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Repealed and New Plan Adopted July 10, 2012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 September 27, 2012
Amended and Adopted June 27, 2017
Certified by TWDB August 24, 2017

Amended and Adopted May 12, 2022
Certified by TWDB June 29, 2022
Amended and Adopted July 20, 2023
Certified by TWDB _____

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APPENDIXES & EXHIBITS

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

The District's management plan satisfies the requirements of SB 1, SB 2, HB 1763, 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 Legislature in 1949 authorized the creation of underground water conservation districts to perform certain prescribed duties, functions, and to hold specific powers as set forth in Article 7880-3c, Texas Civil Statutes, now codified as Chapter 36, 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 groundwater district or, in accordance with the Texas Constitution, seek the creation of a single county groundwater district. After investigating other districts and discussions within the county, the committee recommended that a single county district be created. The Hemphill County Underground Water Conservation District was created the following year by the Hemphill County Underground Water Conservation District Act passed by the Texas Legislature (Act of May 19, 1995, 74th Leg., R.S., ch. 157, 1995 Tex. Gen. Laws 1007) which is now Chapter 8894, Texas Special District Local Laws Code. 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. Elections are held in May of even-numbered years. The Board of Directors holds its regular meetings at the District Offices located at 211 N 2nd Street, Canadian, Texas, at least quarterly. All meetings of the Board of Directors are public meetings noticed and held in accordance with applicable public meeting requirements.

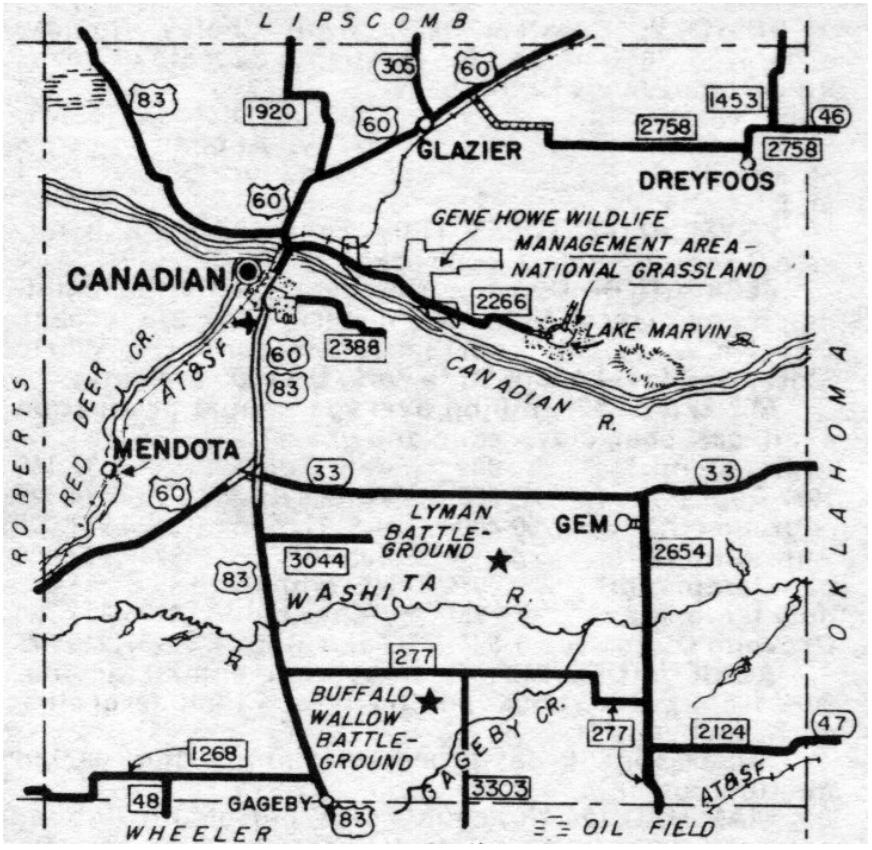
C. Authority

The District derives its authority to manage groundwater within the District by virtue of the powers granted and authorized pursuant to: Article XVI, Section 59, Texas Constitution; Chapter 36, Texas Water Code; and Chapter 8894, Texas Special District Local Laws Code. The District, acting under such authority, assumes all the rights and responsibilities of a groundwater conservation district specified in Chapter 36, Texas Water Code.

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, contains approximately 594,560 acres, and has a current population of 3,382 according to the 2020 United States 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 mean 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 in the general~~ly~~ level Llano Estacado (Staked Plains) portion of the Texas Panhandle. The remainder of the county consists of 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 its 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 City of Canadian. Red Deer Creek drains approximately 10% of the county.

The Washita River originates outside of 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 mainstream. 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 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.

Water produced from the Ogallala sediments is generally of 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 be of a lesser quality than that produced from the Ogallala.

IV. STATEMENT OF GUIDING PRINCIPLES

The District recognizes the importance of groundwater resources in Hemphill County to our industries, our community, and our heritage. This plan addresses the processes established by the District to monitor changes in the aquifer, educate the public about 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 of TWDB or, if appealed, on approval by TWDB. This plan is being submitted as part of the five-year review and re-adoption process as required by § 36.1072(e), Texas Water Code. This management plan will remain in effect until a revised plan is approved by the executive administrator or TWDB.

B. Board Resolution

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

C. Plan Adoption

Evidence that the plan was adopted after notice and hearing 31 TAC § 356.53(a)(3); § 36.1071(a);

Copies of notices documenting that the plan was adopted following appropriately noticed hearings are included at Appendix B – 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); § 356.51;

A copy of the email transmitting this plan to surface water management entities is included at Appendix C – Correspondence to Surface Water Management Entities.

VI. ESTIMATES REQUIRED BY 31 TEX. ADMIN CODE (TAC) § 356.52(a)(5)(A) Implementing TWC § 36.1071(e)(3)

A. Modeled available groundwater in the district based on the desired future condition established under TWC § 36.108 - 31 TAC 356.52(a)(5)(A) Implementing TWC §36.1071(e)(3)(A)

Modeled available groundwater is defined by TWC § 36.001(25) as "the amount of water that the executive administrator [of TWDB] determines may be produced on an average annual basis to achieve a desired future condition established under Section 36.108." The District is in Groundwater Management Area 1 (GMA 1). The member districts of GMA 1 have completed the joint planning process to determine the desired future conditions of the aquifers in the GMA.

The Ogallala aquifer is the sole major aquifer available to producers in Hemphill County and it is therefore the only ~~aquifer in~~aquifer ~~which~~ we will address in this Plan.

1. Ogallala Aquifer

   a. Desired Future Conditions:

   On August 26, 2021, the joint planning committee for GMA 1 adopted the following desired future condition which is to have at least 80% of the volume in storage remaining for each 50-year period between 2018 and 2080 in Hemphill County.

   b. Modeled Available Groundwater:

   The modeled available groundwater value for the 2021 DFC ~~was not available at the time of development of this plan. However, the modeled available Page 8 of 15 groundwater value for the Ogallala Aquifer in Hemphill County provided for the DFC adopted on November 2, 2016, by GMA 1,~~ was developed through TWDB GAM RUN

21-007 MAGRun 16-029MAG, and is set forth in Appendix D. This plan will be amended and re-adopted upon receipt of the modeled available groundwater value for the 2021 DFC.

B. Amount of groundwater being used within the District on an annual basis – 31 TAC § 356.52(a)(5)(B) 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 is shown in Appendix E Estimated Historical Water Use and 2022 State Water Plan Data Set Page 3. All values are in acre-feet.

C. Annual amount of recharge from precipitation to the groundwater resources within the district – 31 TAC §356.52(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 as based on GAM Run 22-001 simulations provided by TWDB to the District for use in this plan, as set forth in Appendix F page 7.

D. For each aquifer, the annual volume of water that discharges from the aquifer to springs and any surface water bodies, including lakes, streams, and rivers – 31 TAC § 356.52(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 GAM run 22-001 simulations provided by TWDB to the District for use in this plan and is set forth in Appendix F page 7.

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 § 356.52(a)(5)(E) Implementing TWC § 36.1071(e)(3)(E)

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 GAM Run 22-001 simulations provided by TWDB to the District for use in this plan and are set forth in Appendix F page 7 and further clarifies that the Ogallala aquifer is the only aquifer modeled for the District.

F. Projected surface water supply in the District, according to the most recently adopted state water plan - 31 TAC § 356.52(a)(5)(F) Implementing TWC § 36.1071(e)(3)(F)

The projected surface water supply within the District, according to the most recently adopted state water plan as provided by TWDB, is set forth in Appendix E Estimated Historical Water Use and 2022 State Water Plan Data Set Page 4. All values are in acre-feet.

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 total demand for water in Hemphill County from the 2022 State Water Plan is set forth in Appendix E Estimated Historical Water Use and 2022 State Water Plan Datasets Page 5.

VII. CONSIDERATION OF THE WATER SUPPLY NEEDS AND WATER MANAGEMENT STATEGIES INCLUDED IN THE ADOPTED STATE WATER PLAN - TWC § 36.1071(e)(4)

A. Water Supplies - The most recent state water plan is the 2022 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 E Page 6.

B. Water Management Strategies - While no shortages were identified in the 2022 State Water Plan, a water management strategy recommended for the City of Canadian is demand reduction through municipal conservation. Municipal conservation strategies include a variety of activities that either reduce everyday water consumption or increase water use efficiency, allowing more to be done with the same amount of water. Examples of municipal conservation strategies include low flow plumbing fixtures, water conservation pricing structure, water system audits, and landscape irrigation restrictions. Demand reduction is also a recommended water management strategy for agricultural use. Demand reduction in agriculture is primarily achieved though conservation strategies and some livestock conservation based on best management practices. Irrigation conservation strategies include changes to irrigation methods, equipment, and crops. For example, conversion to Low Energy Precision Application systems and irrigation scheduling, as well as other activities associated with irrigation best management practices can help producers reduce their water use. Like municipal conservation, irrigation conservation strategies tend to be an aggregate of multiple best management practices, any one or several of which could be implemented to achieve the estimated water savings of the strategy.~~t~~ See Appendix E Page 7.

VIII. MANAGEMENT OF GROUNDWATER SUPPLIES – 31 TAC § 356.52(a)(4)

The District will manage the supply of groundwater within the District 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 seek to identify and engage in such activities and practices, that, if implemented, may result in more efficient use of groundwater.

The District shall implement a management program based on actual aquifer conditions, measured annually by the District as part of its water level measuring program, and maximum

withdrawal rates modified over time to ensure that the desired future conditions are achieved. The District may designate multiple management areas and sub- management areas. Initially, Management Area North will be that portion of the District which is located north of the Canadian River while Management Area South will be that portion of the District that is located south of the Canadian River. The District's management criteria are: (1) a decline rate of no more than 1% reduction in the saturated thickness for three consecutive years; and (2) an average minimum aquifer storage level of 80% of volume in storage remaining for each 50-year period between 2018 and 2080. The District will amend its rules as necessary to implement any 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 water use characteristics within 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, TWDB, and other entities as appropriate.

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

The District will continue to take measurements using a sufficient number of monitoring wells distributed throughout the county on an annual basis. The District will work with new permittees and existing users to add and delete additional monitor wells to ensure an adequate monitoring network is maintained.

Drought conditions will be monitored and acknowledged in the course of managing the aquifer.

IX. ACTION, PROCEDURES, PERFORMANCE AND AVOIDANCE FOR PLAN IMPLEMENTATION - 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 its planning efforts, operations, and activities will be consistent with the provisions of this plan and will be executed in a manner that is fair to all stakeholders.

The District has adopted rules in accordance with Chapter 36 of the Texas Water Code, and the District may amend its rules as necessary to comply with changes to Chapter 36 of the Texas Water Code and its management plan, and to insure the best management of the groundwater within the District according to present and projected aquifer conditions. The District will seek the input of its constituents during the implementation of this plan and any amendment of the District's rules. The enforcement and continued development of the District's rules will be based on the best scientific and technical evidence available to the District. A copy of the District's Rules is available for review at the District office and on the District's website under Documents and then District Rules.

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'S PROGRESS IN ACHIEVING ITS MANAGEMENT GOALS - 31 TAC §356.52(a)(4)

The District's General Manager (GM) 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 regarding achieving its management goals and objectives based on the fiscal year ending September 30th. The GM will present the Annual Report prior to the end of the following fiscal year. Upon its adoption by the Board, the Board will maintain a copy of the Annual Report on file for public inspection at the District's offices.

XI. GOALS, MANAGEMENT OBJECTIVES AND PERFORMANCE STANDARDS

The management goals, objectives and performance standards of the District in the areas specified in 31 TAC §§ 356.51 and 356.52 are addressed below:

Management Goals

A. Providing the Most Efficient Use of Groundwater – 31 TAC § 356.52(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~~ included in 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 those applications, will be included in the Annual Report.

B. Controlling and Preventing Waste of Groundwater – 31 TAC § 356.52(a)(1)(B) Implementing TWC § 36.1071(a)(2)

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

B1. **Performance Standard –** The District will include a discussion of the annual evaluation of the District Rules and its determination of whether any amendments to the rules are recommended to prevent the waste of groundwater in the Annual Report.

B2. **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.

B2. **Performance Standard –** Each year a summary of the information collected from the Texas Railroad Commission website regarding the location and status of all injection 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 any injection 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 injection 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 injection or 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 injection or 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 § 356.52(a)(1)(C) Implementing TWC § 36.1071(a)(3)

We have reviewed TWDB's subsidence risk report *Identification of the Vulnerability of the Major and Minor Aquifers of Texas to Subsidence with Regard to Groundwater Pumping* – TWDB Contract Number 1648302062, by LRE Water, as to its applicability to the District. The District participated in providing additional data to LRE. The Ogallala Aquifer is a major aquifer that is unconsolidated. Figure 4.33 on page 4-55 demonstrates that Hemphill County is a medium risk for future subsidence; however, there is a considerable amount of area that showed insufficient data. Risk factors for the Ogallala are primarily aquifer lithology, pre-consolidation level and anticipated water-level decline. Interferometric Synthetic Aperture Radar (InSAR) data acquisition and processing is cited as being an appropriate investigation and monitoring approach. It was also suggested that the SUB-WT (Leake and Galloway, 2007) be incorporated into the recently revised GAM. Due to costs associated with additional monitoring utilizing InSAR, the newness of such data and the projected minimal declines in the aquifer in Hemphill County, this goal is not applicable to the District for this planning period.

D. Conjunctive Surface Water Management Issues – 31 TAC § 356.52(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.

D.2. **Objective –** Each year, the District will participate in the Texas Clean Rivers Program Canadian and Red River Basins Annual Advisory Committees Meeting by attending the meeting or obtaining a copy of the Annual Basin Summary Report for the Canadian and Red River Basins as presented by the Red River Authority of Texas.

D.2. **Performance Standard** – Each year, the District will obtain a copy of the Annual Basin Summary Report for the Canadian and Red River Basins as presented by the Red River Authority of Texas and a summary of the report as it relates to the site(s) monitored in Hemphill County will be included in the Annual Report.

E. Natural Resource Issues Which Impact the Use and Availability of Groundwater and Which are Impacted by the Use of Groundwater - 31 TAC § 356.52(a)(1)(E) Implementing TWC § 36.1071(a)(5)

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

E.1. **Performance Standard -** Each year the District will attempt to collect water quality samples from at least 85 ~~0~~% of the monitoring sites designated in the point source monitoring network and provide a status report on the number and percent of wells attempted to be tested and a summary of the testing results in the Annual Report.

E.2. **Objective -** The District will establish and maintain a non-point source groundwater monitoring network.

E.2. **Performance Standard -** Each year the District will attempt to collect water quality samples from at least 85 ~~0~~% of the monitoring sites designated in the non-point source monitoring network and include a status report on the number and percent of wells attempted to be collected~~tested~~ and a summary of the testing results in the Annual Report.

F. Drought Conditions - 31 TAC § 356.52(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 drought conditions 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/ or other resources.

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 § 356.52(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.2 **Objective (Conservation) –** The District will ~~develop or implement a pre-existing educational program for use~~ host ~~on~~ at least one ~~public school campus located in the District~~ event to educate students on the importance of water as a natural resource, water conservation or the prevention of contamination.

G2. **Performance Standard (Conservation) –** A summary of the educational event~~program developed or implemented~~ hosted by the District ~~for use in public or private schools located within the District~~ will be included in the Annual Report.

G.3 **Objective (Rainwater Harvesting) -** Each year the District will promote rainwater harvesting by distributing brochures/literature to the public.

G.3 **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.4 **Objective (Brush Control) –** Each year the District will promote brush control by distributing brochures/literature to the public.

G.4 **Performance Standard (Brush Control) –** Each year, the annual report will include a summary of the District activity during the year to promote brush

control.

G.5 **Precipitation Enhancement -** Due to the costs associated with developing and maintaining a precipitation enhancement program, this goal is not applicable to the Hemphill County Underground Water Conservation District.

G.6 **Recharge Enhancement** - Due to other federal agencies overseeing the installation and funding of terraces to manage run-off and enhance recharge in Hemphill County, this goal is not applicable to the District during this planning cycle.

H. Addressing, in a Quantitative Manner, the Desired Future Conditions of the Groundwater Resources Adopted Under TWC § 36.108 - 31 TAC § 356.52(a)(1)(H) Implementing- § 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.

H1. Performance Standard – Each year the District will attempt to obtain water level measurements from at least 85~~80~~% of the wells designated in the water level monitoring network and a report on the number and percent of water level measurements attempted to be 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 volume of water in storage for each 50-year period between 2018 and 2080, and include the results in the Annual Report.

Appendix D

HEMPHILL COUNTY

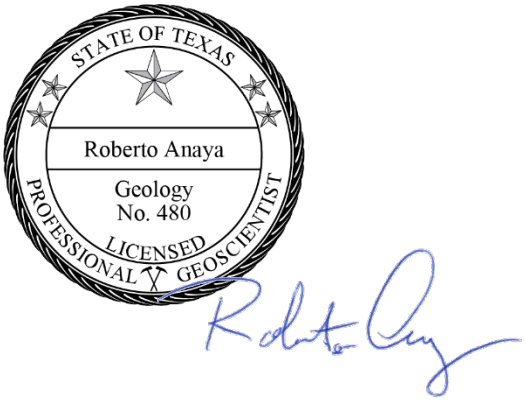
Underground Water Conservation District

Conserving a Texas Oasis

APPENDIX D

GAM RUN 21-007 MAG: MODELED AVAILABLE GROUNDWATER FOR THE HIGH PLAINS AQUIFER SYSTEM IN GROUNDWATER MANAGEMENT AREA 1

Roberto Anaya, P.G.
Texas Water Development Board
Groundwater Division
Groundwater Modeling Department
512-463-6115
February 28, 2023



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Roberto Anaya, P.G.
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512-463-6115
February 28, 2023

EXECUTIVE SUMMARY:

The modeled available groundwater for the High Plains Aquifer System within Groundwater Management Area 1 is summarized by decade for the groundwater conservation districts (Tables 1 and 2) and for use in the regional water planning process (Tables 3 and 4). The modeled available groundwater values for the Ogallala Aquifer (inclusive of the Rita Blanca Aquifer) range from 3,192,963 acre-feet per year in 2020 to 1,991,106 acre-feet per year in 2080 (Table 1). The modeled available groundwater values for the Dockum Aquifer range from 288,052 acre-feet per year in 2020 to 241,087 acre-feet per year in 2080 (Table 2).

The modeled available groundwater values for the Ogallala (inclusive of the Rita Blanca Aquifer) and Dockum aquifers were extracted from results of a model simulation using the groundwater availability model for the High Plains Aquifer System (version 1.01). District representatives in Groundwater Management Area 1 declared the Blaine and Seymour aquifers to be non-relevant for the purposes of joint groundwater planning. The explanatory report and other materials submitted to the TWDB were determined to be administratively complete on December 16, 2022.

REQUESTOR:

Mr. Dustin Meyer, Groundwater Management Area 1 coordinator at the time of the request.

DESCRIPTION OF REQUEST:

District representatives in Groundwater Management Area 1 adopted desired future conditions by resolution for the aquifers in the area on August 26, 2021:

Ogallala (inclusive of the Rita Blanca) Aquifer:

- *"At least 40 percent of volume in storage remaining for each 50-year period between 2018 and 2080 in Dallam, Hartley, Moore, and Sherman Counties"*
- *"At least 50 percent of volume in storage remaining for each 50-year period between 2018 and 2080 in Hansford, Hutchison, Lipscomb, Ochiltree, Carson, Donley, Gray, Roberts, Wheeler, and Oldham Counties; and within the Panhandle District portions of Armstrong and Potter Counties"*
- *"At least 80 percent of volume in storage remaining for each 50-year period between 2018 and 2080 in Hemphill County"*
- *"Approximately 20 feet of total average drawdown for each 50-year period between 2012 and 2080 in Randall County and within High Plains District in Armstrong and Potter Counties".*

Dockum Aquifer:

- *"At least 40 percent of the average available drawdown remaining for each 50-year period between 2018 and 2080 in Dallam, Hartley, Moore, and Sherman Counties"*
- *"No more than 30 feet average decline in water levels for each 50-year period between 2018 and 2080 in Oldham and Carson Counties and the Panhandle District portions of Potter and Armstrong Counties"*
- *"Approximately 40 feet average decline in water levels for each 50-year period between 2012 and 2080 in Randall County and within High Plains District in Armstrong and Potter Counties".*

District representatives in Groundwater Management Area 1 determined the Blaine and Seymour aquifers were not relevant for purposes of joint planning.

On January 4, 2022, Mr. Wade Oliver, on behalf of Groundwater Management Area 1, submitted the Desired Future Conditions Explanatory Report and accompanying files to the TWDB. Groundwater Management Area 1 adopted four geographically defined desired future conditions for the Ogallala (inclusive of the Rita Blanca) Aquifer, and three

geographically defined desired future conditions for the Dockum Aquifer, as presented above. TWDB staff reviewed the model files associated with the desired future conditions and some of the desired future conditions were initially not mutually compatible with the groundwater availability model results for the High Plains Aquifer System.

The technical coordinator and consultant for Groundwater Management Area 1 confirmed that the intended desired future conditions required clarification for the assumption of "averaging the 50-year periods," as defined in the resolution adopting desired future conditions. Additionally, the technical coordinator and consultant for the Groundwater Management Area 1 confirmed that a 1 percent tolerance was acceptable for the desired future conditions of both the Ogallala (inclusive of the Rita Blanca) Aquifer and the Dockum Aquifer.

The TWDB received clarifications on procedures and assumptions from the Groundwater Management Area 1 technical coordinator on November 10, 2022, and on November 17, 2022, and a letter of administrative completeness was then provided by the TWDB to Groundwater Management Area 1 on December 16, 2022. All clarifications are included in Appendix A of this report.

METHODS:

The groundwater availability model for the High Plains Aquifer System version 1.01 was run using model files submitted with the explanatory report (Groundwater Management Area 1 and Oliver, 2021) for both the Ogallala (inclusive of the Rita Blanca) Aquifer and the Dockum Aquifer (Figures 1 and 2). Model-simulated water levels were extracted for the years 2019 (stress period 1) through 2080 (stress period 62).

Average percent volumes in storage remaining, total average drawdowns, percent of average drawdowns remaining, and average decline in water levels were calculated according to the Desired Future Conditions Explanatory Report provided by Groundwater Management Area 1 (Groundwater Management Area 1, and Oliver, W., INTERA Inc., 2021). The calculated average percent volumes in storage remaining, total average drawdowns, percent of average drawdowns remaining, and average decline in water level values were then analyzed to verify that the annual pumping scenarios characterized in the submitted model files achieved the desired future conditions within a tolerance of one percent.

The modeled available groundwater values were determined by extracting pumping rates at the end of each decade from the model results using ZONEBUDGET Version 3.01 (Harbaugh, 2009). Annual pumping rates by aquifer are summarized by county and groundwater conservation district, subtotaled by groundwater conservation district, and then summed for Groundwater Management Area 1 (Tables 1 and 2). Annual pumping rates by aquifer are summarized by county, river basin, and regional water planning area

within Groundwater Management Area 1 (Tables 3 and 4) to be consistent with the format used in the regional water planning process.

Modeled Available Groundwater and Permitting

As defined in Chapter 36 of the Texas Water Code (2011), "modeled available groundwater" is the estimated average amount of water that may be produced annually to achieve a desired future condition. Groundwater conservation districts are required to consider modeled available groundwater, along with several other factors, when issuing permits to manage groundwater production that achieves 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.

PARAMETERS AND ASSUMPTIONS:

The parameters and assumptions for the modeled available groundwater values are described below:

Ogallala (inclusive of the Rita Blanca Aquifer) and Dockum aquifers

- We used Version 1.01 of the groundwater availability model for the High Plains Aquifer System. See Deeds and Jigmond (2015) for assumptions and limitations of the groundwater availability model for the Ogallala, Rita Blanca, and Dockum aquifers.
- This groundwater availability model includes four layers, which generally represent the Ogallala Aquifer (Layer 1), the Rita Blanca Aquifer (Layer 2), the Upper Unit of the Dockum Aquifer (Layer 3), and the Lower Unit of the Dockum Aquifer (Layer 4). Since active model cells extend beyond the official TWDB aquifer extents, please note that only active model cells within the official TWDB aquifer extents and within Groundwater Management Area 1 were considered for analysis of the desired future conditions and modeled available groundwater values.
- The model was run with MODFLOW-NWT (Niswonger and others, 2011).
- Although the original groundwater availability model was calibrated only to 2012, an analysis during the current round of joint planning (Groundwater Management Area 1 and Oliver, 2021) verified that the model satisfactorily matched measured water levels for the period from 2012 to 2018. For this reason, the TWDB considers it acceptable to use the end of 2018 as the reference year for initial starting water levels for the predictive model simulation from 2019 to 2080.

- Average percent volumes in storage remaining, total average drawdowns, percent of average drawdowns remaining, and average decline in water levels, as well as modeled available groundwater values were based on the active model cells spatially coincident within the official TWDB defined aquifer boundaries.
- Model cells that became dry (when the water level in a model cell drops below the base of the aquifer) at the start of a simulated 50-year duration cycle were excluded from the desired future conditions analysis. Pumping in dry cells were excluded from the modeled available groundwater values for the decades after the cell went dry.
- A tolerance value of one percent was assumed when comparing desired future conditions to modeled results of average percent volumes in storage remaining, total average drawdowns, percent of average drawdowns remaining, and average decline in water levels. This one percent tolerance was specified by the Groundwater Management Area 1 in clarification statements for their desired future conditions resolution (Appendix A).
- Calculations of modeled available groundwater from the model simulation were rounded to the nearest whole number in units of acre-feet per year.
- The verification calculation for the desired future conditions of average percent volume in storage remaining for each 50-year period between 2018 and 2080 in the Ogallala (inclusive of the Rita Blanca) Aquifer for Dallam, Sherman, Hartley, and Moore counties is based on model layer 1 where the Rita Blanca Aquifer does not exist and on an average of model layers 1 and 2 for the area where the extent of the Rita Blanca Aquifer is spatially coincident with the Ogallala Aquifer within Dallam and Hartley counties.

RESULTS:

The modeled available groundwater values for the Ogallala (inclusive of the Rita Blanca Aquifer) Aquifer range from 3,192,963 acre-feet per year in 2020 to 1,991,106 acre-feet per year in 2080 (Table 1). The modeled available groundwater values for the Dockum Aquifer range from approximately 288,052 acre-feet per year in 2020 to 241,087 acre-feet per year in 2080 (Table 2). The modeled available groundwater is summarized by groundwater conservation district and county for the Ogallala (inclusive of the Rita Blanca Aquifer) and Dockum aquifers (Tables 1 and 2). The modeled available groundwater has also been summarized by county, river basin, and regional water planning area for use in the regional water planning process for the Ogallala (inclusive of the Rita Blanca Aquifer) and Dockum aquifers (Tables 3 and 4).

FIGURE 1. GROUNDWATER MANAGEMENT AREA (GMA) 1 BOUNDARY, RIVER BASINS, COUNTIES, REGIONAL WATER PLANNING AREAS (RWPAS), AND GROUNDWATER CONSERVATION DISTRICTS (GCDS) OVERLAIN ON THE MODEL EXTENT OF THE OGALLALA (INCLUSIVE OF THE RITA BLANCA) AQUIFER.

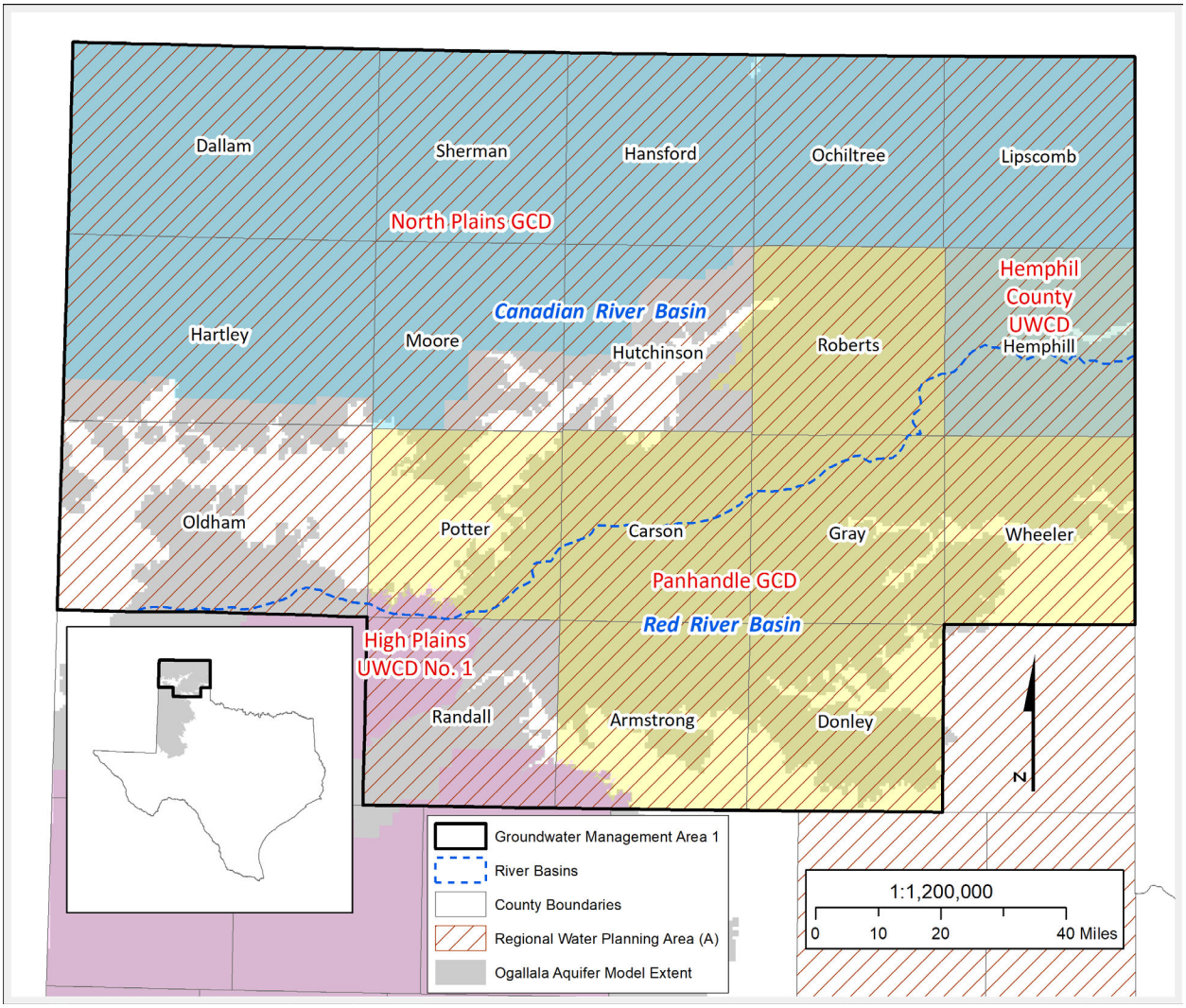

FIGURE 2. GROUNDWATER MANAGEMENT AREA (GMA) 1 BOUNDARY, RIVER BASINS, COUNTIES, REGIONAL WATER PLANNING AREAS (RWPAS), AND GROUNDWATER CONSERVATION DISTRICTS (GCDS) OVERLAIN ON THE MODEL EXTENT OF THE DOCKUM AQUIFER.

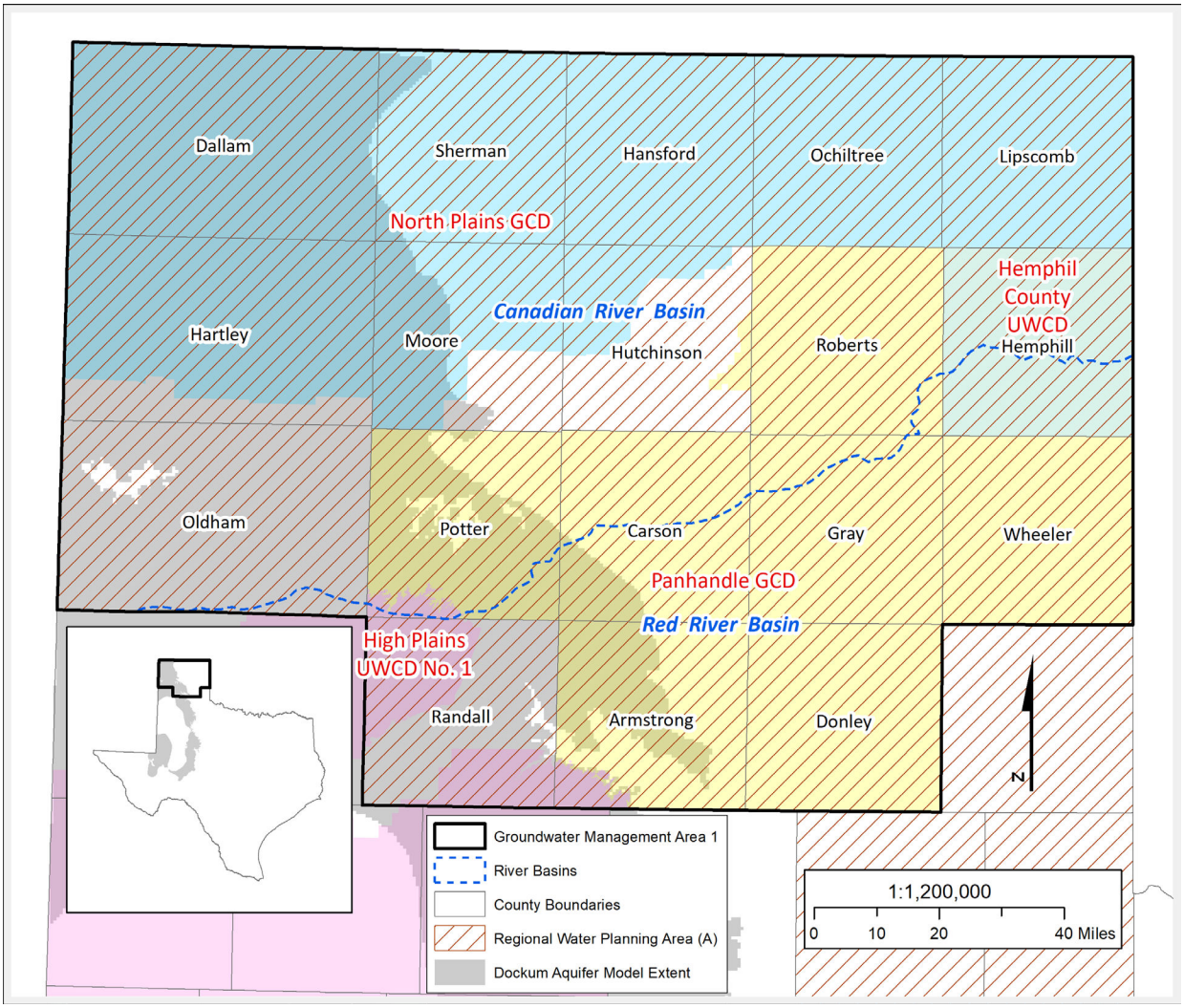

TABLE 1. MODELED AVAILABLE GROUNDWATER FOR THE OGALLALA (INCLUSIVE OF THE RITA BLANCA AQUIFER) AQUIFER IN GROUNDWATER MANAGEMENT AREA 1 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2080. VALUES ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District	County	Aquifer	2020	2030	2040	2050	2060	2070	2080
Hemphill County UWCD	Hemphill	Ogallala	37,259	45,816	52,208	55,621	58,039	59,257	60,177
Hemphill County UWCD Total		**Ogallala**	**37,259**	**45,816**	**52,208**	**55,621**	**58,039**	**59,257**	**60,177**
High Plains UWCD No.1	Armstrong	Ogallala	5,679	4,713	3,007	1,877	1,181	968	786
High Plains UWCD No.1	Potter	Ogallala	2,348	2,538	2,362	2,049	1,634	1,075	802
High Plains UWCD No.1	Randall	Ogallala	36,992	34,674	29,709	24,585	20,385	17,088	14,559
High Plains UWCD No.1 Total		**Ogallala**	**45,019**	**41,925**	**35,078**	**28,511**	**23,200**	**19,131**	**16,147**
North Plains GCD	Dallam	Ogallala*	319,988	269,575	228,726	194,888	165,787	144,360	128,259
North Plains GCD	Hansford	Ogallala	297,486	295,700	281,612	264,290	247,744	229,800	211,464
North Plains GCD	Hartley	Ogallala†	355,646	270,230	207,754	169,890	144,564	124,366	108,352
North Plains GCD	Hutchinson	Ogallala	77,920	80,189	77,835	74,461	70,609	67,496	64,083
North Plains GCD	Lipscomb	Ogallala	251,489	270,819	263,478	249,968	235,561	218,975	201,984

* Ogallala Aquifer also includes the Rita Blanca Aquifer where they are both spatially coincident within the Dallam County portion of North Plains GCD.
† Ogallala Aquifer also includes the Rita Blanca Aquifer where they are both spatially coincident within the Hartley County portion of North Plains GCD.

TABLE 1 (CONTINUED). MODELED AVAILABLE GROUNDWATER FOR THE OGALLALA (INCLUSIVE OF THE RITA BLANCA AQUIFER) AQUIFER IN GROUNDWATER MANAGEMENT AREA 1 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2080. VALUES ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District	County	Aquifer	2020	2030	2040	2050	2060	2070	2080
North Plains GCD	Moore	Ogallala	140,408	139,745	132,737	121,616	106,134	88,165	73,128
North Plains GCD	Ochiltree	Ogallala	259,676	259,973	247,274	231,502	215,617	199,324	181,295
North Plains GCD	Sherman	Ogallala	290,148	287,657	261,521	226,142	198,338	166,675	145,399
North Plains GCD Total		**Ogallala**	**1,992,761**	**1,873,888**	**1,700,937**	**1,532,757**	**1,384,354**	**1,239,161**	**1,113,964**
Panhandle GCD	Armstrong	Ogallala	56,940	51,726	45,757	40,241	35,089	30,685	27,137
Panhandle GCD	Carson	Ogallala	163,315	166,024	159,756	149,768	141,251	134,365	121,774
Panhandle GCD	Donley	Ogallala	72,747	78,267	77,157	72,601	67,032	60,915	53,337
Panhandle GCD	Gray	Ogallala	177,633	181,648	173,602	160,382	147,045	133,802	121,936
Panhandle GCD	Hutchinson	Ogallala	8,524	10,589	11,798	11,784	11,427	10,775	9,606
Panhandle GCD	Potter	Ogallala	24,022	22,245	19,590	16,477	13,607	10,990	8,821
Panhandle GCD	Roberts	Ogallala	358,704	409,300	394,930	369,335	344,109	317,529	286,594
Panhandle GCD	Wheeler	Ogallala	119,602	132,615	132,787	128,472	121,852	114,269	106,929
Panhandle GCD Total		**Ogallala**	**981,487**	**1,052,414**	**1,015,377**	**949,060**	**881,412**	**813,330**	**736,134**
All Districts Total		**Ogallala**	**3,056,526**	**3,014,043**	**2,803,600**	**2,565,949**	**2,347,005**	**2,130,879**	**1,926,422**

TABLE 1 (CONTINUED). MODELED AVAILABLE GROUNDWATER FOR THE OGALLALA (INCLUSIVE OF THE RITA BLANCA AQUIFER) AQUIFER IN GROUNDWATER MANAGEMENT AREA 1 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2080. VALUES ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District	County	Aquifer	2020	2030	2040	2050	2060	2070	2080
No District-County	Hartley	Ogallala‡	15,555	16,380	15,634	14,309	12,989	11,646	10,434
No District-County	Hutchinson	Ogallala	33,955	32,967	28,372	24,059	20,978	18,576	17,204
No District-County	Moore	Ogallala	8,703	9,681	9,415	8,245	7,122	6,198	5,517
No District-County	Oldham	Ogallala	40,496	39,067	36,192	31,219	26,044	21,393	18,041
No District-County	Randall	Ogallala	37,728	35,877	30,800	25,725	20,992	17,103	13,488
No District Total		**Ogallala**	**136,437**	**133,972**	**120,413**	**103,557**	**88,125**	**74,916**	**64,684**
GMA 1 Total		**Ogallala**	**3,192,963**	**3,148,015**	**2,924,013**	**2,669,506**	**2,435,130**	**2,205,795**	**1,991,106**

‡ Ogallala Aquifer also includes the Rita Blanca Aquifer where they are both spatially coincident within Hartley County and outside of any groundwater district.

TABLE 2. MODELED AVAILABLE GROUNDWATER FOR THE DOCKUM AQUIFER IN GROUNDWATER MANAGEMENT AREA 1 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2080. VALUES ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District	County	Aquifer	2020	2030	2040	2050	2060	2070	2080
High Plains UWCD No.1	Armstrong	Dockum	1,853	835	221	221	221	221	221
High Plains UWCD No.1	Potter	Dockum	2,663	2,657	2,406	2,315	2,281	2,248	2,172
High Plains UWCD No.1	Randall	Dockum	6,997	8,736	9,703	8,428	7,698	7,610	7,782
High Plains UWCD No.1 Total		**Dockum**	**11,513**	**12,228**	**12,330**	**10,964**	**10,200**	**10,079**	**10,175**
North Plains GCD	Dallam	Dockum	15,969	15,522	14,700	14,019	13,513	12,895	12,415
North Plains GCD	Hartley	Dockum	12,402	11,792	11,051	10,334	9,755	9,234	8,831
North Plains GCD	Moore	Dockum	4,496	5,399	5,409	5,064	4,782	4,474	4,213
North Plains GCD	Sherman	Dockum	445	416	310	288	293	288	291
North Plains GCD Total		**Dockum**	**33,312**	**33,129**	**31,470**	**29,705**	**28,343**	**26,891**	**25,750**
Panhandle GCD	Armstrong	Dockum	5,313	7,102	8,122	8,601	8,849	8,904	8,914
Panhandle GCD	Carson	Dockum	6	6	6	6	6	6	6
Panhandle GCD	Potter	Dockum	30,160	37,699	37,853	36,963	35,881	34,685	33,571
Panhandle GCD Total		**Dockum**	**35,479**	**44,807**	**45,981**	**45,570**	**44,736**	**43,595**	**42,491**
All Districts Total		**Dockum**	**80,304**	**90,164**	**89,781**	**86,239**	**83,279**	**80,565**	**78,416**

TABLE 2 (CONTINUED). MODELED AVAILABLE GROUNDWATER FOR THE DOCKUM AQUIFER IN GROUNDWATER MANAGEMENT AREA 1 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2080. VALUES ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District	County	Aquifer	2020	2030	2040	2050	2060	2070	2080
No District-County	Hartley	Dockum	44,260	52,799	53,096	50,432	46,907	42,974	39,311
No District-County	Moore	Dockum	241	560	594	616	643	645	625
No District-County	Oldham	Dockum	144,234	153,787	145,925	135,393	124,861	114,569	105,341
No District-County	Randall	Dockum	19,013	29,231	32,057	31,502	28,550	21,149	17,394
No District Total		**Dockum**	**207,748**	**236,377**	**231,672**	**217,943**	**200,961**	**179,337**	**162,671**
GMA 1 Total		**Dockum**	**288,052**	**326,541**	**321,453**	**304,182**	**284,240**	**259,902**	**241,087**

TABLE 3. MODELED AVAILABLE GROUNDWATER FOR THE OGALLALA (INCLUSIVE OF THE RITA BLANCA AQUIFER) AQUIFER IN GROUNDWATER MANAGEMENT AREA 1 SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), RIVER BASIN, AND AQUIFER FOR EACH DECADE BETWEEN 2030 AND 2080. VALUES ARE IN ACRE-FEET PER YEAR.

County	RWPA	River basin	Aquifer	2030	2040	2050	2060	2070	2080
Armstrong	A	RED	Ogallala	56,439	48,764	42,118	36,270	31,653	27,923
Carson	A	CANADIAN	Ogallala	68,193	66,220	62,132	57,975	54,708	49,565
Carson	A	RED	Ogallala	97,831	93,536	87,636	83,276	79,657	72,209
Dallam	A	CANADIAN	Ogallala§	269,575	228,726	194,888	165,787	144,360	128,259
Donley	A	RED	Ogallala	78,267	77,157	72,601	67,032	60,915	53,337
Gray	A	CANADIAN	Ogallala	46,240	43,480	39,643	36,480	33,394	30,628
Gray	A	RED	Ogallala	135,408	130,122	120,739	110,565	100,408	91,308
Hansford	A	CANADIAN	Ogallala	295,700	281,612	264,290	247,744	229,800	211,464
Hartley	A	CANADIAN	Ogallala**	286,610	223,388	184,199	157,553	136,012	118,786
Hemphill	A	CANADIAN	Ogallala	24,975	29,168	32,388	34,729	36,110	37,074
Hemphill	A	RED	Ogallala	20,841	23,040	23,233	23,310	23,147	23,103
Hutchinson	A	CANADIAN	Ogallala	123,745	118,005	110,304	103,014	96,847	90,893
Lipscomb	A	CANADIAN	Ogallala	270,819	263,478	249,968	235,561	218,975	201,984
Moore	A	CANADIAN	Ogallala	149,426	142,152	129,861	113,256	94,363	78,645
Ochiltree	A	CANADIAN	Ogallala	259,973	247,274	231,502	215,617	199,324	181,295
Oldham	A	CANADIAN	Ogallala	34,871	32,845	28,578	23,948	19,789	16,869
Oldham	A	RED	Ogallala	4,196	3,347	2,641	2,096	1,604	1,172
Potter	A	CANADIAN	Ogallala	14,672	13,137	11,036	9,214	7,648	6,337
Potter	A	RED	Ogallala	10,111	8,815	7,490	6,027	4,417	3,286
Randall	A	RED	Ogallala	70,551	60,509	50,310	41,377	34,191	28,047
Roberts	A	CANADIAN	Ogallala	386,950	372,064	346,908	322,461	297,068	267,425
Roberts	A	RED	Ogallala	22,350	22,866	22,427	21,648	20,461	19,169

§ Ogallala Aquifer also includes the Rita Blanca Aquifer where they are both spatially coincident within Dallam County and the Canadian River basin.
** Ogallala Aquifer also includes the Rita Blanca Aquifer where they are both spatially coincident within Hartley County and the Canadian River basin.

TABLE 3 (CONTINUED). MODELED AVAILABLE GROUNDWATER FOR THE OGALLALA (INCLUSIVE OF THE RITA BLANCA AQUIFER) AQUIFER IN GROUNDWATER MANAGEMENT AREA 1 SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), RIVER BASIN, AND AQUIFER FOR EACH DECADE BETWEEN 2030 AND 2080. VALUES ARE IN ACRE-FEET PER YEAR.

County	RWPA	River basin	Aquifer	2030	2040	2050	2060	2070	2080
Sherman	A	CANADIAN	Ogallala	287,657	261,521	226,142	198,338	166,675	145,399
Wheeler	A	RED	Ogallala	132,615	132,787	128,472	121,852	114,269	106,929
GMA 1 Total			**Ogallala**	**3,148,015**	**2,924,013**	**2,669,506**	**2,435,130**	**2,205,795**	**1,991,106**

TABLE 4. MODELED AVAILABLE GROUNDWATER FOR THE DOCKUM AQUIFER IN GROUNDWATER MANAGEMENT AREA 1 SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), RIVER BASIN, AND AQUIFER FOR EACH DECADE BETWEEN 2030 AND 2080. VALUES ARE IN ACRE-FEET PER YEAR.

County	RWPA	River basin	Aquifer	2030	2040	2050	2060	2070	2080
Armstrong	A	RED	Dockum	7,937	8,343	8,822	9,070	9,125	9,135
Carson	A	CANADIAN	Dockum	0	0	0	0	0	0
Carson	A	RED	Dockum	6	6	6	6	6	6
Dallam	A	CANADIAN	Dockum	15,522	14,700	14,019	13,513	12,895	12,415
Hartley	A	CANADIAN	Dockum	64,591	64,147	60,766	56,662	52,208	48,142
Moore	A	CANADIAN	Dockum	5,959	6,003	5,680	5,425	5,119	4,838
Oldham	A	CANADIAN	Dockum	153,694	145,814	135,269	124,727	114,427	105,188
Oldham	A	RED	Dockum	93	111	124	134	142	153
Potter	A	CANADIAN	Dockum	38,004	38,158	37,268	36,186	34,990	33,815
Potter	A	RED	Dockum	2,352	2,101	2,010	1,976	1,943	1,928
Randall	A	RED	Dockum	37,967	41,760	39,930	36,248	28,759	25,176
Sherman	A	CANADIAN	Dockum	416	310	288	293	288	291
GMA 1 Total			**Dockum**	**326,541**	**321,453**	**304,182**	**284,240**	**259,902**	**241,087**

LIMITATIONS:

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

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

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

REFERENCES:

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APPENDIX A

Critical Clarifications requested by the TWDB *(need additional files or potential update to legal DFC Resolutions)***:**

1. Based on TWDB analysis of the High Plains Aquifer System model files provided by the GMA 1 consultant (INTERA, Inc.), some DFCs are unachievable with respect to the current legal phrasing of the DFC Resolution. The TWDB is requesting the following tolerances:
    - A tolerance of 1% for GMA 1 DFCs defined by percent volume in storage remaining in the Ogallala Aquifer (inclusive of Rita Blanca Aquifer).
    - A tolerance of 1% for GMA 1 DFCs defined by percent available drawdown remaining in the Dockum Aquifer.

    Please confirm that the GMA is willing to accept the tolerance clarifications requested above. Alternatively, the GMA or GMA consultant may provide revised High Plains Aquifer System model files for TWDB to review or may revise the DFC Resolution so that the DFCs are achievable without requiring a tolerance.

Other Clarifications requested by the TWDB (*need acknowledgement*)**:**
Note that the tolerances in Clarification #1 were derived from calculations using the following assumptions. If the GMA disagrees with the following assumptions, the requested tolerances may no longer be sufficient for TWDB to declare the DFCs achievable and further action may be required.

Ogallala (inclusive of Rita Blanca) Aquifer:

2. Please confirm that the phrase "percent of volume in storage remaining for each 50-year period between 2018 and 2080" in the DFC Resolution means "the percent of volume remaining in storage averaged over all thirteen 50-year time periods starting from 2018 to 2068 through 2030 to 2080." This interpretation produces calculated storage values consistent with the DFC values provided in the Explanatory Report and supplemental documents provided by the GMA 1 consultant.
3. Please confirm that the phrase "total average drawdown for each 50-year period between 2012 and 2080" in the DFC Resolution means "the total average drawdown averaged over all nineteen 50-year time periods starting from 2012 to 2062 through 2030 to 2080. This interpretation produces calculated drawdown values consistent with the DFC values provided in the Explanatory Report and supplemental documents provided by the GMA 1 consultant.
4. Please confirm that the GMA accepts the following assumptions for calculating modeled drawdown: 1) modeled dry cells are excluded from the calculations, 2) only active model cells within official TWDB aquifer boundaries are included in calculations, and 3) averages are calculated over the entire multi-county area defined

within the resolutions rather than by individual county within those areas. This method produces drawdown values consistent with the DFC values provided in the Explanatory Report and supplemental documents provided by the GMA 1 consultant.

Dockum Aquifer:

5. Please confirm that the phrase "percent of the average available drawdown remaining for each 50-year period between 2018 and 2080" in the DFC Resolution means "the percent of the average available drawdown remaining averaged over all thirteen 50-year time periods starting from 2018 to 2068 through 2030 to 2080." This method produces calculated storage values consistent with the DFC values provided in the Explanatory Report and supplemental documents provided by the GMA 1 consultant.
6. Please confirm that the phrase "average decline in water levels for each 50-year period between 2018 and 2080" in the DFC Resolution means "the average decline in water levels averaged over all thirteen 50-year time periods starting from 2018 to 2068 through 2030 to 2080". This method produces calculated storage values consistent with the DFC values provided in the Explanatory Report and supplemental documents provided by the GMA 1 consultant.
7. Please confirm that the phrase "average decline in water levels for each 50-year period between 2012 and 2080" in the DFC Resolution means "the average decline in water levels averaged over all nineteen 50-year time periods starting from 2012 to 2062 through 2030 to 2080. This method produces calculated storage values consistent with the DFC values provided in the Explanatory Report and supplemental documents provided by the GMA 1 consultant.
8. Please confirm that the GMA accepts the following assumptions for calculating modeled drawdowns: 1) modeled dry cells are excluded from the calculations, 2) only active model cells within official TWDB aquifer boundaries are included in calculations, and 3) averages are calculated over the entire multi-county area defined within the resolutions rather than by individual county within those areas. This method produces drawdown values consistent with the DFC values provided in the Explanatory Report and supplemental documents provided by the GMA 1 consultant.

Optional Clarifications requested by the TWDB *(Typos in Explanatory Report)*[6]:

None

[6] Since the TWDB considers the legal DFC Resolution documents, rather than the Explanatory Report, as the official definition of DFCs, the TWDB does not officially require corrections to the Explanatory Report. However, because the Explanatory Report is often used as a simplified, more-readable summary of the legal DFC Resolution documents, we recommend correcting the Explanatory Report to match the DFC Resolutions in order to avoid confusion.

Informational

For reference, the tables below show the averaged results of DFC analysis calculations provided by the GMA 1 consultant and verified by TWDB for the currently unachievable DFCs:

Bulleted Resolutions	***Percent of volume in storage remaining for each 50-year period between 2018 and 2080***	
	DFC	**Calculated from model**
Ogallala Bullet #2*	>= 50%	49%
Ogallala Bullet #3**	>= 80%	79%

** Refers to Hansford, Hutchinson, Lipscomb, Ochiltree, Carson, Donley, Gray, Roberts, Wheeler, and Oldham counties; and within the Panhandle District portions of Armstrong and Potter counties*
*** refers to Hemphill County*

Resolution Section	***Percent of average available drawdown remaining for each 50-year period between 2018 and 2080***	
	DFC	**Calculated from model**
Dockum Bullet #1*	>= 40%	39%

** Refers to Dallam, Hartley, Moore, and Sherman counties.*

FIGURE A1. LETTER OF AGREEMENT FROM THE GROUNDWATER MANAGEMENT AREA 1 TECHNICAL COORDINATOR FOR CLARIFICATIONS ON PROCEDURES AND ASSUMPTIONS OF THEIR DESIRED FUTURE CONDITIONS RESOLUTION STATEMENTS.

NORTH PLAINS GROUNDWATER Conservation District

November 10, 2022

Robert G. Bradley, PG, CTCM
Groundwater Technical Assistance
Texas Water Development Board
P.O. Box 13231
Austin, Texas 78711

Dear Mr. Bradley,

Thank you for reaching out to clarify the Desired Future Conditions adopted by the groundwater conservation districts in Groundwater Management Area 1 (GMA 1). The GMA 1 technical consultant and the managers from Hemphill County Underground Water Conservation District, High Plains Underground Water Conservation District, and Panhandle Groundwater Conservation District reviewed the clarifications document attached to this correspondence.

The Districts in GMA 1 agree that the approach presented by the TWDB staff including the tolerances below are consistent with our intent when adopting DFCs:

- A tolerance of 1% for GMA 1 DFCs defined by percent volume in storage remaining in the Ogallala Aquifer (inclusive of Rita Blanca Aquifer).
- A tolerance of 1% for GMA 1 DFCs defined by percent available drawdown remaining in the Dockum Aquifer.

We agree with the TWDB staff assumptions presented in the "Other Clarifications" section of your note on November 9, 2022, relating to Ogallala, Rita Blanca and Dockum aquifers.

We look forward to TWDB's determination of administrative completeness and estimation of modeled available groundwater. If there is anything else we can do to help in this process, please let me know.

Sincerely,

Steven D. Walthour, PG
General Manager

CC. Janet Guthrie – Hemphill County Underground Water Conservation District
Britney Britten – Panhandle Groundwater Conservation District
Jason Coleman– High Plains Underground Water Conservation District
Wade Oliver - Intera

Attachment

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