PANHANDLE GROUNDWATER

CONSERVATION DISTRICT

MANAGEMENT PLAN

2019-2024

Approved by the

Panhandle Groundwater Conservation District

Board of Directors

July 25, 2019

The Panhandle Groundwater Conservation District Management Plan was adopted, after notice and hearing, on July 25, 2019.
Hydrologic data developed for this Management Plan were developed and reviewed by
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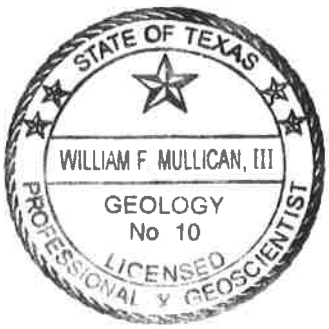

William F. Mullican III
7/25/2019

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CHAPTER 1 DISTRICT MISSION AND OVERVIEW

The Panhandle Groundwater Conservation District (the District) will strive to develop, promote, and implement water conservation, preservation, recharging, augmentation through precipitation enhancement, prevention of waste, and management strategies to protect water resources for the benefit of the citizens, economy, and environment of the District.

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

The District will work to treat all citizens uniformly. The District will enforce the permit terms and conditions and the District rules by enjoining the permit holder in a court of competent jurisdiction, as provided for in Texas Water Code Section 36.102, if required, after exhausting all other remedies.

The District consists of all of Carson, Donley, Gray, Roberts and Wheeler counties, along with parts of Armstrong, Hutchinson, and Potter counties. The District was created by the Legislature in 1955, when it began operating in portions of Gray, Carson, Potter, and Armstrong counties. Elections were held in 1988, 1991, 1994, 1997 and 2000 to annex the remaining portions of the District within the present boundaries.

The District's areal extent is 6,309 square miles or approximately four million acres located in the Panhandle region of Texas, extending from west of Amarillo to the Oklahoma border. The Canadian River to the north and Salt Fork of the Red River to the south generally border the District. The District's economy is dominated by agricultural production and petrochemical production. The agricultural income sources include beef cattle production, wheat, corn, milo, peanuts, soybeans, sunflowers, hay crops and cotton. Petrochemical production also contributes significantly to the income of the District. There are also chemical, manufacturing, and nuclear weapons industries located in the District.

There are over 4,676 irrigation wells capable of producing water to meet the needs of the agricultural community within District boundaries. The District also has more than 470 municipal or public supply wells, and over 450 wells for industrial use and oil and gas secondary recovery (water flood) operations. The remaining wells are registered wells providing water supplies for household, livestock consumption, and oil and gas exploration.

The area contains rolling plains that are used for cattle production, cultivation and oil and gas activities. There is a substantial area of flat plains that contain numerous playa basins. This area is used primarily for crop production. The altitude of the land surface ranges from 2,005 feet to 3,800 feet above mean sea level. The District lies within, and between, the drainage systems of both the Canadian River Basin and the Red River Basin.

All statutorily required elements for this Management Plan, as stipulated in Texas Water Code Section 36.1071 have been addressed herein, and for ease of review, are referenced in the Texas Water Development Board's Groundwater Conservation District Management Plan Checklist included as Appendix 1. Documentation that the Management Plan was adopted after public notice is presented in Appendix 2. A copy of the executed Resolution approved by the Panhandle Groundwater Conservation District Board of director's is included in Appendix 3.

CHAPTER 2 GROUNDWATER MANAGEMENT IN TEXAS

The authority of groundwater conservation districts (GCDs) to conserve, preserve, and protect groundwater through necessary regulation dates to the Underground Water Conservation Districts Act passed by the Texas Legislature in 1949 (Vernon's Civil Statutes, Article 7880-3c). Included in this landmark legislation, which for the most part, remains substantively unchanged today, GCDs receive the following legislative directive, "Such districts shall and are hereby authorized to exercise any one or more of the following:

(8) develop comprehensive plans for the most efficient use of the underground water of the underground reservoir or subdivision thereof and for the control and prevention of waste of such underground water, which plans shall specify in such detail as may be practicable, the acts, procedure, performance and avoidance which are or may be necessary to effect such plans, including specifications therefore; to carry out research projects, develop information and determine limitations, if any, which should be made on the withdrawal of underground water from the underground reservoir or subdivision thereof; to collect and preserve information regarding the use of such underground water and the practicability of recharge of the underground water subdivision thereof; to publish such plans and information, bring them to the notice and attention of the users of such underground water within the District, and to encourage their adoption and execution;"

In 1997 the Texas Legislature approved one of the more significant amendments to the Water Code by expanding the groundwater planning process, requiring all GCDs to develop and adopt management plans. Once adopted, management plans are then to be reviewed and approved by the Executive Administrator at the Texas Water Development Board (TWDB). This review and approval are designed to ensure that certain technical and administrative requirements are met.

Substantial changes in the planning and management of groundwater were put in place in 2005 with the passage of House Bill 1763, which requires GCDs in the same Groundwater Management Area (GMA) to conduct joint planning and establish Desired Future Conditions (DFCs) for all relevant aquifers in the GMA. The first round of joint planning concluded on September 1, 2010. Since the passage of House Bill 1763 in 2005, the District has been an active participant in the joint planning process for GMA 1. GMA 1 adopted DFCs for the Ogallala Aquifer on July 7, 2009, and DFCs for the Dockum and Blaine aquifers on June 3, 2010.

No other aquifers were determined to be relevant during the first round of joint planning in the District. By law, GCDs are required to meet at least annually to continue joint planning and to review and readopt (with amendments as necessary) DFCs at least every five years.

In 2011, the Texas Legislature again made significant changes to the planning and management of groundwater resources with the passage of Senate Bill 660 (SB 660). One of the primary elements of SB 660 was the identification of nine specific criteria that must be considered with respect to any DFCs being proposed for adoption (Texas Water Code Section 36.108 (d) (1-9). Other changes made by SB 660 included requirements that GCDs in a GMA must provide a balance between the highest practicable level of groundwater production and the conservation, preservation, protection, recharging, and prevention of waste of groundwater and control of subsidence in the GMA (Texas Water Code Section 36.108 (d-2)), development of an explanatory report to accompany adopted DFCs when submitted to the TWDB for review (Texas Water Code Section 36.108 (d-3), and also transfer of the petition process from the TWDB to the State Office of Administrative Hearings (Texas Water Code Section 36.1083). Based on the new requirements of SB 660, the District, along with the other GCDs in GMA 1, adopted updated DFCs on November 1, 2016, as required by Texas Water Code Section 36.108 (d). DFCs were adopted for the Ogallala and Dockum aquifers in the District. The Blaine Aquifer, located in Wheeler County in GMA 1 was classified by GMA 1 District Representatives as being non-relevant for the purposes of joint planning.

CHAPTER 3 DESIRED FUTURE CONDITIONS AND THE PANHANDLE GROUNDWATER CONSERVATION DISTRICT

Long before the State of Texas first considered the concept of "Desired Future Conditions" or DFCs in the 2002 State Water Plan[1], or codified the concept in statute in House Bill 1763 in 2005 (Texas Water Code Section 36.108(d)), the District Board of Directors spent countless hours deliberating approaches to better manage and balance current water demands with future water needs. The result of this deliberation that began in 1995 was the District's adoption of the 50/50 Management Standard in 1998. This landmark decision in 1998 to adopt the 50/50 Management Standard represents the first DFC adopted by a GCD anywhere in Texas.

The District's 50/50 Management Standard is the goal to have at least 50 percent of current volume in the Ogallala Aquifer, still available 50 years after the first certification of this plan (which occurred in 1998). This standard was subsequently adopted for the Ogallala Aquifer for the District during both the first and second rounds of joint planning (2005 – 2010 and 2010 - 2016).

[1] Texas Water Development Board, 2002, Water for Texas – The Texas State Water Plan, P.5.

For the purposes of the DFC adopted for the District by the member districts in GMA 1, this Management Plan and District rules, and the 50/50 Management Standard, 50 percent of the current saturated thickness remaining in 50 years, is indistinguishable from 50 percent of the volume of groundwater remaining in the Ogallala Aquifer. The 50/50 Management Standard, originally adopted by the District for the planning period of 1998 – 2048, has now been extended to 2070 in order to fully represent the current planning horizon (Figure 1). An examination of Figure 1 illustrates that as more time passes during the 50-year planning horizon, the reduction in saturated thickness of the Ogallala Aquifer each year becomes less and less.

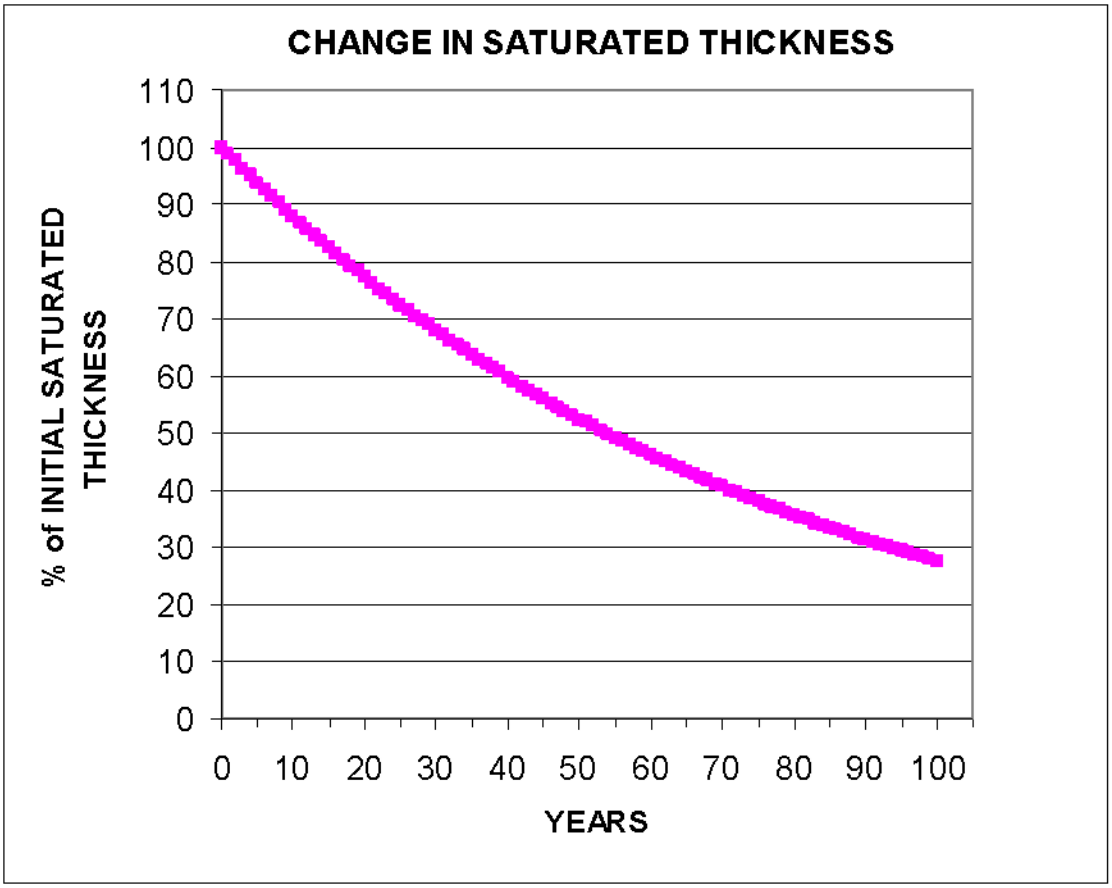

Figure 1 – Illustration of change in saturated thickness as a result of the 50/50 Management Standard.

Texas groundwater law is currently based on a conceptual three-step sequence that a GCD is to follow in accomplishing statutory responsibilities related to the conservation and management of groundwater resources within a GCD. The three primary steps, which are to occur at least every five years, are to: (1) adopt DFCs (Texas Water Code Section 36.108(c), (2) develop and adopt a management plan that includes goals, management objectives, and performance standards, designed to achieve the DFCs (Texas Water Code Section 36.1071(a)(8), and (3) amend and adopt rules necessary to achieve goals, management

objectives, and performance standards, included in the management plan (Texas Water Code Section 36.101(a)(5).

While in concept these three steps are presented as a sequential process, from a practical perspective, all three steps are often ongoing concurrently. This management plan update was developed concurrently with the development of substantive rule amendments adopted by the Panhandle GCD Board of Directors on December 20, 2018, in order to better achieve adopted DFCs. This management plan is a revision of the management plan adopted by the Panhandle GCD Board of Directors on February 23, 2017. This revised management plan will remain in effect until an amended plan is adopted by the district and approved by the Texas Water Development Board, or until five years from the date the Executive Administrator of the Texas Water Development Board approves the plan, whichever is earlier. The Board of Directors will review and adopt the management plan at least every five years, as required by Texas Water Code Section 36.1072(e). The District Management Plan and any amendments thereto, shall be forwarded to the Panhandle Water Planning Group for consideration in their regional water planning process.

CHAPTER 4 GOALS, MANAGEMENT OBJECTIVES, AND PERFORMANCE STANDARDS

For over 60 years, the District has worked to manage and conserve groundwater resources within its jurisdictional boundaries. With the adoption of the 50/50 Management Standard by the District Board of Directors in 1998, this all-encompassing goal for the District to manage and conserve groundwater resources was established. All other goals, management objectives, and performance standards required for inclusion in this management plan by Texas Water Code Section 36.1071(a) have been developed and adopted to ensure that District programs and activities work directly or indirectly in an integrated and comprehensive manner in order to achieve the 50/50 Management Standard. The 50/50 Management Standard is specifically designed to ensure the management and conservation of the finite water resources within the District while seeking to maintain the economic viability of all water resource user groups, both public and private.

Texas Water Code Section 36.1071(a)(1-9) requires that all management plans address the following management goals, as applicable:

- addressing the desired future conditions adopted by the District,
- providing the most efficient use of groundwater;
- controlling and preventing waste of groundwater;
- controlling and preventing subsidence;
- conjunctive surface water management issues;
- natural resource issues;

- drought conditions, and;
- conservation, recharge enhancement, rainwater harvesting, precipitation enhancement, or brush control, where appropriate and cost-effective.

Goals, management objectives, and performance standards included in this management plan have been developed and adopted to ensure the management and conservation of groundwater resources within the District's jurisdiction.

SECTION 4.1 ACTIONS, METHODOLOGIES, PROCEDURES, PERFORMANCE, AND AVOIDANCE NECESSARY TO EFFECTUATE THE PLAN

In order to achieve the goals, management objectives, and performance standards adopted in this management plan, the District continually works to develop, maintain, review, and update rules and procedures for the various programs and activities contained in the management plan. As a means to monitor performance, (a) the General Manager routinely meets with District Staff to track progress on the various management objectives and performance standards adopted in this management plan and, (b) on an annual basis; the General Manager prepares and submits an annual report documenting progress made towards implementation of the management plan to the Board of Directors for their review and approval. In addition, District Staff reviews District rules to ensure that all provisions necessary to implement the management plan are contained in the rules. Reviews of the rules are conducted annually and on an as needed basis. The District Board of Directors will make revisions to the rules as needed to manage and conserve groundwater resources within the District more effectively and to ensure that the duties prescribed in the Texas Water Code and other applicable laws are carried out. Amendments to District rules adopted on December 20, 2018, and this amended management plan are the direct result of this review process between the General Manager, District staff and the District Board of Directors. A copy of this management plan and the District's rules may be found on the District website at www.pgcd.us.

SECTION 4.2 GOAL 1 ADDRESS THE DESIRED FUTURE CONDITIONS ADOPTED BY THE PANHANDLE GCD

The main purpose of a management plan is to develop goals, management objectives, and performance standards that, when successfully implemented, will work together to achieve the adopted DFCs. Goals 2 through 10 directly and/or indirectly support Goal 1. DFCs adopted for the Ogallala and Dockum aquifers by GMA 1 on November 1, 2016, and subsequently adopted by the Panhandle GCD Board of Directors on July 14, 2016, for the District are described below (note, the Blaine Aquifer in Wheeler County is now classified by GMA 1 as non-relevant for joint planning). A 50-year planning horizon was used in setting the DFCs. Throughout the joint planning process, the District actively worked with the other District Representatives and stakeholders within GMA 1 to determine the DFCs for each relevant aquifer located within each district.

Subsection 4.2.1 Ogallala Aquifer DFC

The primary water resource in the District is the Ogallala Aquifer, which is a finite resource and must be managed and conserved for the benefit of future generations. The DFC for the Ogallala Aquifer within the boundaries of the District is to have at least 50 percent of the volume in storage (as discussed above, volume is equivalent to saturated thickness) remaining in 50 years (50/50 DFC). As discussed above, for the District, the 50/50 DFC (goal) is synonymous and interchangeable with the 50/50 Management Standard. Successful attainment of the 50/50 DFC is accomplished using the District's integrated programs focused on conservation, education, regulation, and permitting which are designed to achieve this umbrella goal. Texas Water Code Section 36.1132(a) states that "a district, to the extent possible, shall issue permits up to the point that the total volume of exempt and permitted groundwater production will achieve an applicable desired future condition under Section 36.108." The District's permitting program has been designed in order to achieve this DFC.

The requirement for inclusion of estimates of modeled available groundwater in the management plan is a requirement resulting from the passage of Senate Bill 660 by the 82nd Texas Legislature in 2011. The term "modeled available groundwater" is defined in Texas Water Code Section 36.001(a)(25) as "the amount of water that the executive administrator determines may be produced on an average annual basis to achieve a desired future condition…" This change in terms is included to clarify that the estimates presented in Table 1 represent both exempt and permitted groundwater production. Estimates of modeled available groundwater for the Ogallala Aquifer within the District, based on the updated High Plains Aquifer System Groundwater Availability Model (Deeds and Jigmond, 2015)[2] and Deeds (2016)[3] and further analyses by Goswami (2017)[4] are presented in Table 1 on the next page.

[2] Deeds, N. E., and Jigmond, M., 2015, Numerical Model Report for the High Plains Aquifer System Groundwater Availability Model, 640 p.,http://www.twdb.texas.gov/groundwater/models/gam/hpas/HPAS_GAM_Numerical_Report.pdf.

[3] Deeds, N. E., 2016, Delivery of GMA 1 Predictive Runs: Draft Technical Memorandum prepared for North Plains Groundwater Conservation District and Groundwater Management Area 1 for submission to Texas Water Development Board as part of Desired Future Conditions Submission Package, 18 p.:

[4] Goswami, R. R., 2017, GAM RUN 16-029 MAG: Modeled Available Groundwater for the aquifers in Groundwater Management Area 1: Texas Water Development Board, 17 pg.

Table 1- Estimates of Modeled Available Groundwater for the Ogallala Aquifer in the District (Goswami, 2017)[4].

Ogallala						
County	**2020**	**2030**	**2040**	**2050**	**2060**	**2062**
Armstrong	57,984	53,414	48,170	43,462	38,860	38,080
Carson	192,135	184,263	169,931	153,767	137,215	134,055
Donley	74,808	76,289	72,962	67,873	62,058	60,901
Gray	181,105	175,267	162,653	148,713	134,431	131,744
Hutchinson	15,734	16,740	15,156	13,324	11,742	11,455
Potter	16,969	15,820	14,442	13,162	11,836	11,609
Roberts	430,618	455,129	427,218	390,247	350,459	342,748
Wheeler	130,425	138,810	137,385	132,312	124,778	123,309
District Total	1,099,778	1,115,732	1,047,917	962,860	871,379	853,901

4.2.1.1 Management Objective 1.1

The cornerstone of the many programs and activities of the District is the 50/50 Management Standard which drives its Rules and this Management Plan. The 50/50 Management Standard states that 50 percent of the current volume within the Ogallala Aquifer will remain in 50 years. This 50/50 Management Standard is the tool by which the District will ensure that it meets or exceeds the 50/50 DFC outlined in Rule 1, 3, and 4, which states the maximum allowable volume of pumping from the Ogallala Aquifer is 1-acre foot per acre per year. In order to ensure that the 50/50 Management Standard is being met, the District goes through an annual review process to identify and act upon Contiguous Acreage Tracts exceeding the maximum allowable volume of pumping from the Ogallala Aquifer utilizing flow meter data. Management Objective 1.1 is for the District to successfully undergo and complete the annual flow meter data evaluation and review process for each Contiguous Acreage Tract each year by December 1st of the year following the year for which pumping data is collected. The results of this process will be published in the District's Annual Report which, upon approval by the District Board of Directors, will be published on the District's website.

The District also conducts a systematic winter water level program so as to collect data necessary to evaluate achievement of the District's Desired Future Conditions. Results from the District's winter water level monitoring program are presented to the Board of Directors on an annual basis and published in the District's newsletter.

In order to complete Management Objective 1.1, the following Performance Standards will be met. Actions by the District Board of Directors that may result from this review include the enforcement actions stipulated in Rule 3.3, as required.

4.2.1.1.1 *Performance Standards*

1.1a Based on flow meter readings, quantify all permitted pumping volumes annually for individual Contiguous Acreage Tracts and report results to the Board of Directors in the Annual Report by December 1st of each year.

1.1b Evaluate all Ogallala Aquifer water level measurements collected during the District's annual winter water level monitoring program. This information will be provided to the District Board of Directors at a regularly scheduled meeting by August 31st of each year.

1.1c The District will conduct a Sunset Review of the maximum allowable volume of production contained in Rule 4.2. This review will be concluded no later than January 1, 2025, and the maximum allowable production volume will then be reviewed every 5 years thereafter. Using annual production data, the Board will evaluate the effect of Rule 4.2 on the ability to achieve the District's Desired Future Conditions.

4.2.1.2 Management Objective 1.2

The District maintains an integrated geodatabase system based on the District's Observation Well Network and computer mapping programs to annually track and evaluate current supplies by a baseline (1998) Ogallala Aquifer saturated thickness dataset in the District. This analysis is utilized to track and review changes in water supplies.

4.2.1.2.1 *Performance Standards*

1.2a Update and publish at least once every five years, beginning in 2020, on the District's website the latest updated Ogallala Aquifer saturated thickness map.

Subsection 4.2.2 Dockum Aquifer DFC

The Dockum Aquifer is classified by the TWDB as a minor aquifer that is present primarily in the western portions of the District and is generally under confined (artesian) conditions. Based on our current understanding of water resources in the Dockum Aquifer, DFCs have been adopted for Armstrong, Carson, and Potter counties within the District. Due to the predominantly confined nature of the Dockum Aquifer, a different approach was taken in adopting DFCs for the Dockum Aquifer. The DFCs adopted for the Dockum Aquifer in GMA 1 are that the average decline in water levels will be no more than 30 feet within the District over the next 50 years. The maximum allowable volume of pumping from the Dockum Aquifer is 1-acre foot per acre per year.

The estimates of modeled available groundwater for the Dockum Aquifer were extracted from predictive simulations performed for GMA 1 using the updated High Plains Aquifer System.

Groundwater Availability Model (Deeds and Jigmond, 2015)[5] and Deeds (2016)[6] and further analyses by Goswami (2017)[7] are presented in below.

Table 2 - Estimates of Modeled Available Groundwater for the Dockum Aquifer in the District (Goswami (2017)[8].

Dockum						
County	**2020**	**2030**	**2040**	**2050**	**2060**	**2062**
Armstrong	7,131	9,024	9,588	9,704	9,535	9,494
Carson	68	108	140	169	198	204
Potter	38,803	39,113	36,937	34,505	32,008	31,558
District Total	46,002	48,245	46,665	44,378	41,741	41,256

4.2.2.1 Management Objective 1.3

While there are tens of thousands of data points collected over time relative to the Ogallala Aquifer, the opposite is the case for the Dockum Aquifer. This can primarily be attributed to dominance of the Ogallala Aquifer in the region and the general prevalence of poor water quality and yields from the Dockum Aquifer. Due to declining water levels in the Ogallala Aquifer, there are areas where the Dockum Aquifer is becoming a more important water resource. There are localized areas of good water quality and where technological advances are being made using brackish groundwater desalination.

Due to the scarcity of data regarding the Dockum Aquifer, the District is primarily focused on data collection and trend analysis on wells completed in the Dockum Aquifer currently included in the District's Observation Well Network. This management objective is to monitor and report on Dockum Aquifer wells in the District's Observation Well Network that are experiencing declines for which the trend is in excess of the DFC of 30 feet.

[5] Deeds, N. E., and Jigmond, M., 2015, Numerical Model Report for the High Plains Aquifer System Groundwater Availability Model, 640 p.,http://www.twdb.texas.gov/groundwater/models/gam/hpas/HPAS_GAM_Numerical_Report.pdf.

[6] Deeds, N. E., 2016, Delivery of GMA 1 Predictive Runs: Draft Technical Memorandum prepared for North Plains Groundwater Conservation District and Groundwater Management Area 1 for submission to Texas Water Development Board as part of Desired Future Conditions Submission Package, 18 p.:

[7] Goswami, R. R., 2017, GAM RUN 16-029 MAG: Modeled Available Groundwater for the aquifers in Groundwater Management Area 1: Texas Water Development Board, 17 pg.

[8] *Id.*

4.2.2.1.1 *Performance Standard*

1.3a Results from data collection and trend analysis will be presented to the Board of Directors during the annual review of depletion in the District by August 31st of each year.

SECTION 4.3 GOAL 2 PROVIDING FOR THE MOST EFFICIENT USE OF GROUNDWATER

Throughout its history, the District has operated on the core principle (or goal) that groundwater should be used as efficiently as possible for beneficial purposes. In order to achieve this goal, the District maintains a qualified staff to assist water users in protecting, managing, and conserving groundwater resources. The Board of Directors has in the past and continues today to base its decisions on the best data available to treat all water users as equitably as possible. Once data is collected, the District utilizes a wide variety of forums to provide important information to water users throughout the District so that sound decisions regarding the efficient use of groundwater can be made. The District's Observation Well Network will continuously be reviewed and maintained in order to monitor changing storage conditions of groundwater supplies within the District. The District will continue to undertake and cooperate with technical investigations of groundwater resources within the District. The following management objectives and performance standards have been developed and adopted to collect needed information, disseminate information, and provide opportunities through the District's Agricultural Water Conservation Equipment Loan Program to ensure the efficient use of groundwater.

4.3.1.1 Management Objective 2.1

The Observation Well Network, with approximately 850 water wells located throughout the District is continuously maintained and monitored. Wells in the Observation Well Network produce groundwater from the Ogallala Aquifer, the Dockum Aquifer, and also other minor aquifers in the area. Water levels are measured by District staff in as many wells as possible, with the management objective being to measure water levels in at least 90 percent of the wells in the Observation Well Network each year. This data is then processed for quality assurance/quality control, entered into the District's geodatabase, analyzed, mapped, and used to make decline calculations and update historic trend lines (hydrographs).

Water level measurements from wells in the District's Observation Well Network are used to generate annual decline maps. The District will strive to install additional monitoring wells in locations when necessary in order to evaluate the effects of high-impact pumping operations as necessary.

4.3.1.1.1 *Performance Standard*

2.1a Measure water levels in at least 90 percent of the operational water wells in the District's Observation Well Network annually by April 1st.

2.1b Using water level measurements collected from November to April from wells in the Observation Well Network, prepare an annual decline map based on changes in water levels observed in the last 12 months by July 31st and publish in next available District newsletter, Panhandle Water News (PWN).

2.1c Using water level measurements collected each year from wells in the Observation Well Network and historical information from the District's geodatabase, prepare an Ogallala Aquifer water table decline map for use in the Internal Revenue Service (IRS) annual depletion program. Provide results of IRS Ogallala Aquifer allowable depletion levels to participating producers by January 31st of each year.

4.3.1.2 Management Objective 2.2

The District encourages efficient groundwater use by continued promotion of low pressure and other efficient sprinkler systems, drip irrigation systems, and other recognized water conservation measures, which will decrease the utilization of less efficient row irrigation techniques. This will be accomplished by increasing the use of the District's Agricultural Water Conservation Equipment Loan Program, as long as TWDB Agricultural Loan Program funds are available and economically competitive. The District will enhance awareness of the loan program by utilizing local newspapers and the PWN. The District website will have information on availability of funds and guidelines for applicants. The District will strive to provide timely responses to loan applicants.

4.3.1.2.1 *Performance Standard*

2.2a The District will include a reminder about the District's Agricultural Water Conservation Equipment Loan Program at least bi-annually in the PWN, as long as funds are available at competitive rates.

2.2b District staff strives to complete the District review process for all loan applications and prepare for Board of Director consideration within 60 days of receipt of administratively complete loan applications.

4.3.1.3 Management Objective 2.3

The District encourages the efficient use of groundwater by disseminating educational information regarding current best management practices and trends in water conservation for agricultural, municipal, and industrial applications. The District publishes a newsletter quarterly that contains resources for water users interested in water conservation. In addition, the District also attends and participates in public events throughout the District including the annual Amarillo Farm and Ranch Show as often as possible.

4.3.1.3.1 *Performance Standard*

2.3a The District will publish Panhandle Water News (PWN) on a quarterly basis.

2.3b Each year the District will participate in the Amarillo Farm and Ranch Show, when held.

4.3.1.4 Management Objective 2.4

In order to ensure that the Board of Directors and District constituents are aware of and informed on the most current information on water conservation, groundwater management, and emerging policy issues related to groundwater resources, District staff actively participate in a broad grouping of professional associations that focus on water resource issues. District staff will report at the next available regularly scheduled Board of Directors meeting in the General Manager's Report on any activities resulting from participation with the following active affiliations:

- Texas Alliance of Groundwater Districts (TAGD)
- Texas Water Conservation Association (TWCA), and,
- Groundwater Management Districts Association (GMDA).

4.3.1.4.1 *Performance Standard*

2.4a District staff will attend and participate in 75 percent of the cumulative number of regularly scheduled TAGD, TWCA and GMDA general meetings and report on noteworthy presentations and issues from these meetings at the next available regularly scheduled Board of Directors meeting in the General Manager's Report.

4.3.1.5 Management Objective 2.5

The District has adopted rules that require an approved metering method on all wells producing more than 35 gallons per minute. The District believes that when a water user understands the volume of groundwater being used, they are better able to adopt best management practices that result in the efficient use of groundwater. Therefore, the District is committed to continuing the program focused on requiring a metering method for wells pumping more than 35 gallons per minute, flow meter monitoring, and data collection and analysis of water use by crop and irrigation type. To achieve this objective the District will read and record meter data from installed, registered, and accessible, meters in the District annually. The information from the District's metering program will be published in the District's Annual Report. Additionally, the District will provide water-users with meter data production reports. Finally, the Board will consider meter data with respect to individual Contiguous Acreage Tracts in order to document compliance with the District maximum allowable production rate.

4.3.1.5.1 *Performance Standard*

2.5a Read and record meter data for 90 percent of approved metering methods at least annually.

2.5b Based on data from the approved metering methods, Production Reports will be generated and sent to water-users by September 1st annually starting in 2020.

2.5c Review and prepare revised estimates to TWDB annual draft agricultural water use estimates based on District meter data and other relevant information and submit to designated TWDB staff within the timeframe requested.

SECTION 4.4 GOAL 3 CONTROLLING AND PREVENTING WASTE OF GROUNDWATER.

Another core principle adopted by the District since its inception in order to conserve groundwater resources of the region is by controlling and preventing the waste of groundwater. The following management objectives and performance standards have been developed and adopted as an integral component of the District's umbrella goal to achieve the 50/50 Management Standard.

4.4.1.1 Management Objective 3.1

The District is continuously working to take positive and prompt action to identify and address all reported wasteful practices and instances of waste located by District staff within the District. This effort involves the following actions to be taken by the District.

- Report each complaint to the landowner and/or operator within five working days.
- Resolve the complaint and note the corrective action taken.
- Report resolution of each complaint to the landowner/operator and to the Board at the next regularly scheduled meeting during the General Manager's Report.

4.4.1.1.1 *Performance Standards*

3.1a All notices or complaints will be recorded, investigated and reported to the landowner/operator within five working days.

3.1b Report each complaint and staff resolution to the Board of Directors at the next regularly scheduled meeting.

SECTION 4.5 GOAL 4 IMPLEMENT STRATEGIES TO ADDRESS DROUGHT CONDITIONS

In order to address drought conditions, the District has implemented a number of programs that are designed to positively support constituents in the District when drought conditions exist. While one of these efforts is described below in Management Objectives 4.1, others are documented elsewhere in the management plan. For example, the District operates a state-permitted precipitation enhancement program, described below in Goal 8.

4.5.1.1 Management Objective 4.1

In order to provide ongoing information regarding water conditions in the District, establish and maintain links to National Oceanic and Atmospheric Administration Drought Monitor indices are on the District website.

4.5.1.1.1 *Performance Standard*

4.1a Annually, the District will update links to the National Oceanic and Atmospheric Administration Drought Monitor indices are available for use on the District's website.

SECTION 4.6 GOAL 5 IMPLEMENT STRATEGIES TO ADDRESS CONJUNCTIVE SURFACE WATER MANAGEMENT ISSUES

The Canadian River Municipal Water Authority (CRMWA) supplements member city allocations of groundwater with supplies from Lake Meredith. The CRMWA system is the largest conjunctive use water provider in the State of Texas, providing a combination of groundwater and surface water to 11 member cities. All current CRMWA groundwater supplies are produced within the boundaries of the District.

The Greenbelt Water Authority (GWA) is the second surface water user with supplies inside the boundaries of the District. GWA is now also utilizing groundwater resources from the Ogallala Aquifer. The District will communicate with regards to rules and technical data as it applies to conjunctive use within the District.

4.6.1.1 Management Objective 5.1

In order to continually monitor the impact of declining surface-water availability on groundwater resources within the District, the General Manager or designee will participate in the Panhandle Water Planning Group (PWPG) with the two surface-water entities currently operating within the District. This activity helps facilitate regular communication and cooperation with regards to conjunctive use issues in the District.

4.6.1.1.1 *Performance Standard*

5.1a The District General Manger or designee will participate in at least 75 percent of the regularly scheduled PWPG meetings and activities throughout the current regional water planning cycle (2019 - 2024).

SECTION 4.7 GOAL 6 IMPLEMENT STRATEGIES THAT WILL ADDRESS NATURAL RESOURCE ISSUES

As part of the umbrella goal of achieving the adopted DFCs, the District recognizes that the protection of water quality is equally as important as working to ensure adequate water quantity. In order to protect the District's most important natural resource, the abundant, high quality groundwater resources, the District has for many years maintained and operated a water quality sampling program sampling different areas each summer which yields a complete set of data biennially.

4.7.1.1 Management objective 6.1

In order to control and prevent the contamination of groundwater, the District maintains and works to expand the groundwater quality monitoring. As part of this effort, an annual sampling program will be conducted within the District's Water Quality Network. The objective will be to sample at least 80 percent of the wells in the District's Water Quality Network on a biennial basis. Also, upon request the District will conduct analysis of water within current District sampling capabilities, including sites near oil and gas industry injection well sites.

4.7.1.1.1 *Performance Standards*

6.1a Sample 80 percent of the wells in the District's Water Quality Network on a biennial basis and report program status to the Board of Directors each year.

6.1b Record all water quality measurement data in the District's water quality database within 30 days of sampling.

SECTION 4.8 GOAL 7 IMPROVE OPERATING EFFICIENCY AND CUSTOMER SERVICE

4.8.1.1 Management Objective 7.1

Customer service is of great importance to the Board of Directors and Staff of the District. As detailed in the corresponding performance standards, the District will continue to provide timely response to customer assistance requests in the following areas:

- Pump flow tests.
- Processing of well drilling permits.
- Review and revision of District Rules, as necessary, to incorporate revisions required by new legislation and as necessary to achieve adopted Desired Future Conditions.
- Well camera recordings.

4.8.1.1.1 *Performance Standard*

7.1a Provide requested flow tests annually within five working days of the landowners requested date and report to the Board in the Annual Report.

7.1b General Manager's action on administrative completeness of well drilling permits taken and permit returned to customer within 10 working days of approval.

7.1c Provide the well camera service within five working days of request or the landowners requested date and return the information to the well operator within five working days, and archive a copy of the DVD into the District library and report to the Board in the Annual Report.

SECTION 4.9 GOAL 8 ADDRESSING PRECIPITATION ENHANCEMENT

Texas Water Code Section 36.1071(a)(7) requires groundwater conservation districts to include in the management plan a goal addressing precipitation enhancement. The District has one of the longest continuous precipitation enhancement programs in the Texas.

4.9.1.1 Management Objective 8.1

The District will continue to operate its Precipitation Enhancement Program throughout the planning horizon of this management plan. The program will operate within budget. A rain gauge network will be maintained and monitored to confirm precipitation enhancement results. Flight records will be collected and archived.

The program will abide by Texas Department of Licensing and Regulation requirements for testing, monitoring, and reporting in order to ensure compliance with permit guidelines. Results of the District's Precipitation Enhancement Program will be presented to the Board of Directors and included in the Annual Report each year.

4.9.1.1.1 Performance Standard

8.1a Annually conduct the Precipitation Enhancement Program from April 1st to September 30th.

8.1b Calculate the baseline costs for Precipitation Enhancement Program each year.

8.1c Collect and record rain gauge readings at least once a quarter.

8.1d Annually maintain all flight records on all precipitation enhancement operations and make available for review upon request.

8.1e. Provide precipitation enhancement annual report to Texas Department of Licensing and Regulation.

4.9.1.2 Management Objective 8.2

Educate the public with regards to the benefits of the District's Precipitation Enhancement Program through informational articles in the PWN and local newspapers, public presentations, and program summaries in the District's Annual Report each year.

4.9.1.2.1 Performance Standard

8.2a Publish an article about the Precipitation Enhancement Program in at least 2 of the quarterly issues of PWN.

8.2b Provide at least one article about the Precipitation Enhancement Program to all local newspapers annually.

8.2c District staff will give at least two presentations annually to a public or civic group regarding the Precipitation Enhancement Program.

8.2d Complete the Program Summary Report and include in District's Annual Report each year.

SECTION 4.10 GOAL 9 ADDRESSING CONSERVATION

Texas Water Code Section 36.0015 states, in part, that, "In order to provide for the conservation, preservation, protection, recharging, and prevention of waste of groundwater….Groundwater conservation districts may be created…are the state's preferred method of groundwater management through rules developed, adopted, and promulgated by a district in accordance with the provisions of this chapter." It is noteworthy that in this overview section of Texas water law addressing groundwater management that "conservation" is the first action groundwater conservation districts are to pursue. The 50/50 Management Standard can only be achieved if our groundwater resources are conserved in a manner that ensures adequate water resources will be available for future generations. While water conservation is a fundamental component of many of the District's programs, the following represent management objectives most focused on water conservation.

4.10.1.1 Management Objective 9.1

Continue and expand, when possible, the District's Groundwater Conservation Education Program. District staff will make presentations on the importance of water conservation to at least 5 civic organizations and in at least 30 educational settings. Annually, the District will award at least three college scholarships to students in the District based on participation in a water conservation essay competition. The District will maintain an Internet information page and launch an aggressive conservation education initiative called "Water Warriors", as well as work with other entities to present an ongoing Panhandle area water conservation symposium.

4.10.1.1.1 Performance Standards

9.1a Annually make a minimum of five civic educational presentations.

9.1b Annually make 30 presentations in educational settings.

9.1c Annually provide at least three scholarships to students residing within the District that have participated in the District's water conservation essay competition.

9.1d Continue Water Warrior Program as part of aggressive public relations and education campaign encouraging all users to make water conservation a high priority in at least three public presentations outside of school settings.

SECTION 4.11 GOAL 10 RAINWATER HARVESTING

Rainwater harvesting is becoming an increasingly important strategy for meeting water supply needs, especially in the more rural areas of Texas. While rainwater harvesting is one of the many topics included in the District's water conservation education programs, the following management objective and performance standards are specifically focused on rainwater harvesting.

4.11.1.1 Management Objective 10.1

The District has established and maintains a rainwater harvesting system and provides educational tours to the public regarding the many benefits of the system. Tours of the District office rainwater harvesting system are provided upon request. A link to an informational page highlighting the rainwater harvesting system will be maintained and updated as necessary on the District's website. In addition, a link to the TWDB website on rainwater harvesting will also be maintained on the District's website.

4.11.1.1.1 Performance Standard

10.1a Webpage highlighting the District's rainwater harvesting system along with information regarding availability of tours to the public is maintained and updated as necessary.

10.1b Link to the TWDB Rainwater Harvesting webpage is maintained on the District's webpage.

CHAPTER 5 GOALS DETERMINED NOT-APPLICABLE

SECTION 5.1 GOAL 11 RECHARGE ENHANCEMENT

The District has been a long-standing participant and supporter of recharge enhancement efforts, primarily in partnership with the Texas Water Development Board. However, lack of financial support from the Texas Legislature for this program has resulted in the suspension of this program on an indefinite basis. Due to the scale and nature of a recharge enhancement program and lack of participating support from either state or federal partners, the District has determined that a program addressing recharge enhancement by the District is not feasible at this time

SECTION 5.2 GOAL 12 CONTROL AND PREVENTION OF SUBSIDENCE

Although Furnans and others (2017)[9] classified the Ogallala Aquifer in the High Plains as having a high subsidence risk, and the Dockum Aquifer as having medium subsidence risk potential, the absence of any measured subsidence in the District over the extensive historical period of pumping and he geologic framework and unconfined nature of the Ogallala Aquifer in the region led to the District's determination that the risk of significant subsidence from occurring due to groundwater pumping is not sufficient to warrant the adoption of a goal, management objective, or performance standard to meet a subsidence goal.

[9] Furnans, J., Keester, M., Colvin, D., Bauer, J., Barber, J., Gin, G. Danielson, V., Erickson, L., Ryan, R., Khorzad, K., Worsley, A., Snyder, G., 2017, Final Report: Identification of the Vulnerability of the Major and Minor Aquifers of Texas to Subsidence with Regard to Groundwater Pumping TWDB Contract Number 1648302062, 434 pg.

SECTION 5.3 GOAL 13 BRUSH CONTROL

The Canadian River Municipal Water Authority has a large brush control project along the Canadian River in the District, and the District encourages that action, but the District has determined that a program addressing brush control by the District is not feasible at this time.

CHAPTER 6 POPULATION, WATER USE, AND WATER DEMANDS

Primary activities involved in the development of a water resources management plan include the analysis and development of projections of population, historical and current water use, and projections of water demands in the future (for a defined period of time). In order to develop projections for how much water supply we will need in the future, three questions must be answered: (1) how many people are there now and how much water has been used in the recent past, (2) how many people will there be in the future (population projections), and (3) how much water will be required to meet the needs of the projected population and other water use sectors in the future. These analyses to develop water demand projections are primarily conducted in Texas as part of the regional water supply planning process (created by the 75th Texas Legislature through the passage of Senate Bill 1 in 1997). Water demand projections are developed for the following water user categories; municipal, rural (county-other), irrigation, livestock, manufacturing, mining, and steam-electric power generation. These three tasks are then followed by the evaluation of current water supplies, comparison of water demands to water supplies in order to determine needs for additional water supplies, and finally the identification, evaluation, and selection of water management strategies to meet any water supply needs that identified. This section addresses population projections, water use, and water demands.

Based on information developed for the 2017 Texas State Water Plan, population projections for the District range from 170,045 in 2020 to 264,700 in 2070. This represents a 56 percent increase in population over the 50-year planning horizon. (Table 3, Figure 2).

Table 3 - Decadal population projections for Panhandle GCD included in the 2017 Texas State Water Plan.[10]

County	2020	2030	2040	2050	2060	2070
Armstrong	1,911	1,911	1,911	1,911	1,911	1,911
Armstrong - District *	1,764	1,764	1,764	1,764	1,764	1,764
Carson	6,354	6,520	6,632	6,632	6,632	6,632
Donley	3,788	3,788	3,788	3,788	3,788	3,788
Gray	24,439	27,046	30,168	34,186	37,388	40,730
Hutchinson	22,957	23,779	23,990	23,990	23,990	23,990
Hutchinson - District **	987	1,022	1,032	1,032	1,032	1,032
Potter	134,031	148,960	164,757	180,486	197,638	215,701
Potter - District ***	126,123	140,171	155,036	169,837	185,977	202,975
Roberts	1,003	1,047	1,047	1,047	1,047	1,047
Wheeler	5,587	5,809	6,019	6,239	6,478	6,733
Total	170,045	187,168	205,486	224,525	244,106	264,700
* - county total multiplied by apportioning factor (land area of District in county/land area of county) of 0.923.						
** - county total multiplied by apportioning factor (land area of District in county/land area of county) of 0.043.						
*** - county total multiplied by apportioning factor (land area of District in county/land area of county) of 0.941.						
District total represents the sum of population projections for Carson, Donley, Gray, Roberts, and Wheeler counties and the proportional population estimate based on the proportional amount of area in the county that is within the boundaries for counties partially within the jurisdictional boundaries of the District.						

[10] Texas Water Development Board, 2017, Water for Texas, Texas State Water Plan, variously paginated.

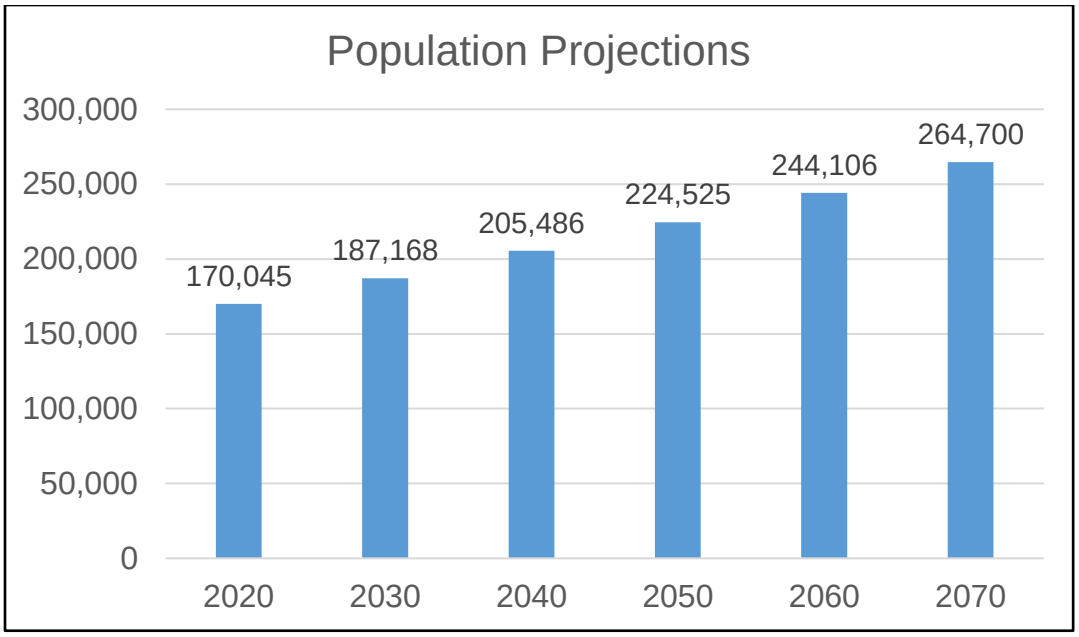

Figure 2 – Decadal population projections for Panhandle GCD included in the 2017 Texas State Water Plan.[11]

[11] Texas Water Development Board, 2017, Water for Texas, Texas State Water Plan, variously paginated

The next important component in planning for and management of water resources is an understanding of water use. The methods used to estimate groundwater use in the District have changed and improved over time, so that flow meters are now available and being used throughout the District to improve estimates of groundwater use. Groundwater use in the District for the six major water use sectors in 2016 (most currently available year) is estimated to be approximately 250,057 acre-feet (see Table 4 and

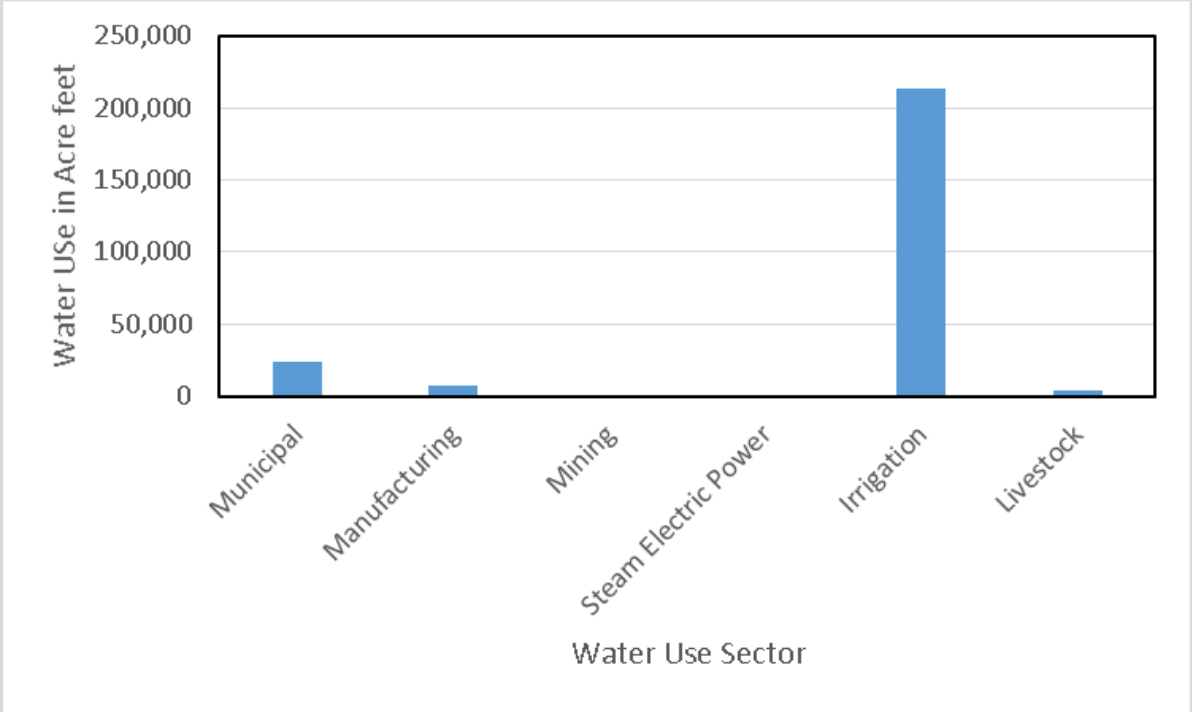

Figure 3 – Groundwater use in the District by water use sector (as defined in regional water planning) in 2016. Groundwater use estimates from Texas Water Development Board.)[12]. In 2016, irrigation continued to be the largest water use sector, representing 85.2 percent of the total groundwater pumpage. Historic estimates of both groundwater and surface water use from 2000 – 2016 are included in Appendix 4. Throughout the period of record, groundwater for irrigated agriculture in the District has been the largest use of groundwater from the Ogallala Aquifer.

[12] Allen, S., 2019, Estimated Historical Groundwater Use and 2017 State Water Plan Datasets: Panhandle Groundwater Conservation District: Texas Water Development Board Technical Report, 29 pg.

Table 4 - Water use estimates for the District in 2016[13]. (In acre-feet per year)

County	Municipal	Manufacturing	Mining	Steam Electric Power	Irrigation	Livestock	Total
Armstrong	305	0	0	0	6,292	243	6,840
Carson	834	987	0	0	104,042	314	106,177
Donley	78	0	0	0	29,946	692	30,716
Gray	736	264	0	0	41,766	1,584	44,350
Hutchinson	258	415	4	0	2,722	12	3,411
Potter	19,906	6,173	84	811	1,438	383	28,795
Roberts	170	0	16	0	9,545	300	10,031
Wheeler	1,389	0	90	0	17,381	877	19,737
District Total	23,676	7,839	194	811	213,132	4,405	250,057

Note - water use estimates for Armstrong, Hutchinson, and Potter counties are proportional to the area of the county within the District. Also, these water use estimates are for water use within the county, and not for water pumped within the county and transported outside of a county for use elsewhere. District total represents the sum of water use estimates for Carson, Donley, Gray, Roberts, and Wheeler counties and the proportional water use estimate based on the proportional amount of area in the county that is within the boundaries for counties partially within the jurisdictional boundaries of the District.

[13] Allen, S., 2019, Estimated Historical Groundwater Use and 2017 State Water Plan Datasets: Panhandle Groundwater Conservation District: Texas Water Development Board Technical Report, 29 pg.

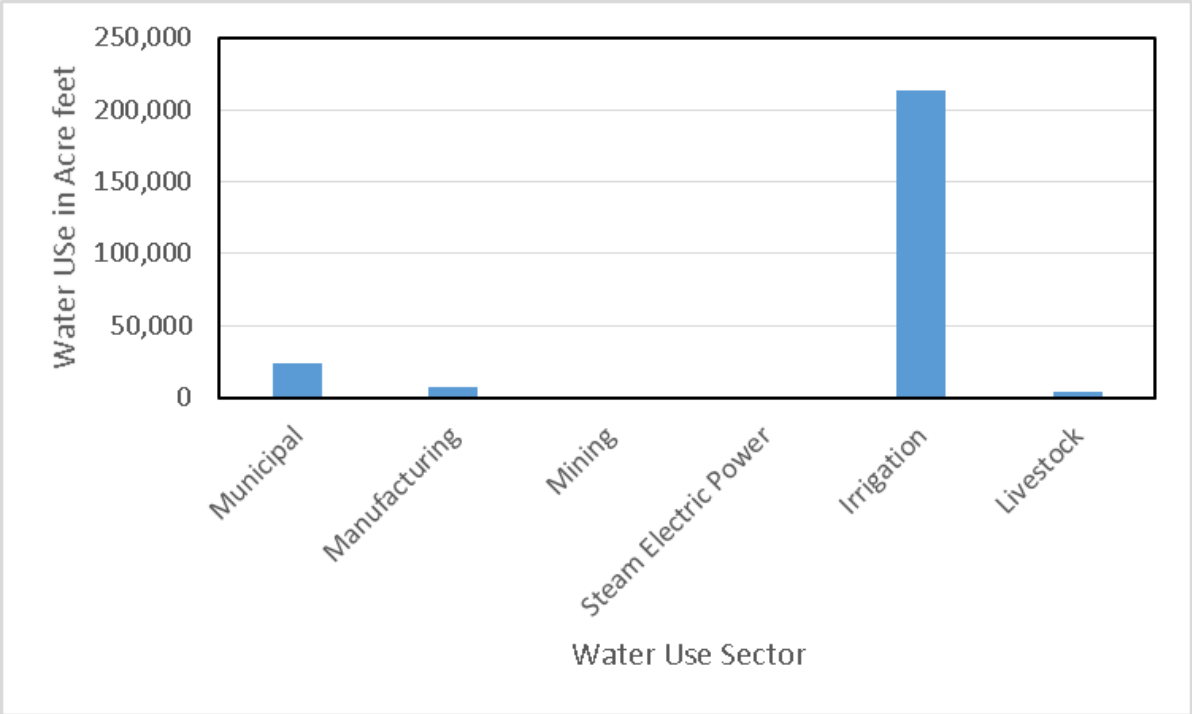

Figure 3 – Groundwater use in the District by water use sector (as defined in regional water planning) in 2016. Groundwater use estimates from Texas Water Development Board. (In acre-feet per year)[14]

The next step in the planning process is the development of water demand projections for the various water use sectors and water user groups over the course of the 50-year planning horizon. Water demand projections are updated for the regional water planning process every five years and are based on changes in population trends including information from the most recent U.S. Census, water use patterns, and changes in technology (for example, anticipated savings from drought tolerant crops in the future). Appendix 4 provides water demand projections for the six water use categories throughout the 50-year planning horizon and Table 5 along with Figure 4 provides summary information on water demands by county in the District. Water demands decrease from 218,939 acre-feet per year in 2020 to 200,513 acre-feet per year in 2070, representing an 8.4 percent decrease in water demands over the 50-year planning horizon.

[14] Allen, S., 2019, Estimated Historical Groundwater Use and 2017 State Water Plan Datasets: Panhandle Groundwater Conservation District: Texas Water Development Board Technical Report, 29 pg.

Table 5 - Cumulative water demand projections for Panhandle GCD included in the 2017 Texas State Water Plan[15]. (In acre-feet per year)

County	2020	2030	2040	2050	2060	2070
Armstrong*	4,910	4,716	4,453	4,073	3,695	3,317
Carson	58,106	55,294	51,273	45,880	40,508	35,140
Donley	26,033	25,141	23,771	21,338	18,912	16,486
Gray	33,086	33,051	32,205	31,540	30,024	28,652
Hutchinson **	7,664	7,697	7,598	7,474	7,389	7,320
Potter ***	66,843	71,545	76,613	81,549	89,596	97,437
Roberts	8,102	7,295	6,408	5,413	4,672	4,083
Wheeler	14,195	13,156	11,711	10,014	8,872	8,078
District Total	218,939	217,895	214,032	207,281	203,668	200,513

* County total multiplied by apportioning factor (land area of district in county/land area of county) of 0.9236

** county total multiplied by apportioning factor (land area of district in county/land area of county) of 0.0424

*** County total multiplied by apportioning factor (land area of district in county/land area of county) of 0.9412

District total represents the sum of water demand projections for Carson, Donley, Gray, Roberts, and Wheeler counties and the proportional water demand estimate based on the proportional amount of area in the county that is within the boundaries for counties partially within the jurisdictional boundaries of the District.

[15] Allen, S., 2019, Estimated Historical Groundwater Use and 2017 State Water Plan Datasets: Panhandle Groundwater Conservation District: Texas Water Development Board Technical Report, 29 pg.

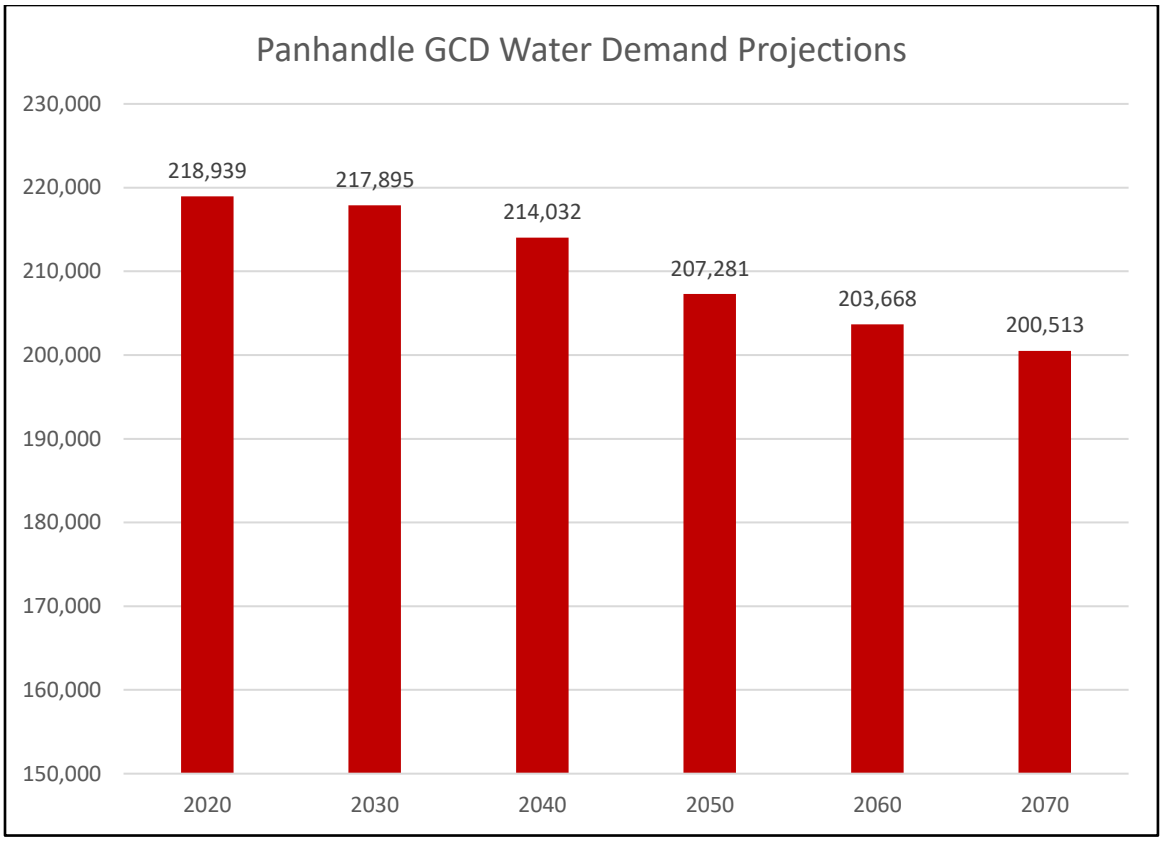

Figure 4 – Cumulative water demand projections for Panhandle GCD for the 50-year planning horizon approved by the Texas Water Development Board for the 2017 Texas State Water Plan. (In acre-feet per year)

CHAPTER 7 GROUNDWATER RESOURCES

The District has invested significant time and resources in an effort to improve the science and understanding of groundwater resources in the Panhandle of Texas. Most significantly, the District participated in the most recent update of the High Plains Aquifer System Groundwater Availability Model (High Plains GAM) approved by the Texas Water Development Board in 2015. This effort culminated in the publication of the High Plains GAM Report by Deeds and Jigmond (2015).[16] The District worked with the Texas Water Development Board during this effort to update the High Plains GAM through financial support, provision of meter data and new well logs, and technical reviews on draft reports. This updated planning and water resources evaluation tool has made significant improvements to the science available to the Board of Directors and Staff at the District, especially with regards to improved historic and current pumping estimates, hydrostratigraphy, and aquifer properties. The updated High

[16] Deeds, N. E., and Jigmond, M., 2015, Numerical Model Report for the High Plains Aquifer System Groundwater Availability Model, 640 p.,http://www.twdb.texas.gov/groundwater/models/gam/hpas/HPAS_GAM_Numerical_Report.pdf.

Plains GAM was most recently used by District Representatives in Groundwater Management Area 1 to evaluate potential predictive simulation scenarios and to establish estimates of modeled available groundwater resulting from the adoption of the 50/50 Management Standard and the 30-foot decline in the Dockum Aquifer.

The Ogallala Aquifer is the primary aquifer within the District and is located in sediments of the Ogallala Formation of Neogene (Pliocene) Period. The Ogallala Aquifer yields water from the mostly unconsolidated gravels, sands, silts, and clays of the Ogallala Formation. Groundwater movement is generally to the northeast, away from groundwater and topographic highs and towards the surface drainage system of the Canadian River basin (Figure 5). There are areas where flow is toward groundwater lows that have developed as a result of production in large well fields. Areas where irrigation wells are co-located with municipal well fields have experienced significant water table declines. Other irrigated areas have demonstrated varying water level declines.

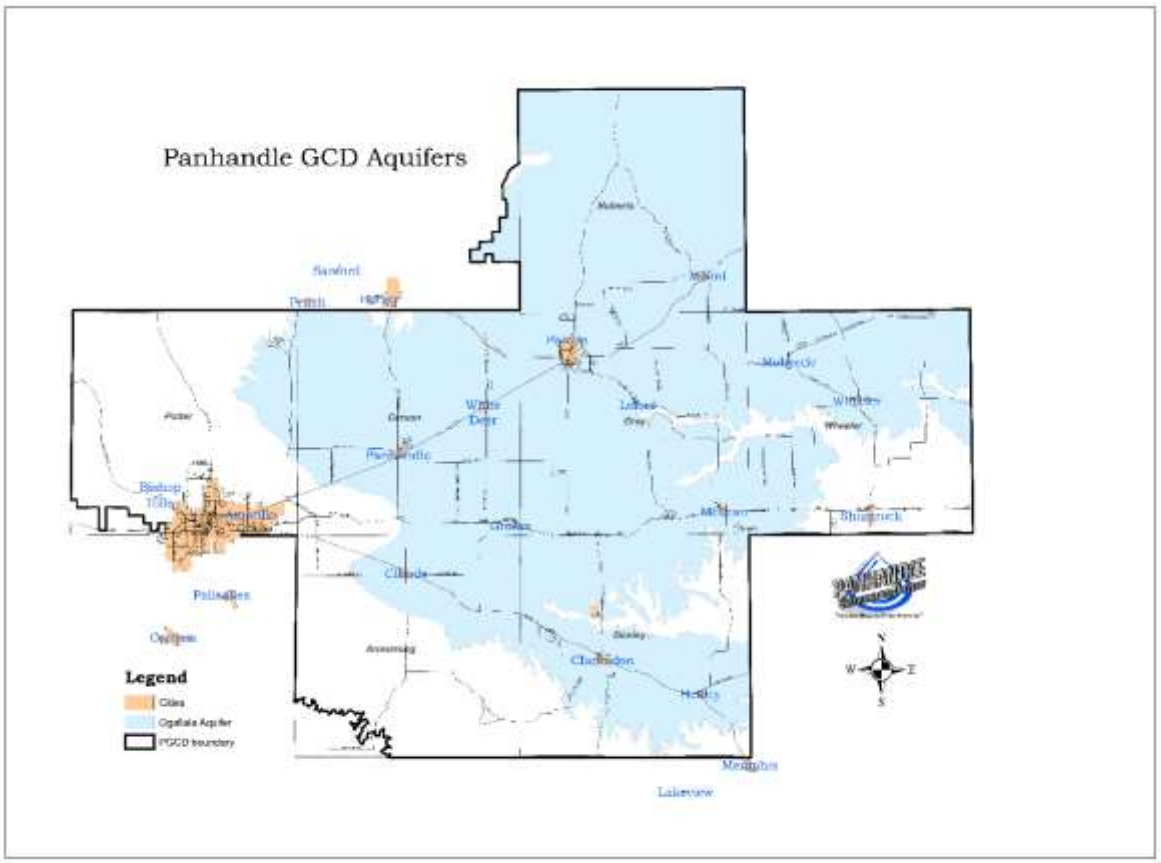

Figure 5 – Map illustrating the areal extent of the Ogallala Aquifer in the District.

In addition to the Ogallala Aquifer, there are three minor aquifers within the District. The Dockum Aquifer furnishes limited amounts of household, livestock and irrigation water within the District. The Dockum Aquifer is present in Triassic age shales, sandstones and siltstones where it is found within the District. Water production from the Dockum Aquifer occurs in Armstrong, Potter and southwest Carson counties (Figure 6).

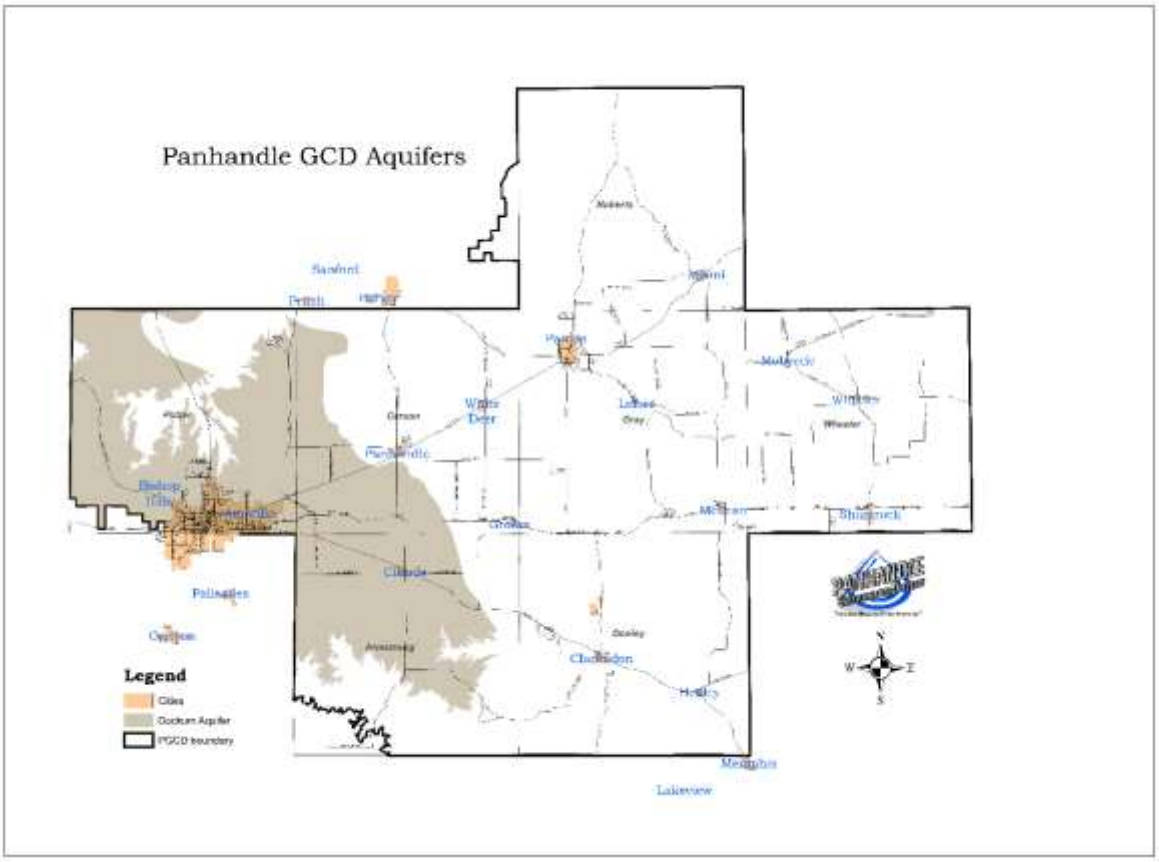

Figure 6 – Map illustrating the areal extent of the Dockum Aquifer in the District.

The Blaine Aquifer is a minor aquifer located in the southern portion of Wheeler County (Figure 7). For the purposes of joint planning, District Representatives classified the Blaine Aquifer as non-relevant. As such, no goals, management objectives, or performance standards are adopted in this management plan for the Blaine Aquifer. The aquifer is contained in the Permian age Blaine Formation. The water is found in solution channels formed by dissolving deposits of anhydrite and halite within the formation. The dissolving salts raise the total dissolved solids to levels above drinking water standards, so the Blaine Aquifer is used mainly for agricultural purposes.

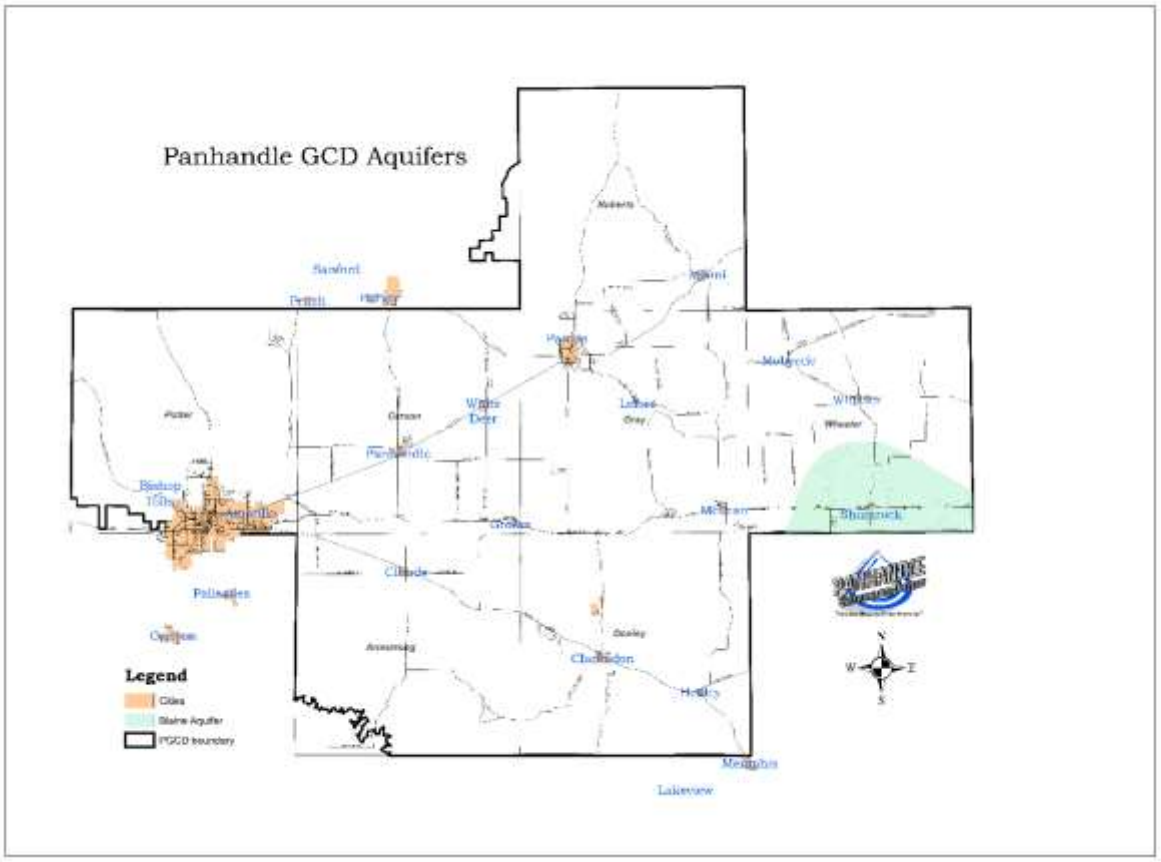

Figure 7 – Map illustrating the areal extent of the Blaine Aquifer in the District.

Texas Water Code Section 36.1071 requires groundwater conservation districts to consider and utilize information from the current groundwater availability model and site-specific information during development of the management plan. As part of this requirement, groundwater conservation districts are to consider estimates of (1) the annual amount of recharge from precipitation to the groundwater resources within the district, if any;(2) 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 (3) the annual volume of flow into and out of the district within each aquifer and between aquifers in the district. This information was provided by the Texas Water Development Board in Wade (2016)[17] to the District for this management plan. The required estimates for the Ogallala, Dockum, and Blaine aquifers are included in Table 6, Table 7, and Table 8.

[17] Wade, S., 2016, GAM RUN 16-001: Panhandle Groundwater Conservation District Management Plan, Texas Water Development Board, 15 p.

Table 6 – Estimates of recharge, discharge, flow into and out of the District and between each aquifer of the District for the Ogallala Aquifer.[18] (In acre-feet per year)

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Ogallala Aquifer	113,864
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Ogallala Aquifer	129,654
Estimated annual volume of flow into the district within each aquifer in the district	Ogallala Aquifer	39,686
Estimated annual volume of flow out of the district within each aquifer in the district	Ogallala Aquifer	26,155
Estimated net annual volume of flow between each aquifer in the district	From the Ogallala Aquifer into Underlying units	2,663

[18] Wade, S., 2016, GAM RUN 16-001: Panhandle Groundwater Conservation District Management Plan, Texas Water Development Board, 15 p.

Table 7 - Estimates of recharge, discharge, flow into and out of the District and between each aquifer of the District for the Dockum Aquifer. (In acre-feet per year)

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Dockum Aquifer	2,333
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Dockum Aquifer	7,937
Estimated annual volume of flow into the district within each aquifer in the district	Dockum Aquifer	4,111
Estimated annual volume of flow out of the district within each aquifer in the district	Dockum Aquifer	1,337
Estimated net annual volume of flow between each aquifer in the district	From overlying units into the Dockum Aquifer	2,663

Table 8 - Estimates of recharge, discharge, flow into and out of the District and between each aquifer of the District for the Blaine Aquifer. (In acre-feet per year)

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Blaine Aquifer	3,702
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Blaine Aquifer	5,165
Estimated annual volume of flow into the district within each aquifer in the district	Blaine Aquifer	0
Estimated annual volume of flow out of the district within each aquifer in the district	Blaine Aquifer	5,096
Estimated net annual volume of flow between each aquifer in the district	Blaine Aquifer	0*

*This model assumes a no-flow boundary at the base of the Blaine Aquifer.

Over the past century, there have been many hydrogeologic investigations focused on the Ogallala Aquifer and to a much lesser extent, the Dockum Aquifer. A detailed discussion of the hydrogeology of the District based on the published scientific literature is clearly beyond the scope of this management plan. For those interested in additional information, the following technical publications are recommended; Johnson (1901)[19], White and others (1946)[20], Seni (1980)[21], Knowles and others (1984)[22], Gutentag and others (1984)[23], Bradley and Kalaswad (2003)[24], Dutton and Simpkins, (1986)[25], Dutton and others, (2001)[26], Dutton (2004)[27]; Gustavson and others (1995)[28], Nativ (1988)[29], Wood and Osterkamp, (1987)[30]; Wood and

[19] Johnson, W. D., 1901, The High Plains and their utilization: U. S. Geological Survey 21st Annual Report, 1890-1900, pt. 4, p. 601-741.

[20] White, W. N., Broadhurst, W. L. and Lang, J. W., 1946, Ground water in the High Plains of Texas: T. S. Geological Survey Water-Supply Paper 889-F, p. 381-420.

[21] Seni, S. J., 1980. Sand-body geometry and depositional systems, Ogallala Formation, Texas. The University of Texas at Austin, Bureau of Economic Geology Report of Investigations No. 105, 36 p.

[22] Knowles, T. R., Nordstrom, P., and Klempt, W. B., 1984, Evaluating the ground-water resources of the High Plains of Texas: Texas Department of Water Resources Report 288, v. 1, 119 p.

[23] Gutentag, E. D., Heimes, F. J., Krothe, N. C., Luckey, R. R., and Weeks, J. B., 1984, Geohydrology of the High Plains Aquifer in parts of Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming: U. S. Geological Survey Professional Paper 1400-B, 63 p.

[24] Bradley, R. G., and Kalaswad, S., 2003, The groundwater resources of the Dockum Aquifer in Texas: Texas Water Development Board Report 359, 73 p.

[25] Dutton, A.R., and Simpkins, W. W.,, 1986, Hydrochemistry and water resources of the Triassic Lower Dockum Group in the Texas Panhandle and Eastern New Mexico; of Economic Geology, The University of Texas at Austin, Report of Investigations No. 161, 51 p.

[26] Dutton, A. R., Reedy, R. C., and Mace, R. E., 2001, Saturated thickness in the Ogallala Aquifer in the Panhandle Water Planning Area—simulation of 2000 through 2050 withdrawal projections: Final Contract Report prepared for the Panhandle Water Planning Group, Panhandle Regional Planning Commission (contract number UTA01-462) by the Bureau of Economic Geology, The University of Texas at Austin, 130 p.

[27] Dutton, A. R., 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.

[28] Gustavson, T. C. Holliday, V. T., and Hovorka, S. D., 1995, Origin and de4velopment of playa basins, sources of recharge to the Ogallala aquifer, Southern High Plains, Texas and New Mexico; The University of Texas at Austin, Bureau of Economic Geology, Report of Investigations No. 229, 44 p.

[29] Nativ, R., 1988, Hydrology and hydrochemistry of the Ogallala Aquifer, Southern High Plains, Texas Panhandle and Eastern New Mexico: The University of Texas at Austin, Bureau of Economic Geology Report of Investigations No. 177, 64 p.

[30] Wood, W. W., and Osterkamp, W. R., 1987, Playa-lake basins on the Southern High Plains of Texas and New Mexico: Part II, A hydraulic model and mass-balance argument for their development: Geological Society of America Bulletin, v. 99, no. 2, p. 224-230.

Sanford, (1995)[31]; Mullican and others, (1997)[32]; Scanlon and Goldsmith, (1997)[33], Scanlon and others (1997)[34], McMahon and others, (2006)[35], and Deeds and Jigmond, (2015)[36].

Primary sources of recharge to the Ogallala Aquifer are infiltration of water from playa lakes and infiltration of precipitation. Localized infiltration of water from playa lakes is the main recharge mechanism in the part of the District located "above the Caprock."

The District has determined that the most feasible method of increasing natural recharge is to increase rainfall by initiating a rainfall enhancement program. The objective of this program is to decrease irrigation demand and increase recharge in those areas where recharge takes place. Cloud seeding operations began in May 2000. The purpose of the cloud seeding program is to add additional rainfall over an extended period. One additional inch of rainfall could provide 2300 acre-feet of additional recharge within the District each year (PGCD, 2001)[37].

CHAPTER 8 SURFACE WATER RESOURCES

While groundwater clearly provides the vast majority of water supplies within the District, it is still important to consider surface water resources during the development of this management plan. Also, Texas Water Code §36.1071(e)(3)(F) requires the inclusion of estimates of projected surface water supplies in the District based on the most recently adopted Texas State Water Plan. These estimates summarized at the county level are presented below in Table 9 and increases slightly from 4,349 acre-feet per year in 2020 to 4,394 in 2070. (Readers note – estimates of groundwater resources as represented by estimates of modeled available groundwater (MAG), as determined based on the adopted desired future conditions, are included in Tables 1 and 2.

[31] Wood, W. W., and Sanford, W.E., 1995. Chemical and isotopic methods for quantifying ground-water recharge in a regional semi-arid environment. Ground Water 33, 458-468.

[32] Mullican, W. F., III. Johns, N. D., and Fryar, A. E., 1997, Playas and recharge of the Ogallala Aquifer on the Southern High Plains of Texas – An examination using numerical techniques; The University of Texas at Austin, Bureau of Economic Geology Report of Investigations No. 242, 72 p.

[33] Scanlon, B.R., and Goldsmith, R.S., 1997. Field study of spatial variability in unsaturated flow beneath and adjacent to playas. Water Resources Research 33, 2239-2252.

[34] Scanlon, B. R., Goldsmith, R. S., and Mullican, W. F., III, 1997, Spatial variability in unsaturated flow beneath playa and adjacent interplay settings and implications for contaminant transport, Southern High Plains, Texas: The University of Texas at Austin, Bureau of Economic Geology Report of Investigations No. 243, 68 p.

[35] McMahon, P.B., Dennehy, K.F., Bruce, B.W., Bohlke, J.K., Michel, R.L., Gurdak, J.J., Hurlbut, D.B., 2006. Storage and transit time of chemicals in thick unsaturated zones under rangeland and irrigated cropland, High Plains, United States. Water Resources Research 42, Article No. 34013.

[36] Deeds, N. E., and Jigmond, M., 2015, Numerical Model Report for the High Plains Aquifer System Groundwater Availability Model, 640 p.,http://www.twdb.texas.gov/groundwater/models/gam/hpas/HPAS_GAM_Numerical_Report.pdf.

[37] Panhandle Groundwater Conservation District, 2001, Annual Evaluation Report on the District's Precipitation Enhancement Program, 15 p.

A detailed breakdown of the summary information provided in Table 9 is included in Appendix 4. The volume of surface water resources identified in the 2017 Texas State Water Plan that is available to the District was reduced significantly from the 2012 Texas State Water Plan (for example, from 22,070 acre-feet per year in 2020 in the 2012 Texas State Water Plan to 4,349 acre-feet per year in 2020 in the 2017 Texas State Water Plan), primarily due to the reductions in firm yield available from Lake Meredith resulting from the impact of the severe drought in 2011. As a result of reduced surface water in storage in Lake Meredith during 2011, no surface water was pumped form the reservoir from late summer in 2011 through the spring of 2014. This interruption in surface water supply from Lake Meredith during the drought of 2011 led to the significant reduction in firm supply that can be relied upon during the regional water planning process.

Lake Meredith and Lake Greenbelt are the two major surface impoundments used to supply water to cities inside and outside the District. There are also numerous other small reservoirs used for agricultural purposes and environmental needs. Lake Meredith is located in parts of Hutchinson, Moore, and Potter counties, and is operated by the Canadian River Municipal Water Authority (CRMWA) as a municipal and industrial water supply for 11 member cities of the Authority. The lake is owned by the United States Bureau of Reclamation and is operated as a National Recreation Area by the National Park Service. Water rights to impound water in the lake (up to 500,000 acre-feet may be held in conservation storage), and to divert water from it for municipal and industrial uses, are held by the Authority under certificates of adjudication issued by the State of Texas. The Ogallala Aquifer now provides most of the water that CRMWA delivers to its member cities. Supplemental water is obtained from Lake Meredith to fulfill the annual CRMWA allocations, however, for the first time since opening, there were no deliveries of surface water to member cities from Lake Meredith in 2012 - 2013. Water from the lake is blended with local groundwater from individual municipality well fields by several cities. Member cities use the water from CRMWA to supply their base demand, and rely upon their localized groundwater supplies to meet their peak demands. Pampa and Amarillo, two of the CRMWA member cities, within the boundaries of the District, follow the latter procedure. The second surface impoundment is Greenbelt Lake, located in Donley County. Greenbelt Municipal & Industrial Water Authority (Greenbelt) is the proprietor and operator.

Table 9 - Projected surface water supplies included in the 2017 Texas State Water Plan[38] (In acre-feet per year)

County	2020	2030	2040	2050	2060	2070
Armstrong	113	113	113	113	113	113
Carson	411	411	411	411	411	411
Donley	766	773	781	790	801	811
Gray	855	855	855	855	855	855
Hutchinson	16	16	16	16	16	16
Potter	529	529	529	529	529	529
Roberts	211	211	211	211	211	211
Wheeler	1,448	1,448	1,448	1,448	1,448	1,448
District Total	4,349	4,356	4,364	4,373	4,384	4,394

CHAPTER 9 WATER MANAGEMENT PLAN

During the regional water planning process in Texas, a water supply need is identified if the projected demands exceed the supply for an individual water user group or wholesale water provider. Water supply needs are quantified on an individual water user group basis, then summarized at the county, groundwater conservation district, regional water planning area, and statewide basis. If no water user group is determined to have a need for additional water supply during drought conditions, then the need for additional supply will be recorded as "0". A review of summary data for counties in the District documents that six of the eight counties in the District have a need for additional water supply throughout the 50-year planning horizon (see Table 10). Only Donley and Roberts counties do not have at least some need for additional water supplies during the 50-year planning horizon. Potter County has the most significant need for additional water supplies, projected to be 39,238 acre-feet per year by 2070. For a complete breakdown of water supply needs by water user groups see Appendix 4.

[38] Allen, S., 2016, Estimated Historical Groundwater Use And 2017 State Water Plan Datasets for the Panhandle Groundwater Conservation District: Texas Water Development Board, 25 p.

Table 10 - Projected water supply needs in the District from the 2017 Texas State Water Plan[39]. Values in red (-) indicate that water user groups in the county have been identified with water supply needs. A value of zero indicates that no water supply need has been identified for the county for the decade listed. (In acre-feet per year)

County	2020	2030	2040	2050	2060	2070
Armstrong		0	0	-35	-72	-110
Carson	-89	-521	-582	-577	-576	-576
Donley	0	0	0	0	0	0
Gray	0	-1,752	-2,491	-2,279	-3,120	-3,988
Hutchinson	-167	-1,642	-3,066	-4,538	-5,834	-7,128
Potter	-5,270	-11,415	-18,509	-25,526	-32,001	-39,238
Roberts	0	0	0	0	0	0
Wheeler	-184	-249	-308	-365	-412	-453
District Total	-5710	-15579	-24956	-33320	-42015	-51493

The final step in the Texas regional water planning process is to identify, evaluate, and then recommend or select water management strategies to meet all identified needs for additional water supply. Basically, any water user group, whether it is a city or irrigated agriculture or mining (at a county aggregate level) for example, that is determined to have a need for additional water supply for any decade during the 50-year planning horizon will go through a deliberate process of identifying all potentially feasible water management strategies to meet the identified need, evaluate the cost, reliability, yield, impact to the environment and water quality, and then recommend the most appropriate strategy or combination of water management strategies to meet the identified needs. Table 11 provides a summation by county of the projected volume of water supply that will result from implementation of all recommended water management strategies. Appendix 4 includes the individual water management strategies recommended in the 2017 Texas State Water Plan to meet the identified needs for additional water supply. An examination of more significant water management strategies recommended for water user groups in the District includes:

- Agricultural water conservation strategies,
- Municipal water conservation,
- Development of additional groundwater supplies,
- Weather modification,
- Water audits and leak repairs,
- Conjunctive use, and
- Expand infrastructure capacity (CRMA II).

[39] Allen, S., 2016, Estimated Historical Groundwater Use And 2017 State Water Plan Datasets for the Panhandle Groundwater Conservation District: Texas Water Development Board, 25 p.

Table 11 - Summation of water supplies resulting from recommended water management strategies included for the District in the 2017 Texas State Water Plan[40]. (In acre-feet per year)

County	2020	2030	2040	2050	2060	2070
Armstrong	637	856	1,551	1,630	1,699	1,730
Carson	9,502	12,434	18,271	19,534	20,298	20,670
Donley	2,716	3,363	4,315	4,608	4,944	5,138
Gray	5,763	7,663	9,614	11,898	12,351	12,712
Hutchinson	13,163	18,835	22,749	23,937	24,715	25,272
Potter	9,713	24,948	32,701	32,369	34,383	42,360
Roberts	921	1,204	1,825	1,961	2,036	2,076
Wheeler	1,884	2,196	2,721	2,856	2,974	3,039
District Total	44,299	71,499	93,747	98,793	103,400	112,997

[40] Allen, S., 2016, Estimated Historical Groundwater Use And 2017 State Water Plan Datasets for the Panhandle Groundwater Conservation District: Texas Water Development Board, 25 p.

Appendix 1

Texas Water Development Board Administrative Review Checklist

Texas Water Development Board

Groundwater Conservation District Management Plan Checklist, effective December 6, 2012

District name: Panhandle Groundwater Conservation District

Reviewing staff:	**Date plan received:**
	Date plan reviewed:

A management plan shall contain, unless explained as not applicable, the following elements, 31 TAC §356.52(a):

	Citation of rule	Citation of statute	Present in plan and administratively complete	Source of data	Evidence that best available data was used
Is a paper hard copy of the plan available?	31 TAC §356.53(a)(1)		Yes		
Is an electronic copy of the plan available?	31 TAC §356.53(a)(2)		Yes		
1. Is an estimate of the modeled available groundwater in the District based on the desired future condition established under Section 36.108 included?	31 TAC §356.52(a)(5)(A)	TWC §36.1071(e)(3)(A)	Ogallala Aquifer – Subsection 4.2.1, pg. 7-8 Dockum Aquifer - Subsection 4.2.1.1, pg. 9-10		

2. Is an estimate of the amount of groundwater being used within the District on an annual basis for at least the most recent five years included?	31 TAC §356.52(a)(5)(B); §356.10(2)	TWC §36.1071(e)(3)(B)	See Chapter 6, pg. 23-25, and Appendix 4		
For sections 3-5 below, each district must use the groundwater availability modeling information provided by the TWDB in conjunction with available site-specific information provided by the district when developing the required estimates, 31 TAC §356.52(c):					
3. Is an estimate of the annual amount of recharge, from precipitation, if any, to the groundwater resources within the District included?	31 TAC §356.52(a)(5)(C)	TWC §36.1071(e)(3)(C)	Chapter 7, pg. 31 – 32, and Appendix 5		
4. For each aquifer in the district, is an estimate of the annual volume of water that discharges from the aquifer to springs and any surface water bodies, including lakes, streams and rivers, included?	31 TAC §356.52(a)(5)(D)	TWC §36.1071(e)(3)(D)	Chapter 7, pg. 31 – 32, and Appendix 5		
5. Is an estimate of the annual volume of flow	31 TAC §356.52(a)(5)(E)	TWC §36.1071(e)(3)(E)			
a) into the District within each aquifer,			Chapter 7, pg. 31 – 32, and Appendix 5		
b) out of the District within each aquifer,			Chapter 7, pg. 31 – 32, and Appendix 5		
c) and between aquifers in the District,			Chapter 7, pg. 31 – 32, and Appendix 5		
if a groundwater availability model is available, included?					
6. Is an estimate of the projected surface water supply within the District according to the most recently adopted state water plan included?	31 TAC §356.52(a)(5)(F)	TWC §36.1071(e)(3)(F)	Chapter 8, pg. 35 – 35=6, and Appendix 4		

7. Is an estimate of the projected total demand for water within the District according to the most recently adopted state water plan included?	31 TAC §356.52(a)(5)(G)	TWC §36.1071(e)(3)(G)	Chapter 6, pg. 26 – 27, and Appendix 4		
8. Did the District consider and include the water supply needs from the adopted state water plan?		TWC §36.1071(e)(4)	Chapter 9, pg. 37 – 38, and Appendix 4		
9. Did the District consider and include the water management strategies from the adopted state water plan?		TWC §36.1071(e)(4)	Chapter 9, pg. 37 – 38, and Appendix 4		
10. Did the district include details of how it will manage groundwater supplies in the district	31 TAC §356.52(a)(4)		Chapter 3, pg. 3-5		
11. Are the actions, procedures, performance, and avoidance necessary to effectuate the management plan, including specifications and proposed rules, all specified in as much detail as possible, included in the plan?		TWC §36.1071(e)(2)	Section 4.1, pg. 6		
12. Was evidence that the plan was adopted, after notice and hearing, included? Evidence includes the posted agenda, meeting minutes, and copies of the notice printed in the newspaper(s) and/or copies of certified receipts from the county courthouse(s).	31 TAC §356.53(a)(3)	TWC §36.1071(a)	Appendix 2		
13. Was evidence that, following notice and hearing, the District coordinated in the development of its management plan with regional surface water management entities?	31 TAC §356.51	TWC §36.1071(a)	Appendix 6		
14. Has any available site-specific information been provided by the district to the executive administrator for review and comment before being used in the management plan when developing the estimates required in subsections 31 TAC §356.52(a)(5)(C),(D), and (E) ?	31 TAC §356.52(c)	TWC §36.1071(h)	No		

Mark an affirmative response with YES
Mark a negative response with NO
Mark a non-applicable checklist item with N/A

Management goals required to be addressed unless declared not applicable	**Management goal** (time-based and quantifiable) 31 TAC §356.51	**Methodology for tracking progress** 31TAC §356.52(a)(4)	**Management objective(s)** (specific and time-based statements of future outcomes) 31 TAC §356.52 (a)(2)	**Performance standard(s)** (measures used to evaluate the effectiveness of district activities) 31 TAC §356.52 (a)(3)	**Notes**
Providing the most efficient use of groundwater 31 TAC 356.52(a)(1)(A); TWC §36.1071(a)(1)	15) 4.3	16) 4.1, 4.3, 4.3.1.2, 4.3.1.3, 4.3.1.4, 4.3.1.5,	17) 4.3.1.1, 4.3.1.2, 4.3.1.3, 4.3.1.4, 4.3.1.5	18) 4.3.1.1.1, 4.3.1.2.1, 4.3.1.3.1, 4.3.1.4.1, 4.3.1.5.1	p. 11-13
Controlling and preventing waste of groundwater 31 TAC 356.52(a)(1)(B); TWC §36.1071(a)(2)	19) 4.4	20) 4.4, 4.4.1.1	21) 4.4.1.1	22) 4.4.1.1.1	p. 14
Controlling and preventing subsidence 31 TAC 356.52(a)(1)(C); TWC §36.1071(a)(3)	23) NA	24) NA	25) NA	26) NA	p. 19
Addressing conjunctive surface water management issues 31 TAC 356.52(a)(1)(D); TWC §36.1071(a)(4)	27) 4.6	28) 4.6, 4.6.1.1	29) 4.6.1.1	30) 4.6.1.1.1	p. 15
Addressing natural resource issues that impact the use and availability of groundwater and which are impacted by the use of groundwater 31 TAC 356.52(a)(1)(E); TWC §36.1071(a)(5)	31) 4.7	32) 4.7, 4.7.1.1	33) 4.7.1.1	34) 4.7.1.1.1	p. 16
Addressing drought conditions 31 TAC 356.52(a)(1)(F); TWC §36.1071(a)(6)	35) 4.5	36) 4.5, 4.5.1.1,	37) 4.5.1.1,	38) 4.5.1.1.1	p. 14-15
Addressing a) conservation, b) recharge enhancement, c) rainwater harvesting, d) precipitation enhancement, and e) brush control where appropriate and cost effective 31 TAC 356.52(a)(1)(G); TWC §36.1071(a)(7)	39)	40)	41)	42)	
	39a) 4.10	40a) 4.10, 4.10.1.1	41a) 4.10.1.1	42a) 4.10.1.1.1	p. 18
	39b) NA	40b) NA	41b) NA	42b) NA	p. 19
	39c) 4.11	40c) 4.11, 4.11.1.1	41c) 4.11.1.1	42c) 4.11.1.1	p. 18-19
	39d) 4.9	40d) 4.9, 4.9.1.1, 4.9.1.2	41d) 4.9.1.1, 4.9.1.2	42d) 4.9.1.1.1, 4.9.1.2.1	p. 17
	39e) NA	40e) NA	41e) NA	42e) NA	p. 20
Addressing the desired future conditions established under TWC §36.108. 31 TAC 356.52(a)(1)(H); TWC §36.1071(a)(8)	43) 4.2	44) 4.2, 4.2.1, 4.2.1.1, 4.2.1.2, 4.2.2, 4.2.2.1	45) 4.2.1.1, 4.2.1.2, 4.2.2.1	46) 4.2.1.1.1, 4.2.1.2.1, 4.2.2.1.1	p. 6-11

Does the plan identify the performance standards and management objectives for effecting the plan? 31 TAC §356.52(a)(2)&(3); TWC §36.1071(e)(1)		47) Chapter 4, pg. 5 - 18	48) Chapter 4, pg. 5 - 18	
Mark required elements that are present in the plan with YES Mark any required elements that are missing from the plan with NO Mark plan elements that have been indicated as not applicable to the district with N/A				

Appendix 2

Documentation for public notices of Panhandle Groundwater Conservation District Board of directors of July 25, 2019, during which the Management Plan was adopted

PANHANDLE GROUNDWATER CONSERVATION DISTRICT

BOARD OF DIRECTORS MEETING
AND
PUBLIC HEARING ON AMENDMENTS TO DISTRICT'S MANAGEMENT PLAN
DISTRICT OFFICE - Windmill Room
201 W. Third Street, White Deer, Texas
July 25, 2019 - 9:00 a.m.

Agenda

1. CALL TO ORDER

2. PUBLIC COMMENT – Please limit comments to 3 minutes.

3. CONSIDERATION AND POSSIBLE ACTION ON MINUTES
   a. Board Meeting 06/27/19

4. CONSIDERATION AND POSSIBLE ACTION TO RATIFY JUNE 2019 EXPENDITURES

5. REPORT FROM BUDGET COMMITTEE AND CONSIDERATION AND POSSIBLE ACTION ON THE 2019-2020 BUDGET

6. CONSIDERATION AND POSSIBLE ACTION ON 2019-2020 TAX RATE

7. CONSIDERATION AND POSSIBLE ACTION ON QUARTERLY PRODUCTION REPORTS AND OUT OF DISTRICT TRANSPORTATION REPORTS FROM THE CITY OF AMARILLO, CONOCO PHILLIPS, CRMWA, THE CITY OF BORGER, THE CITY OF FRITCH, THE CITY OF MEMPHIS, THE CITY OF CLARENDON, BRICE-LESLEY AND GREENBELT WATER AUTHORITY

8. CONSIDERATION AND POSSIBLE ACTION TO APPOINT A REPRESENTATIVE TO THE AMARILLO TIRZ #2 BOARD

9. CONSENT AGENDA – DRILLING PERMITS
   The following items are part of the Consent Agenda. All Well Permit requests have been thoroughly reviewed by staff, are administratively complete and the General Manager is recommending issuance.

RECLASSIFY WELLS – None

IRRIGATION WELLS –

1. CA-1332-R Wade Ritter – A 6" well to be drilled on 640 ac by Matt Litchie by June 1, 2019 in the NW4 of Sec 74, Blk 7, I&GN Survey (being located approx. 2 mi S of Hwy 60 on CR U, at the intersection of CR U & CR 13, on the S side of CR 13 and E side of CR U) Carson County Texas **REPLACEMENT WELL**

2. CA-1334-R Charles Britten – A 6" well to be drilled on 1,733 ac by Matt Litchie by June 21, 2019 in the NW4 of Sec 157, Blk B3, H&GN Survey (being located approx. 3 mi W of Groom, at I-40 & CR X, S side of I-40, E side of CR X) Carson County Texas **REPLACEMENT WELL**

3. DO-501-MUN-R Red River Water Authority – A 4" well to be drilled on 2 ac by unknown driller by unknown date in the SW4 of Sec 3, Blk C3, TT RR Survey (being located on the E side of Howardwick on Pampa Dr on the edge of the city limits) Donley County Texas **REPLACEMENT WELL**

4. GR-802 Merten Family Enterprises – An 8" well to be drilled on 635 ac by Hydro by July 17, 2019 in the SW4 of Sec 29, Blk 3, I&GN Survey (being located approx. 3 mi E of Pampa on Hwy 60 to CR 13, then apprx 1 ½ mi N on CR 13, well location on E side of CR 13) Gray County Texas

5. WH-309 Georgia Tipps – An 8" well to be drilled by Howard Drlg by unknown date in the SW4 of Sec 23, Blk M-1, H&GN Survey (being located 4 mi E of the intersection of FM 1046 & Hwy 83 to FM 3306, then approx. ½ mi N on FM 3306, well located on E side of FM 3306)

10. STAFF UPDATES

11. CONSIDERATION AND POSSIBLE ACTION TO SET FUTURE MEETING DATES

12. MANAGER'S REPORT

Recess until 11:00 a.m. for Public Hearing on Proposed Amendments to the Management Plan

13. CALL TO ORDER

14. INTRODUCTIONS

15. PRESENTATION OF PROPOSED AMENDMENTS TO DISTRICT MANAGEMENT PLAN
CE Williams, PGCD General Manager

16. PUBLIC COMMENT – Public questions and comments on District's proposed Management Plan (Limited to 3 minutes each, please fill out a "Request to Speak" form prior to the discussion of the agenda item.)

17. ADJOURN PUBLIC HEARING

18. CONSIDERATION AND POSSIBLE ACTION TO APPROVE AND ADOPTION OF THE RESOLUTION FOR DISTRICT MANAGEMENT PLAN TO SUBMIT TO TWDB FOR APPROVAL

19. ADJOURN

At any time during the meeting and in compliance with the Texas Open Meetings Act, Chapter 551, Government Code, Vernon's Texas Codes, Annotated, the Panhandle Groundwater Conservation District Board of Directors may meet in executive session on any of the above agenda items for consultation concerning legal matters (§551.071); deliberation regarding real property (§551.072); deliberation regarding prospective gift (§551.073); personnel matters (§551.074); and deliberation regarding security devices (§551.076), or for any other purpose authorized by Chapter 551 of the Texas Government Code. Any subject discussed in executive session may be subject to action during an open meeting.
The presiding office of the Board, prior to the Board meeting in executive session, will announce that a closed meeting will be held and will publicly identify the section or sections of the Government Code Chapter 551 under which the closed meeting is to be held.

PUBLIC NOTICE

This complies with Section 551.043, of the Open Meetings Act, requiring posting of the items to be considered at least 72 hours prior to the meeting. Notice has been filed with the Secretary of State's office in Austin, at a place convenient to the public in the administrative office of the District and on the District's website, in compliance with Section 551.053 of the Open Meetings Act.

Posted this 19th day of July, at 201 W. Third Street, White Deer, Texas at 9:35 a.m./p.m.

Britney Britten

Britney Britten, Panhandle Groundwater Cons. District

LEGAL NOTICE

The Panhandle Groundwater Conservation District, in compliance with Chapter 36 of the Texas Water Code, will receive public comment on proposed amendments to the District Management Plan, at a public meeting of the Board of Directors on **Thursday, July 25, 2019, at 11:00 a.m. in the Panhandle Groundwater District Windmill Room, 201 W. Third Street, White Deer, Texas.** Texas Water Code Section 36.1072, requires each groundwater conservation district to adopt its management plan no less than every five years and to submit the plan to the Texas Water Development Board (TWDB) for approval. The District's management plan was last approved by TWDB on February 23, 2017. These proposed amendments to the District's Management Plan contain changes directly affected by District Rule changes in 2018 and changes required by TWDB. A complete copy of the proposed Management Plan is available on the District's website, www.pgcd.us or at the District office, 201 W. Third St., P.O. Box 637, White Deer, Texas 79097, 806-883-2501.

Britney Britton
Posted at 9:46 a.m.

Appendix 3

Resolution adopting the 2019 Panhandle Groundwater Conservation District Management Plan

Panhandle Groundwater Conservation District

P.O. Box 637
White Deer, TX 79097

Resolution No. MP19-04

Management Plan 2019-2024 Adopted July 25, 2019

WHEREAS, the Panhandle Groundwater Conservation District (District) was created by Acts of the 51st Legislature (Texas Civil Statutes, Chapter 3A, Title 128, Article 7880-3c, and currently operates under Chapter 36 of the Texas Water Code); and

WHEREAS, the District is required by SB1, through Chapter 36.1071 of the Texas Water Code, to develop and adopt a new Management Plan each 5 years; and

WHEREAS, under the direction of the Board of Directors of the District (the "Board"), and in accordance with Sections 36.1071, 36.1072 and 36.108 of the Texas Water Code, and 31 Texas Administrative Code Chapter 356, the District has undertaken the amendment of its Management Plan;

WHEREAS, the District issued the notice in the manner required by state law and held a public hearing on July 25, 2019 at 11:00 AM in White Deer, Texas to receive public and written comments on the Amendments to the Management Plan and received written comments at the District's office located at 201 W. Third St., White Deer, Texas;

WHEREAS, the Board finds that the Management plan meets all the requirements of Chapter 36, Water Code, and 31 Texas Administrative Code Chapter 356; and

WHEREAS, these amendments are changes reflective of substantive District Rule revisions and required updates to Texas Water Development Board estimates to the current duly and approved Management Plan of February 23, 2017; and

WHEREAS, after the public hearing, the Board of Directors met in a regular session on July 25, 2019, properly noticed in accordance with state law, and considered adoption of the attached Management Plan, and approval of this resolution after due consideration of all comments received.

NOW, THEREFORE, BE IT RESOLVED BY THE BOARD OF DIRECTORS OF THE PANHANDLE GROUNDWATAER CONSERVATION DISTRICT THAT:

1. The above recitals are true and correct.

2. The Board of Directors of the District hereby adopts the attached Management Plan as the Management Plan for the District, subject to those amendments necessary to incorporate technical information received from the Texas Water Development Board and/or District geoscientist;

3. The Board President and the General manager of the District are further authorized to take all steps necessary to implement this resolution and submit the Management Plan to the TWDB for its approval; and

4. The Board President and General Manager of the District are further authorized to take any and all action necessary to coordinate with the TWDB as may be required in furtherance of TWDB's approval pursuant to the provisions of Section 36.1072 of the Texas Water Code.

AND IT IS SO ORDERED.

PASSED AND ADOPTED on this 25 day of July, 2019.

PANHANDLE GROUNDWATER CONSERVATION DISTRICT

Phillip Smith
Board President

William W. Breeding
Board Secretary

Appendix 4

Estimated Historical Groundwater Use and 2017 State Water Plan Datasets: prepared for the Panhandle Groundwater Conservation District

Estimated Historical Groundwater Use And 2017 State Water Plan Datasets:

Panhandle Groundwater Conservation District

by Stephen Allen
Texas Water Development Board
Groundwater Division
Groundwater Technical Assistance Section
stephen.allen@twdb.texas.gov
(512) 463-7317
December 5, 2016

GROUNDWATER MANAGEMENT PLAN DATA:

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

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

The five reports included in this part are:

1. Estimated Historical Groundwater 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)
   from the 2017 Texas State Water Plan (SWP)

Part 2 of the 2-part package is the groundwater availability model (GAM) report for the District (checklist items 3 through 5). The District should have received, or will receive, this report from the Groundwater Availability Modeling Section. Questions about the GAM can be directed to Dr. Shirley Wade, shirley.wade@twdb.texas.gov, (512) 936-0883.

DISCLAIMER:

The data presented in this report represents the most up-to-date WUS and 2017 SWP data available as of 12/5/2016. Although it does not happen frequently, either of these datasets are subject to change pending the availability of more accurate WUS data or an amendment to the 2017 SWP. District personnel must review these datasets and correct any discrepancies in order to ensure approval of their groundwater management plan.

The WUS dataset can be verified at this web address:

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

The 2017 SWP dataset can be verified by contacting Sabrina Anderson (sabrina.anderson@twdb.texas.gov or 512-936-0886).

The values presented in the data tables of this report are county-based. In cases where groundwater conservation districts cover only a portion of one or more counties the data values are modified with an apportioning multiplier to create new values that more accurately represent conditions within district boundaries. The multiplier used in the following formula is a land area ratio: (data value * (land area of district in county / land area of county)). For two of the four SWP tables (Projected Surface Water Supplies and Projected Water Demands) only the county-wide water user group (WUG) data values (county other, manufacturing, steam electric power, irrigation, mining and livestock) are modified using the multiplier. WUG values for municipalities, water supply corporations, and utility districts are not apportioned; instead, their full values are retained when they are located within the district, and eliminated when they are located outside (we ask each district to identify these entity locations).

The remaining SWP tables (Projected Water Supply Needs and Projected Water Management Strategies) are not modified because district-specific values are not statutorily required. Each district needs only "consider" the county values in these tables.

In the WUS table every category of water use (including municipal) is apportioned. Staff determined that breaking down the annual municipal values into individual WUGs was too complex.

TWDB recognizes that the apportioning formula used is not perfect but it is the best available process with respect to time and staffing constraints. If a district believes it has data that is more accurate it can add those data to the plan with an explanation of how the data were derived. Apportioning percentages that the TWDB used are listed above each applicable table.

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

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

Groundwater and surface water historical use estimates are currently unavailable for calendar year 2015. TWDB staff anticipates the calculation and posting of these estimates at a later date.

ARMSTRONG COUNTY

92.36% (multiplier)

All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2014	GW	320	0	0	0	5,008	235	5,563
	SW	0	0	0	0	0	26	26
2013	GW	354	0	0	0	7,163	227	7,744
	SW	0	0	0	0	0	25	25
2012	GW	396	0	0	0	8,785	431	9,612
	SW	0	0	0	0	0	48	48
2011	GW	428	0	0	0	7,752	460	8,640
	SW	0	0	0	0	0	51	51
2010	GW	322	0	0	0	4,060	414	4,796
	SW	0	0	0	0	0	46	46
2009	GW	346	0	0	0	5,527	494	6,367
	SW	0	0	0	0	0	54	54
2008	GW	377	0	0	0	6,524	491	7,392
	SW	0	0	0	0	0	54	54
2007	GW	365	0	0	0	5,338	467	6,170
	SW	0	0	0	0	0	53	53
2006	GW	435	0	0	0	6,080	846	7,361
	SW	0	0	0	0	0	94	94
2005	GW	357	0	0	0	7,077	759	8,193
	SW	0	0	0	0	0	84	84
2004	GW	358	0	0	0	6,647	719	7,724
	SW	0	0	0	0	0	179	179
2003	GW	384	0	0	0	7,051	728	8,163
	SW	0	0	0	0	0	181	181
2002	GW	331	0	0	0	9,489	489	10,309
	SW	0	0	0	0	0	122	122
2001	GW	355	0	0	0	7,148	417	7,920
	SW	0	0	0	0	0	104	104
2000	GW	377	0	0	0	10,915	446	11,738
	SW	0	0	0	0	0	112	112

CARSON COUNTY

100% (multiplier)

All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2014	GW	939	982	0	0	91,433	332	93,686
	SW	0	0	0	0	0	37	37
2013	GW	1,019	393	0	0	105,201	317	106,930
	SW	0	0	0	0	0	34	34
2012	GW	1,290	470	0	0	124,090	503	126,353
	SW	0	0	0	0	0	56	56
2011	GW	1,371	954	64	0	95,956	718	99,063
	SW	0	0	23	0	0	80	103
2010	GW	1,349	609	11	0	59,823	631	62,423
	SW	12	0	4	0	246	71	333
2009	GW	1,266	308	38	0	71,965	474	74,051
	SW	2	0	2	0	0	53	57
2008	GW	1,077	365	38	0	88,034	558	90,072
	SW	3	0	0	0	0	62	65
2007	GW	1,108	308	52	0	84,896	571	86,935
	SW	3	0	0	0	0	63	66
2006	GW	1,202	308	43	0	64,707	1,007	67,267
	SW	3	0	0	0	0	112	115
2005	GW	1,141	439	57	0	70,275	586	72,498
	SW	3	0	0	0	0	65	68
2004	GW	1,199	442	65	0	56,545	261	58,512
	SW	4	0	0	0	0	381	385
2003	GW	1,161	442	44	0	55,663	277	57,587
	SW	12	0	0	0	0	404	416
2002	GW	1,181	449	34	0	53,621	377	55,662
	SW	8	0	0	0	0	550	558
2001	GW	1,289	405	80	0	51,012	387	53,173
	SW	11	0	0	0	0	565	576
2000	GW	1,324	494	59	0	79,045	1,135	82,057
	SW	10	0	0	0	0	284	294

DONLEY COUNTY

100% (multiplier)

All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2014	GW	111	0	0	0	35,001	732	35,844
	SW	327	0	0	0	0	183	510
2013	GW	162	0	0	0	30,412	671	31,245
	SW	342	0	0	0	0	167	509
2012	GW	208	0	0	0	42,048	711	42,967
	SW	403	0	0	0	0	178	581
2011	GW	250	0	0	0	39,148	770	40,168
	SW	498	0	0	0	0	193	691
2010	GW	209	0	0	0	25,493	696	26,398
	SW	429	0	0	0	30	174	633
2009	GW	203	0	0	0	29,290	726	30,219
	SW	478	0	0	0	0	182	660
2008	GW	211	0	0	0	32,265	835	33,311
	SW	466	0	0	0	46	209	721
2007	GW	190	0	0	0	38,543	943	39,676
	SW	385	0	0	0	37	235	657
2006	GW	231	0	0	0	26,299	862	27,392
	SW	511	0	0	0	48	215	774
2005	GW	216	0	0	0	30,960	942	32,118
	SW	381	0	0	0	70	236	687
2004	GW	198	0	0	0	29,097	110	29,405
	SW	468	0	0	0	64	985	1,517
2003	GW	208	0	0	0	28,484	100	28,792
	SW	455	0	0	0	0	894	1,349
2002	GW	218	0	0	0	26,256	125	26,599
	SW	472	0	0	0	0	1,122	1,594
2001	GW	225	0	0	0	18,739	135	19,099
	SW	535	0	0	0	0	1,209	1,744
2000	GW	220	0	0	0	23,873	136	24,229
	SW	471	0	0	0	0	1,225	1,696

GRAY COUNTY

100% (multiplier)

All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2014	GW	1,456	309	0	0	40,664	1,467	43,896
	SW	2,222	0	0	0	0	489	2,711
2013	GW	2,574	287	0	0	39,122	1,428	43,411
	SW	2,187	0	0	0	0	475	2,662
2012	GW	2,251	303	2	0	38,708	1,410	42,674
	SW	2,388	0	0	0	0	470	2,858
2011	GW	2,569	316	37	0	37,285	1,406	41,613
	SW	2,334	0	10	0	8	469	2,821
2010	GW	1,612	459	23	0	22,721	1,183	25,998
	SW	3,080	0	6	0	0	396	3,482
2009	GW	1,794	5,378	21	0	31,276	2,148	40,617
	SW	2,259	0	5	0	0	716	2,980
2008	GW	2,822	3,947	19	0	33,218	1,546	41,552
	SW	1,285	0	5	0	0	516	1,806
2007	GW	2,773	3,921	0	0	32,104	1,449	40,247
	SW	1,285	0	0	0	0	483	1,768
2006	GW	2,821	3,694	0	0	27,181	1,998	35,694
	SW	1,285	0	0	0	0	666	1,951
2005	GW	2,844	3,656	0	0	33,406	1,169	41,075
	SW	1,285	0	0	0	0	390	1,675
2004	GW	2,089	4,030	0	0	35,394	118	41,631
	SW	1,151	0	0	0	0	1,426	2,577
2003	GW	2,121	3,952	0	0	37,451	109	43,633
	SW	1,151	0	0	0	0	1,318	2,469
2002	GW	2,116	3,898	0	0	20,494	106	26,614
	SW	1,149	4	0	0	0	1,279	2,432
2001	GW	1,262	4,042	0	0	15,733	91	21,128
	SW	3,241	5	0	0	0	1,106	4,352
2000	GW	1,184	4,265	0	0	20,525	140	26,114
	SW	3,240	5	0	0	0	1,262	4,507

HUTCHINSON COUNTY

4.24% (multiplier)

All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2014	GW	214	673	4	0	2,732	11	3,634
	SW	0	0	0	0	0	4	4
2013	GW	128	638	4	0	2,932	11	3,713
	SW	48	0	0	0	12	4	64
2012	GW	146	684	4	0	3,045	14	3,893
	SW	39	0	0	0	12	5	56
2011	GW	241	720	4	0	3,127	17	4,109
	SW	5	14	0	0	0	6	25
2010	GW	187	1,160	6	0	1,700	16	3,069
	SW	51	39	1	0	12	5	108
2009	GW	153	1,240	6	0	2,255	21	3,675
	SW	9	0	1	0	0	7	17
2008	GW	188	1,104	6	0	2,138	21	3,457
	SW	14	82	5	0	82	7	190
2007	GW	137	1,070	4	0	1,463	16	2,690
	SW	11	114	4	0	12	5	146
2006	GW	138	1,107	4	0	1,735	24	3,008
	SW	13	23	4	0	12	8	60
2005	GW	101	1,028	4	0	1,761	20	2,914
	SW	13	151	0	0	12	7	183
2004	GW	126	1,104	4	0	1,625	3	2,862
	SW	19	110	4	0	12	27	172
2003	GW	153	1,068	0	0	1,542	2	2,765
	SW	50	75	0	0	12	20	157
2002	GW	138	1,053	1	0	2,044	2	3,238
	SW	35	110	0	0	0	20	165
2001	GW	162	1,128	1	0	1,697	2	2,990
	SW	45	105	0	0	0	17	167
2000	GW	134	1,276	1	0	2,492	2	3,905
	SW	40	115	0	0	0	21	176

POTTER COUNTY

94.12% (multiplier)

All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2014	GW	22,828	5,359	187	1,065	2,451	368	32,258
	SW	1	58	56	0	0	65	180
2013	GW	23,871	4,400	104	1,223	3,854	414	33,866
	SW	0	70	32	0	0	72	174
2012	GW	25,914	4,107	105	742	3,365	523	34,756
	SW	3	70	32	0	0	92	197
2011	GW	26,043	5,452	397	1,321	2,246	680	36,139
	SW	1,505	75	430	0	0	120	2,130
2010	GW	17,505	5,738	417	503	1,121	614	25,898
	SW	5,744	544	464	0	0	108	6,860
2009	GW	16,621	4,965	394	665	3,306	600	26,551
	SW	6,253	380	434	0	0	106	7,173
2008	GW	19,614	5,476	380	1,246	2,923	564	30,203
	SW	4,668	218	404	0	0	100	5,390
2007	GW	16,233	5,473	129	1,331	5,539	596	29,301
	SW	6,294	340	0	181	0	105	6,920
2006	GW	19,554	5,312	137	902	3,958	507	30,370
	SW	8,170	422	6	1,732	0	90	10,420
2005	GW	16,872	4,580	137	1,529	5,180	516	28,814
	SW	9,038	252	0	3,540	0	92	12,922
2004	GW	17,984	5,030	136	1,271	4,639	42	29,102
	SW	7,074	301	0	4,404	0	449	12,228
2003	GW	11,012	5,111	134	1,369	4,792	74	22,492
	SW	16,320	310	0	3,788	0	784	21,202
2002	GW	12,962	4,622	136	1,547	8,211	92	27,570
	SW	12,876	321	5	3,022	4,823	968	22,015
2001	GW	12,825	4,739	249	1,267	4,959	44	24,083
	SW	12,738	413	5	3,094	2,913	466	19,629
2000	GW	13,720	5,110	192	3,432	3,518	54	26,026
	SW	15,898	292	0	3,447	5,873	486	25,996

ROBERTS COUNTY

100% (multiplier)

All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2014	GW	195	0	232	0	9,157	287	9,871
	SW	0	0	58	0	0	50	108
2013	GW	190	0	147	0	8,797	289	9,423
	SW	0	0	36	0	0	50	86
2012	GW	206	0	234	0	9,161	264	9,865
	SW	0	0	30	0	0	46	76
2011	GW	226	0	287	0	13,137	312	13,962
	SW	0	0	137	0	0	55	192
2010	GW	168	0	162	0	7,362	273	7,965
	SW	0	0	77	0	0	48	125
2009	GW	159	0	180	0	6,531	295	7,165
	SW	0	0	85	0	0	52	137
2008	GW	147	0	196	0	8,412	287	9,042
	SW	0	0	94	0	0	52	146
2007	GW	155	0	0	0	16,522	388	17,065
	SW	0	0	0	0	0	69	69
2006	GW	179	0	0	0	14,639	350	15,168
	SW	0	0	0	0	0	62	62
2005	GW	203	0	0	0	13,601	459	14,263
	SW	0	0	0	0	0	81	81
2004	GW	186	0	0	0	14,393	48	14,627
	SW	0	0	0	0	0	468	468
2003	GW	149	0	0	0	12,866	46	13,061
	SW	0	0	0	0	0	442	442
2002	GW	151	0	0	0	12,642	50	12,843
	SW	0	0	0	0	0	484	484
2001	GW	140	0	0	0	7,045	45	7,230
	SW	0	0	0	0	0	438	438
2000	GW	160	0	0	0	8,838	54	9,052
	SW	0	0	0	0	0	487	487

WHEELER COUNTY

100% (multiplier)

All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2014	GW	1,497	0	696	0	16,580	843	19,616
	SW	0	0	174	0	0	281	455
2013	GW	1,368	0	1,375	0	16,805	836	20,384
	SW	0	0	343	0	369	278	990
2012	GW	1,675	0	2,416	0	24,070	1,001	29,162
	SW	0	0	329	0	131	334	794
2011	GW	1,586	0	2,454	0	16,601	1,090	21,731
	SW	0	0	1,499	0	170	364	2,033
2010	GW	1,228	0	537	0	13,913	995	16,673
	SW	0	0	328	0	0	331	659
2009	GW	1,138	0	674	0	14,277	1,195	17,284
	SW	0	0	411	0	0	398	809
2008	GW	1,260	0	810	0	15,143	1,170	18,383
	SW	0	0	494	0	0	390	884
2007	GW	857	0	0	0	15,370	1,221	17,448
	SW	0	0	0	0	0	407	407
2006	GW	923	0	0	0	13,528	2,112	16,563
	SW	0	0	0	0	0	704	704
2005	GW	890	0	0	0	12,990	1,358	15,238
	SW	0	0	0	0	0	453	453
2004	GW	865	0	0	0	10,441	168	11,474
	SW	0	0	0	0	0	1,508	1,508
2003	GW	874	0	0	0	13,169	168	14,211
	SW	0	0	0	0	0	1,508	1,508
2002	GW	899	0	0	0	9,104	147	10,150
	SW	0	0	0	0	0	1,326	1,326
2001	GW	966	0	0	0	5,396	395	6,757
	SW	0	0	0	0	0	1,559	1,559
2000	GW	926	0	0	0	7,939	395	9,260
	SW	0	0	0	0	0	1,561	1,561

Projected Surface Water Supplies
TWDB 2017 State Water Plan Data

ARMSTRONG COUNTY

92.36% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070
A	LIVESTOCK, ARMSTRONG	RED	RED LIVESTOCK LOCAL SUPPLY	113	113	113	113	113	113
	Sum of Projected Surface Water Supplies (acre-feet)			**113**	**113**	**113**	**113**	**113**	**113**

CARSON COUNTY

100% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070
A	IRRIGATION, CARSON	RED	RED RUN-OF-RIVER	277	277	277	277	277	277
A	LIVESTOCK, CARSON	CANADIAN	CANADIAN LIVESTOCK LOCAL SUPPLY	59	59	59	59	59	59
A	LIVESTOCK, CARSON	RED	RED LIVESTOCK LOCAL SUPPLY	75	75	75	75	75	75
	Sum of Projected Surface Water Supplies (acre-feet)			**411**	**411**	**411**	**411**	**411**	**411**

DONLEY COUNTY

100% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070
A	CLARENDON	RED	GREENBELT LAKE/RESERVOIR	253	258	263	269	278	286
A	COUNTY-OTHER, DONLEY	RED	GREENBELT LAKE/RESERVOIR	64	66	69	72	74	76
A	IRRIGATION, DONLEY	RED	RED RUN-OF-RIVER	166	166	166	166	166	166
A	LIVESTOCK, DONLEY	RED	RED LIVESTOCK LOCAL SUPPLY	283	283	283	283	283	283
	Sum of Projected Surface Water Supplies (acre-feet)			**766**	**773**	**781**	**790**	**801**	**811**

GRAY COUNTY

100% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070
A	IRRIGATION, GRAY	CANADIAN	CANADIAN RUN-OF-RIVER	1	1	1	1	1	1
A	IRRIGATION, GRAY	RED	RED RUN-OF-RIVER	55	55	55	55	55	55
A	LIVESTOCK, GRAY	CANADIAN	CANADIAN LIVESTOCK LOCAL SUPPLY	199	199	199	199	199	199
A	LIVESTOCK, GRAY	RED	RED LIVESTOCK LOCAL SUPPLY	600	600	600	600	600	600
	Sum of Projected Surface Water Supplies (acre-feet)			**855**	**855**	**855**	**855**	**855**	**855**

HUTCHINSON COUNTY

4.24% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070
A	IRRIGATION, HUTCHINSON	CANADIAN	CANADIAN RUN-OF-RIVER	4	4	4	4	4	4
A	LIVESTOCK, HUTCHINSON	CANADIAN	CANADIAN LIVESTOCK LOCAL SUPPLY	12	12	12	12	12	12
A	MANUFACTURING, HUTCHINSON	CANADIAN	CANADIAN RUN-OF-RIVER	0	0	0	0	0	0
	Sum of Projected Surface Water Supplies (acre-feet)			**16**	**16**	**16**	**16**	**16**	**16**

POTTER COUNTY

94.12% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070
A	LIVESTOCK, POTTER	CANADIAN	CANADIAN LIVESTOCK LOCAL SUPPLY	471	471	471	471	471	471
A	LIVESTOCK, POTTER	RED	RED LIVESTOCK LOCAL SUPPLY	58	58	58	58	58	58
	Sum of Projected Surface Water Supplies (acre-feet)			**529**	**529**	**529**	**529**	**529**	**529**

ROBERTS COUNTY

100% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070
A	IRRIGATION, ROBERTS	CANADIAN	CANADIAN RUN-OF-RIVER	72	72	72	72	72	72
A	LIVESTOCK, ROBERTS	CANADIAN	CANADIAN LIVESTOCK LOCAL SUPPLY	124	124	124	124	124	124
A	LIVESTOCK, ROBERTS	RED	RED LIVESTOCK LOCAL SUPPLY	15	15	15	15	15	15
	Sum of Projected Surface Water Supplies (acre-feet)			**211**	**211**	**211**	**211**	**211**	**211**

WHEELER COUNTY

100% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070
A	IRRIGATION, WHEELER	RED	RED RUN-OF-RIVER	603	603	603	603	603	603
A	LIVESTOCK, WHEELER	RED	RED LIVESTOCK LOCAL SUPPLY	845	845	845	845	845	845
	Sum of Projected Surface Water Supplies (acre-feet)			**1,448**	**1,448**	**1,448**	**1,448**	**1,448**	**1,448**

Projected Water Demands
TWDB 2017 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.

ARMSTRONG COUNTY

92.36% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
A	CLAUDE	RED	358	353	348	346	345	345
A	COUNTY-OTHER, ARMSTRONG	RED	82	79	78	77	77	77
A	IRRIGATION, ARMSTRONG	RED	3,874	3,685	3,425	3,044	2,664	2,283
A	LIVESTOCK, ARMSTRONG	RED	596	599	602	606	609	612
	Sum of Projected Water Demands (acre-feet)		**4,910**	**4,716**	**4,453**	**4,073**	**3,695**	**3,317**

CARSON COUNTY

100% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
A	COUNTY-OTHER, CARSON	CANADIAN	161	161	160	158	157	157
A	COUNTY-OTHER, CARSON	RED	123	120	120	119	119	119
A	GROOM	RED	179	176	174	173	173	173
A	IRRIGATION, CARSON	CANADIAN	14,483	13,738	12,682	11,273	9,864	8,454
A	IRRIGATION, CARSON	RED	41,219	39,100	36,094	32,083	28,073	24,063
A	LIVESTOCK, CARSON	CANADIAN	519	522	525	528	532	535
A	LIVESTOCK, CARSON	RED	173	174	175	176	177	178
A	MANUFACTURING, CARSON	CANADIAN	25	28	30	32	35	37
A	MANUFACTURING, CARSON	RED	394	432	469	500	541	587
A	MINING, CARSON	CANADIAN	14	14	14	14	14	14
A	PANHANDLE	RED	572	581	582	577	576	576
A	WHITE DEER	CANADIAN	106	107	107	107	107	107
A	WHITE DEER	RED	138	141	141	140	140	140
	Sum of Projected Water Demands (acre-feet)		**58,106**	**55,294**	**51,273**	**45,880**	**40,508**	**35,140**

DONLEY COUNTY

100% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
A	CLARENDON	RED	378	369	361	356	356	356
A	COUNTY-OTHER, DONLEY	RED	245	237	230	228	227	227
A	IRRIGATION, DONLEY	RED	24,080	23,203	21,847	19,419	16,992	14,564
A	LIVESTOCK, DONLEY	RED	1,330	1,332	1,333	1,335	1,337	1,339
	Sum of Projected Water Demands (acre-feet)		**26,033**	**25,141**	**23,771**	**21,338**	**18,912**	**16,486**

GRAY COUNTY

100% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
A	COUNTY-OTHER, GRAY	CANADIAN	450	488	537	604	659	717
A	COUNTY-OTHER, GRAY	RED	243	264	290	326	356	388
A	IRRIGATION, GRAY	CANADIAN	5,536	5,227	4,820	4,285	3,749	3,213
A	IRRIGATION, GRAY	RED	15,755	14,877	13,719	12,194	10,670	9,146
A	LIVESTOCK, GRAY	CANADIAN	135	138	141	144	147	151
A	LIVESTOCK, GRAY	RED	1,217	1,240	1,266	1,294	1,326	1,360
A	MANUFACTURING, GRAY	CANADIAN	4,133	4,197	4,240	4,257	4,086	3,923
A	MANUFACTURING, GRAY	RED	217	221	223	224	215	206
A	MCLEAN	RED	205	222	243	274	299	326
A	MINING, GRAY	CANADIAN	7	7	7	6	5	5
A	MINING, GRAY	RED	68	67	60	54	48	42
A	PAMPA	CANADIAN	3,711	3,991	4,360	4,926	5,377	5,855
A	STEAM ELECTRIC POWER, GRAY	CANADIAN	1,409	2,112	2,299	2,952	3,087	3,320
	Sum of Projected Water Demands (acre-feet)		**33,086**	**33,051**	**32,205**	**31,540**	**30,024**	**28,652**

HUTCHINSON COUNTY

4.24% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
A	BORGER	CANADIAN	3,215	3,254	3,234	3,229	3,225	3,224
A	COUNTY-OTHER, HUTCHINSON	CANADIAN	13	14	14	14	14	14
A	FRITCH	CANADIAN	437	441	436	434	433	433
A	IRRIGATION, HUTCHINSON	CANADIAN	1,696	1,597	1,469	1,305	1,142	979
A	LIVESTOCK, HUTCHINSON	CANADIAN	36	37	38	40	41	43
A	MANUFACTURING, HUTCHINSON	CANADIAN	1,075	1,137	1,198	1,250	1,337	1,431
A	MINING, HUTCHINSON	CANADIAN	8	10	7	5	2	1
A	STINNETT	CANADIAN	446	452	448	447	446	446
A	TCW SUPPLY INC	CANADIAN	738	755	754	750	749	749
	Sum of Projected Water Demands (acre-feet)		**7,664**	**7,697**	**7,598**	**7,474**	**7,389**	**7,320**

POTTER COUNTY

94.12% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
A	AMARILLO	CANADIAN	15,884	17,294	18,856	20,510	22,424	24,462
A	AMARILLO	RED	10,458	11,386	12,414	13,504	14,764	16,106
A	COUNTY-OTHER, POTTER	CANADIAN	1,855	2,020	2,204	2,397	2,620	2,857
A	COUNTY-OTHER, POTTER	RED	1,047	1,139	1,242	1,352	1,477	1,611
A	IRRIGATION, POTTER	CANADIAN	1,580	1,518	1,425	1,267	1,109	951
A	IRRIGATION, POTTER	RED	1,645	1,580	1,484	1,320	1,154	989
A	LIVESTOCK, POTTER	CANADIAN	376	376	378	379	381	384
A	LIVESTOCK, POTTER	RED	77	77	77	78	78	78

A	MANUFACTURING, POTTER	CANADIAN	1,371	1,477	1,580	1,669	1,792	1,923
A	MANUFACTURING, POTTER	RED	7,771	8,369	8,953	9,459	10,153	10,898
A	MINING, POTTER	CANADIAN	602	735	858	930	1,044	1,172
A	MINING, POTTER	RED	283	346	404	438	491	552
A	STEAM ELECTRIC POWER, POTTER	CANADIAN	23,894	25,228	26,738	28,246	32,109	35,454
	Sum of Projected Water Demands (acre-feet)		**66,843**	**71,545**	**76,613**	**81,549**	**89,596**	**97,437**

ROBERTS COUNTY

100% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
A	COUNTY-OTHER, ROBERTS	CANADIAN	48	50	48	48	48	48
A	COUNTY-OTHER, ROBERTS	RED	1	1	1	1	1	1
A	IRRIGATION, ROBERTS	CANADIAN	5,660	5,329	4,897	4,353	3,809	3,265
A	IRRIGATION, ROBERTS	RED	298	280	258	229	200	172
A	LIVESTOCK, ROBERTS	CANADIAN	359	359	360	361	362	363
A	LIVESTOCK, ROBERTS	RED	10	10	10	10	10	10
A	MIAMI	CANADIAN	224	225	223	222	222	222
A	MINING, ROBERTS	CANADIAN	1,457	1,010	593	183	19	2
A	MINING, ROBERTS	RED	45	31	18	6	1	0
	Sum of Projected Water Demands (acre-feet)		**8,102**	**7,295**	**6,408**	**5,413**	**4,672**	**4,083**

WHEELER COUNTY

100% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
A	COUNTY-OTHER, WHEELER	RED	290	291	293	302	313	325
A	IRRIGATION, WHEELER	RED	8,203	7,983	7,433	6,607	5,781	4,955
A	LIVESTOCK, WHEELER	RED	1,577	1,680	1,682	1,684	1,687	1,689
A	MINING, WHEELER	RED	3,268	2,329	1,413	503	139	119
A	SHAMROCK	RED	350	353	357	369	383	398
A	WHEELER	RED	507	520	533	549	569	592
	Sum of Projected Water Demands (acre-feet)		**14,195**	**13,156**	**11,711**	**10,014**	**8,872**	**8,078**

Projected Water Supply Needs
TWDB 2017 State Water Plan Data

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

ARMSTRONG COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
A	CLAUDE	RED	105	52	6	-35	-72	-110
A	COUNTY-OTHER, ARMSTRONG	RED	11	15	16	17	17	17
A	IRRIGATION, ARMSTRONG	RED	0	0	0	0	0	0
A	LIVESTOCK, ARMSTRONG	RED	0	0	0	0	0	0
	Sum of Projected Water Supply Needs (acre-feet)		**0**	**0**	**0**	**-35**	**-72**	**-110**

CARSON COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
A	COUNTY-OTHER, CARSON	CANADIAN	88	76	68	67	51	28
A	COUNTY-OTHER, CARSON	RED	92	85	77	75	61	41
A	GROOM	RED	147	166	170	165	153	141
A	IRRIGATION, CARSON	CANADIAN	0	0	0	0	0	0
A	IRRIGATION, CARSON	RED	0	0	0	0	0	0
A	LIVESTOCK, CARSON	CANADIAN	0	0	0	0	0	0
A	LIVESTOCK, CARSON	RED	0	0	0	0	0	0
A	MANUFACTURING, CARSON	CANADIAN	0	0	0	0	0	0
A	MANUFACTURING, CARSON	RED	708	563	458	371	283	190
A	MINING, CARSON	CANADIAN	0	0	0	0	0	0
A	PANHANDLE	RED	-89	-521	-582	-577	-576	-576
A	WHITE DEER	CANADIAN	0	0	0	0	0	0
A	WHITE DEER	RED	0	0	0	0	0	0
	Sum of Projected Water Supply Needs (acre-feet)		**-89**	**-521**	**-582**	**-577**	**-576**	**-576**

DONLEY COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
A	CLARENDON	RED	0	0	0	0	0	0
A	COUNTY-OTHER, DONLEY	RED	20	28	35	37	38	38
A	IRRIGATION, DONLEY	RED	166	166	166	166	166	166
A	LIVESTOCK, DONLEY	RED	0	0	0	0	0	0
	Sum of Projected Water Supply Needs (acre-feet)		**0**	**0**	**0**	**0**	**0**	**0**

GRAY COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
A	COUNTY-OTHER, GRAY	CANADIAN	0	0	0	0	0	0
A	COUNTY-OTHER, GRAY	RED	0	0	0	0	0	0
A	IRRIGATION, GRAY	CANADIAN	0	0	0	0	0	0
A	IRRIGATION, GRAY	RED	0	0	0	0	0	0
A	LIVESTOCK, GRAY	CANADIAN	205	202	199	196	193	189
A	LIVESTOCK, GRAY	RED	557	534	508	480	448	414
A	MANUFACTURING, GRAY	CANADIAN	238	173	225	208	189	162
A	MANUFACTURING, GRAY	RED	12	9	12	11	10	9
A	MCLEAN	RED	40	18	1	-89	-135	-182
A	MINING, GRAY	CANADIAN	0	0	0	0	0	0
A	MINING, GRAY	RED	0	0	0	0	0	0
A	PAMPA	CANADIAN	304	-1,752	-2,491	-2,190	-2,985	-3,806
A	STEAM ELECTRIC POWER, GRAY	CANADIAN	0	0	0	0	0	0
	Sum of Projected Water Supply Needs (acre-feet)		**0**	**-1,752**	**-2,491**	**-2,279**	**-3,120**	**-3,988**

HUTCHINSON COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
A	BORGER	CANADIAN	-92	-531	-952	-1,343	-1,647	-1,927
A	COUNTY-OTHER, HUTCHINSON	CANADIAN	143	129	120	113	106	102
A	FRITCH	CANADIAN	0	0	0	0	0	0
A	IRRIGATION, HUTCHINSON	CANADIAN	96	96	96	96	96	96
A	LIVESTOCK, HUTCHINSON	CANADIAN	0	0	0	0	0	0
A	MANUFACTURING, HUTCHINSON	CANADIAN	10	-860	-1,739	-2,614	-3,487	-4,416
A	MINING, HUTCHINSON	CANADIAN	0	0	0	0	0	0
A	STINNETT	CANADIAN	55	15	0	-115	-165	-216
A	TCW SUPPLY INC	CANADIAN	-75	-251	-375	-466	-535	-569
	Sum of Projected Water Supply Needs (acre-feet)		**-167**	**-1,642**	**-3,066**	**-4,538**	**-5,834**	**-7,128**

POTTER COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
A	AMARILLO	CANADIAN	-1,501	-4,129	-7,241	-10,389	-13,215	-16,315
A	AMARILLO	RED	-987	-2,719	-4,767	-6,840	-8,703	-10,742
A	COUNTY-OTHER, POTTER	CANADIAN	-271	-446	-642	-847	-1,084	-1,336
A	COUNTY-OTHER, POTTER	RED	-412	-510	-620	-736	-869	-1,212
A	IRRIGATION, POTTER	CANADIAN	181	37	0	0	0	7
A	IRRIGATION, POTTER	RED	0	0	1	121	323	519
A	LIVESTOCK, POTTER	CANADIAN	164	163	161	160	158	155
A	LIVESTOCK, POTTER	RED	30	30	30	29	29	29
A	MANUFACTURING, POTTER	CANADIAN	-314	-542	-786	-1,007	-1,220	-1,445

A	MANUFACTURING, POTTER	RED	-1,785	-3,069	-4,453	-5,707	-6,910	-8,188
A	MINING, POTTER	CANADIAN	0	0	0	0	0	0
A	MINING, POTTER	RED	0	0	0	0	0	0
A	STEAM ELECTRIC POWER, POTTER	CANADIAN	0	0	0	0	0	0
	Sum of Projected Water Supply Needs (acre-feet)		**-5,270**	**-11,415**	**-18,509**	**-25,526**	**-32,001**	**-39,238**

ROBERTS COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
A	COUNTY-OTHER, ROBERTS	CANADIAN	12	10	12	12	12	12
A	COUNTY-OTHER, ROBERTS	RED	4	4	4	4	4	4
A	IRRIGATION, ROBERTS	CANADIAN	0	0	0	0	0	0
A	IRRIGATION, ROBERTS	RED	0	0	0	0	0	0
A	LIVESTOCK, ROBERTS	CANADIAN	103	103	102	101	100	99
A	LIVESTOCK, ROBERTS	RED	15	15	15	15	15	15
A	MIAMI	CANADIAN	317	316	318	237	171	104
A	MINING, ROBERTS	CANADIAN	0	0	0	0	0	0
A	MINING, ROBERTS	RED	0	0	0	0	0	0
	Sum of Projected Water Supply Needs (acre-feet)		**0**	**0**	**0**	**0**	**0**	**0**

WHEELER COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
A	COUNTY-OTHER, WHEELER	RED	95	94	92	83	72	60
A	IRRIGATION, WHEELER	RED	895	896	897	899	901	903
A	LIVESTOCK, WHEELER	RED	118	15	13	11	8	6
A	MINING, WHEELER	RED	0	0	0	0	0	0
A	SHAMROCK	RED	607	559	515	451	382	312
A	WHEELER	RED	-184	-249	-308	-365	-412	-453
	Sum of Projected Water Supply Needs (acre-feet)		**-184**	**-249**	**-308**	**-365**	**-412**	**-453**

Projected Water Management Strategies
TWDB 2017 State Water Plan Data

ARMSTRONG COUNTY

WUG, Basin (RWPG) All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
CLAUDE, RED (A)							
DEVELOP OGALLALA AQUIFER SUPPLIES - CLAUDE	OGALLALA AQUIFER [ARMSTRONG]	0	0	400	400	400	400
MUNICIPAL CONSERVATION - CLAUDE	DEMAND REDUCTION [ARMSTRONG]	11	11	10	10	10	10
WATER AUDITS AND LEAK REPAIR - CLAUDE	DEMAND REDUCTION [ARMSTRONG]	18	18	18	18	18	18
		29	**29**	**428**	**428**	**428**	**428**
IRRIGATION, ARMSTRONG, RED (A)							
IRRIGATION CONSERVATION - ARMSTRONG COUNTY	DEMAND REDUCTION [ARMSTRONG]	206	425	721	800	869	900
WEATHER MODIFICATION (PRECIPITATION ENHANCEMENT)	WEATHER MODIFICATION [ATMOSPHERE]	402	402	402	402	402	402
		608	**827**	**1,123**	**1,202**	**1,271**	**1,302**
Sum of Projected Water Management Strategies (acre-feet)		**637**	**856**	**1,551**	**1,630**	**1,699**	**1,730**

CARSON COUNTY

WUG, Basin (RWPG) All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
GROOM, RED (A)							
MUNICIPAL CONSERVATION - GROOM	DEMAND REDUCTION [CARSON]	5	5	5	5	5	5
		5	**5**	**5**	**5**	**5**	**5**
IRRIGATION, CARSON, CANADIAN (A)							
IRRIGATION CONSERVATION - CARSON COUNTY	DEMAND REDUCTION [CARSON]	1,035	1,797	3,314	3,643	3,841	3,938
WEATHER MODIFICATION (PRECIPITATION ENHANCEMENT)	WEATHER MODIFICATION [ATMOSPHERE]	1,261	1,261	1,261	1,261	1,261	1,261
		2,296	**3,058**	**4,575**	**4,904**	**5,102**	**5,199**
IRRIGATION, CARSON, RED (A)							
IRRIGATION CONSERVATION - CARSON COUNTY	DEMAND REDUCTION [CARSON]	2,945	5,113	9,433	10,367	10,933	11,208
WEATHER MODIFICATION (PRECIPITATION ENHANCEMENT)	WEATHER MODIFICATION [ATMOSPHERE]	3,589	3,589	3,589	3,589	3,589	3,589
		6,534	**8,702**	**13,022**	**13,956**	**14,522**	**14,797**
PANHANDLE, RED (A)							
DEVELOP OGALLALA AQUIFER	OGALLALA AQUIFER	600	600	600	600	600	600

SUPPLIES - PANHANDLE	[CARSON]						
MUNICIPAL CONSERVATION - PANHANDLE	DEMAND REDUCTION [CARSON]	18	19	19	19	19	19
WATER AUDITS AND LEAK REPAIR - PANHANDLE	DEMAND REDUCTION [CARSON]	29	29	29	29	29	29
		647	**648**	**648**	**648**	**648**	**648**
WHITE DEER, CANADIAN (A)							
MUNICIPAL CONSERVATION - WHITE DEER	DEMAND REDUCTION [CARSON]	3	4	4	4	4	4
WATER AUDITS AND LEAK REPAIR - WHITE DEER	DEMAND REDUCTION [CARSON]	5	5	5	5	5	5
		8	**9**	**9**	**9**	**9**	**9**
WHITE DEER, RED (A)							
MUNICIPAL CONSERVATION - WHITE DEER	DEMAND REDUCTION [CARSON]	5	5	5	5	5	5
WATER AUDITS AND LEAK REPAIR - WHITE DEER	DEMAND REDUCTION [CARSON]	7	7	7	7	7	7
		12	**12**	**12**	**12**	**12**	**12**
Sum of Projected Water Management Strategies (acre-feet)		**9,502**	**12,434**	**18,271**	**19,534**	**20,298**	**20,670**

DONLEY COUNTY

WUG, Basin (RWPG)

All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
CLARENDON, RED (A)							
MUNICIPAL CONSERVATION - CLARENDON	DEMAND REDUCTION [DONLEY]	14	13	13	13	13	13
		14	**13**	**13**	**13**	**13**	**13**
IRRIGATION, DONLEY, RED (A)							
IRRIGATION CONSERVATION - DONLEY COUNTY	DEMAND REDUCTION [DONLEY]	836	1,484	2,436	2,729	3,065	3,259
WEATHER MODIFICATION (PRECIPITATION ENHANCEMENT)	WEATHER MODIFICATION [ATMOSPHERE]	1,866	1,866	1,866	1,866	1,866	1,866
		2,702	**3,350**	**4,302**	**4,595**	**4,931**	**5,125**
Sum of Projected Water Management Strategies (acre-feet)		**2,716**	**3,363**	**4,315**	**4,608**	**4,944**	**5,138**

GRAY COUNTY

WUG, Basin (RWPG)

All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
IRRIGATION, GRAY, CANADIAN (A)							
IRRIGATION CONSERVATION - GRAY COUNTY	DEMAND REDUCTION [GRAY]	354	598	1,096	1,209	1,282	1,320
WEATHER MODIFICATION (PRECIPITATION ENHANCEMENT)	WEATHER MODIFICATION [ATMOSPHERE]	483	483	483	483	483	483
		837	**1,081**	**1,579**	**1,692**	**1,765**	**1,803**
IRRIGATION, GRAY, RED (A)							

IRRIGATION CONSERVATION - GRAY COUNTY	DEMAND REDUCTION [GRAY]	1,007	1,703	3,120	3,439	3,647	3,758
WEATHER MODIFICATION (PRECIPITATION ENHANCEMENT)	WEATHER MODIFICATION [ATMOSPHERE]	1,375	1,375	1,375	1,375	1,375	1,375
		2,382	**3,078**	**4,495**	**4,814**	**5,022**	**5,133**
MCLEAN, RED (A)							
DEVELOP OGALLALA AQUIFER SUPPLIES - MCLEAN	OGALLALA AQUIFER [GRAY]	200	200	200	200	200	200
MUNICIPAL CONSERVATION - MCLEAN	DEMAND REDUCTION [GRAY]	7	7	8	9	10	11
WATER AUDITS AND LEAK REPAIR - MCLEAN	DEMAND REDUCTION [GRAY]	10	11	12	14	15	16
		217	**218**	**220**	**223**	**225**	**227**
PAMPA, CANADIAN (A)							
CONJUNCTIVE USE - CRMWA	MEREDITH LAKE/RESERVOIR [RESERVOIR]	181	168	161	385	385	385
DEVELOP OGALLALA AQUIFER SUPPLIES - PAMPA	OGALLALA AQUIFER [GRAY]	2,000	2,000	2,000	2,000	2,000	2,000
EXPAND CAPACITY CRMWA II	OGALLALA AQUIFER [ROBERTS]	0	806	772	1,850	1,848	1,847
MUNICIPAL CONSERVATION - PAMPA	DEMAND REDUCTION [GRAY]	146	161	178	202	220	240
REPLACE WELL CAPACITY FOR CRMWA I	OGALLALA AQUIFER [ROBERTS]	0	151	209	732	886	1,077
		2,327	**3,286**	**3,320**	**5,169**	**5,339**	**5,549**
Sum of Projected Water Management Strategies (acre-feet)		**5,763**	**7,663**	**9,614**	**11,898**	**12,351**	**12,712**

HUTCHINSON COUNTY

WUG, Basin (RWPG)

All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
BORGER, CANADIAN (A)							
CONJUNCTIVE USE - CRMWA	MEREDITH LAKE/RESERVOIR [RESERVOIR]	702	652	620	582	581	581
DEVELOP NEW WELL FIELD (OGALLALA AQUIFER) - BORGER	OGALLALA AQUIFER [HUTCHINSON]	6,000	5,140	4,261	3,386	2,513	1,584
EXPAND CAPACITY CRMWA II	OGALLALA AQUIFER [ROBERTS]	0	3,128	2,974	2,793	2,790	2,787
MUNICIPAL CONSERVATION - BORGER	DEMAND REDUCTION [HUTCHINSON]	104	107	106	106	106	106
REPLACE WELL CAPACITY FOR CRMWA I	OGALLALA AQUIFER [ROBERTS]	0	586	805	1,106	1,337	1,626
		6,806	**9,613**	**8,766**	**7,973**	**7,327**	**6,684**
FRITCH, CANADIAN (A)							
MUNICIPAL CONSERVATION - FRITCH	DEMAND REDUCTION [HUTCHINSON]	14	15	14	14	14	14
WATER AUDITS AND LEAK REPAIR - FRITCH	DEMAND REDUCTION [HUTCHINSON]	21	21	21	21	21	21
		35	**36**	**35**	**35**	**35**	**35**

IRRIGATION, HUTCHINSON, CANADIAN (A)							
IRRIGATION CONSERVATION - HUTCHINSON COUNTY	DEMAND REDUCTION [HUTCHINSON]	2,692	4,694	8,578	9,459	10,010	10,281
WEATHER MODIFICATION (PRECIPITATION ENHANCEMENT)	WEATHER MODIFICATION [ATMOSPHERE]	2,960	2,960	2,960	2,960	2,960	2,960
		5,652	**7,654**	**11,538**	**12,419**	**12,970**	**13,241**
MANUFACTURING, HUTCHINSON, CANADIAN (A)							
DEVELOP NEW WELL FIELD (OGALLALA AQUIFER) - BORGER	OGALLALA AQUIFER [HUTCHINSON]	0	860	1,739	2,614	3,487	4,416
		0	**860**	**1,739**	**2,614**	**3,487**	**4,416**
STINNETT, CANADIAN (A)							
DEVELOP OGALLALA AQUIFER SUPPLIES - STINNETT	OGALLALA AQUIFER [HUTCHINSON]	0	0	0	225	225	225
MUNICIPAL CONSERVATION - STINNETT	DEMAND REDUCTION [HUTCHINSON]	15	15	15	15	15	15
WATER AUDITS AND LEAK REPAIR - STINNETT	DEMAND REDUCTION [HUTCHINSON]	22	23	22	22	22	22
		37	**38**	**37**	**262**	**262**	**262**
TCW SUPPLY INC, CANADIAN (A)							
DEVELOP OGALLALA AQUIFER SUPPLIES - TCW SUPPLY	OGALLALA AQUIFER [HUTCHINSON]	575	575	575	575	575	575
MUNICIPAL CONSERVATION - TCW SUPPLY	DEMAND REDUCTION [HUTCHINSON]	21	21	21	21	22	22
WATER AUDITS AND LEAK REPAIR - TCW SUPPLY	DEMAND REDUCTION [HUTCHINSON]	37	38	38	38	37	37
		633	**634**	**634**	**634**	**634**	**634**
Sum of Projected Water Management Strategies (acre-feet)		**13,163**	**18,835**	**22,749**	**23,937**	**24,715**	**25,272**

POTTER COUNTY

WUG, Basin (RWPG)

All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
AMARILLO, CANADIAN (A)							
CONJUNCTIVE USE - CRMWA	MEREDITH LAKE/RESERVOIR [RESERVOIR]	1,524	1,525	1,454	1,365	1,364	1,364
DEVELOP CARSON COUNTY WELL FIELD (OGALLALA AQUIFER) - AMARILLO	OGALLALA AQUIFER [CARSON]	0	0	3,718	1,700	1,700	1,700
DEVELOP POTTER COUNTY WELL FIELD (OGALLALA AQUIFER) - AMARILLO	OGALLALA AQUIFER [POTTER]	510	300	200	500	567	0
DEVELOP ROBERTS COUNTY WELL FIELD (OGALLALA AQUIFER) - AMARILLO	OGALLALA AQUIFER [ROBERTS]	0	0	0	0	0	3,715
EXPAND CAPACITY CRMWA II	OGALLALA AQUIFER [ROBERTS]	0	7,320	6,979	6,552	6,547	6,546
MUNICIPAL CONSERVATION - AMARILLO	DEMAND REDUCTION [POTTER]	577	642	704	768	840	916
REPLACE WELL CAPACITY FOR CRMWA I	OGALLALA AQUIFER [ROBERTS]	0	1,372	1,890	2,593	3,137	3,818
		2,611	**11,159**	**14,945**	**13,478**	**14,155**	**18,059**

AMARILLO, RED (A)

CONJUNCTIVE USE - CRMWA	MEREDITH LAKE/RESERVOIR [RESERVOIR]	1,003	1,004	957	899	898	898
DEVELOP CARSON COUNTY WELL FIELD (OGALLALA AQUIFER) - AMARILLO	OGALLALA AQUIFER [CARSON]	0	0	2,448	1,000	1,325	1,000
DEVELOP POTTER COUNTY WELL FIELD (OGALLALA AQUIFER) - AMARILLO	OGALLALA AQUIFER [POTTER]	900	575	387	750	233	0
DEVELOP ROBERTS COUNTY WELL FIELD (OGALLALA AQUIFER) - AMARILLO	OGALLALA AQUIFER [ROBERTS]	0	0	0	0	0	2,446
EXPAND CAPACITY CRMWA II	OGALLALA AQUIFER [ROBERTS]	0	4,819	4,595	4,314	4,310	4,310
MUNICIPAL CONSERVATION - AMARILLO	DEMAND REDUCTION [POTTER]	380	423	464	506	553	603
REPLACE WELL CAPACITY FOR CRMWA I	OGALLALA AQUIFER [ROBERTS]	0	903	944	1,708	2,065	2,514
		2,283	**7,724**	**9,795**	**9,177**	**9,384**	**11,771**

COUNTY-OTHER, POTTER, CANADIAN (A)

DEVELOP DOCKUM AQUIFER SUPPLIES - POTTER COUNTY OTHER	DOCKUM AQUIFER [POTTER]	560	560	560	560	560	560
DEVELOP OGALLALA AQUIFER SUPPLIES (IRRIGATION CONSERVATION) - POTTER COUNTY OTHER	OGALLALA AQUIFER [POTTER]	0	0	0	0	0	44
DEVELOP OGALLALA AQUIFER SUPPLIES - POTTER COUNTY OTHER	OGALLALA AQUIFER [POTTER]	575	576	535	429	308	0
MUNICIPAL CONSERVATION - POTTER COUNTY OTHER	DEMAND REDUCTION [POTTER]	72	79	86	95	103	113
WATER AUDITS AND LEAK REPAIR - POTTER COUNTY OTHER	DEMAND REDUCTION [POTTER]	98	107	117	127	139	152
		1,305	**1,322**	**1,298**	**1,211**	**1,110**	**869**

COUNTY-OTHER, POTTER, RED (A)

DEVELOP DOCKUM AQUIFER SUPPLIES - POTTER COUNTY OTHER	DOCKUM AQUIFER [POTTER]	140	140	140	140	140	140
DEVELOP OGALLALA AQUIFER SUPPLIES - POTTER COUNTY OTHER	OGALLALA AQUIFER [POTTER]	325	324	365	471	592	856
MUNICIPAL CONSERVATION - POTTER COUNTY OTHER	DEMAND REDUCTION [POTTER]	40	44	49	53	58	63
WATER AUDITS AND LEAK REPAIR - POTTER COUNTY OTHER	DEMAND REDUCTION [POTTER]	56	61	66	72	79	85
		561	**569**	**620**	**736**	**869**	**1,144**

IRRIGATION, POTTER, CANADIAN (A)

IRRIGATION CONSERVATION - POTTER COUNTY	DEMAND REDUCTION [POTTER]	47	102	231	276	337	311
WEATHER MODIFICATION (PRECIPITATION ENHANCEMENT)	WEATHER MODIFICATION [ATMOSPHERE]	106	106	106	106	106	106
		153	**208**	**337**	**382**	**443**	**417**

IRRIGATION, POTTER, RED (A)

IRRIGATION CONSERVATION - POTTER COUNTY	DEMAND REDUCTION [POTTER]	48	107	88	83	76	130
WEATHER MODIFICATION	WEATHER MODIFICATION	110	110	110	110	110	110

(PRECIPITATION ENHANCEMENT)	[ATMOSPHERE]						
		158	**217**	**198**	**193**	**186**	**240**
MANUFACTURING, POTTER, CANADIAN (A)							
DEVELOP CARSON COUNTY WELL FIELD (OGALLALA AQUIFER) - AMARILLO	OGALLALA AQUIFER [CARSON]	0	0	0	579	635	479
DEVELOP POTTER COUNTY WELL FIELD (OGALLALA AQUIFER) - AMARILLO	OGALLALA AQUIFER [POTTER]	396	562	526	500	600	1,000
REPLACE WELL CAPACITY FOR CRMWA I	OGALLALA AQUIFER [ROBERTS]	0	0	300	0	0	0
		396	**562**	**826**	**1,079**	**1,235**	**1,479**
MANUFACTURING, POTTER, RED (A)							
DEVELOP CARSON COUNTY WELL FIELD (OGALLALA AQUIFER) - AMARILLO	OGALLALA AQUIFER [CARSON]	0	0	0	5,112	4,540	5,798
DEVELOP POTTER COUNTY WELL FIELD (OGALLALA AQUIFER) - AMARILLO	OGALLALA AQUIFER [POTTER]	2,246	3,187	2,982	1,001	2,461	2,583
REPLACE WELL CAPACITY FOR CRMWA I	OGALLALA AQUIFER [ROBERTS]	0	0	1,700	0	0	0
		2,246	**3,187**	**4,682**	**6,113**	**7,001**	**8,381**
Sum of Projected Water Management Strategies (acre-feet)		**9,713**	**24,948**	**32,701**	**32,369**	**34,383**	**42,360**

ROBERTS COUNTY

WUG, Basin (RWPG)

All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
IRRIGATION, ROBERTS, CANADIAN (A)							
IRRIGATION CONSERVATION - ROBERTS COUNTY	DEMAND REDUCTION [ROBERTS]	413	681	1,272	1,401	1,473	1,510
WEATHER MODIFICATION (PRECIPITATION ENHANCEMENT)	WEATHER MODIFICATION [ATMOSPHERE]	446	446	446	446	446	446
		859	**1,127**	**1,718**	**1,847**	**1,919**	**1,956**
IRRIGATION, ROBERTS, RED (A)							
IRRIGATION CONSERVATION - ROBERTS COUNTY	DEMAND REDUCTION [ROBERTS]	22	36	67	74	77	80
WEATHER MODIFICATION (PRECIPITATION ENHANCEMENT)	WEATHER MODIFICATION [ATMOSPHERE]	23	23	23	23	23	23
		45	**59**	**90**	**97**	**100**	**103**
MIAMI, CANADIAN (A)							
MUNICIPAL CONSERVATION - MIAMI	DEMAND REDUCTION [ROBERTS]	6	7	6	6	6	6
WATER AUDITS AND LEAK REPAIR - MIAMI	DEMAND REDUCTION [ROBERTS]	11	11	11	11	11	11
		17	**18**	**17**	**17**	**17**	**17**
Sum of Projected Water Management Strategies (acre-feet)		**921**	**1,204**	**1,825**	**1,961**	**2,036**	**2,076**

WHEELER COUNTY

WUG, Basin (RWPG)

All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
IRRIGATION, WHEELER, RED (A)							
IRRIGATION CONSERVATION - WHEELER COUNTY	DEMAND REDUCTION [WHEELER]	395	706	1,230	1,364	1,480	1,542
WEATHER MODIFICATION (PRECIPITATION ENHANCEMENT)	WEATHER MODIFICATION [ATMOSPHERE]	944	944	944	944	944	944
		1,339	**1,650**	**2,174**	**2,308**	**2,424**	**2,486**
SHAMROCK, RED (A)							
MUNICIPAL CONSERVATION - SHAMROCK	DEMAND REDUCTION [WHEELER]	12	13	13	14	14	15
WATER AUDITS AND LEAK REPAIR - SHAMROCK	DEMAND REDUCTION [WHEELER]	18	18	18	18	19	20
		30	**31**	**31**	**32**	**33**	**35**
WHEELER, RED (A)							
DEVELOP OGALLALA AQUIFER SUPPLIES - WHEELER	OGALLALA AQUIFER [WHEELER]	500	500	500	500	500	500
MUNICIPAL CONSERVATION - WHEELER	DEMAND REDUCTION [WHEELER]	15	15	16	16	17	18
		515	**515**	**516**	**516**	**517**	**518**
Sum of Projected Water Management Strategies (acre-feet)		**1,884**	**2,196**	**2,721**	**2,856**	**2,974**	**3,039**

Appendix 5

GAM RUN 16-029 MAG: Modeled Available Groundwater for the Aquifers in Groundwater Management Area 1 (Goswami, R., 2017)

GAM RUN 16-029 MAG: MODELED AVAILABLE GROUNDWATER FOR THE AQUIFERS IN GROUNDWATER MANAGEMENT AREA 1

Rohit Raj Goswami, Ph.D., P.E.
Texas Water Development Board
Groundwater Division
Groundwater Availability Modeling Section
(512) 463-0495
April 19, 2017

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GAM RUN 16-029 MAG: MODELED AVAILABLE GROUNDWATER FOR THE AQUIFERS IN GROUNDWATER MANAGEMENT AREA 1

Rohit Raj Goswami, Ph.D., P.E.
Texas Water Development Board
Groundwater Division
Groundwater Availability Modeling Section
(512) 463-0495
April 19, 2017

EXECUTIVE SUMMARY:

The modeled available groundwater for Groundwater Management Area 1 for the Ogallala Aquifer (inclusive of the Rita Blanca Aquifer) is summarized by decade for the groundwater conservation districts (Table 1) and for use in the regional water planning process (Table 2). The modeled available groundwater estimates range from 3,553,273 acre-feet per year in 2020 to 2,236,434 acre-feet per year in 2062 (Table 1). The modeled available groundwater for Groundwater Management Area 1 for the Dockum Aquifer is summarized by decade for the groundwater conservation districts (Table 3) and for use in the regional water planning process (Table 4). The modeled available groundwater estimates for the Dockum Aquifer range from 261,079 acre-feet per year in 2020 to 229,900 acre-feet per year in 2062 (Table 4). The modeled available groundwater estimates were extracted from results of a model run using the groundwater availability model for the High Plains Aquifer System (version 1.01). The model run files, which meet the desired future conditions for the relevant aquifers in Groundwater Management Area 1, were submitted to the Texas Water Development Board (TWDB) as part of the Desired Future Conditions Explanatory Report for Groundwater Management Area 1 (Deeds and Walthour, 2016). The Executive Administrator of the TWDB determined that the explanatory report and other materials were administratively complete on March 10, 2017.

REQUESTOR:

Mr. Kyle G. Ingham, chair of Groundwater Management Area 1.

DESCRIPTION OF REQUEST:

On December 16, 2016, Mr. Kyle G. Ingham provided the TWDB with the desired future conditions of the Ogallala Aquifer (inclusive of the Rita Blanca Aquifer) and the Dockum Aquifer adopted by the groundwater conservation districts in Groundwater Management Area 1 on November 2, 2016. The Blaine Aquifer in Wheeler County was designated non-relevant. The desired future conditions for the aquifers in Groundwater Management Area 1, as described in Resolution No. 2016-2, are described below:

Ogallala Aquifer (inclusive of the Rita Blanca Aquifer)

- At least 40 percent of volume in storage remaining in 50 years, for the period 2012-2062 collectively in Dallam, Hartley, Moore, and Sherman counties;
- At least 50 percent of volume in storage remaining in 50 years, for the period 2012-2062 collectively in Hansford, Lipscomb, and Ochiltree counties and that portion of Hutchinson County with North Plains [Groundwater Conservation District;]
- At least 50 percent of volume in storage remaining in 50 years, for the period 2012-2062 in Carson, Donley, Gray, Hutchinson, Oldham, Roberts, and Wheeler counties; and portions of Armstrong and Potter counties within the Panhandle [Groundwater Conservation District];
- At least 80 percent of volume in storage remaining in 50 years, for the period 2012-2062, within the Hemphill County;
- Approximately 20 feet of total average drawdown in 50 years for the period 2012-2062 collectively in Randall County and in Armstrong and Potter counties within the High Plains [Underground Water Conservation District No. 1].

Dockum Aquifer

- At least 40 percent of the available drawdown remaining in 50 years for the period 2012-2062 collectively for Dallam, Hartley, Moore, and Sherman counties[;]
- No more than 30 feet average decline in water levels in 50 years for the period 2012-2062 collectively in Carson and Oldham counties and in Armstrong and Potter counties within the Panhandle [Groundwater Conservation District]; and
- The total average drawdown is approximately 40 feet in 50 years for the period 2012-2062, collectively in Randall County, and in Armstrong and Potter counties within the High Plains [Underground Water Conservation District No. 1].

METHODS:

The groundwater availability model for the High Plains Aquifer System was run using the model files submitted with the explanatory report. The modeled available groundwater values were determined by extracting pumping rates by decade from the model results using ZONEBUDGET Version 3.01 (Harbaugh, 2009). Annual pumping rates for the Ogallala Aquifer (inclusive of the Rita Blanca Aquifer) and Dockum Aquifer were divided by county and groundwater conservation district, subtotaled by groundwater conservation district, and then summed for all of Groundwater Management Area 1 (Figures 1 and 3 and Tables 1 and 3). Modeled available groundwater for the Ogallala Aquifer (inclusive of the Rita Blanca Aquifer) and Dockum Aquifer were also divided by county, river basin, regional water planning area, and groundwater conservation district (Figures 2 and 4 and Tables 2 and 4).

Modeled Available Groundwater and Permitting

Chapter 36 of the Texas Water Code defines "modeled available groundwater" as 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.

PARAMETERS AND ASSUMPTIONS:

The parameters and assumptions for the groundwater availability are described below:

- Version 1.01 of the groundwater availability model for the High Plains Aquifer System was used for this analysis. See Deeds and Jigmond (2015) for assumptions and limitations of the groundwater availability model.
- This groundwater availability model includes 4 layers which generally represent the Ogallala Aquifer and other younger geologic units (Layer 1), geologic units that directly overlie the Dockum Aquifer, the Rita Blanca and Edwards-Trinity (High Plains) aquifers (Layer 2), upper portion of the Dockum Aquifer (Layer 3), and the lower portion of the Dockum Aquifer (Layer 4).
- The model was run with MODFLOW-NWT (Niswonger and others, 2011) which is based on MODFLOW-2005 (Harbaugh, 2005).
- The analysis assumed model extent within Texas for all aquifers except for the Rita Blanca Aquifer, which assumed the official TWDB mapped aquifer boundary.

- Only the cells in Lower Dockum (Layer 4) were considered while processing results (desired future conditions and modeled available groundwater) for the Dockum Aquifer. The Groundwater Management Area consultant, Dr. Deeds (INTERA, Incorporated), confirmed this on March 6, 2017, in response to a clarification letter sent by Groundwater staff to Groundwater Management Area 1 on February 27, 2017. Mr. Ingham, chair of Groundwater Management Area 1, agreed with the assumptions while responding to the clarification letter on March 21, 2017.

RESULTS:

The modeled available groundwater estimates for the Ogallala Aquifer (including the Rita Blanca Aquifer) range from 3,553,273 acre-feet per year in 2020 to 2,236,434 acre-feet per year in 2062 (Table 1). The modeled available groundwater estimates for the Dockum Aquifer range from 261,079 acre-feet per year in 2020 to 229,900 acre-feet per year in 2062 (Table 3). Modeled available groundwater estimates for each aquifer are summarized by groundwater conservation district and by county, river basin, and regional water planning area for use in the regional water planning process (Figures 1 to 4 and Tables1 to 4). Small differences of values between table summaries are due to rounding.

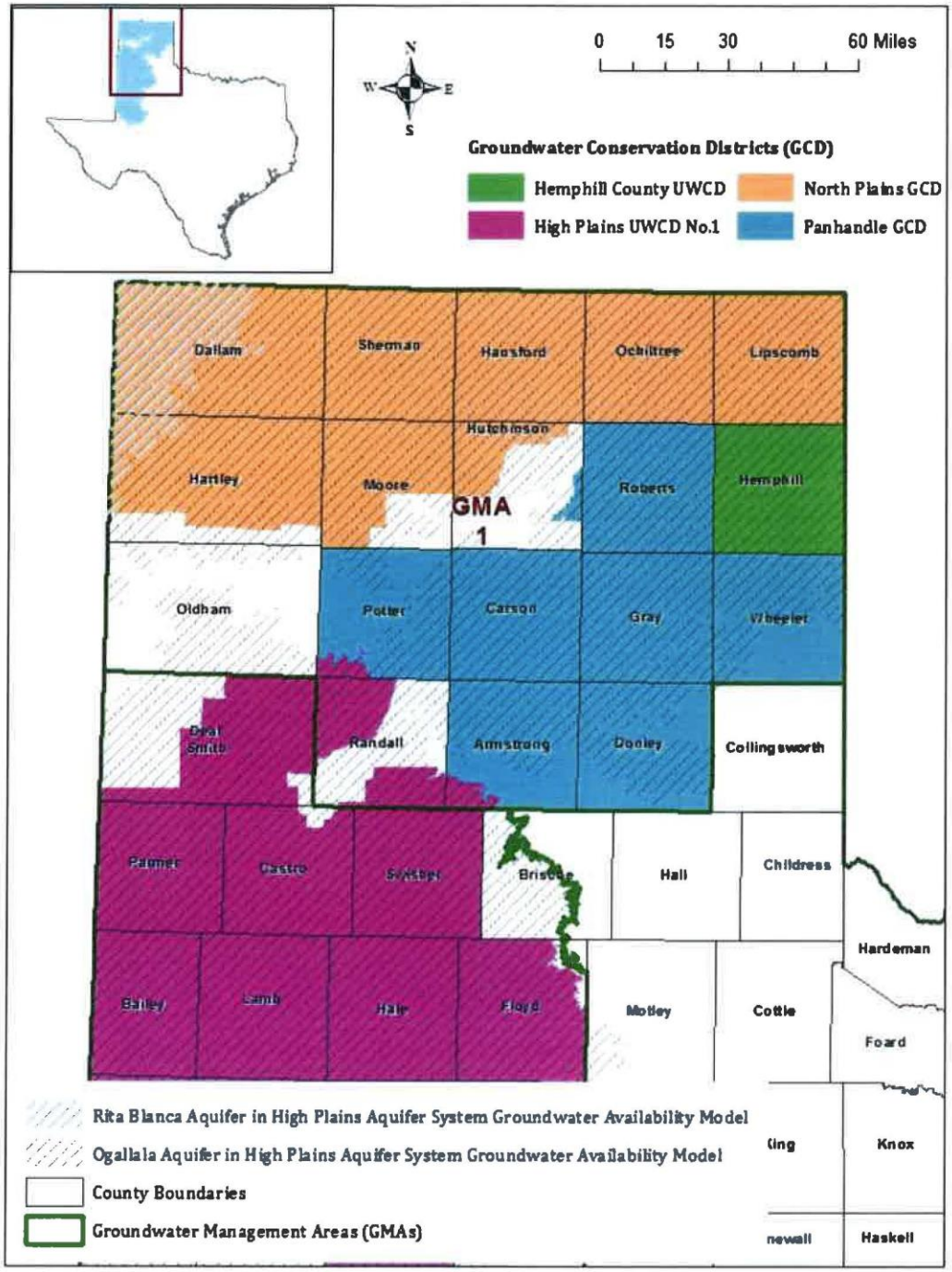

FIGURE 1. MAP SHOWING THE OGALLALA AND RITA BLANCA AQUIFERS AND GROUNDWATER CONSERVATION DISTRICTS IN GROUNDWATER MANAGEMENT AREA 1 OVERLAIN BY THE GROUNDWATER AVAILABILITY MODEL EXTENT FOR THE HIGH PLAINS AQUIFER SYSTEM.

TABLE 1. MODELED AVAILABLE GROUNDWATER FOR THE OGALLALA AND RITA BLANCA AQUIFERS IN GROUNDWATER MANAGEMENT AREA 1 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE (2020 TO 2060) AND THE YEAR 2062. VALUES ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District	County	Aquifer	2020	2030	2040	2050	2060	2062
High Plains UWCD No. 1	Armstrong	Ogallala	1,286	1,048	866	723	610	591
High Plains UWCD No. 1	Potter	Ogallala	225	225	225	223	221	221
High Plains UWCD No. 1	Randall	Ogallala	39,084	37,987	32,477	28,334	25,018	24,459
High Plains UWCD No. 1 Total		**Ogallala**	**40,595**	**39,260**	**33,568**	**29,280**	**25,849**	**25,271**
Hemphill County UWCD Total	Hemphill	Ogallala	52,196	52,218	52,267	52,305	52,336	52,341
North Plains GCD	Dallam	Ogallala/Rita Blanca	387,471	287,205	225,573	166,890	112,864	103,258
North Plains GCD	Hansford	Ogallala	275,016	272,656	271,226	270,281	269,589	269,479
North Plains GCD	Hartley	Ogallala	397,585	271,523	212,321	154,433	100,407	90,842
North Plains GCD	Hutchinson	Ogallala	62,803	64,522	65,652	66,075	66,027	65,956
North Plains GCD	Lipscomb	Ogallala	266,809	266,710	266,640	266,591	266,559	266,557
North Plains GCD	Moore	Ogallala	214,853	172,621	139,322	105,016	73,384	67,650
North Plains GCD	Ochiltree	Ogallala	243,778	243,932	244,002	244,051	244,082	244,085
North Plains GCD	Sherman	Ogallala	398,056	348,895	281,690	212,744	148,552	136,776
North Plains GCD Total		**Ogallala/Rita Blanca**	**2,246,371**	**1,928,064**	**1,706,426**	**1,486,081**	**1,281,464**	**1,244,603**

Table 1 (Continued)

Groundwater Conservation District	County	Aquifer	2020	2030	2040	2050	2060	2062
Panhandle GCD	Armstrong	Ogallala	57,984	53,414	48,170	43,462	38,860	38,080
Panhandle GCD	Carson	Ogallala	192,135	184,263	169,931	153,767	137,215	134,055
Panhandle GCD	Donley	Ogallala	74,808	76,289	72,962	67,873	62,058	60,901
Panhandle GCD	Gray	Ogallala	181,105	175,267	162,653	148,713	134,431	131,744
Panhandle GCD	Hutchinson	Ogallala	15,734	16,740	15,156	13,324	11,742	11,455
Panhandle GCD	Potter	Ogallala	16,969	15,820	14,442	13,162	11,836	11,609
Panhandle GCD	Roberts	Ogallala	430,618	455,129	427,218	390,247	350,459	342,748
Panhandle GCD	Wheeler	Ogallala	130,425	138,810	137,385	132,312	124,778	123,309
Panhandle GCD Total		**Ogallala**	**1,099,778**	**1,115,732**	**1,047,917**	**962,860**	**871,379**	**853,901**
No District-County	Hartley	Ogallala	19,528	17,639	14,527	11,147	8,016	7,458
No District-County	Moore	Ogallala	8,932	8,598	7,592	6,186	4,788	4,532
No District-County	Oldham	Ogallala	44,599	40,203	33,423	26,207	19,590	18,617
No District-County	Randall	Ogallala	24,826	23,945	21,864	19,471	17,012	16,541
No District-County	Hutchinson	Ogallala	16,448	14,432	13,353	12,973	13,089	13,170
No District-County Total		**Ogallala**	**114,333**	**104,817**	**90,759**	**75,984**	**62,495**	**60,318**
GMA 1 - Total		**Ogallala/Rita Blanca**	**3,553,273**	**3,240,091**	**2,930,937**	**2,606,510**	**2,293,523**	**2,236,434**

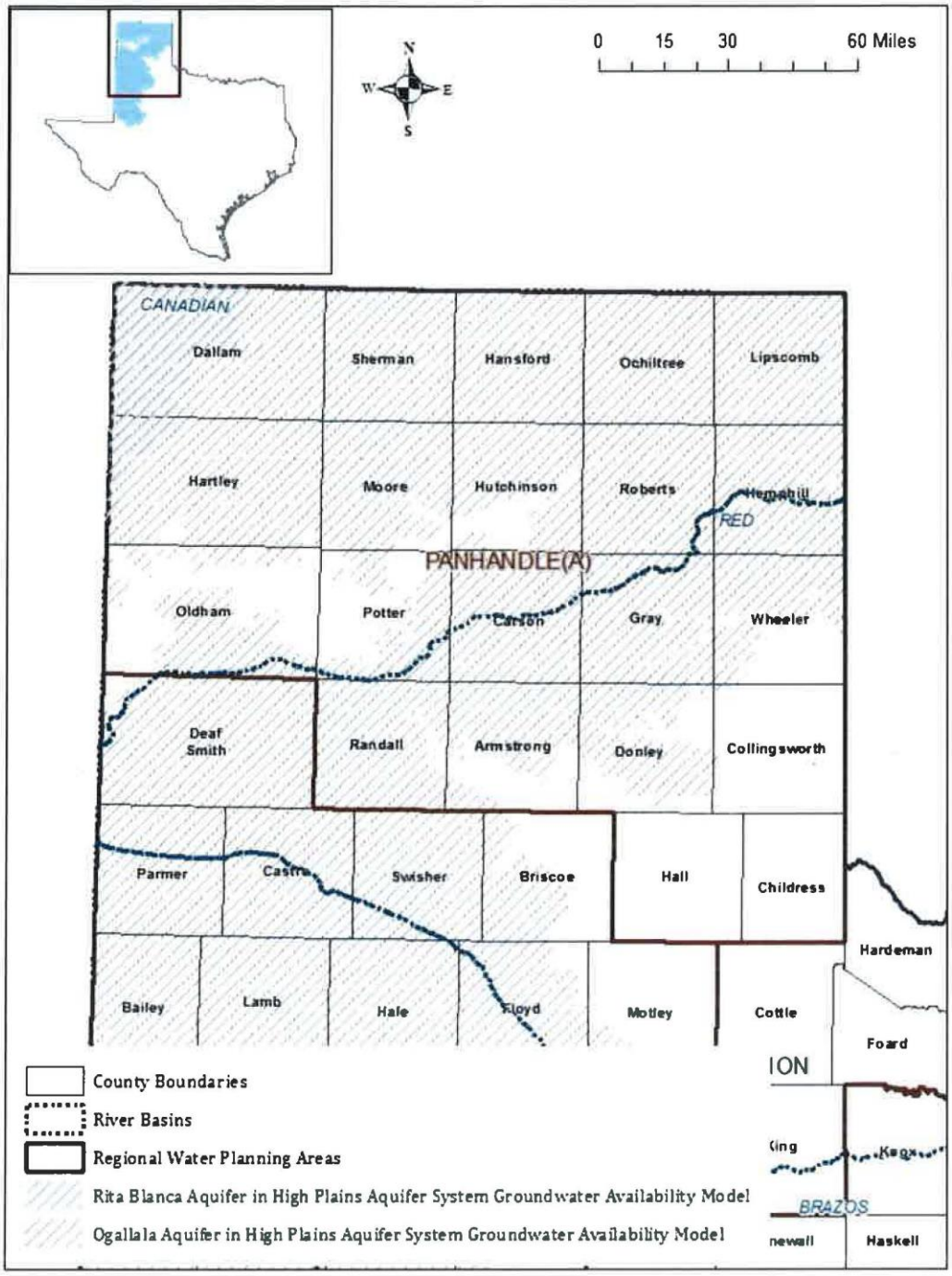

FIGURE 2. MAP SHOWING THE OGALLALA AND RITA BLANCA AQUIFERS AND REGIONAL WATER PLANNING AREAS, COUNTIES, AND RIVER BASINS IN GROUNDWATER MANAGEMENT AREA 1 OVERLAIN BY THE GROUNDWATER AVAILABILITY MODEL EXTENT FOR THE HIGH PLAINS AQUIFER SYSTEM.

TABLE 2. MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE OGALLALA AND RITA BLANCA AQUIFERS IN GROUNDWATER MANAGEMENT AREA 1 SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA) FOR EACH DECADE (2020 TO 2060). VALUES ARE IN ACRE-FEET PER YEAR.

County	RWPA	River Basin	Aquifer	2020	2030	2040	2050	2060
Armstrong	A	Red	Ogallala	59,270	54,462	49,036	44,185	39,470
Carson	A	Canadian	Ogallala	77,157	74,542	69,042	62,520	55,902
Carson	A	Red	Ogallala	114,978	109,721	100,889	91,247	81,313
Dallam	A	Canadian	Ogallala/Rita Blanca	387,471	287,205	225,573	166,890	112,864
Donley	A	Red	Ogallala	74,808	76,289	72,962	67,873	62,058
Gray	A	Canadian	Ogallala	44,778	42,146	37,337	32,130	27,432
Gray	A	Red	Ogallala	136,327	133,121	125,316	116,583	106,999
Hansford	A	Canadian	Ogallala	275,016	272,656	271,226	270,281	269,589
Hartley	A	Canadian	Ogallala	417,113	289,162	226,848	165,580	108,423
Hemphill	A	Canadian	Ogallala	27,789	30,260	31,999	33,363	34,058
Hemphill	A	Red	Ogallala	24,407	21,958	20,268	18,942	18,278
Hutchinson	A	Canadian	Ogallala	94,985	95,694	94,161	92,372	90,858
Lipscomb	A	Canadian	Ogallala	266,809	266,710	266,640	266,591	266,559
Moore	A	Canadian	Ogallala	223,785	181,219	146,914	111,202	78,172
Ochiltree	A	Canadian	Ogallala	243,778	243,932	244,002	244,051	244,082
Oldham	A	Canadian	Ogallala	37,367	34,376	29,078	23,039	17,800
Oldham	A	Red	Ogallala	7,232	5,827	4,345	3,168	1,790
Potter	A	Canadian	Ogallala	9,552	9,196	8,519	7,898	7,214
Potter	A	Red	Ogallala	7,642	6,849	6,148	5,487	4,843
Randall	A	Red	Ogallala	63,910	61,932	54,341	47,805	42,030
Roberts	A	Canadian	Ogallala	408,968	430,269	401,642	365,119	326,457
Roberts	A	Red	Ogallala	21,650	24,860	25,576	25,128	24,002
Sherman	A	Canadian	Ogallala	398,056	348,895	281,690	212,744	148,552
Wheeler	A	Red	Ogallala	130,425	138,810	137,385	132,312	124,778
GMA 1 Total				**3,553,273**	**3,240,091**	**2,930,937**	**2,606,510**	**2,293,523**

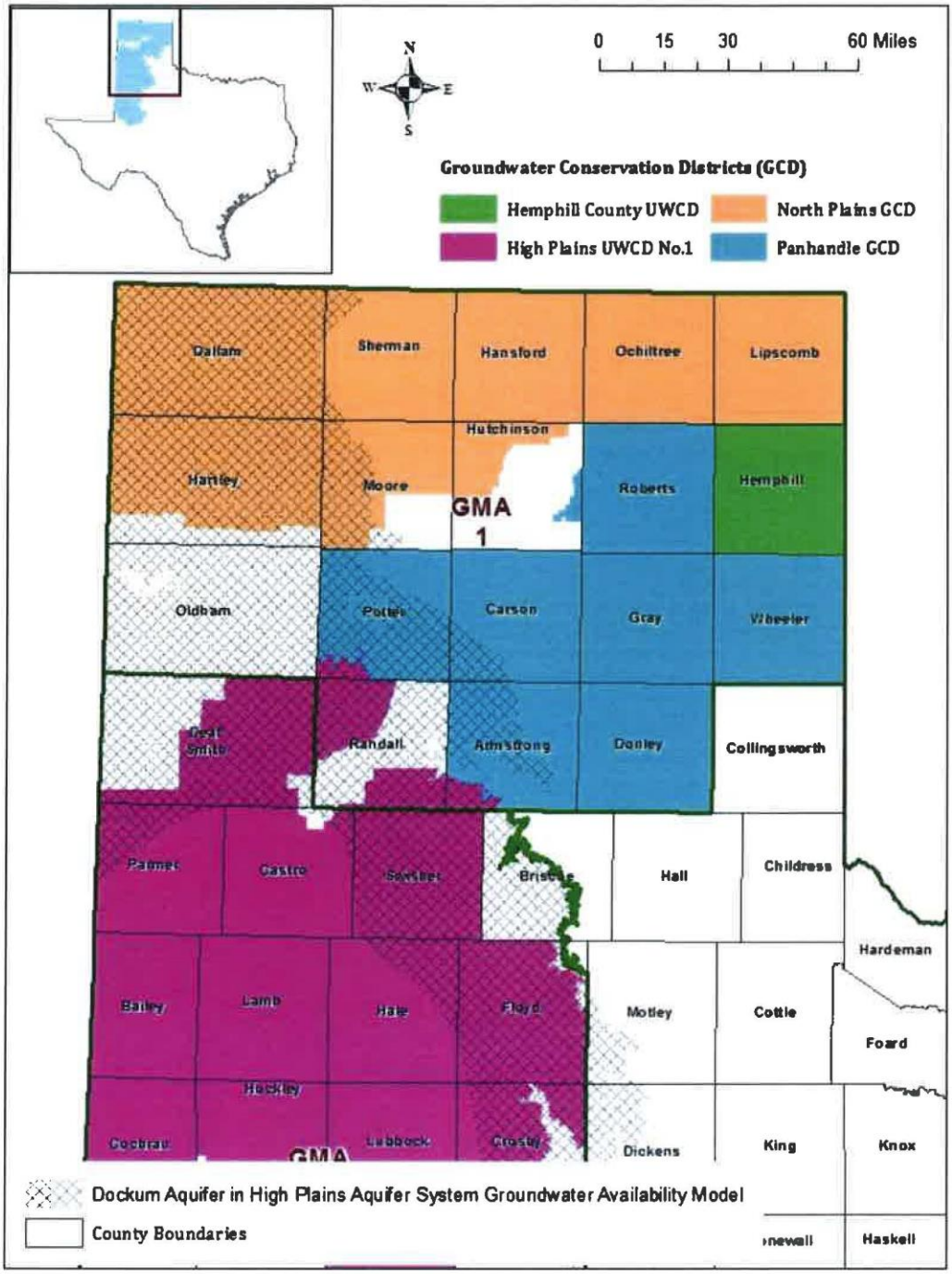

FIGURE 3. MAP SHOWING THE DOCKUM AQUIFER AND GROUNDWATER CONSERVATION DISTRICTS IN GROUNDWATER MANAGEMENT AREA 1 OVERLAIN BY THE GROUNDWATER AVAILABILITY MODEL EXTENT FOR THE HIGH PLAINS AQUIFER SYSTEM.

TABLE 3. MODELED AVAILABLE GROUNDWATER FOR THE DOCKUM AQUIFER IN GROUNDWATER MANAGEMENT AREA 1 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE (2020 TO 2060) AND THE YEAR 2062.VALUES ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District	County	Aquifer	2020	2030	2040	2050	2060	2062
High Plains UWCD No. 1	Armstrong	Dockum	96	0	0	0	0	0
High Plains UWCD No. 1	Potter	Dockum	21	0	0	0	0	0
High Plains UWCD No. 1	Randall	Dockum	2,189	2,714	2,954	3,111	3,214	3,229
High Plains UWCD No. 1 Total		**Dockum**	**2,306**	**2,714**	**2,954**	**3,111**	**3,214**	**3,229**
North Plains GCD	Dallam	Dockum	14,192	14,188	14,186	14,184	14,184	14,184
North Plains GCD	Moore	Dockum	4,801	4,532	4,493	4,417	4,289	4,261
North Plains GCD	Hartley	Dockum	11,602	10,766	10,524	10,560	10,815	10,895
North Plains GCD	Sherman	Dockum	127	127	127	127	95	93
North Plains GCD Total		**Dockum**	**30,722**	**29,613**	**29,330**	**29,288**	**29,383**	**29,433**
Panhandle GCD	Armstrong	Dockum	7,131	9,024	9,588	9,704	9,535	9,494
Panhandle GCD	Carson	Dockum	68	108	140	169	198	204
Panhandle GCD	Potter	Dockum	38,803	39,113	36,937	34,505	32,008	31,558
Panhandle GCD Total		**Dockum**	**46,002**	**48,245**	**46,665**	**44,378**	**41,741**	**41,256**
No District-County	Hartley	Dockum	43,647	44,269	44,404	44,304	44,022	43,941
No District-County	Moore	Dockum	418	575	527	509	500	498
No District-County	Oldham	Dockum	129,001	128,829	120,518	111,196	101,413	99,736
No District-County	Randall	Dockum	8,983	11,302	11,909	12,002	11,855	11,807
No District- County Total		**Dockum**	**182,049**	**184,975**	**177,358**	**168,011**	**157,790**	**155,982**
GMA 1 Total		**Dockum**	**261,079**	**265,547**	**256,307**	**244,788**	**232,128**	**229,900**

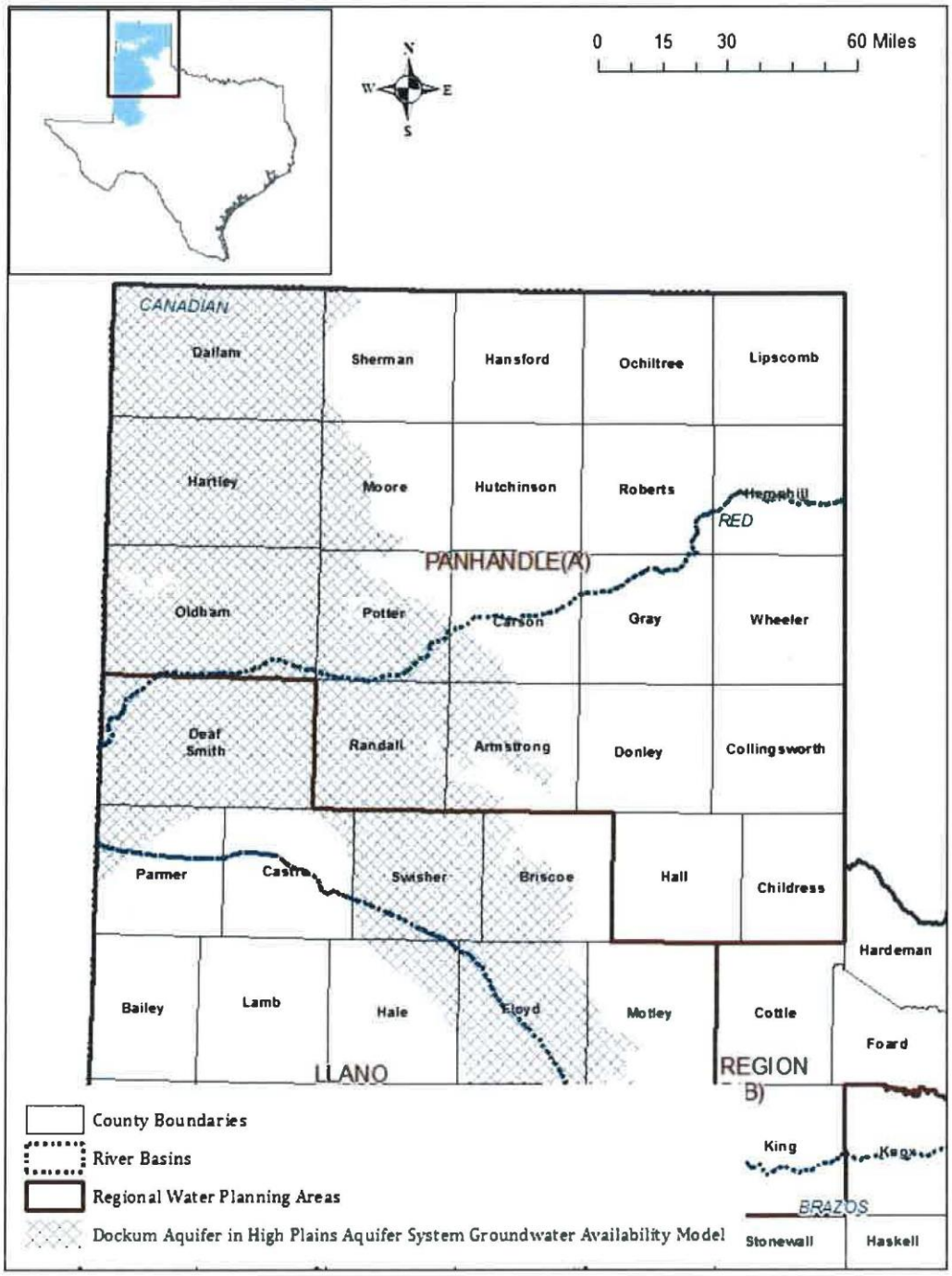

FIGURE 4. MAP SHOWING THE DOCKUM AQUIFER AND REGIONAL WATER PLANNING AREAS, COUNTIES, AND RIVER BASINS IN GROUNDWATER MANAGEMENT AREA 1 OVERLAIN BY THE GROUNDWATER AVAILABILITY MODEL EXTENT FOR THE HIGH PLAINS AQUIFER SYSTEM.

TABLE 4. MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE DOCKUM AQUIFER IN GROUNDWATER MANAGEMENT AREA 1 SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA) FOR EACH DECADE (2020 TO 2060). VALUES ARE IN ACRE-FEET PER YEAR.

County	RWPA	River Basin	Aquifer	2020	2030	2040	2050	2060
Armstrong	A	Red	Dockum	7,227	9,024	9,588	9,704	9,535
Carson	A	Canadian	Dockum	4	10	15	19	23
Carson	A	Red	Dockum	64	98	125	150	175
Dallam	A	Canadian	Dockum	14,192	14,188	14,186	14,184	14,184
Hartley	A	Canadian	Dockum	55,249	55,035	54,928	54,864	54,837
Moore	A	Canadian	Dockum	5,219	5,107	5,020	4,926	4,789
Oldham	A	Canadian	Dockum	128,938	128,771	120,466	111,146	101,365
Oldham	A	Red	Dockum	63	58	52	50	48
Potter	A	Canadian	Dockum	38,641	38,983	36,832	34,409	31,900
Potter	A	Red	Dockum	183	130	105	96	108
Randall	A	Red	Dockum	11,172	14,016	14,863	15,113	15,069
Sherman	A	Canadian	Dockum	127	127	127	127	95
GMA 1 Total			**Dockum**	**261,079**	**265,547**	**256,307**	**244,788**	**232,128**

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.

The TWDB is available to work with groundwater conservation districts to use ongoing data collection programs to compare the predictions of the model against how the aquifer responds to the actual amount and location of pumping. Besides groundwater pumping and use trends, historic precipitation patterns also need to be placed in context as future climatic conditions, such as dry and wet year precipitation patterns, may differ and affect groundwater flow conditions.

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Appendix 6

Coordination letters with regional surface water management entities

Panhandle Groundwater Conservation District
201 W. Third / PO Box 637
White Deer, TX 79097
Ph: 806-883-2501
Fax: 806-883-2162
www.pgcd.us

July 25, 2019

CRMWA
Kent Satterwhite
PO Box 9
Sanford, TX 79078

Dear Kent,

Enclosed please find the Panhandle Groundwater Conservation District's approved Management Plan as required by Texas Water Code Section 36.1072 to develop and adopt a new Management Plan each 5 years.

Respectfully,

C.E. Williams
General Manager

Panhandle Groundwater Conservation District
201 W. Third / PO Box 637
White Deer, TX 79097
Ph: 806-883-2501
Fax: 806-883-2162
www.pgcd.us

July 25, 2019

Greenbelt Water Authority
Bobbie Kidd
PO Box 665
Clarendon, TX 79226

Dear Bobbie,

Enclosed please find the Panhandle Groundwater Conservation District's approved Management Plan as required by Texas Water Code Section 36.1072 to develop and adopt a new Management Plan each 5 years.

Respectfully,

C.E. Williams
General Manager