South Plains Underground Water Conservation District

Groundwater Management Plan

2018-2023

Effective

November 14, 2018

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District Mission Statement

The South Plains Underground Water Conservation District (the District) will develop, promote, and implement management strategies to provide for the conservation, preservation, protection, recharging and prevention of waste of the groundwater resources, over which it has jurisdictional authority, for the benefit of the people that the District serves.

Time Period for this Plan

This plan becomes effective October 9, 2018, upon adoption by the Board of Directors (the Board) of the District and remains in effect until a revised plan is approved or until October 9, 2023, whichever is earlier.

Guiding Principles

The District was formed, and has been operated from its inception, with the guiding belief that the ownership and production of groundwater is a private property right. It is understood that, without the District, there is no protection of private property rights. The methods of protecting private property rights in groundwater are implemented using the policies adopted by the locally elected board members.

The Board understands the responsibilities of the District and creates programs necessary for meeting them. The Board believes that the District should be more knowledgeable of its groundwater resources than any other entity.

Additionally, the Board realizes that the aquifer extends beyond the District's boundaries, and the sharing of information, programs and ideas with neighboring districts is important. As a result, the District will consider the joint administration of certain programs when practical.

This management plan is a tool which provides continuity in the management of the District. The District staff uses this guide to ensure that the goals of the District are met. The Board uses it for planning, as well as measuring the performance of the staff.

Conditions change over time which requires that the Board modify this document. The dynamic nature of this plan shall be maintained such that the District continues serving the needs of the constituents. At the very least, the Board will review and readopt this plan every five years, or as specified by Chapter 36, Texas Water Code.

In the opinion of the Board, the goals, management objectives, and performance standards in this planning document have been set at a reasonable level considering existing and future fiscal and technical resources. Evolving conditions may change the management objectives defined to reach the stated goals. Whatever the future holds, the following guidelines are used to insure the management objectives are set at a sufficient level to be realistic and effective:

- The District's constituents will determine if the District's goals are set at a level that is both meaningful and attainable; through their voting right, the public will appraise the District's overall performance in the process of electing or re-electing Board members.
- The duly elected Board will guide and direct the District staff and will gauge the achievement of the goals set forth in this document.
- The interests and needs of the District's constituents shall control the direction of the management of the District.
- The Board will maintain local management of the privately-owned resource over which the District has jurisdictional authority, as provided by Chapter 36, Texas Water Code.
- The Board will evaluate District activities on a fiscal year basis. That is, the District budgets operations on a September 1 – August 31 fiscal year. When considering stated goals, management objectives, and performance standards, any reference to the terms annual, annually, or yearly will refer to the fiscal year of the District.

General Description, Location and Extent

The District was created by HB 281 (72nd Legislature) during 1991. The District was confirmed by voter approval, the initial Board elected, and an ad valorem tax rate cap of $0.025/$100 valuation was set in an election held in August 1992. Table 1 lists the current Board of Directors, office held, occupation, and term.

Table 1: Board of Directors of the South Plains Underground Water Conservation District

Office	Name	Occupation	Term Ends
President	Matt Hogue	Active Farmer	May 2022
Secretary	Larry Yowell	Agri-Business	May 2020
Member	David Swaringen	Agri-Business	May 2020
Member	Barrett Brown	Active Farmer	May 2022
Member	Tye Day	Active Farmer	May 2020

Originally, the jurisdictional extent of the District was the same as Terry County, Texas. However, in 1994 the District annexed about 1,100 acres of Hockley County from individual landowner petitions. As a result, the District includes about .26% of the land area in Hockley County.

The District now covers approximately 902 square miles of the Southern High Plains of Texas (Figure 1). Brownfield, the Terry county seat, is the largest municipality in the District, having a population of about 9,779. Meadow (pop. 596) and Wellman (pop. 204) are the other two incorporated communities in the District.

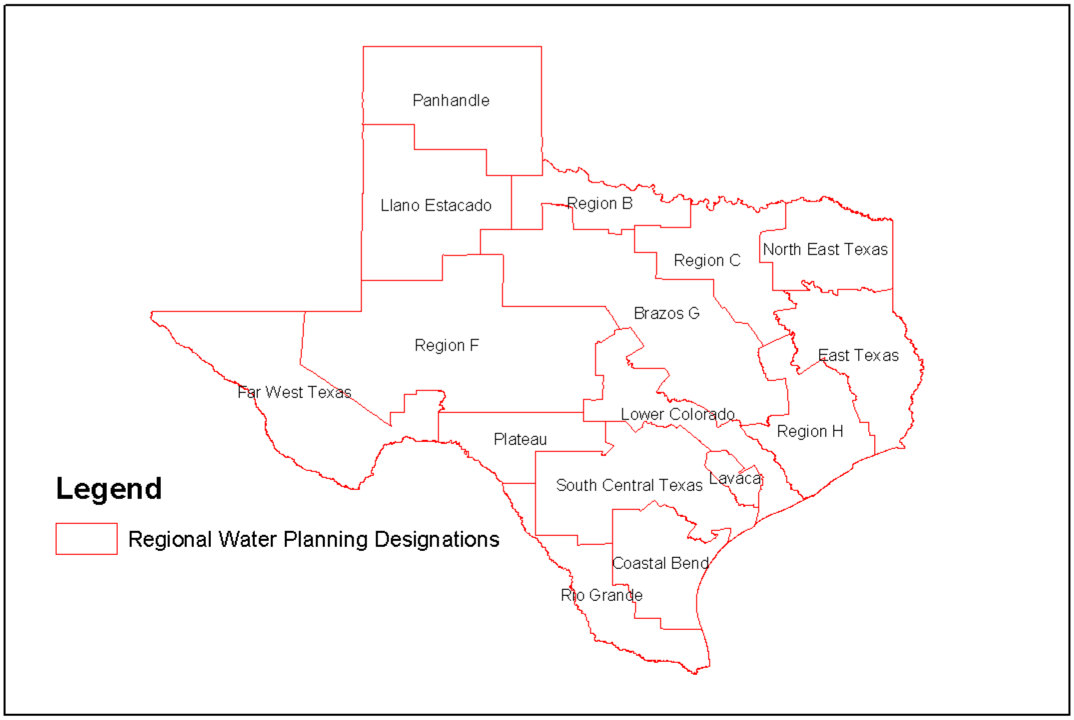
Four other groundwater districts border the South Plains Underground Water Conservation District. These include High Plains UWCD #1, Llano Estacado UWCD, Mesa UWCD and the Sandy Land UWCD.

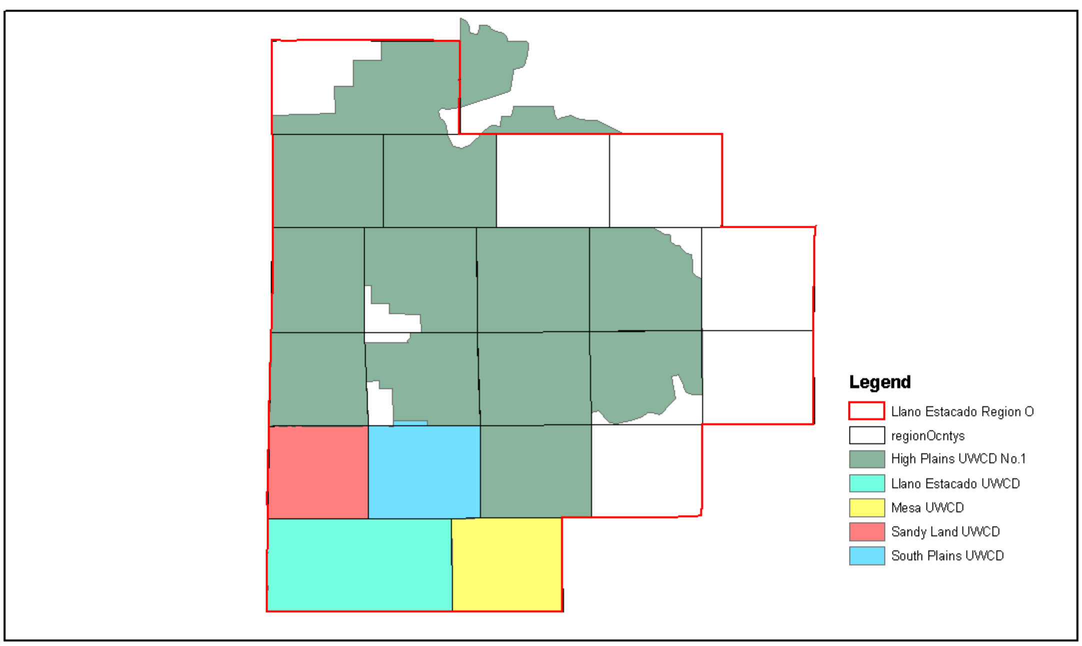
The economy of the District is supported predominately by row crop agriculture. The 150,000 plus acres of irrigated cropland (out of total row crop acreage of 500,000) affords economic stability to the area covered by the District. The major crops cultivated within the District include: cotton, peanuts, grain sorghum and wheat and, to a lesser extent, grapes, watermelons, sunflowers, guar and hay crops. Two dairy facilities are located in the District.

Grapes have become an important crop within the last 5 years. Currently, there are approximately 3,500 acres of wine grapes grown in the District. This accounts for 80% of the wine grapes grown in the state. Grapes use less water than other crops and are usually irrigated by drip irrigation during the winter months. Terry County has been designated by the Texas Legislature as the "Grape Capital of Texas".

A significant portion of the District's tax-based revenues are generated by mineral valuation. Fluctuating oil prices are a challenge to the budgeting process.

Figure 1: Location of the South Plains Underground Water Conservation District





Topography and Drainage

The land surface in the District is a nearly level to very gently undulating constructional plain that has little dissection. The northwestern part of the District is the most undulating, largely because eolian deposits of sand have been shifted and reworked by wind.

The elevation ranges from about 3150 feet above sea level in the southeastern part of the District to 3600 feet in the northwestern part. Brownfield, which is near the center of the District, has an approximate elevation of 3300 feet. There is a general slope of about 10 feet per mile from the northwest to southeast.

Two relic drainage ways, Sulfur Springs Draw and Lost Draw, cross the District from northwest to southeast. These draws are shallow and are usually dry; they seldom carry runoff water.

Rick Lake and Mound Lake are the largest salt lakes in the District. Around these lakes is the sharpest topographical relief. The eolian hills that border the east sides of these lakes are sometimes 100 feet or more higher than the lakebeds.

Playas, or shallow lakes, are more common in the northeastern part of the district. Playas are not prevalent in the sandier areas. The playas range in size from 2 to 40 acres and provide the only surface drainage in many areas. Aquifer recharge occurs through these playa basins during and after significant rainfall events. Recharge is limited once the clays in the basins swell and effectively stop percolation of groundwater (Sanders, 1961).

Groundwater Resources

The District has jurisdictional authority over all groundwater that lies within the District's boundaries. Three aquifers, the Ogallala, the Cretaceous, and the Dockum occur within the District. The following is a description of these formations that may be beneficial to District constituents by providing useable quantities of groundwater.

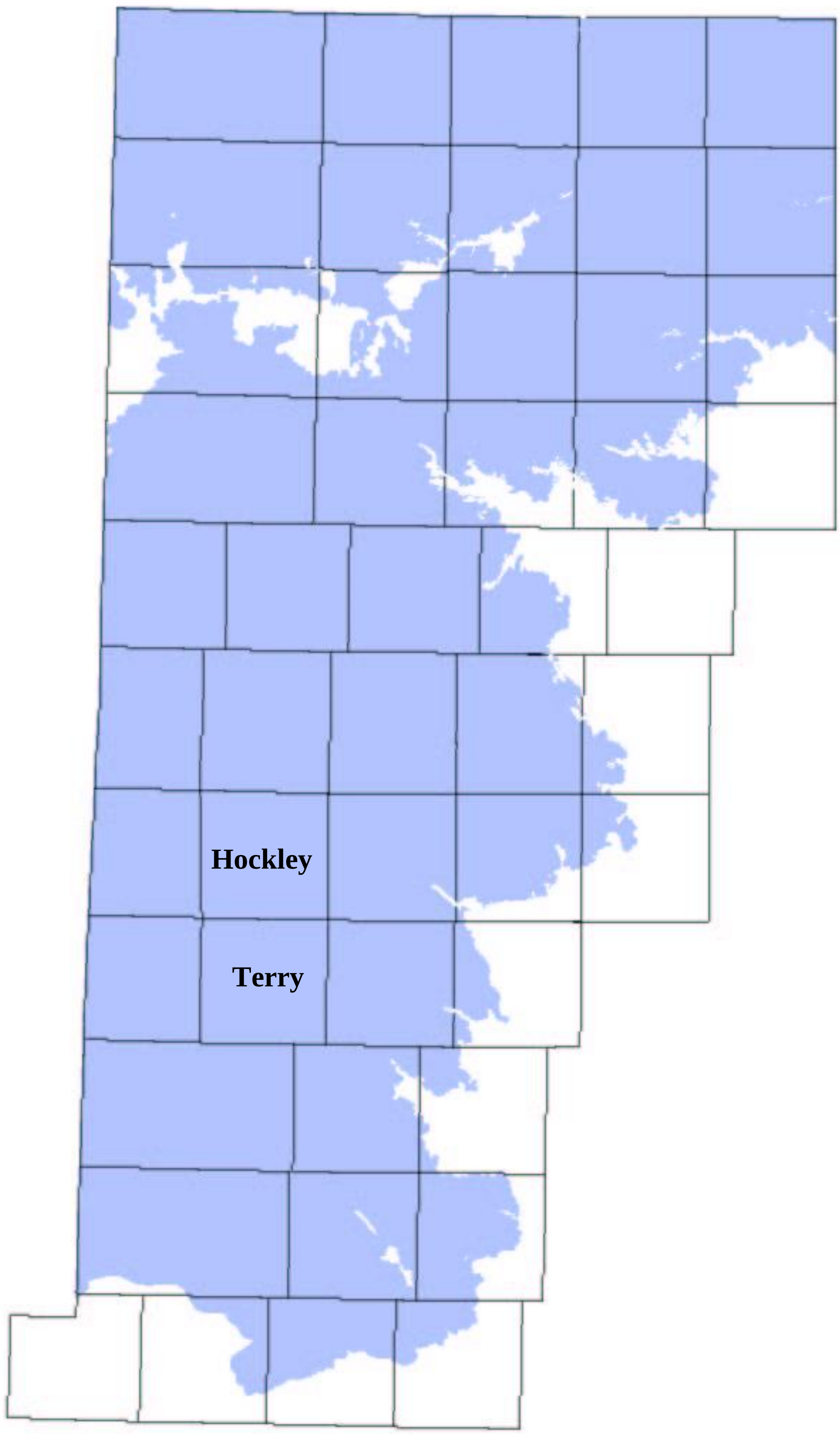
Ogallala Aquifer

The Ogallala Aquifer is the primary source of groundwater in the District (Figure 2). The aquifer extends from the ground surface downward, ranging in thickness from 80 feet to more than 200 feet in the area covered by the District.

The formation consists of heterogeneous sequences of clay, silt, sand and gravel. These sediments are thought to have been deposited by eastward flowing aggrading streams that filled and buried valleys eroded into pre-Ogallala rocks. A resistant layer of calcium carbonate-cemented caliche known locally as the "caprock" occurs near the surface of much of the area. (Ashworth and Hopkins, 1995).

Water levels in the Ogallala Aquifer are influenced by the rate of recharge and discharge. Recharge occurs primarily by infiltration of precipitation. GAM studies show that recharge is

Figure 2: Extent of the Ogallala Aquifer in Texas
(Adapted from Ashworth and Hopkins, 1995)



greater beneath irrigated lands. To a lesser extent, recharge may also occur by upward leakage from underlying Cretaceous units that, in places, have a higher water table elevation than the Ogallala. Generally, only a small percentage of water from precipitation actually reaches the water table due to a combination of limited annual precipitation (17.59 inches per year), high evaporation rate (60-70 inches per year), and slow infiltration rate. However, where deep sands are prevalent, and the water table is shallow, precipitation may affect recharge rather quickly.

Groundwater in the aquifer generally flows from northwest to southeast, normally at right angles to water level contours. Velocities of less than one foot per day are typical, but higher velocities may occur along filled erosional valleys where coarser grained deposits have greater permeability.

Discharge from the Ogallala aquifer within the District primarily occurs through the pumping of irrigation wells. Groundwater usage typically exceeds recharge and results in water-level declines (Ashworth and Hopkins, 1995).

The chemical quality of Ogallala groundwater varies greatly across the District. Electrical conductance (EC) varies from less than 1.0 dS/m to over 4.0 dS/m. Generally, groundwater in the eastern and southeastern parts of the District exhibits the highest EC. Isolated occurrences of high EC values elsewhere in the District may be due to pollution through oil field salt water disposal pits or upward leakage and mixing from the underlying Cretaceous aquifer.

The suitability of groundwater for irrigation purposes is largely dependent on the chemical composition of the water and is determined primarily by the total concentration of soluble salts. Some farm acreage in the District is already limited to certain varieties of salt tolerant crops due to limiting or damaging total salt levels.

Cretaceous Aquifer

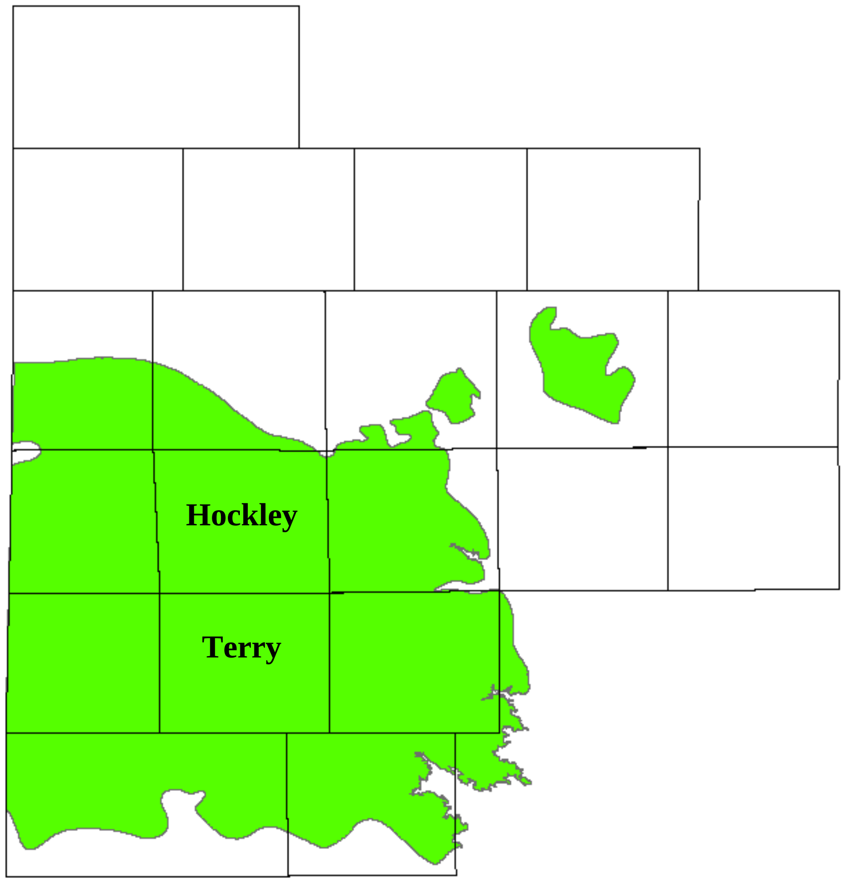
The Edwards-Trinity (High Plains) Aquifer, commonly referred to as the Cretaceous Aquifer, underlies the Ogallala Aquifer throughout the District (Figure 3). In some areas of the District, the Cretaceous and Ogallala Aquifers may be hydrologically connected. Groundwater in the Cretaceous is generally fresh to slightly saline. Water quality deteriorates where Cretaceous formations are overlain by saline lakes.

Studies performed by the District suggest that water quality in Cretaceous units is generally similar to that of the Ogallala. However, there are some instances where it has been discovered that lower Cretaceous units have poor quality water. This work is a continual investigation and limited by the sparse locations of Cretaceous water wells. Further work should provide additional understanding of this issue.

As Ogallala water levels decline, it is expected that there will be greater interest in this minor aquifer. The District is implementing a water level measurement program for this minor aquifer and is committing additional resources to the study of Cretaceous units.

Recharge of the Cretaceous occurs directly from the bounding Ogallala formation. Some upward movement of groundwater from the underlying Triassic Dockum formation may also occur, affecting recharge of the Cretaceous (Ashworth and Hopkins, 1995). As mentioned earlier, in some places the potentiometric surface elevation of the Cretaceous Aquifer is higher than the water table elevation of the Ogallala Aquifer, resulting in the upward leakage from the Cretaceous Aquifer. Movement of water in the Cretaceous is generally east to southeast.

Figure 3: Extent of the Edwards-Trinity (High Plains) Aquifer in Texas
(Adapted from Ashworth and Hopkins, 1995)



Dockum Aquifer

The Dockum Aquifer underlies the Cretaceous and Ogallala formations throughout the District. The primary water-bearing zone in the Dockum group, commonly called the "Santa Rosa", consists of up to 700 feet of sand and conglomerate interbedded with layers of silt and shale (Ashworth and Hopkins, 1995). Aquifer permeability is typically low and well yields normally do not exceed 300 gpm.

Water quality in the Dockum is the main limiting factor when considering its use within the District (Ashworth and Hopkins, 1995). EC values for Dockum groundwater range from 15.0 dS/m to over 50.0 dS/m. Even the most salt tolerant row crops grown cannot withstand such levels of salinity.

Currently, it seems the only practical use of Dockum groundwater may be for make-up water in secondary recovery operations of crude oil. By using water from this aquifer, oil companies could reduce their use of Ogallala and/or Cretaceous groundwater, thereby relieving some pressure from the freshwater sources.

At some point, it may be feasible to treat Dockum water for use as municipal supply. As desalination technology evolves, this process might be feasible for meeting some needs within the District. However, due to the limited productivity of this aquifer, it is likely best suited (using this scenario) for stock or municipal supply. These uses permit a storage system for water that is not available for agricultural irrigation usage.

Surface Water Resources

The only fresh surface water in the District exists as playa lakes. The playas play an important role in aquifer recharge and support some wildlife when rainfall accumulates in these naturally occurring depressions. Playas are rarely, if ever, used to support irrigation activities.

As previously mentioned, Rich Lake and Mound Lake are naturally occurring salt lakes within the District. Each of these naturally occurring impoundments support limited wildlife populations, primarily migratory waterfowl and opportunistic predators.

Perhaps the most significant surface water resource of benefit to the District is Lake Meredith located on the Canadian River in the Texas Panhandle. The lake is managed by the Canadian River Municipal Water Authority and provides water to the City of Brownfield, and starting 2009, the City of Meadow.

1. **<u>Estimates of Modeled Available Groundwater</u>**

GMA 2 adopted Desired Future Conditions for relevant aquifers in October 2016. The relevant aquifers are the Ogallala and Edwards-Trinity (High Plains) Aquifers. The Board decided that the Dockum Aquifer is non-relevant for the South Plains UWCD at this time.

The desired future condition for the Ogallala and Edwards-Trinity (High Plains) aquifers is average drawdown of between 23 and 27 feet for all of GMA 2. The drawdown is calculated from the end of 2012 conditions to the year 2070. The drawdown is expressed as a range due to the link between future pumping and future rainfall. As documented in GMA 2 Technical Memorandum 15-01 and GMA 2 Technical Memorandum 16-01, historic pumping is higher in dry years than in wet years. Since most of the water use in GMA 2 from the Ogallala Aquifer is for irrigation, producers pump more groundwater in dry years than in normal or wet years. The simulations assumed that initial pumping rates in the future would be between 100 percent and 150 percent of 2012 pumping rates. Essentially, in average or wet years, initial annual pumping would be approximately the same as 2012 pumping rates. In dry years, initial annual pumping rates could be as high as 150 percent of 2012 pumping rates based on the variation of pumping rates in the recent past. For Estimated Modeled Available Groundwater for the South Plains UWCD, refer to the *GMA 2 MAG Report table from the TWDB GAM Run 16-028 MAG Report, Appendix C*

2. **<u>Estimates of Historical Groundwater Usage</u>**

The estimated Historical Water Use from the TWDB Estimated Historical Water Use Survey (WUS) are estimations of the historical quantity of groundwater used in the area served by the District. It will be used as a guide to estimate future demands on the resource in the District. It should be emphasized that the quantities shown are estimates.

Refer to Estimated Historical Groundwater Use and 2017 State Water Plan Data Sets, Appendix B

3. **<u>Estimates of Annual Groundwater Recharge from Precipitation</u>**

Refer to GAM Run 18-004, Appendix A

4. **<u>Estimates of Annual Groundwater Discharge to Springs/Surface Water Bodies</u>**

Refer to GAM Run 18-004, Appendix A

5. **<u>Estimates of Annual Groundwater Flow Into/Out of the District for the Ogallala; estimates of annual groundwater flow between aquifers in the District</u>**

Refer to GAM Run 18-004, Appendix A

6. Estimates of Projected Surface Water Supply

Currently, there are two towns within the District that use surface water. The Canadian River Municipal Water Authority supplies some water to Brownfield. In 2009, the town of Meadow negotiated the purchase of some CRMWA water with Brownfield. The purchase was necessary for blending the higher quality CRMWA supply with the town's groundwater wells; several of which have elevated arsenic and fluoride. As Lake Meredith has declined, CRMWA has purchased groundwater in Roberts County as a supplement. The town of Wellman is searching for a more stable source of groundwater to supply its municipal water needs.

Refer to Estimated Historical Groundwater Use and 2017 State Water Plan Data Sets, Appendix B

7. Estimates of Projected Total Demand for Water in the District

Projecting water demand is a challenging task. Some user group projections are more accurate than others. This is an inherent part of the process. Of particular difficulty is the projection of irrigation water demand. Rainfall, commodity prices, water level changes, and federal farm policy are a few of the factors that complicate the matter.

Refer to Estimated Historical Groundwater Use and 2017 State Water Plan Data Sets, Appendix B

8. Water Supply Needs and Water Management Strategies

It is required that the District Management Plan consider the water supply needs and water management strategies included in the 2017 State Water Plan (TWC 36.1071(e)(4)).

Refer to Estimated Historical Groundwater Use and 2017 State Water Plan Data Sets, Appendix B

Now, it seems necessary that the issue of irrigation needs be discussed. While the District understands that there is need for more irrigation supply than is currently available, the demand figures are not indicative of the average usage. Consequently, the unmet needs, while real, are not as great as shown.

Actions, Procedures, Performance and Avoidance for Plan Implementation

The District currently employs a set of rules governing the spacing and production of wells, as well as production limitations based on tract size. It is expected that this approach will remain the foundation of the Board's strategies for groundwater management. As conditions dictate, and as the DFC process is completed, it may require that the specific provisions within the existing rules be modified. The District's Board of Directors is responsible for that determination. The District's rules are available on the District web site: http://www.spuwcd.org/Rules_Mgt_Plan.html.

Additional water management strategies the District may consider, when applicable, are listed below.

A. Conversion to Dryland Farming—As water supplies decline, there are some landowners that may exercise this option. There are incentive payments available through the USDA NRCS for those interested in this option. The District supports the use of these incentive payments to help those landowners interested in this program.
B. Increased study of Minor Aquifers—Some future needs may be addressed using the two minor aquifers, the Cretaceous (Edwards-Trinity High Plains) and the Dockum, within the District. At this time, it is uncertain what additional amount of water may be available from minor aquifers. The District supports the continued and further investigation of these resources and is committed to the monitoring and study of them.
C. Conservation Programs—The implementation of educational programs and resources regarding conservation remains top priority for the District. The Board supports the expansion of resources pertaining to those programs, which include, but are not limited to: maximizing crop water use efficiency, minimizing irrigation water evaporative losses, rainwater harvesting, use of water wise plants and drought tolerant landscaping, wise water use, and device giveaways.

Drought Contingency Plan

Drought is a normal, recurrent feature of climate, although many erroneously consider it a rare and random event. Drought is also a temporary aberration, and differs from aridity, which is restricted to low rainfall regions and is a permanent feature of climate ("What is Drought?" National Drought Mitigation Center). The South Plains Underground Water Conservation District is in a semi-arid region that also experiences drought. However, even in the midst of a drought, rainfall at crucial times of the growing season may significantly reduce irrigation water demand.

Drought response conservation measures typically used in other regions of Texas (i.e. rationing) cannot and are not used in this region due to extreme economic impact potential. In the District, groundwater conservation is stressed at all times. The Board recognizes that irrigated agriculture provides the economic stability to the communities within the District. Therefore, through the notice and hearing provisions required in the development and adoption of this management plan, the Board adopts the official position that, in times of precipitation shortage, irrigated agricultural producers will not be limited to any less usage of groundwater than is provided for by District rules.

In order to treat all other groundwater user groups fairly and equally, the District will encourage more stringent conservation measures, where practical, but likewise, will not limit groundwater use in any way not already provided for by District rules.

Regional Water Planning

The Board of Directors recognizes the regional water plan requirements listed in Ch. 36, TWC, §36.1071. Namely, the District's management plan must be forwarded to the regional water planning group for their consideration in their planning process, and the plan must address water supply needs such that there is no conflict with the approved regional water plan. It is the Board's belief that no such conflict exists.

The Board agrees that the regional water plan should include the District's best data. The Board also recognizes that the regional water planning process provides a necessary overview of the region's water supply and needs. However, the Board also believes it is the duty of the District to develop the best and most accurate information concerning groundwater within the District.

Goals, Management Objectives and Performance Standards

Method for Tracking the District's Progress in Achieving Management Goals

The District Manager will prepare an annual report of the District's performance achieving management goals and objectives. The report will be prepared in a format that will be reflective of the performance standards listed following each management objective. The report will be maintained on file in the open records of the District.

The District will actively enforce all rules of the District in order to conserve, preserve, protect and prevent the waste of the groundwater resources over which the District has jurisdictional authority. The Board may periodically review the District's rules, and may modify the rules, with public approval, to better manage the groundwater resources within the District and to carry out the duties prescribed in Chapter 36, Texas Water Code.

Goal 1.0 Providing the most efficient use of groundwater

Management Objective—Water Level Monitoring

1.01 Measure the depth to water in the District's water level monitoring well network.

Performance Standards

1.01a Number of wells measured

1.01b Number of wells added to the network, if required, each year

Management Objective—Technical Field Services

1.02 Provide technical field services including flow testing and drawdown measurement for wells and irrigation systems.

Performance Standards

1.02a Number of field services tests performed each year

Management Objective—Laboratory Services

1.03 Provide basic water quality testing services. Maintain a record of tests performed by entering the results in the District's computer database.

Performance Standards

1.03a Number of laboratory service tests.

1.03b Number of records entered into District's computer database each year

Management Objective—Water Use Monitoring

1.04 Monitor seasonal irrigation applications using a network of cooperative producers.

Performance Standards

1.04a Number of irrigation systems in the cooperative program

1.04b Number and type of crops monitored

1.04c Average irrigation application by crop

Management Objective—Irrigation System Inventory

1.05 Every five years perform a physical inventory of irrigation systems in the District. Enter data in District's data base file by block and section.

Performance Standards

1.05a Number of irrigation systems recorded each documenting period

1.05b Number of active irrigation systems by type in District's database

Goal 2.0 **Controlling and preventing waste of groundwater**

Management Objective—Well Permitting and Well Completion

2.01 Issue temporary water well drilling permits for the drilling and completion of non-exempt water wells. Inspect all well sites to be assured that the District's completion and spacing standards are met.

Performance Standards

2.01a Number of water well drilling permits issued each year

2.01b Number of well sites inspected after well completion each year

Management Objective—Open, Deteriorated or Uncovered Wells

2.02 If an open, deteriorated or uncovered well is found, the District will insure that the open hole is properly closed according to District rules and, in so doing, prevent potential contamination of the groundwater resource. The District will contact the party responsible for the open, deteriorated or uncovered. The site will be inspected after notification to insure the well closure process occurs

Performance Standards

2.02a Number of open, deteriorated or uncovered wells

2.02b Number of initial inspections accomplished each year

Management Objective—Maximum Allowable Production

2.03 The District will investigate reports of usage of groundwater in excess of the maximum production allowable under the District's rules.

Performance Standards

2.03a Number of reports received

Management Objective—Water Quality Monitoring

2.04 Conduct a District-wide water quality testing program. The results will be entered into the District's computer database and will be made available to the public.

Performance Standards

2.04a Number of samples collected and analyzed each year

Goal 3.0 **Controlling and preventing subsidence**

(not applicable)

Goal 4.0 **Addressing Conjunctive surface water management issues**

The District is not directly involved in conjunctive surface water management issues. However, conjunctive use does occur as discussed in Section 6, Page 15 of this Plan.

Goal 5.0 **Addressing Natural resource issues**

Management Objective

The District will investigate, or refer to the proper agency, any citizen's or District initiated complaint related to surface water, groundwater, or any natural resource within the District

Performance Standards

The District will record all complaints and report these annually to the District Board of Directors

Goal 6.0 **Addressing Drought Conditions**

Management Objective—Rain Gages

6.01 Maintain a network of rain gages in the District. Publish rainfall data on the District's web site

Performance Standards

6.01a Number of rain gages in the network

Goal 7.0 **Addressing Conservation**

Management Objective—Classroom Education

7.01 The District will promote water conservation through presentations given at schools within the District.

Performance Standards

7.01a Number of classroom presentations

Management Objective—Newsletter

7.02 The District will produce a newsletter. Newsletters will be distributed to District constituents and other interested parties. Articles will address groundwater conservation, groundwater quality and District activities.

Performance Standards

7.02a Number of newsletter editions published each year

7.02b Number of newsletters distributed each year

Management Objective—News Releases

7.03 District staff will prepare news releases addressing groundwater conservation, groundwater quality and District activities.

Performance Standards

7.03a Number of news releases prepared for publication in local newspapers.

Management Objective—Public Speaking Engagements

7.04 The District staff and/or directors will present programs addressing groundwater conservation, groundwater quality and District information or activities.

Performance Standards

7.04a Number of programs presented

Management Objective—Printed Material Resource Center

7.05 Maintain a self-service printed material resource center in the District office. Conduct an annual inventory of these items. Through the inventory process, determine the number and type of materials obtained by the public each year.

Performance Standards

7.05a Number of items, by type, obtained by the public from the resource center each year

Management Objective—Saturated Thickness Maps

7.06 Every 5 years, provide a saturated thickness map to show the varying thickness of groundwater remaining in storage. The most recent saturated thickness map will be available at the District office and on District web site.

Performance Standards

7.06a Most recent saturated thickness map available at the District office and on District web site

Goal 8.0 Addressing Recharge Enhancement

8.01 A review of past work conducted by others indicates this goal is not appropriate at present. Therefore, this goal is not applicable.

Goal 9.0 Addressing Rainwater Harvesting

Management Objective—Public Awareness Program

9.01 The District will conduct an educational program for this conservation strategy at least once a year.

Performance Standards

9.01a Document the type of program conducted (i.e. newsletter article, public presentation)

Goal 10.0 Addressing Precipitation Enhancement

10.01 While the District did participate in this program for eleven years, the Board has since determined it is not cost-effective. Therefore, this goal is not applicable.

<u>Goal 11.0</u> Addressing Brush Control

11.01 Existing programs administered by the USDA-NRCS are sufficient for addressing this goal. The Board does not believe that this activity is cost-effective and applicable for the District at this time. Therefore, this goal is not applicable.

<u>Goal 12.0</u> Addressing Desired future condition of the aquifers

<u>Management Objective</u>—Calculate Annual Drawdown

12.01 The District will calculate the average annual drawdown using the results of annual water level measurements each winter.

Performance Standards

12.01a Present the average drawdown results to the District Board each year.

12.01b Publish the average drawdown results in the District newsletter each year.

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Appendix A

GAM Run 18-004

GAM Run 18-004: South Plains Underground Water Conservation District Groundwater Management Plan

Natalie Ballew, GIT
Texas Water Development Board
Groundwater Division
Groundwater Availability Modeling Department
512-463-2779
March 30, 2018

STATE OF TEXAS
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Cynthia K. Ridgeway is the Manager of the Groundwater Availability Modeling Department and is responsible for oversight of work performed by Natalie Ballew under her direct supervision. The seal appearing on this document was authorized by Cynthia K. Ridgeway, P.G. 471 on March 30, 2018.

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GAM RUN 18-004: SOUTH PLAINS UNDERGROUND WATER CONSERVATION DISTRICT GROUNDWATER MANAGEMENT PLAN

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EXECUTIVE SUMMARY:

Texas State Water Code, Section 36.1071, Subsection (h) (Texas Water Code, 2015), states that, in developing its groundwater management plan, a groundwater conservation district shall use groundwater availability modeling information provided by the Executive Administrator of the Texas Water Development Board (TWDB) in conjunction with any available site-specific information provided by the district for review and comment to the Executive Administrator.

The TWDB provides data and information to the South Plains Underground Water Conservation District in two parts. Part 1 is the Estimated Historical Water Use/State Water Plan dataset report, which will be provided to you separately by the TWDB Groundwater Technical Assistance Department. Please direct questions about the water data report to Mr. Stephen Allen at 512-463-7317 or stephen.allen@twdb.texas.gov. Part 2 is the required groundwater availability modeling information and this information includes:

1. the annual amount of recharge from precipitation, if any, to the groundwater resources within the district;
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.

The groundwater management plan for the South Plains Underground Water Conservation District should be adopted by the district on or before October 15, 2018, and submitted to the Executive Administrator of the TWDB on or before November 14, 2018. The current management plan for the South Plains Underground Water Conservation District expires on January 13, 2019.

We used version 1.01 of the groundwater availability model for the High Plains Aquifer System (Deeds and Jigmond, 2015) to estimate the management plan information for the aquifers within South Plains Underground Water Conservation District.

This report replaces the results of GAM Run 12-006 (Wade, 2012). Tables 1 and 2 summarize the groundwater availability model data required by statute and Figures 1 and 2 show the area of the models from which the values in the tables were extracted. If, after review of the figures, the South Plains Underground Water Conservation District determines that the district boundaries used in the assessment do not reflect current conditions, please notify the TWDB at your earliest convenience.

METHODS:

In accordance with the provisions of the Texas State Water Code, Section 36.1071, Subsection (h), the groundwater availability model for the High Plains Aquifer System was used to estimate information for the South Plains Underground Water Conservation District management plan. Water budgets were extracted for the historical model period (1980 through 2012) using ZONEBUDGET Version 3.01 (Harbaugh, 2009). The average annual water budget values for recharge, surface-water outflow, inflow to the district, and outflow from the district for the aquifers within the district are summarized in this report.

PARAMETERS AND ASSUMPTIONS:

High Plains Aquifer System

- We used version 1.01 of the groundwater availability model for the High Plains Aquifer System for this analysis. See Deeds and Jigmond (2015) for assumptions and limitations of the model.
- The model has four layers which, in the area under the South Plains Underground Water Conservation District, represent the Ogallala Aquifer (Layer 1), the Edwards-Trinity (High Plains) Aquifer (Layer 2), and the Dockum Units (Layers 3 and 4). Within the South Plain Underground Water Conservation District the Dockum units are not designated as part of the Dockum Aquifer.
- Water budgets for the district were determined for the Ogallala Aquifer (Layer 1) and the Edwards-Trinity (High Plains) Aquifer

- The model was run with MODFLOW-NWT (Niswonger and others, 2011).

RESULTS:

A groundwater budget summarizes the amount of water entering and leaving the aquifers according to the groundwater availability model. Selected groundwater budget components listed below were extracted from the groundwater availability model results for the Ogallala and Edwards-Trinity (High Plains) aquifers located within South Plains Underground Water Conservation District and averaged over the historical calibration periods, as shown in Tables 1 through 2.

1. Precipitation recharge—the areally distributed recharge sourced from precipitation falling on the outcrop areas of the aquifers (where the aquifer is exposed at land surface) within the district.

2. Surface-water outflow—the total water discharging from the aquifer (outflow) to surface-water features such as streams, reservoirs, and springs.

3. Flow into and out of district—the lateral flow within the aquifer between the district and adjacent counties.

4. Flow between aquifers—the net vertical flow between the aquifer and adjacent aquifers or confining units. This flow is controlled by the relative water levels in each aquifer and aquifer properties of each aquifer or confining unit that define the amount of leakage that occurs.

The information needed for the district's management plan is summarized in Tables 1 through 2. It is important to note that sub-regional water budgets are not exact. This is due to the size of the model cells and the approach used to extract data from the model. To avoid double accounting, a model cell that straddles a political boundary, such as a district or county boundary, is assigned to one side of the boundary based on the location of the centroid of the model cell. For example, if a cell contains two counties, the cell is assigned to the county where the centroid of the cell is located.

TABLE 1. SUMMARIZED INFORMATION FOR THE OGALLALA AQUIFER FOR SOUTH PLAINS UNDERGROUND WATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT.

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Ogallala Aquifer	53,379
Estimated annual volume of water that discharges from the aquifer to springs and any surface-water body including lakes, streams, and rivers	Ogallala Aquifer	616
Estimated annual volume of flow into the district within each aquifer in the district	Ogallala Aquifer	3,124
Estimated annual volume of flow out of the district within each aquifer in the district	Ogallala Aquifer	5,567
Estimated net annual volume of flow between each aquifer in the district	Flow from Ogallala Aquifer to underlying Edwards-Trinity (High Plains) Aquifer	339

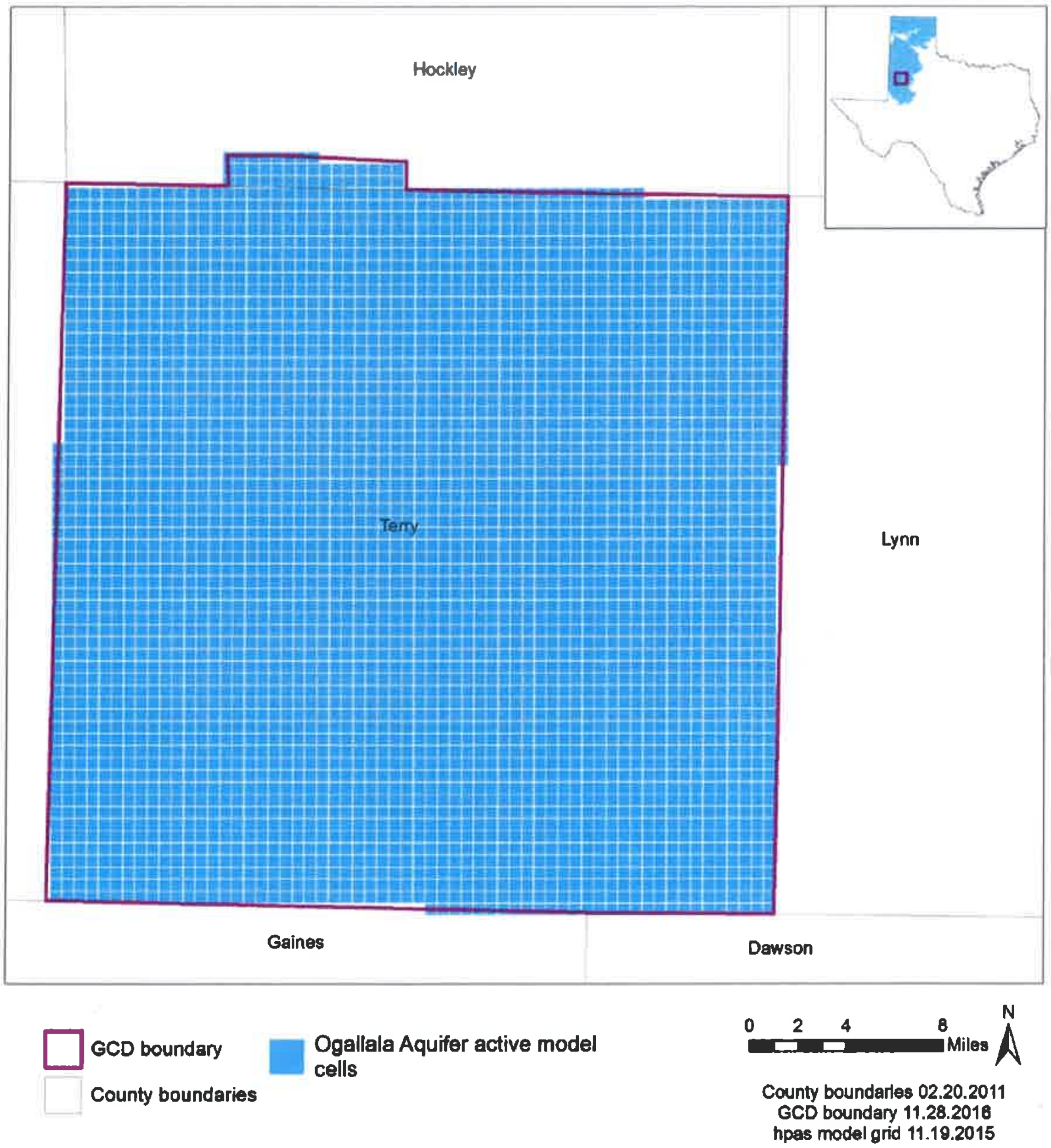

FIGURE 1. AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE HIGH PLAINS AQUIFER SYSTEM FROM WHICH THE INFORMATION IN TABLE 1 WAS EXTRACTED (THE OGALLALA AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).

TABLE 2. SUMMARIZED INFORMATION FOR THE EDWARDS-TRINITY (HIGH PLAINS) AQUIFER FOR SOUTH PLAINS UNDERGROUND WATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT.

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Edwards-Trinity (High Plains) Aquifer	0
Estimated annual volume of water that discharges from the aquifer to springs and any surface-water body including lakes, streams, and rivers	Edwards-Trinity (High Plains) Aquifer	0
Estimated annual volume of flow into the district within each aquifer in the district	Edwards-Trinity (High Plains) Aquifer	5,614
Estimated annual volume of flow out of the district within each aquifer in the district	Edwards-Trinity (High Plains) Aquifer	6,746
Estimated net annual volume of flow between each aquifer in the district	Flow from Ogallala Aquifer to underlying Edwards-Trinity (High Plains) Aquifer	339
Estimated net annual volume of flow between each aquifer in the district	Flow to Edwards-Trinity (High Plains) Aquifer from underlying Dockum units	425

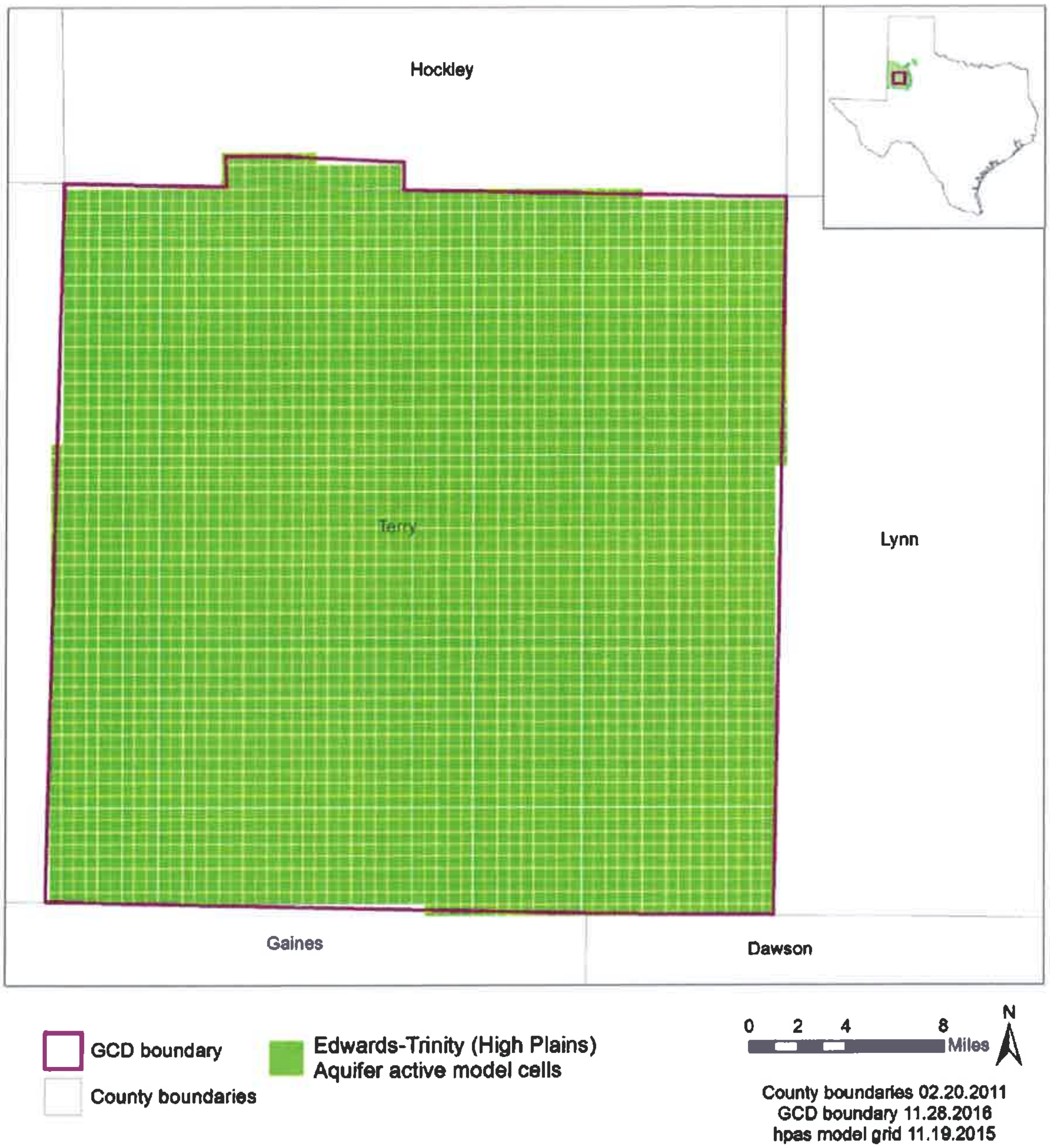

FIGURE 2. AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE HIGH PLAINS AQUIFER SYSTEM FROM WHICH THE INFORMATION IN TABLE 2 WAS EXTRACTED (THE EDWARDS-TRINITY (HIGH PLAINS) AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).

LIMITATIONS:

The groundwater models used in completing this analysis are the best available scientific tools 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 interaction with streams are specific to particular historic time periods.

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

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

REFERENCES:

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

Harbaugh, A. W., 2009, Zonebudget Version 3.01, A computer program for computing subregional water budgets for MODFLOW ground-water flow models: U.S. Geological Survey Groundwater Software.

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

Niswonger, R. G., Panday, S., and Ibaraki, M., 2011, MODFLOW-NWT, A Newtonian formulation for MODFLOW-2005: U.S. Geological Survey Survey Techniques and Methods 6-A37, 44 p.

Wade, S.C., 2012, GAM Run 12-006: South Plains Underground Water Conservation District Management Plan, 11 p., http://www.twdb.texas.gov/groundwater/docs/GAMruns/GR12-006.pdf

Texas Water Code, 2015, http://www.statutes.legis.state.tx.us/docs/WA/pdf/WA.36.pdf.

Appendix B

Estimated Historical Groundwater Use And 2017 State Water Plan Datasets

Estimated Historical Groundwater Use And 2017 State Water Plan Datasets:

South Plains Underground Water Conservation District

by Stephen Allen
Texas Water Development Board
Groundwater Division
Groundwater Technical Assistance Section
stephen.allen@twdb.texas.gov
(512) 463-7317
July 26, 2018

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 7/26/2018. 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).

Estimated Historical Water Use

TWDB Historical Water Use Survey (WUS) Data

Groundwater and surface water historical use estimates are currently unavailable for calendar year 2017. TWDB staff anticipates the calculation and posting of these estimates at a later date.

HOCKLEY COUNTY *1% (multiplier)* All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2016	GW	13	6	0	0	1,367	4	1,390
	SW	16	0	0	0	0	0	16
2015	GW	10	11	0	0	1,143	4	1,168
	SW	19	0	0	0	0	0	19
2014	GW	15	6	1	0	1,099	3	1,124
	SW	18	0	0	0	0	0	18
2013	GW	20	6	0	0	1,383	3	1,412
	SW	16	0	0	0	0	0	16
2012	GW	18	6	0	0	1,603	4	1,631
	SW	15	0	0	0	0	0	15
2011	GW	20	6	0	0	1,499	4	1,529
	SW	18	0	0	0	0	0	18
2010	GW	14	6	0	0	989	4	1,013
	SW	17	0	0	0	0	0	17
2009	GW	14	6	8	0	1,504	3	1,535
	SW	18	0	2	0	0	0	20
2008	GW	13	5	15	0	1,298	3	1,334
	SW	15	1	4	0	0	0	20
2007	GW	23	4	0	0	1,975	3	2,005
	SW	6	0	0	0	0	0	6
2006	GW	16	4	0	0	1,089	4	1,113
	SW	18	0	0	0	0	0	18
2005	GW	16	4	0	0	903	2	925
	SW	18	0	0	0	0	0	18
2004	GW	16	4	0	0	1,856	2	1,878
	SW	15	0	0	0	0	1	16
2003	GW	32	4	0	0	1,901	3	1,940
	SW	0	0	0	0	0	2	2
2002	GW	16	4	0	0	1,648	4	1,672
	SW	19	0	0	0	0	3	22
2001	GW	19	4	0	0	1,867	4	1,894
	SW	18	0	0	0	0	3	21

TERRY COUNTY

100% (multiplier)

All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2016	GW	706	0	4	0	120,643	428	121,781
	SW	1,326	15	0	0	730	47	2,118
2015	GW	308	0	3	0	88,714	405	89,430
	SW	1,309	12	0	0	828	45	2,194
2014	GW	361	0	5	0	151,201	375	151,942
	SW	1,376	14	0	0	0	42	1,432
2013	GW	421	0	22	0	205,364	358	206,165
	SW	1,381	7	0	0	741	40	2,169
2012	GW	482	2	65	0	159,021	185	159,755
	SW	1,371	4	0	0	0	21	1,396
2011	GW	776	2	57	0	210,380	235	211,450
	SW	1,419	5	13	0	0	26	1,463
2010	GW	558	2	100	0	137,221	208	138,089
	SW	1,302	5	23	0	0	23	1,353
2009	GW	565	2	98	0	183,056	288	184,009
	SW	1,218	76	23	0	0	32	1,349
2008	GW	666	2	96	0	158,840	169	159,773
	SW	1,186	36	22	0	0	19	1,263
2007	GW	674	2	0	0	98,195	245	99,116
	SW	1,116	0	0	0	0	27	1,143
2006	GW	555	2	0	0	176,587	182	177,326
	SW	1,523	0	0	0	733	20	2,276
2005	GW	540	2	0	0	137,895	155	138,592
	SW	1,322	0	0	0	763	17	2,102
2004	GW	633	2	0	0	115,286	80	116,001
	SW	1,190	0	0	0	791	37	2,018
2003	GW	652	2	0	0	162,245	93	162,992
	SW	2,398	0	0	0	827	43	3,268
2002	GW	576	2	0	0	204,008	91	204,677
	SW	1,581	0	0	0	0	41	1,622
2001	GW	831	2	0	0	183,691	92	184,616
	SW	2,322	0	0	0	0	41	2,363

Projected Surface Water Supplies
TWDB 2017 State Water Plan Data

HOCKLEY COUNTY

1% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070
O	LIVESTOCK, HOCKLEY	BRAZOS	BRAZOS LIVESTOCK LOCAL SUPPLY	0	0	0	0	0	0
O	LIVESTOCK, HOCKLEY	COLORADO	COLORADO LIVESTOCK LOCAL SUPPLY	0	0	0	0	0	0
	Sum of Projected Surface Water Supplies (acre-feet)			**0**	**0**	**0**	**0**	**0**	**0**

TERRY COUNTY

100% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070
O	LIVESTOCK, TERRY	BRAZOS	BRAZOS LIVESTOCK LOCAL SUPPLY	0	0	0	0	0	0
O	LIVESTOCK, TERRY	COLORADO	COLORADO LIVESTOCK LOCAL SUPPLY	0	0	0	0	0	0
	Sum of Projected Surface Water Supplies (acre-feet)			**0**	**0**	**0**	**0**	**0**	**0**

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.

HOCKLEY COUNTY

1% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
O	ANTON	BRAZOS	161	164	165	165	172	176
O	COUNTY-OTHER, HOCKLEY	BRAZOS	9	9	9	9	10	10
O	COUNTY-OTHER, HOCKLEY	COLORADO	0	0	0	0	0	0
O	IRRIGATION, HOCKLEY	BRAZOS	1,220	1,173	1,127	1,083	1,040	1,003
O	IRRIGATION, HOCKLEY	COLORADO	92	88	85	81	78	75
O	LEVELLAND	BRAZOS	2,442	2,521	2,554	2,547	2,655	2,727
O	LIVESTOCK, HOCKLEY	BRAZOS	2	2	2	2	2	3
O	LIVESTOCK, HOCKLEY	COLORADO	0	0	0	0	0	0
O	MANUFACTURING, HOCKLEY	BRAZOS	12	12	12	12	12	12
O	MINING, HOCKLEY	BRAZOS	0	0	0	0	0	0
O	MINING, HOCKLEY	COLORADO	0	0	0	0	0	0
O	SUNDOWN	COLORADO	416	434	446	448	467	480
		Sum of Projected Water Demands (acre-feet)	**4,354**	**4,403**	**4,400**	**4,347**	**4,436**	**4,486**

TERRY COUNTY

100% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
O	BROWNFIELD	COLORADO	1,793	1,854	1,923	2,000	2,087	2,172
O	COUNTY-OTHER, TERRY	BRAZOS	8	8	8	8	9	9
O	COUNTY-OTHER, TERRY	COLORADO	312	317	329	345	359	374
O	IRRIGATION, TERRY	BRAZOS	7,173	6,805	6,456	6,125	5,811	5,542
O	IRRIGATION, TERRY	COLORADO	136,288	129,302	122,673	116,383	110,415	105,306
O	LIVESTOCK, TERRY	BRAZOS	12	13	14	15	16	18
O	LIVESTOCK, TERRY	COLORADO	258	275	295	317	340	377
O	MANUFACTURING, TERRY	COLORADO	2	2	2	2	2	2
O	MEADOW	COLORADO	95	97	101	105	109	113
O	MINING, TERRY	BRAZOS	25	37	38	29	21	14
O	MINING, TERRY	COLORADO	330	488	505	387	272	192
		Sum of Projected Water Demands (acre-feet)	**146,296**	**139,198**	**132,344**	**125,716**	**119,441**	**114,119**

Projected Water Supply Needs
TWDB 2017 State Water Plan Data

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

HOCKLEY COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
O	ANTON	BRAZOS	92	89	88	88	81	77
O	COUNTY-OTHER, HOCKLEY	BRAZOS	125	102	93	101	63	37
O	COUNTY-OTHER, HOCKLEY	COLORADO	1	8	8	7	2	2
O	IRRIGATION, HOCKLEY	BRAZOS	-45,997	-52,877	-58,977	-56,085	-55,322	-53,726
O	IRRIGATION, HOCKLEY	COLORADO	-1,645	-1,220	-1,307	-1,106	-1,092	-1,401
O	LEVELLAND	BRAZOS	264	-407	-558	-691	-873	-1,029
O	LIVESTOCK, HOCKLEY	BRAZOS	265	284	305	326	349	366
O	LIVESTOCK, HOCKLEY	COLORADO	-35	-37	-39	-41	-43	-45
O	MANUFACTURING, HOCKLEY	BRAZOS	0	0	0	0	0	-3
O	MINING, HOCKLEY	BRAZOS	1,494	965	363	4	-14	-13
O	MINING, HOCKLEY	COLORADO	195	121	120	4	-2	-2
O	SUNDOWN	COLORADO	-18	-36	-48	-50	-69	-82
		Sum of Projected Water Supply Needs (acre-feet)	**-47,695**	**-54,577**	**-60,929**	**-57,973**	**-57,415**	**-56,301**

TERRY COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
O	BROWNFIELD	COLORADO	6	-739	-863	-991	-1,149	-1,304
O	COUNTY-OTHER, TERRY	BRAZOS	1	1	1	1	0	0
O	COUNTY-OTHER, TERRY	COLORADO	18	13	1	35	21	6
O	IRRIGATION, TERRY	BRAZOS	142	506	311	-788	-1,728	-5,456
O	IRRIGATION, TERRY	COLORADO	419	-9,480	-46,855	-68,747	-81,727	-102,011
O	LIVESTOCK, TERRY	BRAZOS	3	2	1	-13	-16	-18
O	LIVESTOCK, TERRY	COLORADO	42	0	0	-137	-219	-361
O	MANUFACTURING, TERRY	COLORADO	0	0	0	-1	-1	-2
O	MEADOW	COLORADO	3	1	2	3	4	0
O	MINING, TERRY	BRAZOS	0	0	0	-29	-21	-14
O	MINING, TERRY	COLORADO	0	0	0	-387	-272	-192
		Sum of Projected Water Supply Needs (acre-feet)	**0**	**-10,219**	**-47,718**	**-71,093**	**-85,133**	**-109,358**

Projected Water Management Strategies
TWDB 2017 State Water Plan Data

HOCKLEY COUNTY

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

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
ANTON, BRAZOS (O)							
HOCKLEY COUNTY - ANTON MUNICIPAL WATER CONSERVATION	DEMAND REDUCTION [HOCKLEY]	8	8	8	8	9	9
		8	**8**	**8**	**8**	**9**	**9**
COUNTY-OTHER, HOCKLEY, BRAZOS (O)							
HOCKLEY COUNTY-OTHER LOCAL GROUNDWATER DEVELOPMENT	OGALLALA AQUIFER [HOCKLEY]	150	150	150	150	150	150
		150	**150**	**150**	**150**	**150**	**150**
IRRIGATION, HOCKLEY, BRAZOS (O)							
HOCKLEY COUNTY IRRIGATION WATER CONSERVATION	DEMAND REDUCTION [HOCKLEY]	3,886	3,886	5,660	5,660	7,735	7,735
		3,886	**3,886**	**5,660**	**5,660**	**7,735**	**7,735**
IRRIGATION, HOCKLEY, COLORADO (O)							
HOCKLEY COUNTY IRRIGATION WATER CONSERVATION	DEMAND REDUCTION [HOCKLEY]	292	292	426	426	582	582
		292	**292**	**426**	**426**	**582**	**582**
LEVELLAND, BRAZOS (O)							
CONJUNCTIVE USE - CRMWA	MEREDITH LAKE/RESERVOIR [RESERVOIR]	229	220	219	213	220	225
EXPAND CAPACITY CRMWA II	OGALLALA AQUIFER [ROBERTS]	0	1,059	1,051	1,023	1,055	1,082
HOCKLEY COUNTY - LEVELLAND MUNICIPAL WATER CONSERVATION	DEMAND REDUCTION [HOCKLEY]	116	53	0	0	0	0
REPLACE WELL CAPACITY FOR CRMWA I	OGALLALA AQUIFER [ROBERTS]	0	199	285	405	505	631
		345	**1,531**	**1,555**	**1,641**	**1,780**	**1,938**
SUNDOWN, COLORADO (O)							
HOCKLEY COUNTY - SUNDOWN LOCAL GROUNDWATER DEVELOPMENT	OGALLALA AQUIFER [HOCKLEY]	0	0	0	0	0	100
HOCKLEY COUNTY - SUNDOWN MUNICIPAL WATER CONSERVATION	DEMAND REDUCTION [HOCKLEY]	21	22	22	22	23	24
HOCKLEY COUNTY - SUNDOWN WATER LOSS REDUCTION	DEMAND REDUCTION [HOCKLEY]	27	28	48	48	50	52
		48	**50**	**70**	**70**	**73**	**176**
Sum of Projected Water Management Strategies (acre-feet)		**4,729**	**5,917**	**7,869**	**7,955**	**10,329**	**10,590**

Projected Water Management Strategies
TWDB 2017 State Water Plan Data

TERRY COUNTY

WUG, Basin (RWPG)

All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
BROWNFIELD, COLORADO (O)							
CONJUNCTIVE USE - CRMWA	MEREDITH LAKE/RESERVOIR [RESERVOIR]	137	138	140	144	144	144
EXPAND CAPACITY CRMWA II	OGALLALA AQUIFER [ROBERTS]	0	662	673	692	691	691
REPLACE WELL CAPACITY FOR CRMWA I	OGALLALA AQUIFER [ROBERTS]	0	124	182	274	331	403
TERRY COUNTY - BROWNFIELD MUNICIPAL WATER CONSERVATION	DEMAND REDUCTION [TERRY]	90	93	92	69	72	75
		227	**1,017**	**1,087**	**1,179**	**1,238**	**1,313**
IRRIGATION, TERRY, BRAZOS (O)							
TERRY COUNTY IRRIGATION WATER CONSERVATION	DEMAND REDUCTION [TERRY]	360	360	413	413	246	246
		360	**360**	**413**	**413**	**246**	**246**
IRRIGATION, TERRY, COLORADO (O)							
TERRY COUNTY IRRIGATION WATER CONSERVATION	DEMAND REDUCTION [TERRY]	6,841	6,841	7,846	7,846	4,670	4,670
		6,841	**6,841**	**7,846**	**7,846**	**4,670**	**4,670**
Sum of Projected Water Management Strategies (acre-feet)		**7,428**	**8,218**	**9,346**	**9,438**	**6,154**	**6,229**

Appendix C

GMA 2 MAG Report

Groundwater Management Area 2 – Modeled Available Groundwater

Groundwater Conservation District	County	Aquifer	Modeled Available Groundwater							TWDB Report
			2012	2020	2030	2040	2050	2060	2070	
Garza County UWCD	Garza	Ogallala and Edwards-Trinity (High Plains)	14,932	16,297	13,648	12,395	11,657	11,180	10,855	GR16-028 MAG
High Plains UWCD No.1	Bailey	Ogallala and Edwards-Trinity (High Plains)	79,604	97,679	67,307	51,199	42,704	37,858	34,815	GR16-028 MAG
High Plains UWCD No.1	Castro	Ogallala and Edwards-Trinity (High Plains)	200,692	261,434	181,190	102,732	55,811	35,734	26,291	GR16-028 MAG
High Plains UWCD No.1	Cochran	Ogallala and Edwards-Trinity (High Plains)	67,032	101,762	79,152	64,503	55,408	47,858	42,674	GR16-028 MAG
High Plains UWCD No.1	Crosby	Ogallala and Edwards-Trinity (High Plains)	124,336	163,188	108,662	68,885	46,778	35,651	29,619	GR16-028 MAG
High Plains UWCD No.1	Deaf Smith	Ogallala and Edwards-Trinity (High Plains)	148,161	182,988	118,471	74,107	51,551	40,042	33,785	GR16-028 MAG
High Plains UWCD No.1	Floyd	Ogallala and Edwards-Trinity (High Plains)	124,867	170,451	94,139	67,802	54,090	46,197	41,537	GR16-028 MAG
High Plains UWCD No.1	Hale	Ogallala and Edwards-Trinity (High Plains)	283,391	220,111	114,928	70,663	48,719	37,740	31,954	GR16-028 MAG
High Plains UWCD No.1	Hockley	Ogallala and Edwards-Trinity (High Plains)	132,145	154,091	96,609	71,741	60,822	55,285	52,185	GR16-028 MAG
High Plains UWCD No.1	Lamb	Ogallala and Edwards-Trinity (High Plains)	244,726	223,477	112,082	71,220	56,582	50,140	46,816	GR16-028 MAG
High Plains UWCD No.1	Lubbock	Ogallala and Edwards-Trinity (High Plains)	131,793	151,056	121,404	109,134	100,850	94,935	90,798	GR16-028 MAG
High Plains UWCD No.1	Lynn	Ogallala and Edwards-Trinity (High Plains)	81,678	112,607	96,151	85,494	78,603	74,349	71,640	GR16-028 MAG
High Plains UWCD No.1	Parmer	Ogallala and Edwards-Trinity (High Plains)	150,001	152,014	91,098	59,259	43,737	35,469	30,537	GR16-028 MAG

Groundwater Management Area 2 – Modeled Available Groundwater

Groundwater Conservation District	County	Aquifer	Modeled Available Groundwater							TWDB Report
			2012	2020	2030	2040	2050	2060	2070	
High Plains UWCD No.1	Swisher	Ogallala and Edwards-Trinity (High Plains)	119,658	129,283	71,638	46,284	33,912	27,019	22,783	GR16-028 MAG
Llano Estacado UWCD	Gaines	Ogallala and Edwards-Trinity (High Plains)	266,072	277,954	218,338	184,298	162,643	147,743	138,294	GR16-028 MAG
Mesa UWCD	Dawson	Ogallala and Edwards-Trinity (High Plains)	122,802	172,851	123,476	96,796	82,283	74,610	69,928	GR16-028 MAG
Permian Basin UWCD	Howard	Ogallala and Edwards-Trinity (High Plains)	12,428	19,285	16,865	15,737	15,105	14,738	14,513	GR16-028 MAG
Permian Basin UWCD	Martin	Ogallala and Edwards-Trinity (High Plains)	41,993	63,463	51,126	43,861	39,793	37,210	35,425	GR16-028 MAG
Sandy Land UWCD	Yoakum	Ogallala and Edwards-Trinity (High Plains)	131,815	138,940	92,952	69,400	58,308	52,469	48,940	GR16-028 MAG
South Plains UWCD	Hockley	Ogallala and Edwards-Trinity (High Plains)	3,527	4,895	2,213	726	389	283	240	GR16-028 MAG
South Plains UWCD	Terry	Ogallala and Edwards-Trinity (High Plains)	205,507	190,768	132,777	105,892	94,696	88,883	85,518	GR16-028 MAG
No District-County	Andrews	Ogallala and Edwards-Trinity (High Plains)	19,037	24,937	21,375	19,795	18,774	18,040	17,474	GR16-028 MAG
No District-County	Borden	Ogallala and Edwards-Trinity (High Plains)	5,025	5,922	4,639	4,069	3,737	3,421	3,212	GR16-028 MAG
No District-County	Briscoe	Ogallala and Edwards-Trinity (High Plains)	27,107	29,022	17,637	11,907	9,053	7,445	6,451	GR16-028 MAG
No District-County	Castro	Ogallala and Edwards-Trinity (High Plains)	3,159	5,859	3,280	2,367	1,814	1,452	1,214	GR16-028 MAG
No District-County	Crosby	Ogallala and Edwards-Trinity (High Plains)	1,691	3,135	2,918	2,292	1,959	1,783	1,671	GR16-028 MAG

Groundwater Management Area 2 – Modeled Available Groundwater

Groundwater Conservation District	County	Aquifer	Modeled Available Groundwater							TWDB Report
			2012	2020	2030	2040	2050	2060	2070	
No District-County	Deaf Smith	Ogallala and Edwards-Trinity (High Plains)	16,585	23,348	18,932	15,981	14,110	12,791	11,821	GR16-028 MAG
No District-County	Hockley	Ogallala and Edwards-Trinity (High Plains)	10,604	18,445	13,065	5,303	2,577	1,618	1,185	GR16-028 MAG
No District-County	Howard	Ogallala and Edwards-Trinity (High Plains)	352	550	527	526	534	543	553	GR16-028 MAG
Garza County UWCD	Garza	Dockum	191	911	911	911	911	911	911	GR16-028 MAG
High Plains UWCD No.1	Bailey	Dockum	7	833	833	833	833	833	833	GR16-028 MAG
High Plains UWCD No.1	Castro	Dockum	323	425	425	425	425	425	425	GR16-028 MAG
High Plains UWCD No.1	Cochran	Dockum	0	972	972	972	972	972	972	GR16-028 MAG
High Plains UWCD No.1	Crosby	Dockum	2,883	3,787	3,787	3,787	3,787	3,787	3,787	GR16-028 MAG
High Plains UWCD No.1	Deaf Smith	Dockum	2,134	4,395	4,395	4,395	4,395	4,395	4,395	GR16-028 MAG
High Plains UWCD No.1	Floyd	Dockum	2,456	3,226	3,226	3,226	3,226	3,226	3,226	GR16-028 MAG
High Plains UWCD No.1	Hale	Dockum	135	1,121	1,121	1,121	1,121	1,121	1,121	GR16-028 MAG
High Plains UWCD No.1	Hockley	Dockum	28	973	973	973	973	973	973	GR16-028 MAG
High Plains UWCD No.1	Lamb	Dockum	4	923	923	923	923	923	923	GR16-028 MAG
High Plains UWCD No.1	Lubbock	Dockum	3	1,086	1,086	1,086	1,086	1,086	1,086	GR16-028 MAG
High Plains UWCD No.1	Lynn	Dockum	81	912	912	912	912	912	912	GR16-028 MAG
High Plains UWCD No.1	Parmer	Dockum	0	5,450	5,450	5,450	5,450	4,689	4,589	GR16-028 MAG
High Plains UWCD No.1	Swisher	Dockum	1,200	1,576	1,576	1,576	1,576	1,576	1,576	GR16-028 MAG

Groundwater Management Area 2 – Modeled Available Groundwater

Groundwater Conservation District	County	Aquifer	Modeled Available Groundwater							TWDB Report
			2012	2020	2030	2040	2050	2060	2070	
Permian Basin UWCD	Howard	Dockum	737	1,471	1,471	1,471	1,471	1,471	1,471	GR16-028 MAG
Permian Basin UWCD	Martin	Dockum	6	8	8	8	8	8	8	GR16-028 MAG
No District-County	Andrews	Dockum	4	1,319	1,319	1,319	1,319	1,319	1,319	GR16-028 MAG
No District-County	Borden	Dockum	114	900	900	900	900	900	900	GR16-028 MAG
No District-County	Crosby	Dockum	54	71	71	71	71	71	71	GR16-028 MAG
No District-County	Deaf Smith	Dockum	27	6	6	6	6	6	6	GR16-028 MAG
No District-County	Hockley	Dockum	0	83	83	83	83	83	83	GR16-028 MAG
No District-County	Howard	Dockum	1	118	118	118	118	118	118	GR16-028 MAG
Totals										
Garza County UWCD Total		Ogallala and Edwards-Trinity (High Plains)	14,932	16,297	13,648	12,395	11,657	11,180	10,855	GR16-028 MAG
High Plains UWCD No.1 Total		Ogallala and Edwards-Trinity (High Plains)	1,888,087	2,120,141	1,352,831	943,023	729,567	618,277	555,434	GR16-028 MAG
Llano Estacado UWCD Total		Ogallala and Edwards-Trinity (High Plains)	266,072	277,954	218,338	184,298	162,643	147,743	138,294	GR16-028 MAG
Mesa UWCD Total		Ogallala and Edwards-Trinity (High Plains)	122,802	172,851	123,476	96,796	82,283	74,610	69,928	GR16-028 MAG
Permian Basin UWCD Total		Ogallala and Edwards-Trinity (High Plains)	54,421	82,748	67,991	59,598	54,898	51,948	49,938	GR16-028 MAG
Sandy Land UWCD Total		Ogallala and Edwards-Trinity (High Plains)	131,815	138,940	92,952	69,400	58,308	52,469	48,940	GR16-028 MAG
South Plains UWCD Total		Ogallala and Edwards-Trinity (High Plains)	209,034	195,663	134,990	106,618	95,085	89,166	85,758	GR16-028 MAG

Groundwater Management Area 2 – Modeled Available Groundwater

Groundwater Conservation District	County	Aquifer	Modeled Available Groundwater							TWDB Report
			2012	2020	2030	2040	2050	2060	2070	
No District-County Total		Ogallala and Edwards-Trinity (High Plains)	83,560	111,218	82,373	62,240	52,558	47,093	43,581	GR16-028 MAG
Garza County UWCD Total		Dockum	191	911	911	911	911	911	911	GR16-028 MAG
High Plains UWCD No. 1 Total		Dockum	9,255	25,679	25,679	25,679	25,679	24,918	24,818	GR16-028 MAG
Permian Basin UWCD Total		Dockum	743	1,479	1,479	1,479	1,479	1,479	1,479	GR16-028 MAG
No District-County Total		Dockum	200	2,497	2,497	2,497	2,497	2,497	2,497	GR16-028 MAG
GMA 2 Total		Ogallala and Edwards-Trinity (High Plains)	2,770,723	3,115,812	2,086,599	1,534,368	1,246,999	1,092,486	1,002,728	GR16-028 MAG
GMA 2 Total		Dockum	10,389	30,566	30,566	30,566	30,566	29,805	29,705	GR16-028 MAG
GMA 2			**2,781,112**	**3,146,378**	**2,117,165**	**1,564,934**	**1,277,565**	**1,122,291**	**1,032,433**	**GR16-028 MAG**