to 1,969,333 acre-feet per year in 2060. The managed available groundwater estimates are reported by county (Table 10), groundwater conservation district (Table 11), geographic area (Table 12), and river basin (Table 13).

It is important to acknowledge the limitations of the precision of the sub-regional water budgets 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 (for example, a county) 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.

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 1. Estimates of total pumping by year for the Ogallala and Rita Blanca aquifers in Groundwater Management Area 1. Results are in acre-feet per year and are divided by county, groundwater conservation district (GCD), and river basin. UWCD refers to Underground Water Conservation District.

County	District	Basin	Year					
			2010	2020	2030	2040	2050	2060
Armstrong	High Plains UWCD No. 1	Red	8,301	8,301	8,301	8,301	8,241	8,186
	Panhandle GCD	Red	46,315	42,978	39,881	37,008	34,342	32,447
Carson	Panhandle GCD	Canadian	90,494	83,974	77,924	72,309	67,099	63,677
		Red	95,516	88,634	82,248	76,322	70,823	67,211
Dallam	North Plains GCD	Canadian	319,738	258,174	201,321	141,484	92,522	67,739
	No District	Canadian	99,053	83,833	75,332	64,746	52,982	40,965
Donley	Panhandle GCD	Red	86,072	79,870	74,115	68,775	63,820	60,565
Gray	Panhandle GCD	Canadian	39,303	36,471	33,843	31,405	29,142	27,604
		Red	137,295	127,403	118,223	109,705	101,674	96,442
Hansford	North Plains GCD	Canadian	264,397	245,347	227,670	211,237	195,789	184,430
Hartley	North Plains GCD	Canadian	343,255	297,682	272,145	258,245	245,612	231,917
	No District	Canadian	51,590	36,312	23,749	15,449	10,239	6,328
Hemphill	Hemphill County UWCD	Canadian	31,660	31,660	31,660	31,660	31,660	31,660
		Red	23,338	23,338	23,338	23,338	23,278	23,278
Hutchinson	North Plains GCD	Canadian	52,972	49,156	45,614	42,286	39,047	36,316
	Panhandle GCD	Canadian	13,411	12,445	11,548	10,716	9,944	9,437
	No District	Canadian	80,679	74,866	69,472	64,466	59,821	56,770
Lipscomb	North Plains GCD	Canadian	244,981	227,330	210,951	195,751	181,647	172,319
Moore	North Plains GCD	Canadian	186,990	134,601	103,224	87,973	76,074	67,724
	No District	Canadian	32,933	22,357	11,776	6,140	3,137	2,184
Ochiltree	North Plains GCD	Canadian	246,579	228,813	212,326	197,028	182,726	173,125
Oldham	No District	Canadian	20,418	18,094	17,208	16,271	15,096	14,062
		Red	3,952	3,122	2,885	2,772	2,306	2,269
Potter	High Plains UWCD No. 1	Canadian	1,659	1,299	1,219	1,207	1,195	885
		Red	3,491	2,772	1,248	419	412	408
	Panhandle GCD	Canadian	27,992	25,975	24,104	22,367	20,755	19,634
		Red	7,161	6,645	6,166	5,722	5,310	4,996
Randall	High Plains UWCD No. 1	Red	59,381	57,141	55,995	51,410	47,357	39,455
	No District	Red	25,514	24,146	22,979	21,836	19,913	18,280
Roberts	Panhandle GCD	Canadian	345,418	320,530	297,436	276,005	256,118	243,057
		Red	13,528	12,554	11,649	10,810	10,031	9,519
Sherman	North Plains GCD	Canadian	246,787	193,748	164,250	148,183	139,062	134,304
Wheeler	Panhandle GCD	Red	114,217	105,987	98,351	91,264	84,585	80,272

Table 2. Estimates of total pumping for the Ogallala and Rita Blanca aquifers by county for each decade between 2010 and 2060. Results are in acre-feet per year.

County	Geographic Area	Year					
		2010	2020	2030	2040	2050	2060
Armstrong	3	54,616	51,279	48,182	45,308	42,582	40,633
Carson	3	186,010	172,608	160,171	148,631	137,922	130,888
Dallam	1	418,791	342,007	276,653	206,230	145,504	108,704
Donley	3	86,072	79,870	74,115	68,775	63,820	60,565
Gray	3	176,598	163,874	152,066	141,110	130,816	124,046
Hansford	3	264,397	245,347	227,670	211,237	195,789	184,430
Hartley	1	394,845	333,993	295,895	273,694	255,851	238,246
Hemphill	2	54,998	54,998	54,998	54,998	54,938	54,938
Hutchinson	3	147,062	136,466	126,633	117,468	108,812	102,523
Lipscomb	3	244,981	227,330	210,951	195,751	181,647	172,319
Moore	1	219,923	156,958	115,001	94,113	79,212	69,908
Ochiltree	3	246,579	228,813	212,326	197,028	182,726	173,125
Oldham	3	24,370	21,215	20,093	19,043	17,402	16,330
Potter	3	40,303	36,691	32,737	29,714	27,672	25,924
Randall	3	84,895	81,287	78,974	73,246	67,269	57,735
Roberts	3	358,946	333,084	309,085	286,815	266,149	252,576
Sherman	1	246,787	193,748	164,250	148,183	139,062	134,304
Wheeler	3	114,217	105,987	98,351	91,264	84,585	80,272
Total		**3,364,389**	**2,965,556**	**2,658,150**	**2,402,610**	**2,181,758**	**2,027,465**

Table 3. Estimates of total pumping for the Ogallala and Rita Blanca aquifers 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.

District	Geographic Area	Year					
		2010	2020	2030	2040	2050	2060
Hemphill County UWCD	2	54,998	54,998	54,998	54,998	54,938	54,938
High Plains UWCD No. 1	3	72,832	69,513	66,763	61,336	57,204	48,934
North Plains GCD	1	1,096,770	884,205	740,940	635,885	553,270	501,684
	3	808,930	750,645	696,560	646,303	599,209	566,190
Panhandle GCD	3	1,016,722	943,466	875,487	812,407	753,642	714,861
No District	1	183,575	142,502	110,858	86,335	66,358	49,478
	3	130,562	120,227	112,544	105,345	97,136	91,381
Total		**3,364,389**	**2,965,556**	**2,658,150**	**2,402,610**	**2,181,758**	**2,027,465**

Table 4. Estimates of total pumping for the Ogallala and Rita Blanca aquifers by geographic area for each decade between 2010 and 2060. Results are in acre-feet per year.

Geographic Area	Year					
	2010	2020	2030	2040	2050	2060
1	1,280,345	1,026,707	851,798	722,220	619,628	551,161
2	54,998	54,998	54,998	54,998	54,938	54,938
3	2,029,045	1,883,851	1,751,354	1,625,392	1,507,192	1,421,366
Total	**3,364,389**	**2,965,556**	**2,658,150**	**2,402,610**	**2,181,758**	**2,027,465**

Table 5. Estimates of total pumping for the Ogallala and Rita Blanca aquifers by river basin for each decade between 2010 and 2060. Results are in acre-feet per year.

Basin	Year					
	2010	2020	2030	2040	2050	2060
Canadian	2,740,309	2,382,665	2,112,772	1,894,928	1,709,667	1,584,138
Red	624,080	582,891	545,379	507,682	472,090	443,327
Total	**3,364,389**	**2,965,556**	**2,658,150**	**2,402,610**	**2,181,758**	**2,027,465**

Table 6. Estimates of exempt use for the Ogallala and Rita Blanca aquifers by county for each decade between 2010 and 2060. Results are in acre-feet per year.

County	Geographic Area	Year					
		2010	2020	2030	2040	2050	2060
Armstrong	3	399	375	381	367	360	347
Carson	3	568	426	440	425	396	369
Dallam	1	5,481	5,609	5,689	5,708	5,670	5,585
Donley	3	582	558	516	483	453	414
Gray	3	1,074	877	865	835	797	760
Hansford	3	4,531	4,531	4,531	4,531	4,531	4,531
Hartley	1	6,269	6,315	6,340	6,349	6,331	6,256
Hemphill	2	9,121	9,132	8,371	7,063	6,050	5,174
Hutchinson	3	2,204	2,264	2,206	2,187	2,168	2,149
Lipscomb	3	2,867	2,867	2,867	2,867	2,867	2,867
Moore	1	3,903	4,192	4,530	4,799	4,963	5,061
Ochiltree	3	3,261	3,261	3,261	3,261	3,261	3,261
Oldham	3	391	399	371	327	284	230
Potter	3	1,952	2,560	3,139	3,804	4,529	5,123
Randall	3	5,581	6,763	7,896	9,190	10,601	11,768
Roberts	3	403	598	181	129	121	114
Sherman	1	3,476	3,476	3,476	3,476	3,476	3,476
Wheeler	3	1,470	1,070	734	687	669	647
Total		**53,533**	**55,273**	**55,794**	**56,488**	**57,527**	**58,132**

Table 7. Estimates exempt use for the Ogallala and Rita Blanca aquifers by groundwater conservation district (GCD) for each decade between 2010 and 2060. Results are in acre-feet per year.

District	Geographic Area	Year					
		2010	2020	2030	2040	2050	2060
Hemphill County UWCD	2	9,121	9,132	8,371	7,063	6,050	5,174
High Plains UWCD No. 1	3	3,286	3,917	4,528	5,228	5,995	6,625
North Plains GCD	1	15,343	15,343	15,343	15,343	15,343	15,343
	3	12,482	12,482	12,482	12,482	12,482	12,482
Panhandle GCD	3	6,300	6,332	6,042	6,475	7,027	7,444
No District	1	3,786	4,249	4,692	4,989	5,097	5,035
	3	3,215	3,818	4,336	4,908	5,533	6,029
Total		**53,533**	**55,273**	**55,794**	**56,488**	**57,527**	**58,132**

Table 8. Estimates of exempt use for the Ogallala and Rita Blanca aquifers by geographic area for each decade between 2010 and 2060. Results are in acre-feet per year.

Geographic Area	Year					
	2010	2020	2030	2040	2050	2060
1	19,129	19,592	20,035	20,332	20,440	20,378
2	9,121	9,132	8,371	7,063	6,050	5,174
3	25,283	26,549	27,388	29,093	31,037	32,580
Total	**53,533**	**55,273**	**55,794**	**56,488**	**57,527**	**58,132**

Table 9. Estimates of exempt use for the Ogallala and Rita Blanca aquifers by river basin for each decade between 2010 and 2060. Results are in acre-feet per year.

Basin	Year					
	2010	2020	2030	2040	2050	2060
Canadian	39,919	41,124	41,175	41,222	41,336	41,230
Red	13,614	14,149	14,619	15,266	16,191	16,902
Total	**53,533**	**55,273**	**55,794**	**56,488**	**57,527**	**58,132**

Table 10. Estimates of managed available groundwater for the Ogallala and Rita Blanca aquifers by county for each decade between 2010 and 2060. Results are in acre-feet per year.

County	Geographic Area	Year					
		2010	2020	2030	2040	2050	2060
Armstrong	3	54,217	50,904	47,801	44,941	42,222	40,286
Carson	3	185,442	172,182	159,731	148,206	137,526	130,519
Dallam	1	413,310	336,398	270,964	200,522	139,834	103,119
Donley	3	85,490	79,312	73,599	68,292	63,367	60,151
Gray	3	175,524	162,997	151,201	140,275	130,019	123,286
Hansford	3	259,866	240,816	223,139	206,706	191,258	179,899
Hartley	1	388,576	327,678	289,555	267,345	249,520	231,990
Hemphill	2	45,877	45,866	46,627	47,935	48,888	49,764
Hutchinson	3	144,858	134,202	124,427	115,281	106,644	100,374
Lipscomb	3	242,114	224,463	208,084	192,884	178,780	169,452
Moore	1	216,020	152,766	110,471	89,314	74,249	64,847
Ochiltree	3	243,318	225,552	209,065	193,767	179,465	169,864
Oldham	3	23,979	20,816	19,722	18,716	17,118	16,100
Potter	3	38,351	34,131	29,598	25,910	23,143	20,801
Randall	3	79,314	74,524	71,078	64,056	56,668	45,967
Roberts	3	358,543	332,486	308,904	286,686	266,028	252,462
Sherman	1	243,311	190,272	160,774	144,707	135,586	130,828
Wheeler	3	112,747	104,917	97,617	90,577	83,916	79,625
Total		**3,310,856**	**2,910,283**	**2,602,356**	**2,346,122**	**2,124,231**	**1,969,333**

Table 11. Estimates of managed available groundwater for the Ogallala and Rita Blanca aquifers 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.

District	Geographic Area	Year					
		2010	2020	2030	2040	2050	2060
Hemphill County UWCD	2	45,877	45,866	46,627	47,935	48,888	49,764
High Plains UWCD No. 1	3	69,546	65,596	62,235	56,108	51,209	42,309
North Plains GCD	1	1,081,427	868,862	725,597	620,542	537,927	486,341
	3	796,448	738,163	684,078	633,821	586,727	553,708
Panhandle GCD	3	1,010,422	937,134	869,445	805,932	746,615	707,417
No District	1	179,789	138,253	106,166	81,346	61,261	44,443
	3	127,347	116,409	108,208	100,437	91,603	85,352
Total		**3,310,856**	**2,910,283**	**2,602,356**	**2,346,122**	**2,124,231**	**1,969,333**

Table 12. Estimates of managed available groundwater for the Ogallala and Rita Blanca aquifers by geographic area for each decade between 2010 and 2060. Results are in acre-feet per year.

Geographic Area	Year					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
1	1,261,216	1,007,115	831,763	701,888	599,188	530,783
2	45,877	45,866	46,627	47,935	48,888	49,764
3	2,003,762	1,857,302	1,723,966	1,596,299	1,476,155	1,388,786
Total	**3,310,856**	**2,910,283**	**2,602,356**	**2,346,122**	**2,124,231**	**1,969,333**

Table 13. Estimates of managed available groundwater for the Ogallala and Rita Blanca aquifers by river basin for each decade between 2010 and 2060. Results are in acre-feet per year.

Basin	Year					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Canadian	2,700,390	2,341,541	2,071,597	1,853,706	1,668,331	1,542,908
Red	610,466	568,742	530,760	492,416	455,899	426,425
Total	**3,310,856**	**2,910,283**	**2,602,356**	**2,346,122**	**2,124,231**	**1,969,333**

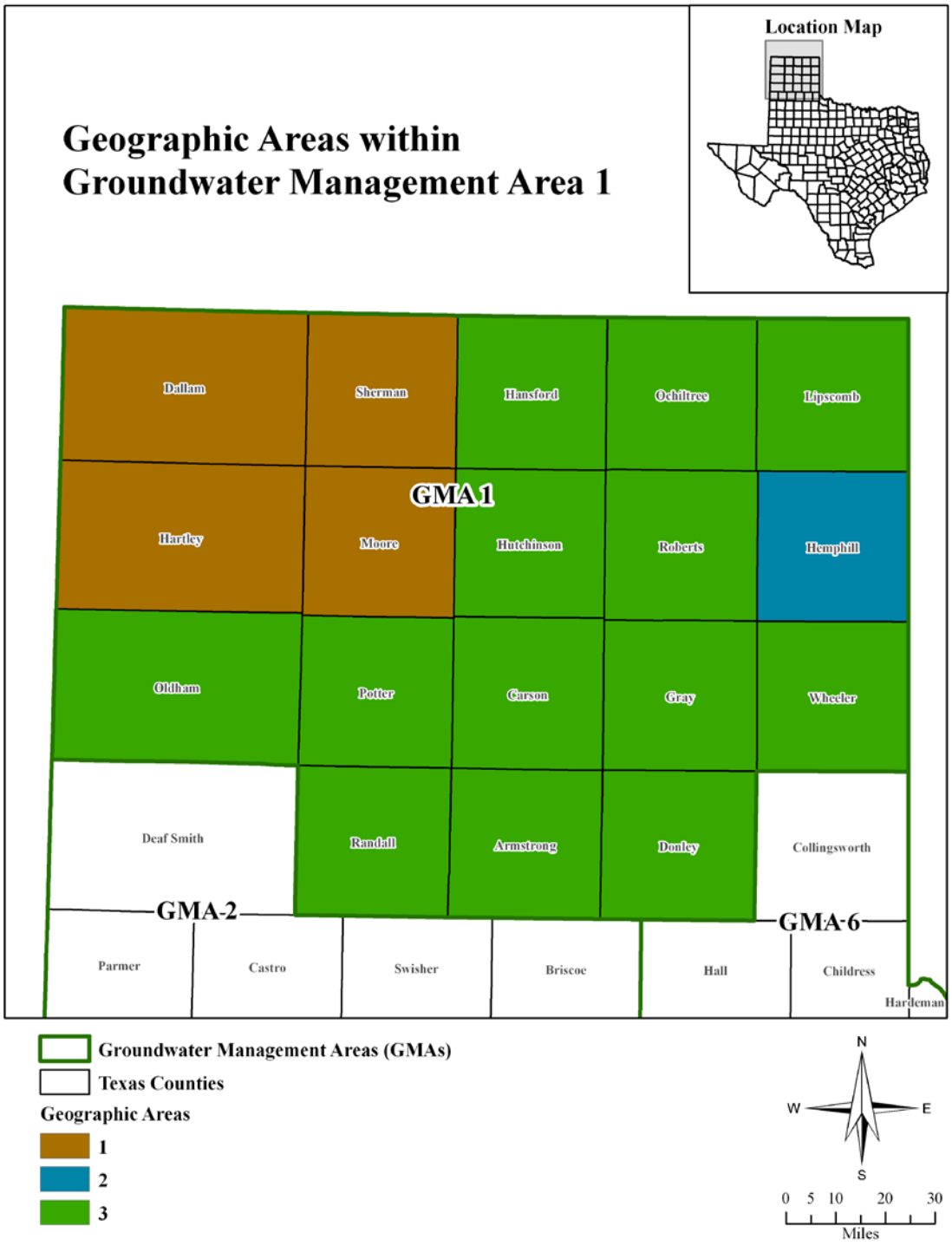

Figure 1. Map showing the geographic areas defined by Groundwater Management Area 1 for defining desired future conditions for the Ogallala Aquifer.

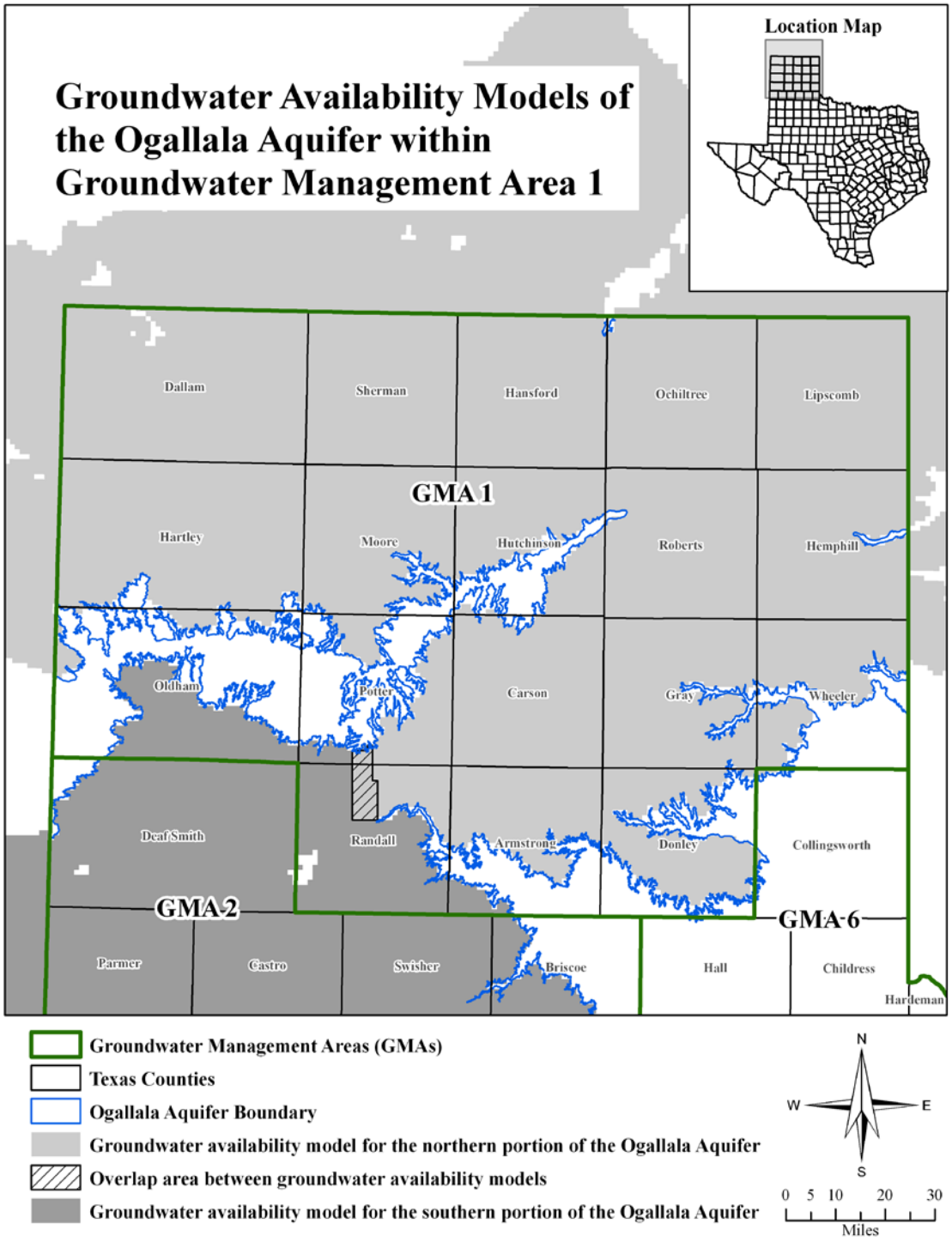

Figure 2. Map showing the areas covered by the groundwater availability models for the northern and southern portions of the Ogallala Aquifer.

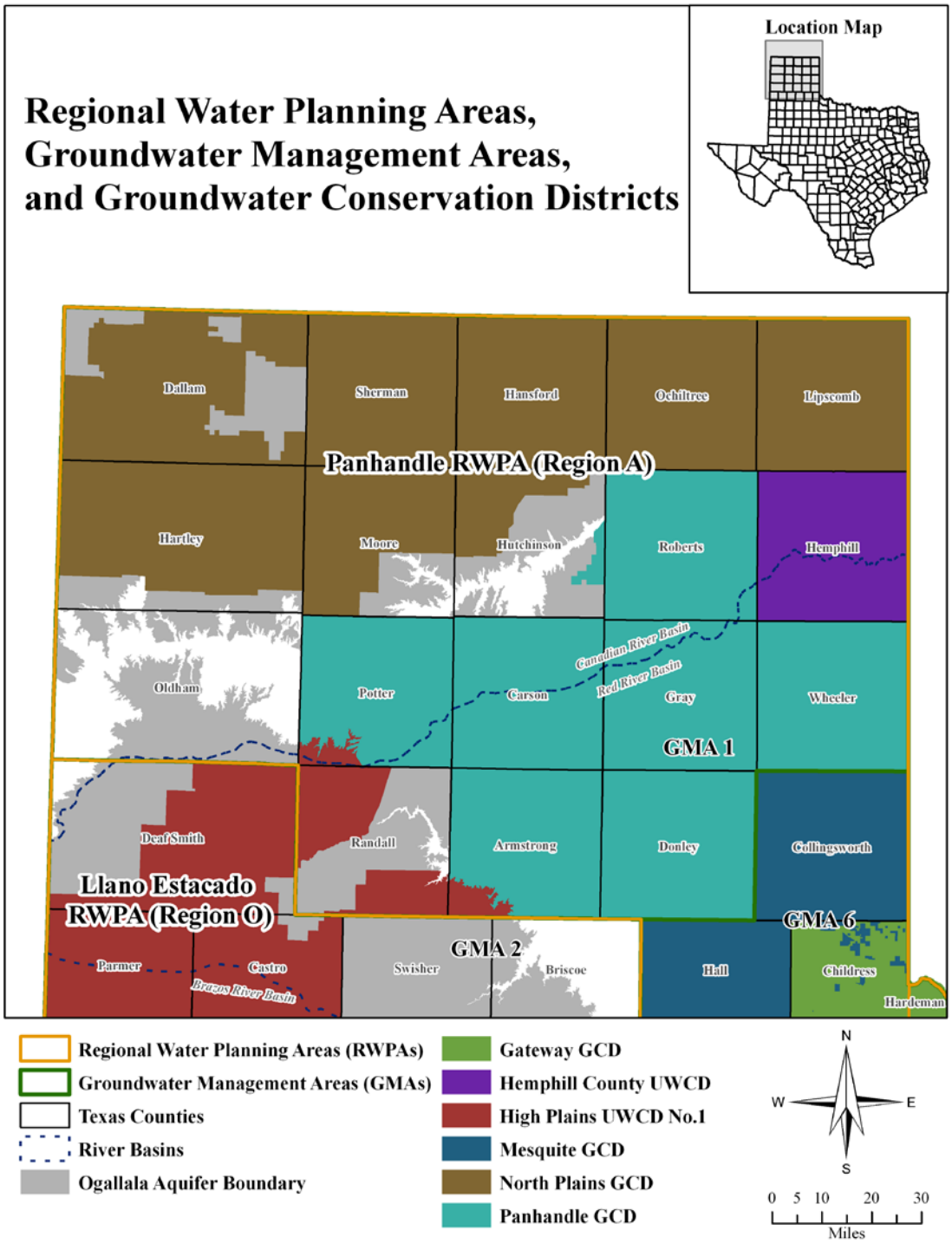

Figure 3. Map showing regional water planning areas, groundwater management areas, groundwater conservation districts, counties, and river basins in and neighboring Groundwater Management Area 1.

Estimated Historical Water Use And 2012 State Water Plan Datasets:

Hemphill County Underground Water Conservation District

by Stephen Allen
Texas Water Development Board
Groundwater Resources Division
Groundwater Technical Assistance Section
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(512) 463-7317
March 27, 2012

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/gmpchecklist0911.pdf

The five reports included in part 1 are:

1. Estimated Historical Water Use (checklist Item 2)

   from the TWDB Historical Water Use Survey (WUS)

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

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

Part 2 of the 2-part package is the groundwater availability model (GAM) report. The District should have received this report from the Groundwater Availability Modeling Section. Questions about the GAM can be directed to Dr. Shirley Wade, shirley.wade@twdb.texas.gov, or (512) 463-0749 (to contact the Administrative Assistant).

DISCLAIMER:

The data presented in this report represents the most updated Historical Water Use and 2012 State Water Planning data available as of 3/27/2012. Although it does not happen frequently, neither of these datasets are static and are subject to change pending the availability of more accurate data (Historical Water Use data) or an amendment to the 2012 State Water Plan (2012 State Water Planning data). District personnel must review these datasets and correct any discrepancies in order to ensure approval of their groundwater management plan.

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

http://www.twdb.texas.gov/wrpi/wus/summary.asp

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

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

Estimated Historical Water Use

TWDB Historical Water Use Survey (WUS) Data

Groundwater and surface water use estimates are currently unavailable for 2005, 2009 and 2010.
TWDB staff anticipates the calculation and posting of such estimates during the first half of 2012.

HEMPHILL COUNTY

All values are in acre-feet/year

Year	Source	Municipal	Manufacturing	Steam Electric	Irrigation	Mining	Livestock	Total
1974	GW	1,068	56	0	5,144	44	202	6,514
	SW	0	0	0	36	0	531	567
1980	GW	1,588	125	0	2,772	1	516	5,002
	SW	0	0	0	0	0	534	534
1984	GW	1,287	125	0	5,180	0	157	6,749
	SW	0	0	0	80	0	1,426	1,506
1985	GW	1,182	125	0	6,712	0	175	8,194
	SW	0	0	0	137	0	1,583	1,720
1986	GW	861	125	0	7,500	0	565	9,051
	SW	0	0	0	0	0	849	849
1987	GW	707	0	0	5,950	0	144	6,801
	SW	0	0	0	0	0	1,302	1,302
1988	GW	777	0	0	4,300	0	401	5,478
	SW	0	0	0	0	0	602	602
1989	GW	695	2	0	1,936	0	402	3,035
	SW	0	0	0	0	0	604	604
1990	GW	729	3	0	2,700	0	435	3,867
	SW	0	0	0	0	0	653	653
1991	GW	743	2	0	2,866	0	446	4,057
	SW	0	0	0	0	0	670	670
1992	GW	662	1	0	2,866	0	872	4,401
	SW	0	0	0	0	0	1,308	1,308
1993	GW	621	2	0	1,071	0	838	2,532
	SW	0	0	0	0	0	1,257	1,257
1994	GW	713	2	0	1,641	0	761	3,117
	SW	0	0	0	0	0	1,141	1,141
1995	GW	618	1	0	1,303	0	766	2,688
	SW	0	0	0	0	0	1,149	1,149
1996	GW	655	0	0	1,815	0	968	3,438
	SW	0	0	0	0	0	1,452	1,452
1997	GW	600	1	0	1,963	0	822	3,386
	SW	0	0	0	0	0	1,234	1,234
1998	GW	599	0	0	1,857	0	939	3,395

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

Groundwater and surface water use estimates are currently unavailable for 2005, 2009 and 2010.
TWDB staff anticipates the calculation and posting of such estimates during the first half of 2012.

Year	Source	Municipal	Manufacturing	Steam Electric	Irrigation	Mining	Livestock	Total
1998	SW	0	0	0	0	0	1,409	1,409
1999	GW	624	0	0	3,171	0	956	4,751
	SW	0	0	0	0	0	1,433	1,433
2000	GW	607	1	0	3,373	0	592	4,573
	SW	0	0	0	0	0	888	888
2001	GW	619	2	0	2,349	0	265	3,235
	SW	0	0	0	0	0	1,018	1,018
2002	GW	596	3	0	4,560	0	293	5,452
	SW	0	0	0	0	0	1,125	1,125
2003	GW	594	6	0	1,626	0	301	2,527
	SW	0	0	0	0	0	1,156	1,156
2004	GW	749	2	0	1,451	0	314	2,516
	SW	0	0	0	0	0	1,206	1,206
2006	GW	591	2	0	7,187	0	1,991	9,771
	SW	0	0	0	0	0	351	351
2007	GW	648	2	0	5,769	0	1,294	7,713
	SW	0	0	0	0	0	229	229
2008	GW	775	3	0	9,140	0	1,082	11,000
	SW	0	0	0	0	0	191	191

Projected Surface Water Supplies
TWDB 2012 State Water Plan Data

HEMPHILL COUNTY

All values are in acre-feet/year

RWPG	WUG	WUG Basin	Source Name	2010	2020	2030	2040	2050	2060
A	LIVESTOCK	CANADIAN	LIVESTOCK LOCAL SUPPLY	524	524	524	524	524	524
A	LIVESTOCK	RED	LIVESTOCK LOCAL SUPPLY	364	364	364	364	364	364
	Sum of Projected Surface Water Supplies (acre-feet/year)			888	888	888	888	888	888

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.

HEMPHILL COUNTY

All values are in acre-feet/year

RWPG	WUG	WUG Basin	2010	2020	2030	2040	2050	2060
A	CANADIAN	CANADIAN	475	477	461	444	432	411
A	COUNTY-OTHER	CANADIAN	110	111	107	103	100	96
A	COUNTY-OTHER	RED	48	48	46	45	43	41
A	IRRIGATION	CANADIAN	1,259	1,176	1,140	1,080	960	840
A	IRRIGATION	RED	566	529	513	486	432	378
A	LIVESTOCK	CANADIAN	758	761	763	766	770	773
A	LIVESTOCK	RED	518	520	522	524	526	528
A	MANUFACTURING	RED	1	1	1	1	1	1
A	MINING	CANADIAN	1,529	1,529	1,374	1,095	878	702
A	MINING	RED	1,046	1,046	940	749	601	481
	Sum of Projected Water Demands (acre-feet/year)		6,310	6,198	5,867	5,293	4,743	4,251

Projected Water Supply Needs
TWDB 2012 State Water Plan Data

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

HEMPHILL COUNTY

All values are in acre-feet/year

RWPG	WUG	WUG Basin	2010	2020	2030	2040	2050	2060
A	CANADIAN	CANADIAN	0	0	0	0	0	0
A	COUNTY-OTHER	CANADIAN	22	21	25	29	32	36
A	COUNTY-OTHER	RED	42	42	44	45	47	49
A	IRRIGATION	CANADIAN	0	0	0	0	0	0
A	IRRIGATION	RED	0	0	0	0	0	0
A	LIVESTOCK	CANADIAN	266	263	261	258	254	251
A	LIVESTOCK	RED	296	294	292	290	288	286
A	MANUFACTURING	RED	0	0	0	0	0	0
A	MINING	CANADIAN	0	0	0	0	0	0
A	MINING	RED	0	0	0	0	0	0
	Sum of Projected Water Supply Needs (acre-feet/year)		0	0	0	0	0	0

Projected Water Management Strategies
TWDB 2012 State Water Plan Data

HEMPHILL COUNTY

WUG, Basin (RWPG)

All values are in acre-feet/year

Water Management Strategy	Source Name [Origin]	2010	2020	2030	2040	2050	2060
IRRIGATION, CANADIAN (A)							
IRRIGATION CONSERVATION	CONSERVATION [HEMPHILL]	0	187	194	207	213	220
IRRIGATION, RED (A)							
IRRIGATION CONSERVATION	CONSERVATION [HEMPHILL]	0	41	43	46	47	48
Sum of Projected Water Management Strategies (acre-feet/year)		0	228	237	253	260	268

HEMPHILL COUNTY
Underground Water Conservation District
Conserving a Texas Oasis

APPENDIX H

SOURCE INFORMATION FOR EXHIBIT D DISTRICT'S ESTIMATES OF THE ANNUAL AMOUNT OF GROUNDWATER BEING USED IN HEMPHILL COUNTY IN ACRE FEET PER YEAR

Our mission is to conserve and protect
the groundwater resources of Hemphill County,
by ensuring sustainable development through
local management and the best available science.

DISTRICT'S ESTIMATES OF THE ANNUAL AMOUNT OF GROUNDWATER BEING USED IN HEMPHILL COUNTY

The Texas Water Development Board provided "Appendix G" The Estimated Historical Water Use and 2012 State Water Plan Datasets which included the Estimated Historical Water Use Data from the TWDB Historical Water Use Survey. This data fulfils the requirements of item 2 on the TWDB Management Plan Interim Checklist required by TWDB ruled 31 TAC §356.5(a)(5)(B) and §356.2(2). Exhibit D is the District's Estimates of the Annual Amount of Groundwater Being used in Hemphill County. The estimates of groundwater use included are for the years 2003-2010. The sources of each user group and amounts used in this table are provided below.

MUNICIPAL USE:

City of Canadian – The volumes submitted by the City of Canadian to TWDB on the Water Use Survey reports were reported to the District by the City of Canadian for years 2003-2010. This information reflects actual metered volumes of groundwater produced. Since the City of Canadian does not import or export water outside the District, the District makes the assumption that production and use by the City of Canadian is the same.

County Other – The County Other use estimates are not actual metered values. They are estimates based on the result of taking the total Hemphill County Population as reported by the US Census Bureau less the City of Canadian Population as reported by the US Census Bureau and then applying 121 gallons per capita per day use. This is the same gallons per capita per day value used in the 2012 State Water Plan for County Other. This estimate is based on the source being 100% groundwater.

INDUSTRIAL USE:

Mining – In response to exempt use estimates needed for establishing the Modeled Available Groundwater numbers, the District submitted estimates in a letter dated January 18, 2011 to the TWDB that estimated Ogallala Aquifer water used during the drilling and hydrofracturing operations in the Granite Wash in Hemphill County for the period of 2001 to 2010. The District chose to update the Mining use estimates based on significant changes in the operating practices of the industry with the introduction of horizontal drilling and the number of wells being drilled. A copy of that letter is attached to this Appendix.

Manufacturing – The District used the same values given by the TWDB in Appendix G for this user group for years 2003, 2004 and 2006-2008. For the year 2005, the District used the valued from the District's 2007 Management Plan. For the year 2010, the District used the value in the 2012 State Water Plan and for the year 2009, the District used an average between years 2010 and 2008.

Steam Electric - The District used the same values given by the TWDB in Appendix G for this user group for years 2003, 2004 and 2006-2008. For the year 2005, the District used the valued from the District's 2007 Management Plan. For the year 2010, the District used the value in the 2012 State Water Plan and for the year 2009, the District used an average between years 2010 and 2008.

AGRICULTURAL USE:

Irrigation - The District used the same values given by the TWDB in Appendix G for this user group for years 2003, 2004 and 2006-2008. For the years 2005, 2009 and 2010, the District used the estimates derived from the TWDB Irrigation Water Use Estimates Surveys submitted annually by the District. Each year the District surveys the crop and number of acres irrigated in Hemphill County. In years 2003 and 2004 the District made no adjustments to the number of acres reported or the estimates of use by crop. In 2005-2010, the District did submit revised estimates of the number of acres and crop types. It was not until 2009 & 2010 the District submitted revised estimates of the acre inches per crop based on water use reports submitted to the North Plains Groundwater Conservation District.

Livestock – To determine the groundwater use for this category, the District used the total livestock use volume provided by TWDB and split the use 85% groundwater and 15% surface water for each year starting with 2003-2009. The 2010 estimates were taken from the 2012 State Water Plan which also split the use 85% to 15%. Only groundwater use is reported in the Exhibit. Total demand is provided in the table below:

YEAR	Total Livestock Water Demand	Demand on Groundwater (85%)	Demand on Surface Water (15%)
2003	**1,457**	**1,238**	**219**
2004	**1,520**	**1,292**	**228**
2005	**1,439**	**1,223**	**216**
2006	**1,455**	**1,237**	**218**
2007	**1,523**	**1,294**	**228**
2008	**1,273**	**1,082**	**191**
2009	**1,401**	**1,191**	**210**
2010	**1,276**	**1,085**	**191**

April 19, 2012

Janet Guthrie
General Manager
Hemphill County UWCD
P.O. Box 1142
Canadian, TX 79014

RE: City of Canadian Historical Use

Dear Mrs. Guthrie,

As per your request, please find below the City of Canadian's annual pumpage for the years 2003-2010. As you are aware, 100% of the City's water supply comes from groundwater.

2003	180.573 million gallons
2004	184.503 million gallons
2005	175.693 million gallons
2006	199.624 million gallons
2007	171.919 million gallons
2008	186.085 million gallons
2009	196.992 million gallons
2010	204.647 million gallons

If you have any further questions, or need additional information, please feel free to call me at 806-323-6473.

Best regards,

Abel Lucero
Water and Wastewater Supt.

HEMPHILL COUNTY
Underground Water Conservation District
Conserving a Texas Oasis

January 18, 2011

Bill Hutchison
Texas Water Development Board
Austin, Texas

RE: Estimation of Ogallala Aquifer water use in oil and gas drilling and hydro-fracturing activities in Hemphill County

Dear Mr. Hutchison and staff:

In response to exempt use estimates needed for establishing Managed Available Groundwater numbers, the District has reviewed and updated the methodologies previously used in estimating Ogallala Aquifer water use during the drilling and hydro-fracturing operations in the Granite Wash in Hemphill County. Oil and gas use has not previously been included in the Regional Planning in Hemphill County until the 2010 plan was developed. Since that time, the District has observed changes in the operating practices of the industry and we submit the following sections to support our estimates of water used during oil and gas exploration activities.

Evaluation of the number of oil and gas wells drilled per year:

The District staff went to the following web page at the Texas Railroad Commission (RRC),

http://webapps.rrc.state.tx.us/DP/initializePublicQueryAction.do

Queried data base by District = 10, County = Hemphill, Well type = Oil or Gas Well, Status = All Statuses, and Approved Date = 01/01/1999-12/31/1999. This query was ran for each year thru 2010 to acquire what oil and gas wells were permitted during that year. Then the report was refined to separate the W-1s by: Horizontal wells, Vertical Wells, Directional Wells, Horizontal/Vertical Wells, Directional Sidetrack Wells, Horizontal Sidetrack Wells, No profile indicated and Total W1s. Then the total W1s were refined into categories: Recompletions, Re-enter, New Drills, Field Transfers and Other. For our purposes, the numbers were then categorized as Permit Amendments and

Total Unique Wells. The Total Unique Wells is the number we will be using throughout the remaining report. Below is the result of this research per year:

Table 1 Total Unique Wells drilled per year

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Total Unique Wells	**66**	**68**	**78**	**110**	**159**	**207**	**161**	**228**	**280**	**347**	**109**	**177**

The average number of wells drilled per year from 2001 to 2010 is 186.

Estimation of the quantity of Ogallala Aquifer water used for drilling and hydro-fracturing activities:

During 2006, as General Manager, I observed drilling and hydro-fracturing activities at a number of oil and gas (predominately gas) wells in Hemphill County. In addition to these observations, I also had conversations concerning water use with the local pump installers, land owners and oil and gas producers.

According to these observations and information obtained, the following is the estimate of water use per well for drilling

Drilling (Field observations, pump installers, landowners) vertical well

1) The drilling of an oil/gas well takes an average of 16 days

2) The average Ogallala water well produces x 65 gpm (24 hr/day, 7 days/week)

1,497,600 gals or **4.6 acre feet per well**

Hydro-fracturing (Field observations, pump installers, landowners and operators) Vertical wells

1) Between three and five zones are hydro-fractured

In the Granite Wash or an average of four 4 zones

2) Approximately 25,000 barrels (3.2 acre feet) of

Water is needed per zone x 3.2 acre feet

12.8 acre feet per well

Vertical Well Water Use:

Total estimated water used (drilling and hydro-fracturing) is 17.4 acre feet per vertical well.

Changes observed - drilling and hydro-fracturing process for horizontal wells

Over the last 3-4 years, operating practices have changed. It was initially thought to be cost prohibitive to refrac a production well; however, this is no longer true. The District's query of W-1s showed a total of 93 recompletions during 2001-2010. Recompletion is working over an existing wellbore to complete in a different field/reservoir. Since no data on water use under this category is available, our estimates will not include any estimations of water used relating to this activity. The District will continue to monitor for increased activity and address if necessary in the next round of joint planning.

The trend to drill and hydro-fracture horizontal wells began in 2007. In 2010, the number of horizontal wells actually exceeded the number of vertical wells being drilled in Hemphill County. The District spoke with engineers from two different companies operating in Hemphill County and got an estimate of total groundwater demand during the drilling and hydro-fracturing process for horizontal wells. The hydro-fracturing of the horizontal wells is where more water is used. Operational practices now often include the use of a "frac pit" for fresh water. These pits can vary in size and depth. The operators must keep the pit filled to prevent wildlife from puncturing the lining when they drink from the pit and from damage due to high winds. Assuming water used in the actual fracturing process is replaced in the pit, the numbers double for total water used.

Table 2 Estimated water use numbers for Horizontal Wells

WATER USE	OPERATOR "A"	OPERATOR "B"
Drilling bbls	12,000	7,000
Hz frac bbls	250,000	200,000
Total bbls	262,000	207,000
Acre-feet	33.8	26.7
Average Acre-feet	**30.2**	
Assuming water replacement in the pit (bbls)	524,000	414,000
Acre-feet	67.5	53.4
Average Acre-feet	**60.5**	

To derive at a number reflective of the water use variances documented in vertical versus horizontal drilling and completions, the district chose to use the following allocations and alot them on the following percentage basis:

Table 3 % of Unique Wells for Horizontal Wells

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
% of unique wells for horizontal	0%	1%	1%	0%	4%	3%	5%	23%	24%	61%

Total Water Use per Vertical Well **17.4 acre feet**
Total Water Use per Horizontal Well **30.2 acre feet**
Horizontal assuming water replaced in pit **60.5 acre feet**

Table 4 Total Water Use per Year (expressed in acre feet):

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Total assuming just water used	1,357	1,934	2,778	3,612	2,882	4,046	5,062	7,068	2,236	4,482
Total assuming Water used in horz. Is replaced in pit	1,357	1,980	2,804	3,635	3,070	4,232	5,507	9,489	3,033	7,777

During periods of **low oil and gas activities** (2001 = 78 wells) an estimated total of **1,357 acre feet** of Ogallala groundwater was used during a year. There were no horizontal wells drilled in 2001.

During periods of **high oil and gas activities** (2008 = 347 wells) an estimated total of **7,068 acre feet** of Ogallala groundwater was used during a year. Assuming a frac pit is used for horizontal wells and water used during the horizontal fracturing is replaced to maintain the pit, then a total of **9,489 acre feet** of Ogallala groundwater was used.

During an **average year of oil and gas activities** (2001–2010 = 186 wells) an average estimated total of **3,546 acre feet** of Ogallala groundwater was used annually. Assuming a frac pit is used for horizontal wells and water consumed during the horizontal fracturing is replaced then a total of **4,288 acre feet** of Ogallala groundwater was used.

Future projections:

Realizing that most drilling activity is market driven, any assumption about future drilling is simply that, an assumption. One can look to the last 3 years of operations as an example of what fluctuations in natural gas/oil prices can do to drilling activity. 2008 reflects a market high and 2009 reflects a market low. 2010 reflects drilling activity during a market some where in between. Never the less, some information is available regarding future development plans by the larger operators. Resources indicate there is the likelihood that at least 60% of all future wells will

be horizontal wells, just as depicted in 2010. It would be negligent of the District to not recognize the changing trend and attempt to make some estimation of the increase in water use this activity will bring about. The District is aware that not all operators require the frac pit for horizontal drilling and therefore would not require the additional groundwater to preserve the liners integrity. Assuming the previously discussed water use numbers; the District offers the following:

The average number of wells drilled in the last decade is: 186 wells.

	112 Horizontal	74 Vertical
Assume 60% will be horizontal wells:		
Assume 60% will have a pit	67 x 60.5 = 4,054	74 X 17.4 = 1,288
Assume 40% will not	45 X 30.2 = 1,359	

ESTIMATED FUTURE WATER USE **5,413.00 + 1,288 = 6,701 acre feet/year**

Requested amendments to Exempt Use estimates in Hemphill County:

Oil and Gas Use:

Based on the review of historical activity in Hemphill County, correspondence with producers, landowners, pump installers, and the 2010 Region A Water Plan, the Hemphill County UWCD requests that estimates of exempt use in draft report GAM run 09-026 MAG be amended to include oil and gas exempt use estimates of 6,701 acre feet for the first two decades of 2010 and 2020. The District recommends using the same declining scale over time as adopted in the 2010 Region A Water Plan.

Municipal Use:

Chapter 36 Section 121 describes a groundwater districts limitation on rulemaking power over wells in certain counties. It states "Except at provided in by Section 36.117, a district is created under this chapter on or after September 1, 1991, shall exempt from regulation under this chapter a well and any water produced or to be produced by a well that is located in a county that has a population of 14,000 or less if the water is to be used solely to supply a municipality that has a population of 121,000 or less and the rights to the water produced from the well are owned by a political subdivision that is not a municipality, or by a municipality that has a population of 100,000 or less, and that purchased, owned or held rights to the water before the date on which the district was created, regardless of the date the well is drilled or the water is produced. The district may not prohibit the political subdivision or municipality from transporting produced water inside or outside the district's boundaries.

Based on this statute, the City of Canadian's water use is exempt from the District's regulatory authority and should be included in the exempt use category in Hemphill County. The District proposes using the demands adopted in the 2010 Region A Water Plan as the City of Canadian is the only municipal water user in Hemphill County.

Table 5 Municipal Use in Hemphill County taken from Table 1-10 Region A Water Plan

County	2000	2006	2010	2020	2030	2040	2050	2060
Hemphill	607	591	633	636	614	592	575	548

Tables 6, 7, 8 and 9 will need to be amended in the Draft Report GAM Run 09-026 MAG.

The District appreciates the assistance the Texas Water Development Board has provided the members districts and GMA 1 as we work through the joint planning process for the first time. We are available for any questions and open to any comments regarding the proposed exempt use numbers.

Sincerely,

Janet Guthrie

Janet Guthrie
General Manager

Encl. Excel tables

GAM RUN 11-014: HEMPHILL COUNTY UNDERGROUND WATER CONSERVATION DISTRICT MANAGEMENT PLAN

by Marius Jigmond
Texas Water Development Board
Groundwater Resources Division
Groundwater Availability Modeling Section
(512) 463-8499
October 4, 2011

Cynthia K. Ridgeway is the manager of the Groundwater Availability Modeling Section and Is responsible for oversight of work performed by Marius Jigmond under her direct supervision. The seal appearing on this document was authorized by Cynthia K. Ridgeway, P.G. 471, on October 4, 2011.

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GAM RUN 11-014: HEMPHILL COUNTY UNDERGROUND WATER CONSERVATION DISTRICT MANAGEMENT PLAN

by Marius Jigmond
Texas Water Development Board
Groundwater Resources Division
Groundwater Availability Modeling Section
(512) 463-8499
October 4, 2011

EXECUTIVE SUMMARY:

Texas State Water Code, Section 36.1071, Subsection (h), states that, in developing its groundwater management plan, groundwater conservation districts shall use groundwater availability modeling information provided by the Executive Administrator of the Texas Water Development Board 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 for your groundwater management plan that was derived from groundwater availability model(s) in this report includes:

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

The purpose of this report is to provide Part 2 of a two-part package of information from the Texas Water Development Board to Hemphill County Underground Water Conservation District required for its groundwater management plan. The groundwater management plan for Hemphill County Underground Water Conservation District is due for approval by the Executive Administrator of the Texas Water Development Board before September 17, 2012.

This report supersedes GAM Run 05-26 (Smith, 2005) because:

[1] the latter was run using a predictive simulation instead of the historical simulation as is the case with management plan runs; and

[2] the Texas Water Development Board has updated the standards for reporting information related to management plans.

This report discusses the method, assumptions, and results from model run using a groundwater model for the northern part of the Ogallala. Table 1 summarizes the groundwater model data required by the statute, and figure 1shows the areas of the model from which the values in the respective tables were extracted. If after review of the figures, Hemphill 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:

A groundwater model for the northern part of the Ogallala Aquifer was run for this analysis. Water budgets for the transient model period were extracted and the average annual water budget values for recharge, surface water outflow, inflow to the district, and outflow from the district for the portions of the aquifer located within the district are summarized in this report.

PARAMETERS AND ASSUMPTIONS:

Northern part of the Ogallala Aquifer

- Version 2.01 of the groundwater availability model for the northern part of the Ogallala Aquifer (Dutton, 2004) was used for these simulations. This model is an update to the original version documented in Dutton and others (2001). See Dutton (2004) and Dutton and others (2001) for assumptions and limitations of the groundwater availability model.

- The model has one layer which represents the Ogallala Aquifer.

- The root mean square error (a measure of the difference between simulated and actual water levels during model calibration) for the calibration and verification time period (1950 through 1998) was 53 feet, which represents less than two percent of the maximum change in water levels across the model (Dutton, 2004).

- The model was run with Processing MODFLOW for Windows (PMWIN) 5.3 (Chiang and Kinzelbach, 2001).

RESULTS:

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

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

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

LIMITATIONS:

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

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

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

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

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

TABLE 1: SUMMARIZED INFORMATION FOR THE OGALLALA AQUIFER THAT IS NEEDED FOR HEMPHILL 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	31,881
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Ogallala Aquifer	45,187
Estimated annual volume of flow into the district within each aquifer in the district	Ogallala Aquifer	14,932
Estimated annual volume of flow out of the district within each aquifer in the district	Ogallala Aquifer	1,600

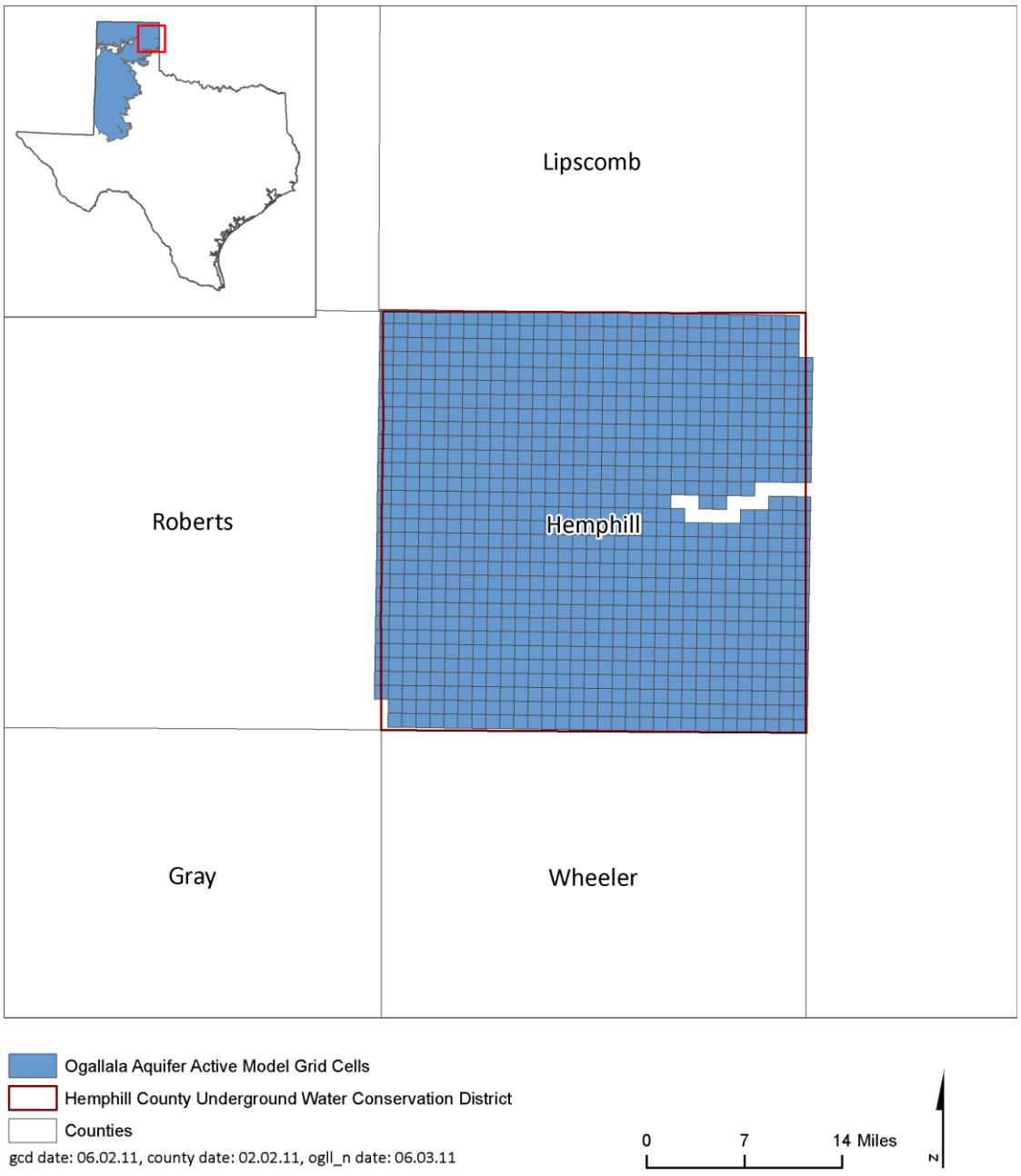

FIGURE 1: AREA OF THE GROUNDWATER MODEL FOR THE OGALLALA AQUIFER FROM WHICH THE INFORMATION IN TABLE 1 WAS EXTRACTED (THE AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).

REFERENCES:

Chiang, W., and Kinzelbach, W., 2001, Groundwater Modeling with PMWIN, 346 p.

Dutton, A., 2004, Adjustments of Parameters to Improve the Calibration of the Og-N Model of the Ogallala Aquifer, Panhandle Water Planning Area: Bureau of Economic Geology, The University of Texas at Austin, 9 p.

Dutton, A., Reedy, R., and Mace, R., 2001, Saturated Thickness of the Ogallala Aquifer in the Panhandle Water Planning Area – Simulation of 2000 Through 2050 Withdrawal Projections: prepared for the Panhandle Water Planning Group by the Bureau of Economic Geology, The University of Texas at Austin, 54 p.

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

Smith, R. M., 2005, GAM Run 05-26, Texas Water Development Board, 11 p.

HEMPHILL COUNTY
Underground Water Conservation District
Conserving a Texas Oasis

APPENDIX J

SOURCE INFORMATION FOR EXHIBIT E DISTRICT'S ESTIMATES OF THE PROJECTED WATER DEMANDS IN HEMPHILL COUNTY

Our mission is to conserve and protect
the groundwater resources of Hemphill County,
by ensuring sustainable development through
local management and the best available science.

DISTRICT'S ESTIMATES OF THE PROJECTED GROUNDWATER DEMANDS IN HEMPHILL COUNTY

The Texas Water Development Board provided "Appendix G" The Estimated Historical Water Use and 2012 State Water Plan Datasets which included the Projected Water Demand from the TWDB 2012 State Water Plan Data on Page 6 of 8. This data fulfils the requirements of item 7 on the TWDB Management Plan Interim Checklist required by TWDB ruled 31 TAC §356.5(a)(5)(G). Exhibit E is the District's Estimates of the Projected Groundwater Demands in Hemphill County. The sources of each user group and amounts used in this table are the same as provided in Appendix G with the exception of Mining.

INDUSTRIAL USE:

Mining – In response to exempt use estimates needed for establishing the Modeled Available Groundwater numbers, the District submitted estimates in a letter dated January 18, 2011 to the TWDB that estimated projected Ogallala Aquifer water use during the drilling and hydrofracturing operations in the Granite Wash in Hemphill County for each decade starting 2010 and ending 2060. The District chose to update the Mining use estimates based on significant changes in the operating practices of the industry with the introduction of horizontal drilling and the number of wells being drilled. A copy of that letter is attached to this Appendix. These estimates were used by TWDB in preparing the Managed Available Groundwater Estimates.

HEMPHILL COUNTY
Underground Water Conservation District
Conserving a Texas Oasis

January 18, 2011

Bill Hutchison
Texas Water Development Board
Austin, Texas

RE: Estimation of Ogallala Aquifer water use in oil and gas drilling and hydro-fracturing activities in Hemphill County

Dear Mr. Hutchison and staff:

In response to exempt use estimates needed for establishing Managed Available Groundwater numbers, the District has reviewed and updated the methodologies previously used in estimating Ogallala Aquifer water use during the drilling and hydro-fracturing operations in the Granite Wash in Hemphill County. Oil and gas use has not previously been included in the Regional Planning in Hemphill County until the 2010 plan was developed. Since that time, the District has observed changes in the operating practices of the industry and we submit the following sections to support our estimates of water used during oil and gas exploration activities.

Evaluation of the number of oil and gas wells drilled per year:

The District staff went to the following web page at the Texas Railroad Commission (RRC),

http://webapps.rrc.state.tx.us/DP/initializePublicQueryAction.do

Queried data base by District = 10, County = Hemphill, Well type = Oil or Gas Well, Status = All Statuses, and Approved Date = 01/01/1999-12/31/1999. This query was ran for each year thru 2010 to acquire what oil and gas wells were permitted during that year. Then the report was refined to separate the W-1s by: Horizontal wells, Vertical Wells, Directional Wells, Horizontal/Vertical Wells, Directional Sidetrack Wells, Horizontal Sidetrack Wells, No profile indicated and Total W1s. Then the total W1s were refined into categories: Recompletions, Re-enter, New Drills, Field Transfers and Other. For our purposes, the numbers were then categorized as Permit Amendments and

Total Unique Wells. The Total Unique Wells is the number we will be using throughout the remaining report. Below is the result of this research per year:

Table 1 Total Unique Wells drilled per year

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Total Unique Wells	**66**	**68**	**78**	**110**	**159**	**207**	**161**	**228**	**280**	**347**	**109**	**177**

The average number of wells drilled per year from 2001 to 2010 is 186.

Estimation of the quantity of Ogallala Aquifer water used for drilling and hydro-fracturing activities:

During 2006, as General Manager, I observed drilling and hydro-fracturing activities at a number of oil and gas (predominately gas) wells in Hemphill County. In addition to these observations, I also had conversations concerning water use with the local pump installers, land owners and oil and gas producers.

According to these observations and information obtained, the following is the estimate of water use per well for drilling

Drilling (Field observations, pump installers, landowners) vertical well

1) The drilling of an oil/gas well takes an average of 16 days

2) The average Ogallala water well produces x 65 gpm (24 hr/day, 7 days/week)

1,497,600 gals or **4.6 acre feet per well**

Hydro-fracturing (Field observations, pump installers, landowners and operators) Vertical wells

1) Between three and five zones are hydro-fractured

In the Granite Wash or an average of four 4 zones

2) Approximately 25,000 barrels (3.2 acre feet) of

Water is needed per zone x 3.2 acre feet

12.8 acre feet per well

Vertical Well Water Use:

Total estimated water used (drilling and hydro-fracturing) is 17.4 acre feet per vertical well.

Changes observed - drilling and hydro-fracturing process for horizontal wells

Over the last 3-4 years, operating practices have changed. It was initially thought to be cost prohibitive to refrac a production well; however, this is no longer true. The District's query of W-1s showed a total of 93 recompletions during 2001-2010. Recompletion is working over an existing wellbore to complete in a different field/reservoir. Since no data on water use under this category is available, our estimates will not include any estimations of water used relating to this activity. The District will continue to monitor for increased activity and address if necessary in the next round of joint planning.

The trend to drill and hydro-fracture horizontal wells began in 2007. In 2010, the number of horizontal wells actually exceeded the number of vertical wells being drilled in Hemphill County. The District spoke with engineers from two different companies operating in Hemphill County and got an estimate of total groundwater demand during the drilling and hydro-fracturing process for horizontal wells. The hydro-fracturing of the horizontal wells is where more water is used. Operational practices now often include the use of a "frac pit" for fresh water. These pits can vary in size and depth. The operators must keep the pit filled to prevent wildlife from puncturing the lining when they drink from the pit and from damage due to high winds. Assuming water used in the actual fracturing process is replaced in the pit, the numbers double for total water used.

Table 2 Estimated water use numbers for Horizontal Wells

WATER USE	OPERATOR "A"	OPERATOR "B"
Drilling bbls	12,000	7,000
Hz frac bbls	250,000	200,000
Total bbls	262,000	207,000
Acre-feet	33.8	26.7
Average Acre-feet	**30.2**	
Assuming water replacement in the pit (bbls)	524,000	414,000
Acre-feet	67.5	53.4
Average Acre-feet	**60.5**	

To derive at a number reflective of the water use variances documented in vertical versus horizontal drilling and completions, the district chose to use the following allocations and alot them on the following percentage basis:

Table 3 % of Unique Wells for Horizontal Wells

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
% of unique wells for horizontal	0%	1%	1%	0%	4%	3%	5%	23%	24%	61%

Total Water Use per Vertical Well **17.4 acre feet**
Total Water Use per Horizontal Well **30.2 acre feet**
Horizontal assuming water replaced in pit **60.5 acre feet**

Table 4 Total Water Use per Year (expressed in acre feet):

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Total assuming just water used	1,357	1,934	2,778	3,612	2,882	4,046	5,062	7,068	2,236	4,482
Total assuming Water used in horz. Is replaced in pit	1,357	1,980	2,804	3,635	3,070	4,232	5,507	9,489	3,033	7,777

During periods of **low oil and gas activities** (2001 = 78 wells) an estimated total of **1,357 acre feet** of Ogallala groundwater was used during a year. There were no horizontal wells drilled in 2001.

During periods of **high oil and gas activities** (2008 = 347 wells) an estimated total of **7,068 acre feet** of Ogallala groundwater was used during a year. Assuming a frac pit is used for horizontal wells and water used during the horizontal fracturing is replaced to maintain the pit, then a total of **9,489 acre feet** of Ogallala groundwater was used.

During an **average year of oil and gas activities** (2001–2010 = 186 wells) an average estimated total of **3,546 acre feet** of Ogallala groundwater was used annually. Assuming a frac pit is used for horizontal wells and water consumed during the horizontal fracturing is replaced then a total of **4,288 acre feet** of Ogallala groundwater was used.

Future projections:

Realizing that most drilling activity is market driven, any assumption about future drilling is simply that, an assumption. One can look to the last 3 years of operations as an example of what fluctuations in natural gas/oil prices can do to drilling activity. 2008 reflects a market high and 2009 reflects a market low. 2010 reflects drilling activity during a market some where in between. Never the less, some information is available regarding future development plans by the larger operators. Resources indicate there is the likelihood that at least 60% of all future wells will

be horizontal wells, just as depicted in 2010. It would be negligent of the District to not recognize the changing trend and attempt to make some estimation of the increase in water use this activity will bring about. The District is aware that not all operators require the frac pit for horizontal drilling and therefore would not require the additional groundwater to preserve the liners integrity. Assuming the previously discussed water use numbers; the District offers the following:

The average number of wells drilled in the last decade is: 186 wells.

	112 Horizontal	74 Vertical
Assume 60% will be horizontal wells:		
Assume 60% will have a pit	67 x 60.5 = 4,054	74 X 17.4 = 1,288
Assume 40% will not	45 X 30.2 = 1,359	

ESTIMATED FUTURE WATER USE **5,413.00 + 1,288 = 6,701 acre feet/year**

Requested amendments to Exempt Use estimates in Hemphill County:

Oil and Gas Use:

Based on the review of historical activity in Hemphill County, correspondence with producers, landowners, pump installers, and the 2010 Region A Water Plan, the Hemphill County UWCD requests that estimates of exempt use in draft report GAM run 09-026 MAG be amended to include oil and gas exempt use estimates of 6,701 acre feet for the first two decades of 2010 and 2020. The District recommends using the same declining scale over time as adopted in the 2010 Region A Water Plan.

Municipal Use:

Chapter 36 Section 121 describes a groundwater districts limitation on rulemaking power over wells in certain counties. It states "Except at provided in by Section 36.117, a district is created under this chapter on or after September 1, 1991, shall exempt from regulation under this chapter a well and any water produced or to be produced by a well that is located in a county that has a population of 14,000 or less if the water is to be used solely to supply a municipality that has a population of 121,000 or less and the rights to the water produced from the well are owned by a political subdivision that is not a municipality, or by a municipality that has a population of 100,000 or less, and that purchased, owned or held rights to the water before the date on which the district was created, regardless of the date the well is drilled or the water is produced. The district may not prohibit the political subdivision or municipality from transporting produced water inside or outside the district's boundaries.

Based on this statute, the City of Canadian's water use is exempt from the District's regulatory authority and should be included in the exempt use category in Hemphill County. The District proposes using the demands adopted in the 2010 Region A Water Plan as the City of Canadian is the only municipal water user in Hemphill County.

Table 5 Municipal Use in Hemphill County taken from Table 1-10 Region A Water Plan

County	2000	2006	2010	2020	2030	2040	2050	2060
Hemphill	607	591	633	636	614	592	575	548

Tables 6, 7, 8 and 9 will need to be amended in the Draft Report GAM Run 09-026 MAG.

The District appreciates the assistance the Texas Water Development Board has provided the members districts and GMA 1 as we work through the joint planning process for the first time. We are available for any questions and open to any comments regarding the proposed exempt use numbers.

Sincerely,

Janet Guthrie

Janet Guthrie
General Manager

Encl. Excel tables

APPENDIX K

DRAFT GAM RUN 12-005 MAG: MODELED AVAILABLE GROUNDWATER FOR THE OGALLALA AQUIFER IN GROUNDWATER MANAGEMENT AREA 1

by Marius Jigmond
Texas Water Development Board
Groundwater Resources Division
Groundwater Availability Modeling Section
(512) 463-8499
May 4, 2012

Cynthia K. Ridgeway, the Manager of the Groundwater Availability Modeling Section, is responsible for oversight of work performed by employees under her direct supervision. The seal appearing on this document was authorized by Cynthia K. Ridgeway, P.G. 471 on May 4, 2012.

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DRAFT GAM RUN 12-005 MAG: MODELED AVAILABLE GROUNDWATER FOR THE OGALLALA AQUIFER IN GROUNDWATER MANAGEMENT AREA 1

by Marius Jigmond
Texas Water Development Board
Groundwater Resources Division
Groundwater Availability Modeling Section
(512) 463-8499
May 4, 2012

EXECUTIVE SUMMARY:

An updated Groundwater Availability Model (GAM) for the Ogallala Aquifer (northern portion) developed by INTERA, Inc. (Kelley and others, 2010) has been approved by the Texas Water Development Board (TWDB). Accordingly, the TWDB has conducted a GAM model run and is issuing updated modeled available groundwater numbers as requested by members of Groundwater Management Area 1. This model run supersedes model run 09-026 (Oliver, 2011) with respect to results extracted from the groundwater availability model for the northern portion of the Ogallala Aquifer. Estimates of modeled available groundwater extracted from the groundwater availability model for the southern portion of the Ogallala Aquifer remain unchanged.

In addition, legislation that became effective September 1, 2011 changed the definition and meaning of "Managed Available Groundwater" to "Modeled Available Groundwater." Modeled available groundwater represents estimates of total pumping as presented in the former "Managed Available Groundwater" report 09-026 (Oliver, 2011). The modeled available groundwater for the Ogallala Aquifer, as a result of the desired future conditions adopted by Groundwater Management Area 1, declines from 3,666,259 acre-feet per year in 2010 to 2,151,403 acre-feet per year in 2060. This report summarizes modeled available groundwater by county, groundwater conservation district, river basin, and geographic area for each decade between 2010 and 2060. The pumping estimates were extracted from the Groundwater Availability Model Run performed by INTERA, Inc. (Kelley and others, 2010) as part of the recalibration process.

REQUESTOR:

Mr. John R. Spearman, chairman of Groundwater Management Area 1.

DESCRIPTION OF REQUEST:

In a letter dated December 22, 2011, Mr. Spearman requested that the updated groundwater flow model for the Ogallala Aquifer (northern portion) be considered for adoption as an official GAM by TWDB. TWDB has adopted the updated model as the official GAM and is issuing revised modeled available groundwater estimates. The modeled available groundwater estimates are based on the desired future conditions for the Ogallala Aquifer as described in Resolution 2009-01 and adopted July 7, 2009:

- **"40 [percent] volume in storage remaining in 50 years in the following:**
    - **North Plains [Groundwater Conservation District] consisting of all or parts of the following counties: Dallam, Hartley, Moore and Sherman; and**
    - **Parts of the following counties that are not in a Groundwater Conservation District will also fall under the 40/50 [desired future condition], those counties being Dallam, Hartley and Moore**
- **50 [percent] volume in storage remaining in 50 years in the following:**
    - **High Plains Underground Water Conservation District consisting of parts of the following counties: Armstrong, Potter and Randall;**
    - **North Plains [Groundwater Conservation District] consisting of all or parts of the following counties: Hansford, Hutchinson, Lipscomb and Ochiltree;**
    - **Panhandle Groundwater Conservation District consisting of all or part of the following counties: Armstrong, Carson, Donley, Gray, Hutchinson, Potter, Roberts and Wheeler; and**
    - **All or parts of the following counties that are not in a Groundwater Conservation District will also fall under the 50/50 [desired future condition], those counties being Hutchinson, Oldham and Randall**
- **80 [percent] volume in storage remaining in 50 years in Hemphill County; provided that, in the event it is legally determined that the roughly 390-acre tract of land located in southwest Hemphill County and described more particularly in Attachment A (the "390-acre tract") lies within the jurisdiction of the Panhandle Groundwater Conservation District and not within the jurisdiction of the Hemphill County Underground Water Conservation District, then the Desired Future Condition for the 390-acre tract shall be 50 [percent] volume in storage remaining in 50 years and the Desired Future Condition for the remainder of Hemphill County shall be 80 [percent] volume in storage remaining in 50 years"**

The three geographic areas defined in the above desired future conditions statement are shown in Figure 1. Please note that the Attorney General of Texas, Opinion No. GA-0792, dated August 26, 2010, indicates the roughly 390-acre tract of land located in southwest Hemphill County lies within the jurisdiction of the Hemphill County

Underground Water Conservation District. As such the 80 percent volume in storage remaining in 50 years condition applies to the entire Hemphill County.

METHODS:

The Ogallala Aquifer within Groundwater Management Area 1 is covered by two GAMs. The GAM for the northern portion of the Ogallala Aquifer, documented in Dutton and others (2001), Dutton (2004), and Kelley and others (2010) covers the majority of Groundwater Management Area 1 and includes the Rita Blanca Aquifer. The GAM for the southern portion of the Ogallala Aquifer, documented in Blandford and others (2003) and Blandford and others (2008), covers the remaining areas of the Ogallala Aquifer within Groundwater Management Area 1. The area covered by each of the groundwater availability models is shown in Figure 2. Notice that there is an area in Potter and Randall counties where the two models overlap. Since the model for the northern portion of the Ogallala Aquifer is the primary model for Groundwater Management Area 1, results from the northern model were preferentially used over the results from the southern model in the overlap area.

The previously completed availability model run (Kelley and others, 2010) documents the model results reviewed by members of Groundwater Management Area 1. This new model run honors the above desired future conditions. The model run for the northern portion of the Ogallala Aquifer presented in this report divides the modeled available groundwater by county, groundwater conservation district, geographic area, and river basin within Groundwater Management Area 1. Note that Groundwater Management Area 1 is entirely contained within the Panhandle Regional Water Planning Area (Region A). The locations of these areas are shown in Figure 3.

For the southern portion of the Ogallala Aquifer, which covers portions of Oldham, Potter, Randall, and Armstrong counties, the Groundwater Availability Model Run 08-016 Supplement (Smith, 2008) was previously completed and meets the above request. Since completion of the model run, however, the groundwater availability model for the southern portion of the Ogallala Aquifer has been updated (Blandford and others, 2008). For this reason, the updated groundwater availability model was used to reassess these areas. This report documents the methods used in the updated groundwater availability model run for the southern portion of the Ogallala Aquifer in addition to reporting modeled available groundwater for Groundwater Management Area 1.

Modeled Available Groundwater and Permitting

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

PARAMETERS AND ASSUMPTIONS:

Northern Portion of the Ogallala Aquifer

The parameters and assumptions for the GAM run for the northern portion of the Ogallala Aquifer are described below:

- We used version 3.01 of the GAM for the northern portion of the Ogallala Aquifer. This model is an update to the previous versions documented in Dutton and others (2001) and Dutton (2004). See Kelley and others (2010), Dutton (2004), and Dutton and others (2001) for assumptions and limitations of the GAM.
- The GAM for the northern portion of the Ogallala Aquifer has only one layer which collectively represents the Ogallala and Rita Blanca aquifers. As described in the Resolution 2009-01 adopted by the members of Groundwater Management Area 1, the adopted desired future conditions apply to both the Ogallala and Rita Blanca aquifers. In both the desired future conditions statement and this report as a whole the Ogallala and Rita Blanca aquifers are referred to collectively as the "Ogallala Aquifer."
- The root mean squared error (a measure of the difference between simulated and measured water levels during model calibration) for the model for the northern portion of the Ogallala Aquifer is 45.7 feet. This represents 1.6 percent of the range of measured water levels across the model area.
- Cells were assigned to individual counties, groundwater conservation districts, and river basins as shown in the February 3, 2012 version of the file that associates the model grid to political and natural boundaries for the northern portion of the Ogallala. Note that some minor corrections were made to county

and groundwater conservation district grid cell assignments compared to the original Groundwater Availability Model Run 09-001 (Smith, 2009).

- See section 4.2 of Kelley and others (2010) for additional details about the pumping in the model run for the northern portion of the Ogallala Aquifer that meets the above desired future conditions.

Southern Portion of the Ogallala Aquifer

The parameters and assumptions for the GAM run for the southern portion of the Ogallala Aquifer are described below:

- We used version 2.01 of the GAM for the southern portion of the Ogallala Aquifer, which also includes the Edwards-Trinity (High Plains) 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 GAM.
- The model includes four layers representing the southern portion of the Ogallala Aquifer and the Edwards-Trinity (High Plains) Aquifer. However, only Layer 1 of the model, representing the Ogallala Aquifer, is active within Groundwater Management Area 1. For this reason, results are only presented for the Ogallala Aquifer from the GAM.
- 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. This represents 1.8 percent of the range of measured water levels across the model area.
- Cells were assigned to individual counties, groundwater conservation districts, and river basins as shown in the September 14, 2009 version of the file that associates the model grid to political and natural boundaries for the southern portion of the Ogallala Aquifer and Edwards-Trinity (High Plains) Aquifer.

The pumping for areas outside of Groundwater Management Area 1 is the same as described for the "base" scenario in GAM Run 09-023 (Oliver, 2010).

RESULTS:

Table 1 contains modeled available groundwater for the Ogallala Aquifer within Groundwater Management Area 1. It contains pumping totals from the groundwater availability models for the northern and southern portions of the Ogallala Aquifer subdivided by county, groundwater conservation district, and river basin. These areas are shown in figure 1. Note that all of Groundwater Management Area 1 is within the Panhandle Regional Water Planning Area (Region A). For this reason results have not been divided by Regional Water Planning Area.

Table 2 shows modeled available groundwater summarized by county and geographic area within Groundwater Management Area 1 and the total for the area as a whole. The modeled available groundwater for Groundwater Management Area 1 in 2010 is 3,666,259 acre-feet per year. This declines to 2,151,403 acre-feet of pumping per year by 2060 due to reductions in pumping necessary to minimize the occurrence of dry cells. A model cell becomes inactive when the water level in the cell drops below the base of the aquifer. In this situation, pumping cannot occur for the remainder of the model simulation.

Table 3 shows modeled available groundwater summarized by groundwater conservation district and geographic area. Geographic areas are shown in figure 3.

Table 4 shows modeled available groundwater summarized by geographic area. The decline in the volume of water stored in the Ogallala Aquifer over 50 years for each of these areas matches the desired future condition adopted by the members of Groundwater Management Area 1. For Area 1, which consists of Dallam, Sherman, Hartley, and Moore counties modeled available groundwater declines from 1,387,054 acre-feet per year to 691,874 acre-feet per year between 2010 and 2060. For Area 2, consisting of Hemphill County, pumping remains relatively constant between 42,000 and 45,000 acre-feet per year. For Area 3, which encompasses the remaining counties in Groundwater Management Area 1, modeled available groundwater declines from 2,234,035 to 1,416,370 acre-feet per year for the same time period.

Table 5 shows the results summarized by river basin. Between 2010 and 2060, the estimated total pumping declines from 3,027,060 to 1,739,871 acre-feet per year in the Canadian River basin. In the Red River basin for the same time period, modeled available groundwater declines from 639,199 to 411,532 acre-feet per year.

LIMITATIONS:

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

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

> for a particular regulatory application. These characteristics make evaluation of a regulatory model more complex than solely a comparison of measurement data with model results."

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

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

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

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TABLE 1: MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE OGALLALA AND RITA BLANCA AQUIFERS IN GROUNDWATER MANAGEMENT AREA 1. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE DIVIDED BY COUNTY, GROUNDWATER CONSERVATION DISTRICT (GCD), AND RIVER BASIN. UWCD REFERS TO UNDERGROUND WATER CONSERVATION DISTRICT.

County	District	Basin	Year					
			2010	2020	2030	2040	2050	2060
Armstrong	High Plains UWCD No. 1	Red	8,301	8,301	8,301	8,301	8,241	8,186
	Panhandle GCD	Red	44,587	37,066	32,778	29,115	25,920	23,142
Carson	Panhandle GCD	Canadian	96,113	81,718	73,958	66,324	59,324	53,120
		Red	93,885	89,424	80,108	71,529	63,665	56,289
Dallam	North Plains GCD	Canadian	314,814	277,174	245,338	216,215	188,745	163,943
	No District	Canadian	89,793	75,300	63,738	54,102	46,068	39,548
Donley	Panhandle GCD	Red	82,437	74,540	70,208	64,373	58,707	53,537
Gray	Panhandle GCD	Canadian	43,874	39,813	36,848	33,749	30,659	27,766
		Red	147,516	120,860	109,180	98,784	89,135	80,128
Hansford	North Plains GCD	Canadian	284,588	262,271	240,502	218,405	197,454	177,536
Hartley	North Plains GCD	Canadian	424,813	368,430	319,149	276,075	238,186	205,137
	No District	Canadian	27,646	21,118	17,852	15,019	12,780	10,961
Hemphill*	Hemphill County UWCD	Canadian	24,763	22,931	22,969	23,262	23,412	23,642
		Red	20,407	18,828	19,429	19,515	19,577	19,517
Hutchinson	North Plains GCD	Canadian	61,306	58,383	50,723	44,360	39,048	34,580
	Panhandle GCD	Canadian	14,798	13,968	14,414	14,293	13,865	13,194
	No District	Canadian	85,918	64,082	59,436	53,496	47,662	42,664
Lipscomb	North Plains GCD	Canadian	290,510	283,794	273,836	256,406	237,765	219,100
Moore	North Plains GCD	Canadian	193,001	186,154	162,142	137,321	114,658	95,490
	No District	Canadian	14,304	13,200	11,845	10,296	8,915	7,623
Ochiltree	North Plains GCD	Canadian	269,463	246,475	224,578	203,704	183,227	164,265
Oldham	No District	Canadian	20,553	19,360	18,722	17,694	16,406	15,198
		Red	3,952	3,122	2,885	2,772	2,306	2,269
Potter	High Plains UWCD No. 1	Canadian	1,731	1,118	1,041	1,041	1,041	740
		Red	3,521	2,664	1,147	326	326	326
	Panhandle GCD	Canadian	26,810	20,926	19,580	17,919	16,277	14,710
		Red	3,351	2,164	1,770	1,489	1,270	1,080
Randall	High Plains UWCD No. 1	Red	61,381	57,858	56,203	51,346	47,118	39,007
	No District	Red	28,773	27,756	26,195	24,352	21,763	19,377
Roberts	Panhandle GCD	Canadian	419,579	372,950	350,415	321,680	290,903	261,482
		Red	15,380	17,951	18,202	17,565	16,609	15,557
Sherman	North Plains GCD	Canadian	322,683	300,908	263,747	229,122	197,480	169,172
Wheeler	Panhandle GCD	Red	125,708	119,556	114,817	107,697	100,289	93,117
Total			**3,666,259**	**3,310,163**	**3,012,056**	**2,707,647**	**2,418,801**	**2,151,403**

*Hemphill county 2010 is taken from simulation year 2011

TABLE 2: MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE OGALLALA AND RITA BLANCA AQUIFERS IN GROUNDWATER MANAGEMENT AREA 1. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE DIVIDED BY COUNTY AND GEOGRAPHIC AREA.

County	Geographic Area	Year					
		2010	2020	2030	2040	2050	2060
Armstrong	3	52,888	45,367	41,079	37,416	34,161	31,328
Carson	3	189,998	171,142	154,066	137,853	122,989	109,409
Dallam	1	404,607	352,474	309,076	270,317	234,813	203,491
Donley	3	82,437	74,540	70,208	64,373	58,707	53,537
Gray	3	191,390	160,673	146,028	132,533	119,794	107,894
Hansford	3	284,588	262,271	240,502	218,405	197,454	177,536
Hartley	1	452,459	389,548	337,001	291,094	250,966	216,098
Hemphill*	2	45,170	41,759	42,398	42,777	42,989	43,159
Hutchinson	3	162,022	136,433	124,573	112,149	100,575	90,438
Lipscomb	3	290,510	283,794	273,836	256,406	237,765	219,100
Moore	1	207,305	199,354	173,987	147,617	123,573	103,113
Ochiltree	3	269,463	246,475	224,578	203,704	183,227	164,265
Oldham	3	24,505	22,482	21,607	20,466	18,712	17,467
Potter	3	35,413	26,872	23,538	20,775	18,914	16,856
Randall	3	90,154	85,614	82,398	75,698	68,881	58,384
Roberts	3	434,959	390,901	368,617	339,245	307,512	277,039
Sherman	1	322,683	300,908	263,747	229,122	197,480	169,172
Wheeler	3	125,708	119,556	114,817	107,697	100,289	93,117
Total		**3,666,259**	**3,310,163**	**3,012,056**	**2,707,647**	**2,418,801**	**2,151,403**

*Hemphill county 2010 is taken from simulation year 2011

TABLE 3: MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE OGALLALA AND RITA BLANCA AQUIFERS IN GROUNDWATER MANAGEMENT AREA 1. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE DIVIDED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND GEOGRAPHIC AREA. UWCD REFERS TO UNDERGROUND WATER CONSERVATION DISTRICT.

District	Geographic Area	Year					
		2010	2020	2030	2040	2050	2060
Hemphill County UWCD*	2	45,170	41,759	42,398	42,777	42,989	43,159
High Plains UWCD No. 1	3	74,934	69,941	66,692	61,014	56,726	48,259
North Plains GCD	1	1,255,311	1,132,666	990,376	858,733	739,069	633,742
	3	905,867	850,923	789,639	722,875	657,494	595,481
Panhandle GCD	3	1,114,038	990,936	922,278	844,517	766,623	693,122
No District	1	131,743	109,618	93,435	79,417	67,763	58,132
	3	139,196	114,320	107,238	98,314	88,137	79,508
Total		**3,666,259**	**3,310,163**	**3,012,056**	**2,707,647**	**2,418,801**	**2,151,403**

*Hemphill county 2010 is taken from simulation year 2011

TABLE 4: MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE OGALLALA AND RITA BLANCA AQUIFERS IN GROUNDWATER MANAGEMENT AREA 1. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE DIVIDED BY GEOGRAPHIC AREA.

Geographic Area	Year					
	2010	2020	2030	2040	2050	2060
1	1,387,054	1,242,284	1,083,811	938,150	806,832	691,874
2*	45,170	41,759	42,398	42,777	42,989	43,159
3	2,234,035	2,026,120	1,885,847	1,726,720	1,568,980	1,416,370
Total	**3,666,259**	**3,310,163**	**3,012,056**	**2,707,647**	**2,418,801**	**2,151,403**

*Hemphill county 2010 is taken from simulation year 2011

TABLE 5: MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE OGALLALA AND RITA BLANCA AQUIFERS IN GROUNDWATER MANAGEMENT AREA 1. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE DIVIDED BY RIVER BASIN.

Basin	Year					
	2010	2020	2030	2040	2050	2060
Canadian*	3,027,060	2,730,073	2,470,833	2,210,483	1,963,875	1,739,871
Red*	639,199	580,090	541,223	497,164	454,926	411,532
Total	**3,666,259**	**3,310,163**	**3,012,056**	**2,707,647**	**2,418,801**	**2,151,403**

*Hemphill county 2010 is taken from simulation year 2011

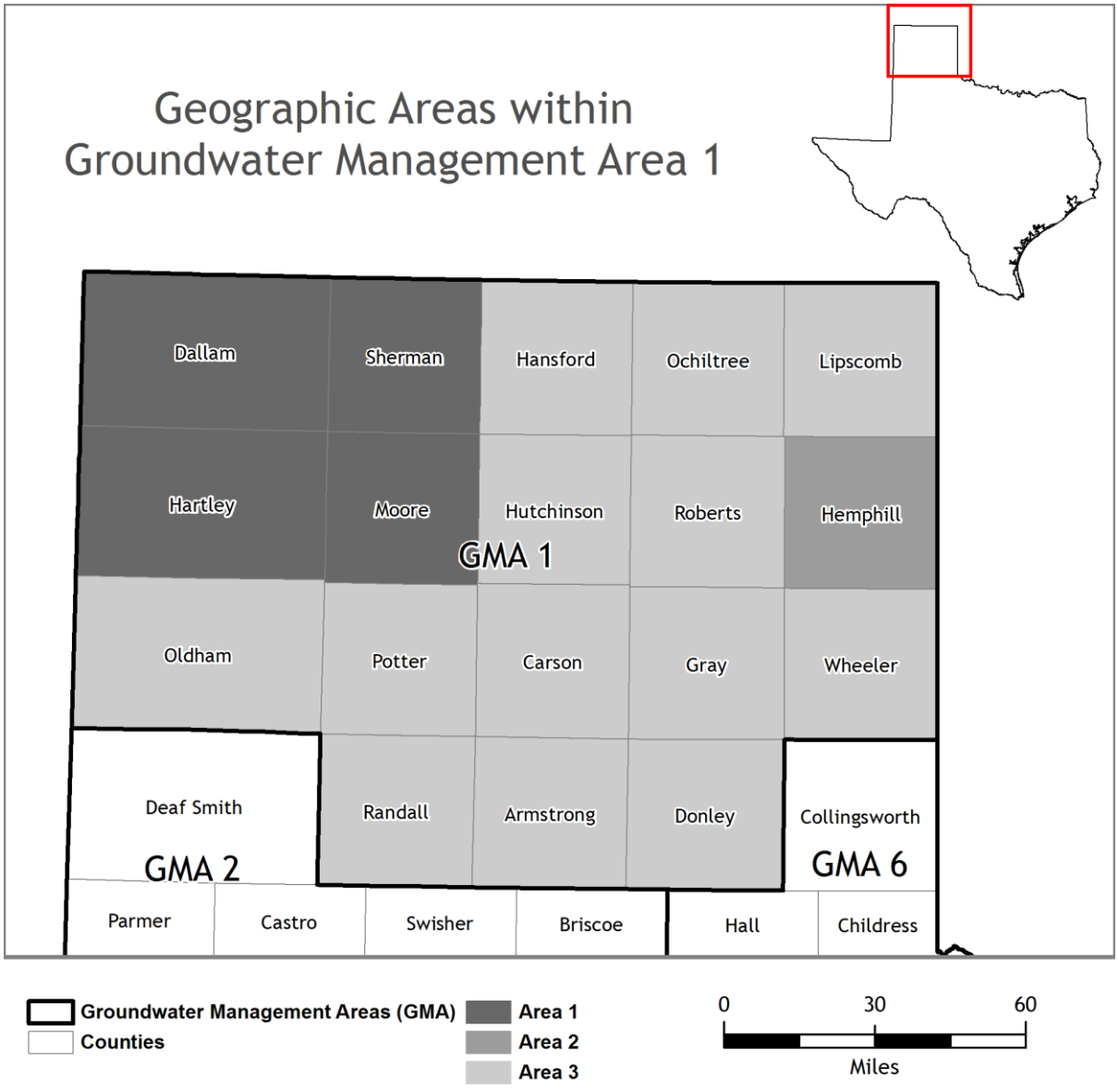

FIGURE 1: MAP SHOWING GEOGRAPHIC AREAS DEFINED BY GROUNDWATER MANAGEMENT AREA 1 IN THE DESIRED FUTURE CONDITIONS PROCESS FOR THE OGALLALA AQUIFER.

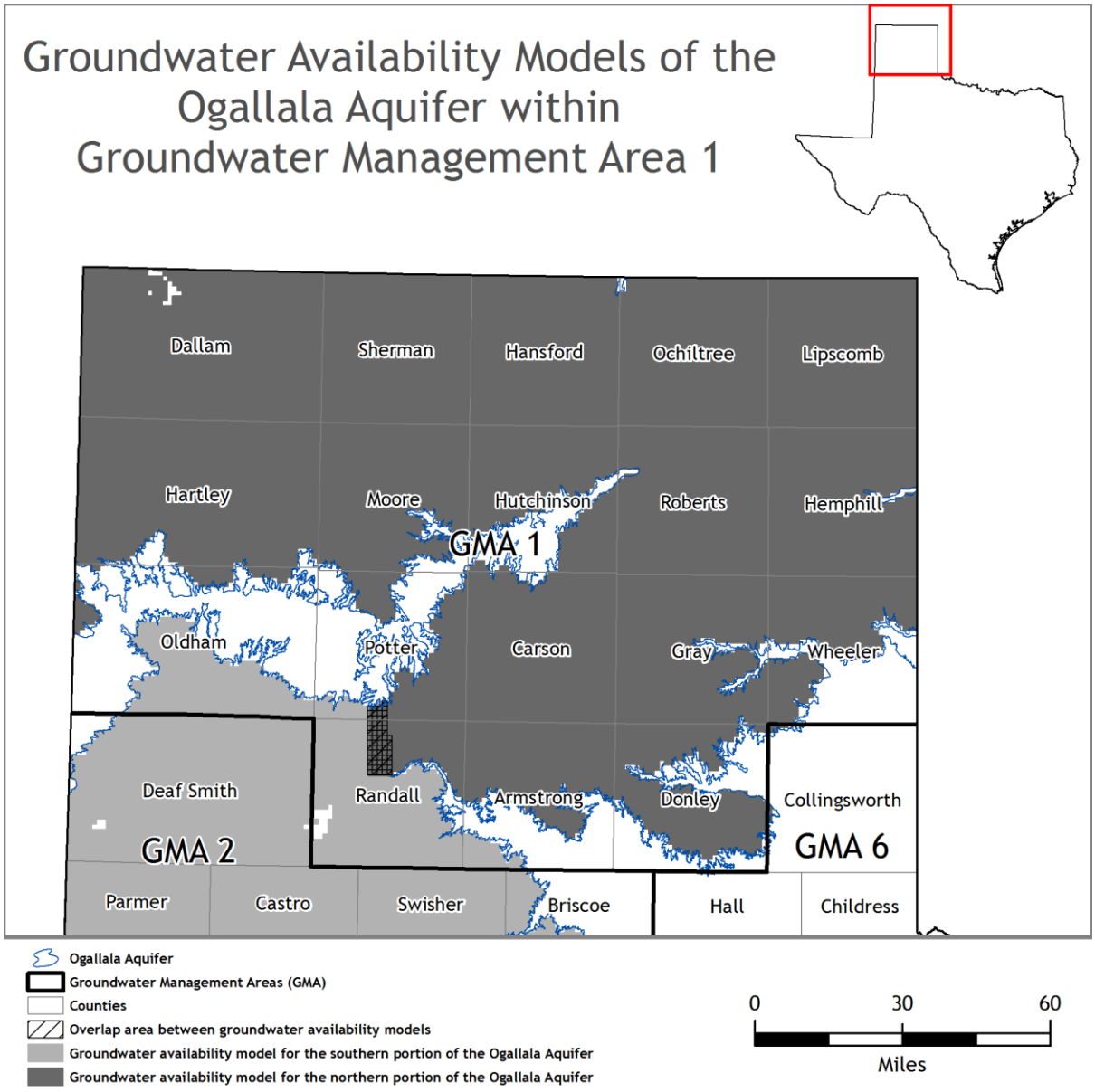

FIGURE 2: MAP SHOWING THE AREAS COVERED BY THE GROUNDWATER AVAILABILITY MODELS FOR THE NORTHERN AND SOUTHERN PORTIONS OF THE OGALLALA AQUIFER.

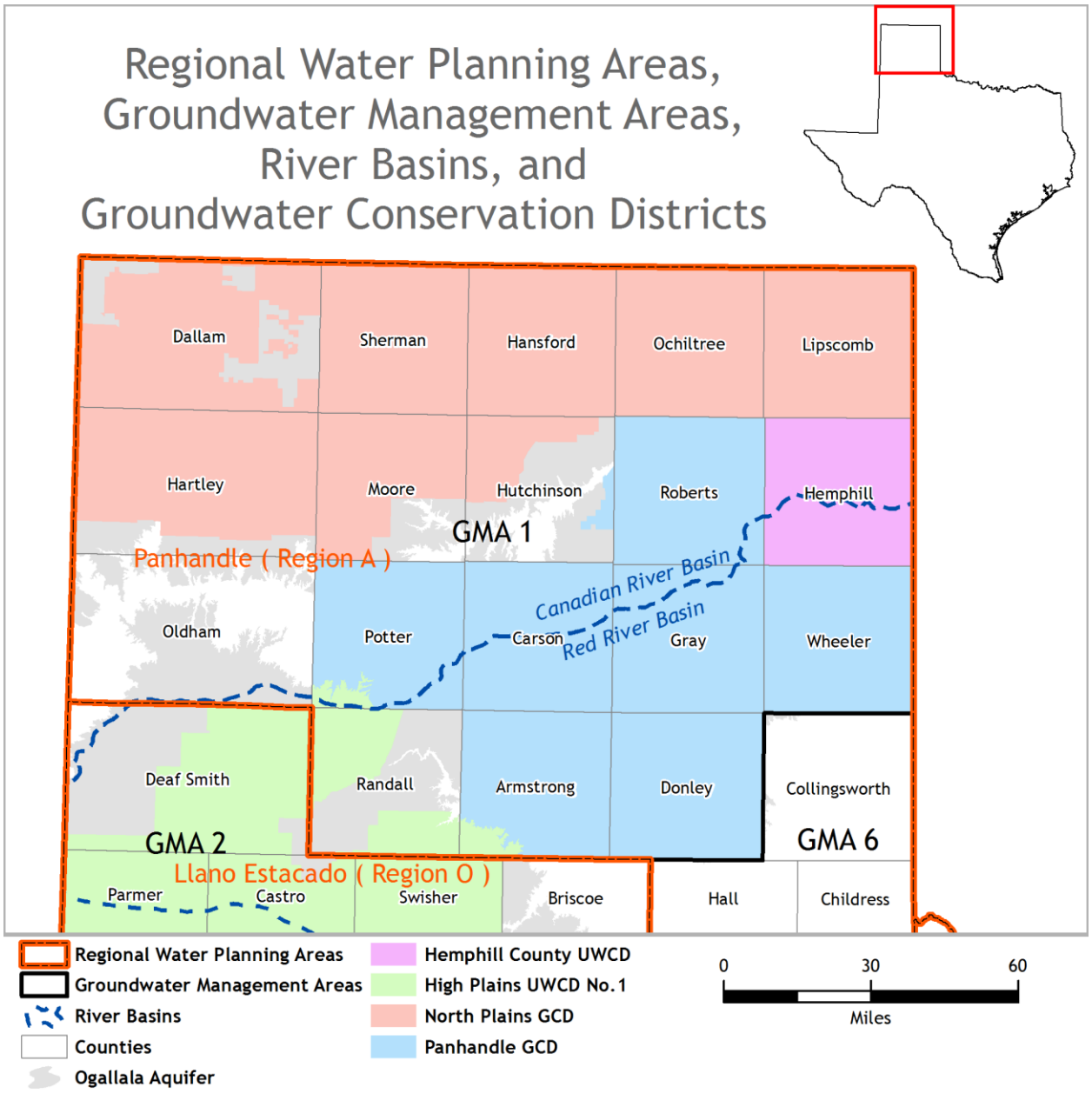

FIGURE 3: MAP SHOWING REGIONAL WATER PLANNING AREAS, GROUNDWATER MANAGEMENT AREAS, RIVER BASINS, AND GROUNDWATER CONSERVATION DISTRICTS.