High Plains Underground Water Conservation District No.1

Management Plan 2024-2029

High Plains Water District
www.hpwd.org

Contents

Section 1—Introduction

District Mission

The mission of the High Plains Underground Water Conservation District No. 1 (HPWD) is to provide for the conservation, preservation, and protection of groundwater resources within the district's jurisdictional boundaries. This is consistent with the purpose of groundwater conservation districts (GCDs) as stated in Chapter 36 of the Texas Water Code.

Guiding Principles/Groundwater Management Planning

HPWD was formed and operates with the guiding belief that groundwater ownership and production are private property rights. It is understood that private property rights would not be protected without the district.

The District's Board of Directors (the Board) considers private property rights, historical groundwater use, water demand projections, current and projected water supply availability, and water supply needs to develop its management plan and establish its policies. Rules promulgated by the Board are carefully considered and are adopted only after considerable public input. The rules are meant to provide all users with a fair and equal opportunity to produce groundwater for beneficial purposes. HPWD believes it should be the primary source of information on groundwater conditions and educate residents on groundwater availability so they make informed decisions and practice water conservation.

Additionally, the Board realizes that the aquifers extend beyond the district's boundaries, and sharing information, programs, and ideas with neighboring districts is important. As a result, HPWD will consider the joint administration of certain programs when appropriate.

This document will be reviewed, evaluated, and revised as necessary to ensure that the district's goals are met. The goals, management objectives, and performance standards in this document are considered by the Board to be reasonable and prudent. Whenever the Board determines that a change is needed, it will act accordingly after carefully reviewing all the facts and receiving public input. The following guidelines are used to determine if the management objectives are set at a sufficient level to be realistic and effective:

- The duly elected Board will guide and direct the staff and measure the achievement of the goals established in this document.
- 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 HPWD activities on a fiscal-year basis. The district's fiscal year is October 1-September 30.

Section 2—History and Description of HPWD

District Creation, Location, and Extent

The Texas State Board of Water Engineers delineated the original boundaries of HPWD in March 1951. Later that year, voters in 13 Southern High Plains counties created the district in accordance with the Underground Water Conservation Districts Act passed by the Texas Legislature in 1949. After several annexation elections, the district now consists of Bailey, Cochran, Hale, Lamb, Lubbock, Lynn, Parmer, and Swisher counties, and portions of Armstrong, Castro, Crosby, Deaf Smith, Floyd, Hockley, Potter, and Randall counties (see Figure 1). HPWD's jurisdictional area now consists of approximately 11,850 square miles or 7,584,000 acres. The Board is comprised of five elected directors. The directors represent precincts, which are comprised of multiple counties.

HPWD is one of the seven GCDs in Groundwater Management Area #2 and one of the four GCDS in Groundwater Management Area #1. HPWD counties Armstrong, Potter, and Randall are in the Region A Water Planning Area and Groundwater Management Area #1. The remaining counties of HPWD are in the Region O Water Planning Area and Groundwater Management Area #2. Figures 2-4 illustrate these boundaries.

Figure 1: HPWD Boundary and Precincts

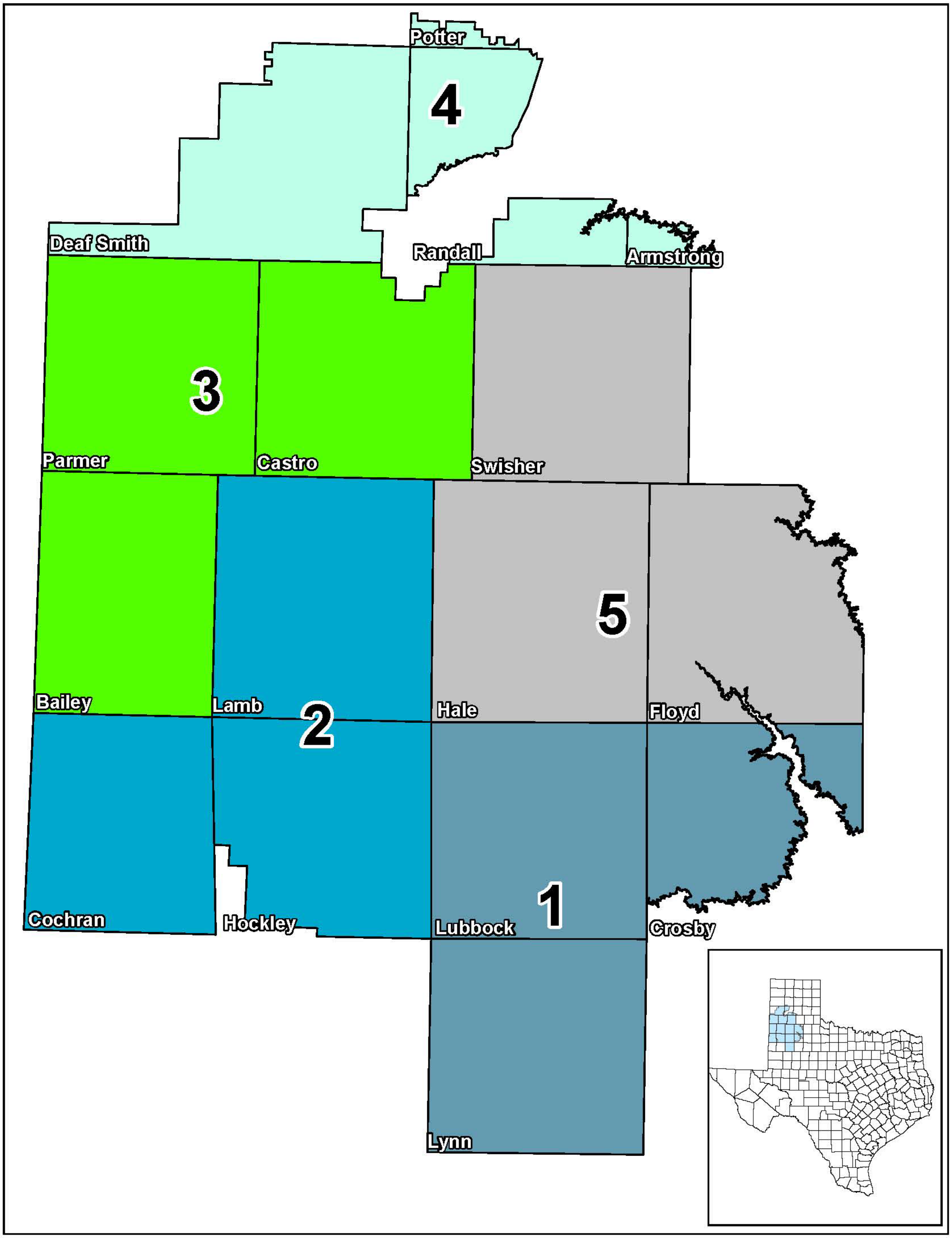


Figure 2: Locations of GMAs and GCDs

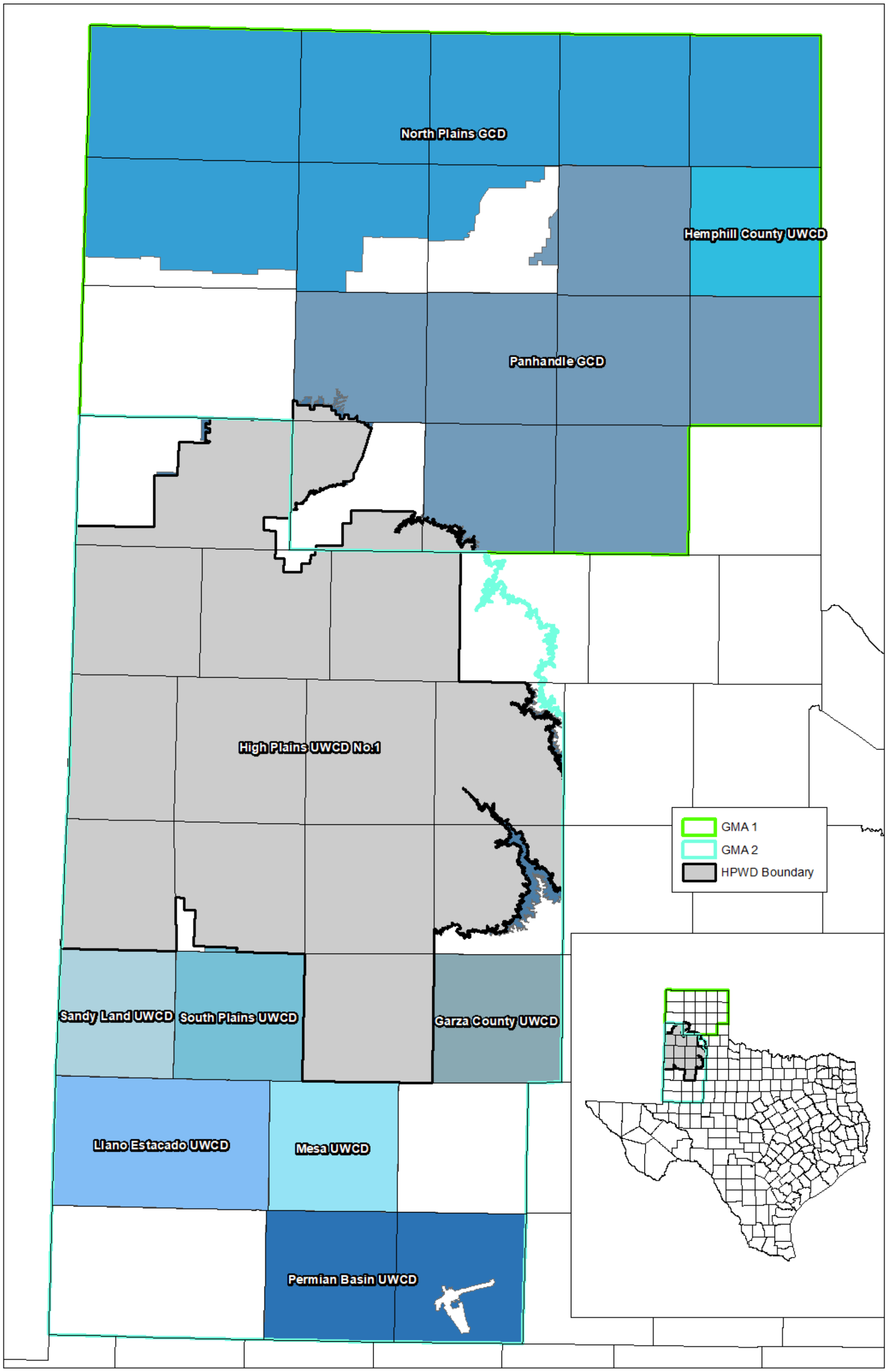


Figure 3: Boundaries of Regional Water Planning Areas

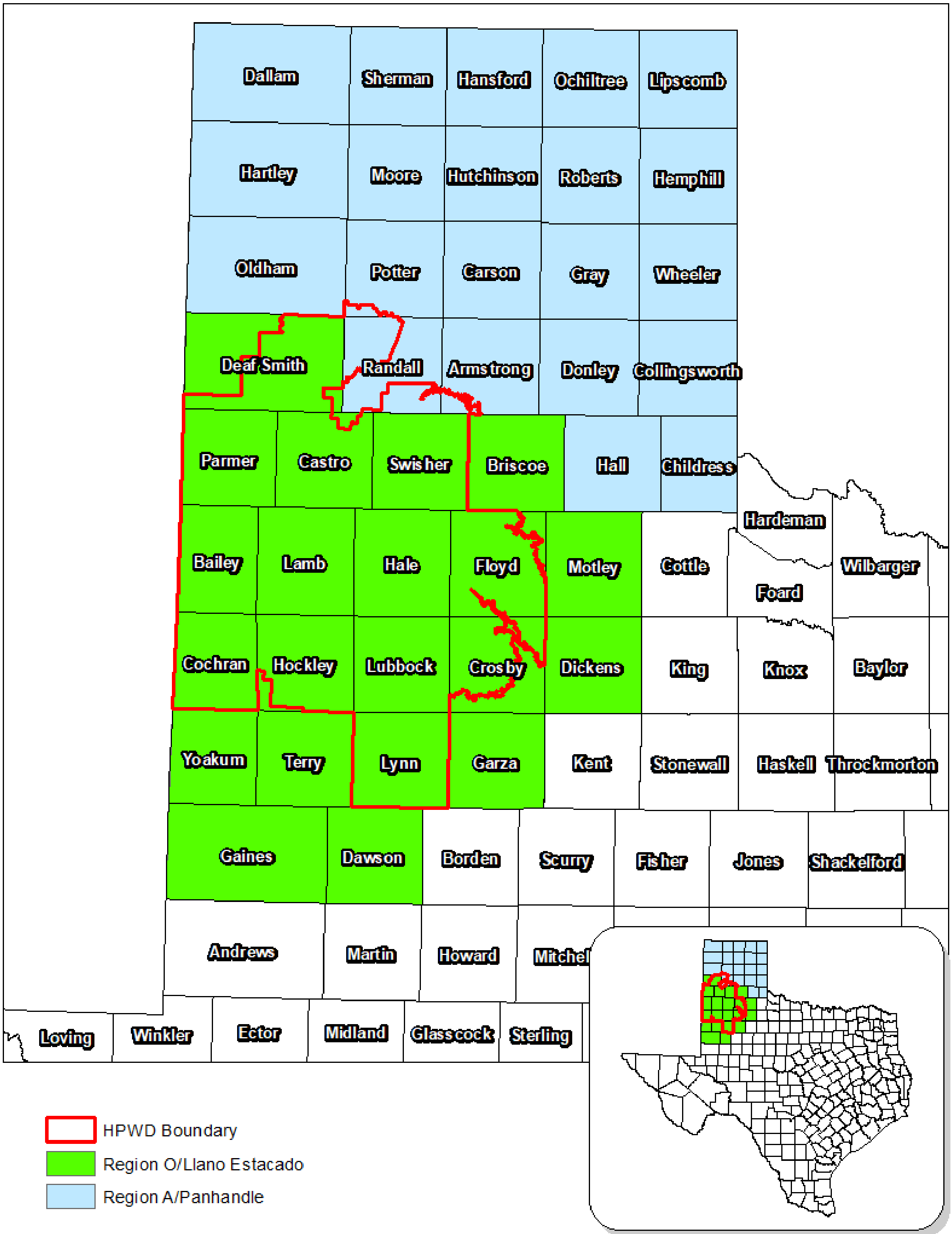
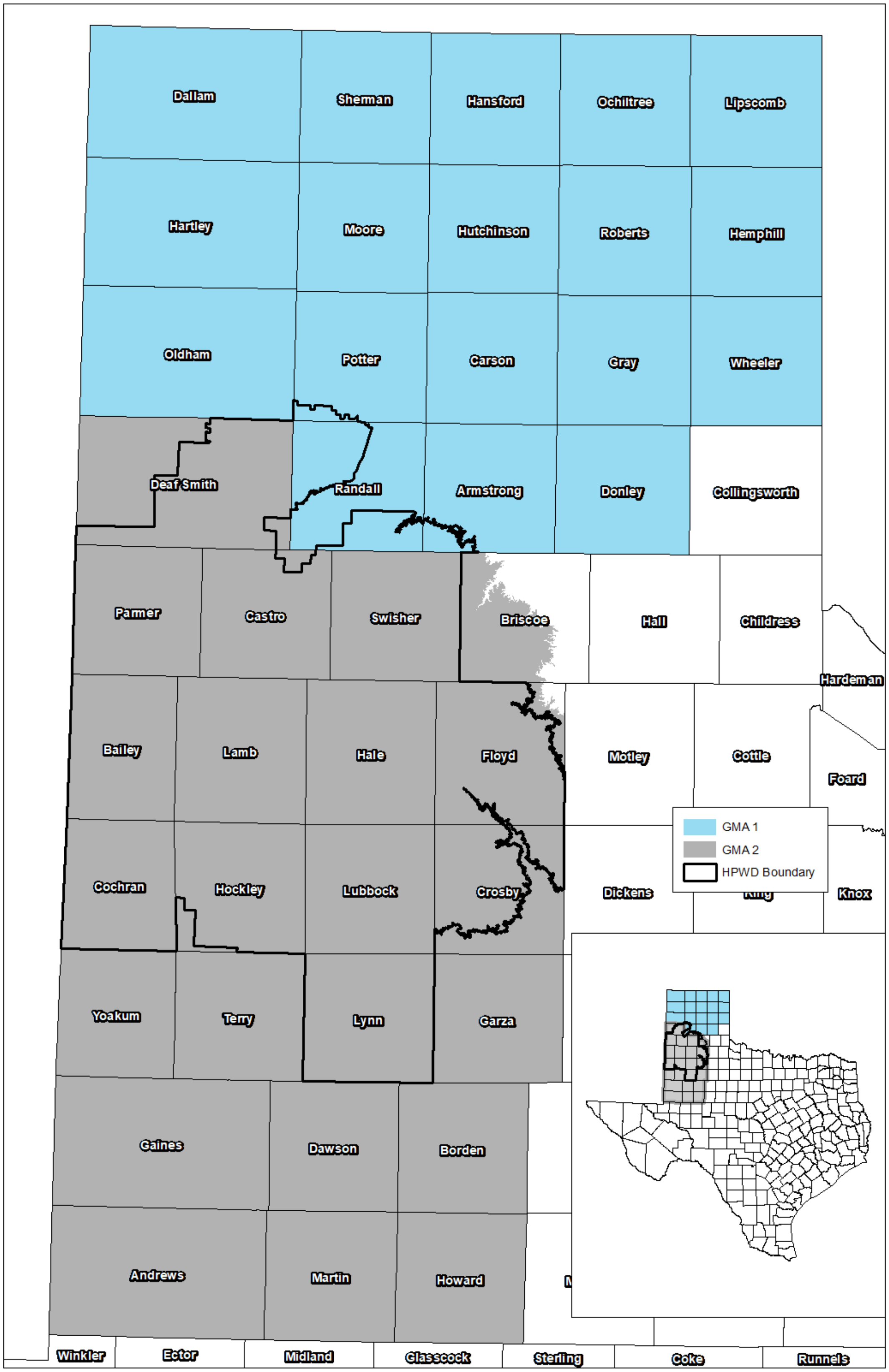


Figure 4: Boundaries of Groundwater Management Areas



General Description

The economy of HPWD is largely supported by agriculture. Approximately two million acres of the district are irrigated using groundwater. These irrigated farms afford economic stability to the area and support a number of other industries. Major animal feeding operations in HPWD include 65 beef cattle feed yards. Also, the dairy industry relies heavily on the resources of this region, as 76 dairies currently operate in this area. Various agri-businesses also support these industries, including animal health businesses, crop fertilizer and pesticide dealers, cotton gins, grain elevators, farm equipment dealers, irrigation dealers, and many more.

Other important industries in the area include beef processing, steam electric power generation, and oilfield operations. These industries supply a good portion of the HPWD tax base and employ many people in this region.

Most of the communities of the HPWD are small, rural towns. The larger cities of HPWD include Amarillo, Lubbock, and Plainview. The current population of HPWD is about 590,000, according to 2020 census data. These residents depend on the groundwater available locally and the water available from several other sources outside the district. For instance, the Canadian River Municipal Water Authority (CRMWA) delivers water to the following cities within the HPWD service area: Amarillo, Levelland, Lubbock, O'Donnell, Plainview, Slaton, and Tahoka. The CRMWA supply includes both surface water from Lake Meredith and groundwater from the Ogallala Aquifer in Roberts County. Other surface water providers include White River Municipal Water District (WRMWD) and Mackenzie Municipal Water Authority (MMWA). Communities within HPWD that receive water from these include Ralls and Crosbyton (WRMWD) and Tulia, Lockney, and Floydada (MMWA).

Lubbock depends on water supplied by CRMWA, Lake Alan Henry in Garza County, and groundwater from its well field in Bailey County. Some Ogallala wells within the city limits also supply landscape irrigation water for residents, schools, and parks.

Topography and Drainage

The land surface elevation ranges from about 2,659 feet above sea level in the southeastern part of the district to 4,442 feet in the northwestern part. The district's eastern boundary lies along the Caprock Escarpment in Floyd and Crosby Counties. A number of draws also cross the district, running from northwest to southeast. They are mostly shallow and seldom contain water. Playa lakes are numerous in the district and most prevalent in Hale and Floyd Counties. These provide some surface drainage and may contribute to aquifer recharge. HPWD also covers four major river basins in Texas, including the Canadian, Red, Brazos, and Colorado rivers.

Section 3—Groundwater Resources

Ogallala

The Ogallala is the major aquifer within the district. It is an unconfined (water table) aquifer, and the depths to water cover a wide range. Water level measurements vary from a few feet below the land surface to over 450 feet below the land surface. The Ogallala overlies

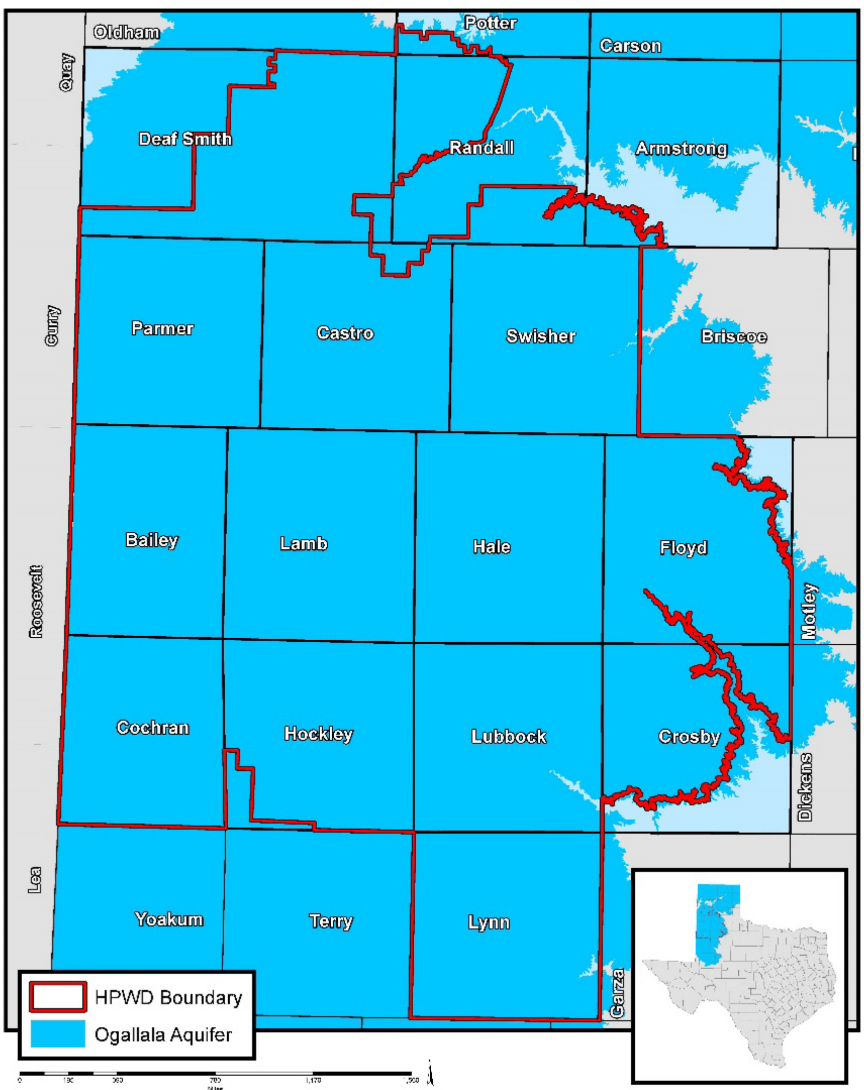
Cretaceous Period sediments in parts of Bailey, Lamb, Hale, Floyd, Cochran, Hockley, Lubbock, and Lynn counties. (Ashworth and Hopkins, 1995). In these areas, the Ogallala section is generally thinner than where it directly overlies the Triassic red beds.

The Ogallala Formation is heterogeneous and contains sequences of clay, silt, sand, and gravel. These sediments are thought to have been deposited by ancient streams that filled buried valleys that were eroded into pre-Ogallala rocks.

Groundwater moves slowly downhill through the formation, which is generally southeast. The saturated thickness of the aquifer may be only a few feet in some areas, while others still have over 150 feet of saturated thickness.

Discharge of the aquifer occurs primarily through pumping. According to GAM studies, recharge occurs primarily through precipitation, although some areas are also influenced by upward leakage from underlying aquifers.

Figure 5: Extent of the Ogallala Within HPWD



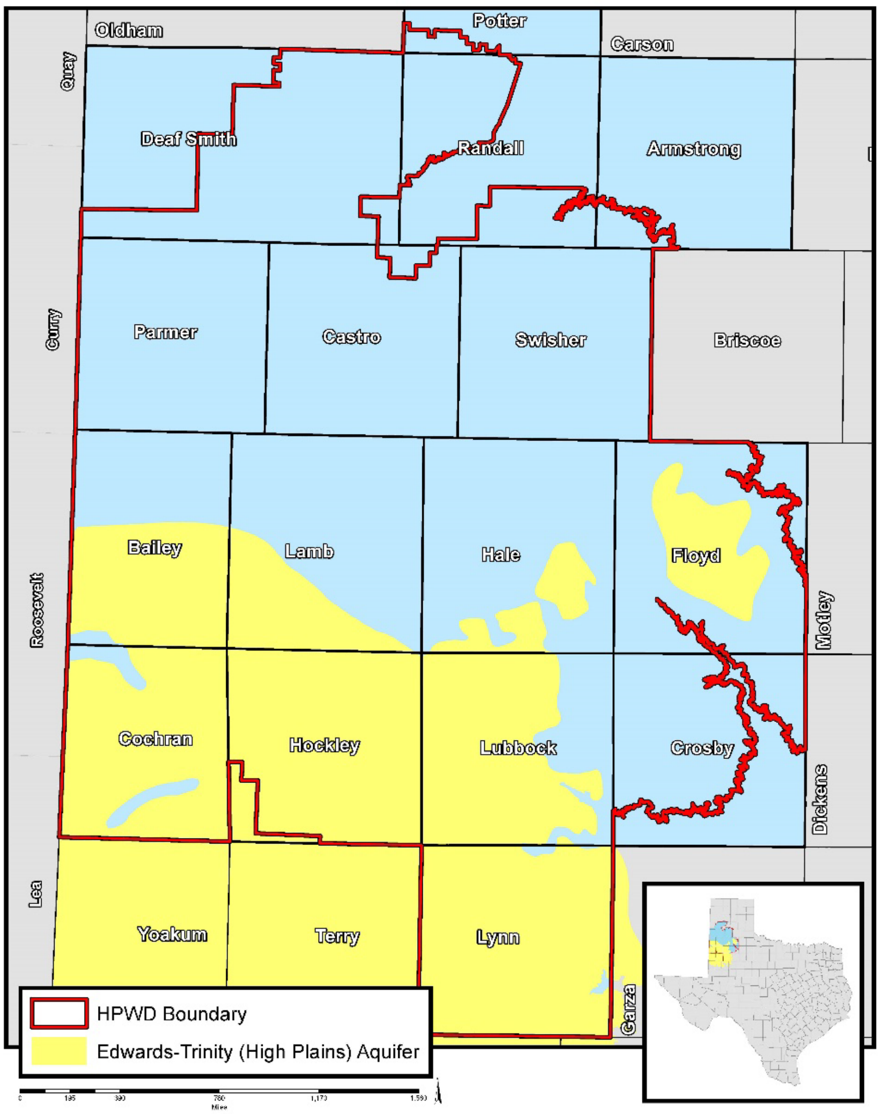
Edwards-Trinity (High Plains)

The Edwards-Trinity (High Plains) Aquifer, which is considered a minor aquifer, contains Cretaceous-period sediments. In some areas of HPWD, this aquifer and the Ogallala may be hydraulically connected. This occurs when Ogallala sand and gravel directly overlie Edwards Limestone or Antlers Sand. (Blandford, et. al, 2008)

Sometimes, water wells may be completed in the Ogallala section and the Edwards-Trinity (High Plains) aquifer. As Ogallala water levels decline, this minor aquifer may provide usable quantities of water in some locations. Groundwater in this minor aquifer is generally fresh to slightly saline but typically poorer in quality than the overlying Ogallala (Ashworth and Hopkins, 1995).

Recharge of this aquifer may occur from the bounding Ogallala Formation or the underlying Dockum. The movement of water is generally east to southeast.

Figure 6: Location of the Edwards-Trinity (High Plains) Aquifer Within HPWD

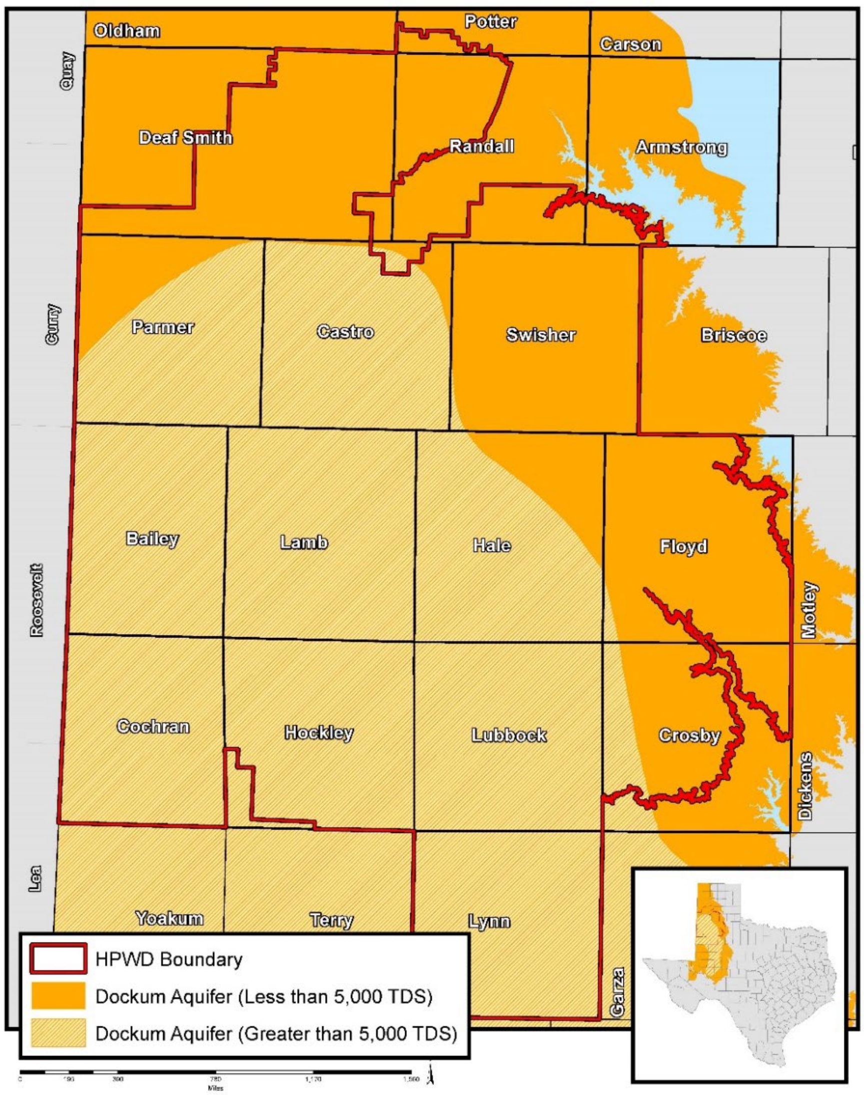


Dockum

The Dockum Aquifer underlies the Ogallala and Edwards-Trinity (High Plains) Aquifers throughout HPWD. It contains layers of silt and shale, interbedded with other conglomerates. The Santa Rosa Sandstone is likely the most productive zone in this aquifer.

The Dockum's water quality is the primary limiting factor when considering its use. In most of HPWD, it is highly saline and tends to deteriorate with depth. In fact, total dissolved solids (TDS) concentrations may exceed 60,000 mg/L in the deeper parts of the aquifer (Bradley and Kalaswad, 2003). However, in parts of Deaf Smith, Randall, and Swisher counties, Dockum Aquifer wells provide fresh water to users.

Figure 7: Location of the Dockum Aquifer Within HPWD



Section 4—Technical Water Data

Estimates of Modeled Available Groundwater

Estimates of modeled available groundwater for the adopted DFC are found in Appendix A.

Estimates of Annual Groundwater Use

The estimates of annual groundwater use from the TWDB are taken from the Water Use Survey (WUS). These are used as a guide and may have limitations, but they are useful when examining trends in groundwater withdrawals. Refer to Appendix C for estimates of annual usage.

Estimates of Annual Groundwater Recharge from Precipitation

Refer to GAM Run 24-006 found in Appendix B.

Estimates of Annual Groundwater Discharge to Springs/Surface Water Bodies

Refer to GAM Run 24-006 found in Appendix B.

Estimates of Annual Groundwater Flow Into/Out of the District Within Each Aquifer; Estimates of Annual Groundwater Flow Between Aquifers in the District

Refer to GAM Run 24-006 found in Appendix B.

Estimates of Projected Surface Water Supply

Refer to Appendix C for estimates of projected surface water supply.

Estimates of Projected Total Demand for Water in the District

Projecting water demand is a challenging task and contains some uncertainty. Irrigation demand projections are particularly difficult since rainfall, commodity prices, and federal farm policy are but a few factors that complicate the matter.

Refer to Appendix C for the district's projected total water demand.

Section 5—Needs and Strategies

Water Supply Needs and Water Management Strategies

Water supply needs and resulting water management strategies are developed within each Regional Water Planning Group every five years as part of the State Water Plan. These needs and strategies are initially formed by specific water user groups (WUGs) and reflect the unique circumstances and challenges of the respective WUGs. Reviewing this data helps the district understand the anticipated needs, strategies, and usage trends over the planning period. Needs exist for most of the HPWD county irrigation user groups. There are also needs for various municipal WUGs. Demand reduction is a common strategy for many of the water needs shown in the plan. Conservation advancements in irrigation technology are part of the strategies for this reduction. Many of the municipalities are using additional groundwater development from the Ogallala Aquifer as local supplies decline. Minor aquifers and brackish groundwater are likely to become more widely used. Furthermore, there are strategies in Lubbock County for direct reuse and in Hale County for aquifer storage and recovery (ASR). Refer to Appendix C for water supply needs and water management strategies included in the most recently adopted State Water Plan.

Section 6—Plan Implementation

Actions, Procedures, Performance and Avoidance for Plan Implementation and Groundwater Management

HPWD has rules that address the spacing of wells from property lines and other valid well sites. An annual production limit also limits total withdrawals from non-exempt wells.

The effectiveness of HPWD conservation programs is continually evaluated. Water conservation technology continues to improve, and the district has a history of supporting innovative research and demonstration programs.

The County Advisory Committees, comprised of about ninety individuals, have evaluated HPWD rules. Other water user groups have also provided valuable input. The Board has developed this plan and the rules using a very transparent and deliberate process. A current copy of the rules is available at hpwd.org/rules.

Section 7—Goals, Objectives, Methodology and Performance Standards

HPWD staff will prepare an annual report on the district's achievement of its management goals and objectives. The report will be prepared in a format reflective of the performance standards for each management objective. It will be presented to the Board at the end of each fiscal year and maintained on file in the district's open records.

HPWD will enforce its rules to conserve, preserve, protect, and prevent the waste of groundwater within its service area. The Board may periodically review the district's rules and may modify them, following public input, to better manage the groundwater resources within the district and to carry out the duties prescribed by Chapter 36 of the Texas Water Code. A petition for rulemaking is now part of HPWD rules and gives residents a process to follow if they desire changes to these rules.

Goal 1: Providing the Most Efficient Use of Groundwater

Management Objective 1.1 (Monitor water levels):

Water level measurements are vital to the study of the aquifers in the district. Annual measurements are taken each winter, during which time most of the irrigation usage is at a minimum.

Performance Standards

1.1a Number of wells marked as current observation sites each year

1.1b Number of wells with publishable measurements each year.

1.1c Number of wells without publishable measurements each year

1.1d Publish yearly water level changes on the interactive web map.

1.1e Maintain continuous water level monitoring transducers in at least 10 water wells

Management Objective 1.2 (Monitor saturated thickness):

Saturated thickness represents the aquifer section where pumping occurs. Water users should be aware of changing saturated thickness.

Performance Standards

1.2a Once per year, calculate saturated thickness for water level observation wells that have a log of well construction

1.2b Provide saturated thickness data on the HPWD website

Management Objective 1.3 (Technical field services):

HPWD is frequently asked to measure well capacities. District staff use a variety of tools for this purpose, including ultrasonic flow meters and e-lines.

Performance Standards

1.3a Number of flow tests performed by HPWD staff each year

1.3b Number of water level measurements performed by HPWD staff each year

Management Objective 1.4 (Irrigation assessment program):

Agricultural irrigation comprises the majority of groundwater usage within the district. For this reason, it is important that the district understand the patterns of usage on different crops. Using a network of cooperators, the district should monitor application amounts and crop types.

Performance Standards

1.4a Number of sites enrolled in the district's irrigation assessment program each year

1.4b Calculate and perform a summary of crops reported by participants in the irrigation assessment program once each year.

Goal 2: Controlling and Preventing Waste of Groundwater

Management Objective 2.1 (Well permitting and well completion):
HPWD requires permits for wells that produce 17.5 gpm or more.

Performance Standards

2.1a Number of water well permits granted by the HPWD Board (by aquifer) each year

2.1b Production categories of well permits granted by the HPWD Board (by aquifer) each year

Management Objective 2.2 (Uncovered or deteriorated water wells):
Uncovered or deteriorated wells pose a threat to groundwater quality and human and animal safety. HPWD staff may discover such a well during routine fieldwork, or the office may receive notice from a member of the public.

Performance Standards

2.2a Number of uncovered wells that are covered each year

2.2b Number of deteriorated wells reported each year and the status of each at the close of the fiscal year.

Management Objective 2.3 (Waste of groundwater):
Since waste is prohibited by state law, HPWD will emphasize public awareness of this matter.

Performance Standards

2.3a Include a waste prevention reminder in each newsletter

Goal 3: Controlling and preventing subsidence (not applicable)

Using the TWDB subsidence predictor tool, we analyzed selected water level observation wells. The transient predictions ended in the year 2070. The minimum predicted subsidence values were about 0.15 feet, while the maximum predicted subsidence values were about 0.70 feet. We also reviewed the TWDB report, "Identification of the Vulnerability of the Major and Minor Aquifers of Texas to Subsidence with Regard to Groundwater Pumping". The district concluded that this goal is not applicable to the operation of the district.

Goal 4: Conjunctive surface water management issues

Management Objective 4.1 (Coordination with surface water management agencies):
HPWD has very limited surface water resources. Attending Regional Water Planning Group (RWPG) meetings within HPWD will ensure that the district stays current with issues affecting the region's surface water agencies. Several HPWD surface water entities supplement their surface water with groundwater wells. Groundwater needs are most often discussed during regional water planning group meetings.

Performance Standard

4.1a Number of RWPG meetings attended by district staff each year

Goal 5: Natural resource issues

Management Objective 5.1 (Monitor Water Quality):
Water quality affects many different user groups within HPWD. Screening factors for water quality may include total dissolved solids (TDS) or other parameters that assess water quality. HPWD has several tools available for conducting these tests.

Performance Standards

5.1a Document the aquifer(s) being sampled

5.1b Number of sites sampled each year

5.1c Document the type of sampling methods

Goal 6: Drought Conditions

Management Objective 6.1 (Provide ongoing and relevant drought information):
Drought awareness helps water users understand the level of conservation required to meet a particular need. The Texas Water Development Board (TWDB) has a very useful website for drought information, which is waterdatafortexas.org/drought. HPWD will promote drought awareness through the newsletter, which is our most popular information source.

Performance Standards

6.1a Number of newsletters with drought-related information each year

Goal 7: Conservation, recharge enhancement, rainwater harvesting, precipitation enhancement, or brush control, where appropriate and cost-effective

Management Objective 7.1 (Newsletter):
HPWD will produce and distribute a newsletter to area residents and other interested parties. The newsletter will include articles discussing methods to conserve and preserve groundwater quality and quantity.

Performance Standards

7.1a Number of newsletters produced each year

7.1b Include a conservation reminder in each newsletter

Management Objective 7.2 (Public presentations):
HPWD representatives will present information about water conservation practices and other subjects to civic clubs, professional groups, and other interested parties.

Performance Standards

7.2a Number of public presentations delivered each year

7.2b Document the estimated attendance at each venue

Management Objective 7.3 (Conservation research):
HPWD will seek opportunities to participate in and partner with other groups conducting water conservation research and demonstrations.

Performance Standards

7.3a Once per year, document the number of water conservation research/demonstration projects in which the district participates

Management Objective 7.4 (Public information):
HPWD staff will provide general water conservation information at suitable venues within the district each year. This may include exhibits at farm shows and information tables with publications at other meetings.

Performance Standards

7.4a Document the venues at which water conservation information is provided

Management Objective 7.5 (Youth education):
HPWD will provide water conservation education to youth within its service area.

Performance Standards

7.5a Document the number of presentations and youth reached once per year

Management Objective 7.6 (Website):
HPWD will provide information about groundwater, water conservation, and other subjects on its website.

Performance Standards

7.6a Document annual web traffic using an analytical program

Goal 8: Recharge Enhancement

Management Objective 8.1 (Research/Demonstration Opportunities):
HPWD has committed many resources to recharge enhancement studies and demonstrations since its creation. Several examples of this past work are recharge wells and enhanced recharge structures. As managed aquifer research (MAR) technologies evolve, we expect additional research and demonstration opportunities. HPWD may encourage work in this area through its research and demonstration policy.

Performance Standards

8.1a Number of research/demonstration MAR proposals received by HPWD each year

8.1b Number of research/demonstration MAR proposals funded by HPWD each year

Goal 9: Rainwater Harvesting

Management Objective 9.1 (Rainwater Harvesting):

HPWD will promote awareness of this conservation practice among the district's residents.

Performance Standards

9.1a Number of public presentations addressing rainwater harvesting each year

9.1b Number of rainwater harvesting devices distributed to the public year

Goal 10: Precipitation Enhancement (not applicable)

During the years 1997-2002, HPWD conducted a weather modification program. In late 2002, residents of the district voiced much opposition to this program, and several county commissioners' courts adopted resolutions against the continuation of the program. The program was subsequently terminated by the HPWD board, and this goal is not applicable.

Goal 11: Brush Control (not applicable)

Existing programs administered by the USDA-NRCS are addressing this issue. This activity is not cost-effective and applicable to HPWD at this time. Therefore, this goal is not applicable to the operation of the district.

Goal 12: Desired future condition of the aquifers

Management Objective 12.1 (Calculate average yearly water level change):

HPWD desired future conditions (DFCs) were developed using an average yearly water level change within the GMAs. Each winter, HPWD and other GCDs obtain water level measurements to determine the change from the previous year.

Performance Standards

12.1a Number of wells included in the calculation

12.1b Calculated average water level change

12.1c Compare total cumulative change to the adopted DFC

Management Objective 12.2 (Estimating annual usage):

Calculating annual usage is helpful for monitoring progress toward achieving the desired future conditions. Although a regional groundwater model provides estimations of usage to meet that goal, a more specific local estimate may increase our understanding of the usage and corresponding changes in volume.

Performance Standards

12.2a Estimate total usage within HPWD using reported data and irrigation estimates

12.2b Compare estimated annual usage to data from the High Plains Aquifer System (HPAS) GAM

References

Ashworth, J. and Hopkins, J., 1995, Aquifers of Texas: Texas Water Development Board, 44-45 p.

Blandford, T.N., Kuchanur, M., Standen, A., Ruggiero, R., Calhoun, K.C., Kirby, P., and Shah, G., 2008, Groundwater availability model of the Edwards-Trinity (High Plains) Aquifer in Texas and New Mexico: Final report prepared for the Texas Water Development Board by Daniel B. Stephens & Associates, Inc., 80 p.

Bradley, R. and Kalaswad, S, 2003, The Groundwater Resources of the Dockum Aquifer in Texas: Texas Water Development Board, 51 p.

Appendix A

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

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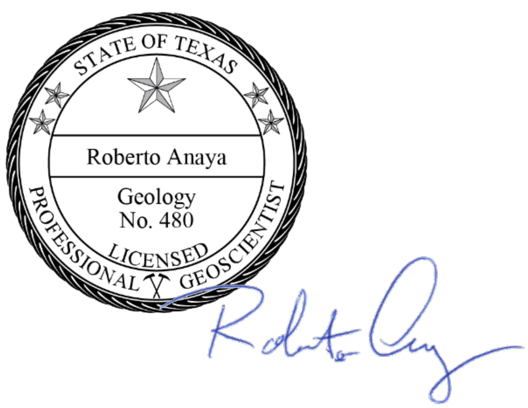
512-463-6115
February 28, 2023



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

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512-463-6115
February 28, 2023

EXECUTIVE SUMMARY:

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

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

REQUESTOR:

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

DESCRIPTION OF REQUEST:

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

Ogallala (inclusive of the Rita Blanca) Aquifer:

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

Dockum Aquifer:

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

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

On January 4, 2022, Mr. Wade Oliver, on behalf of Groundwater Management Area 1, submitted the Desired Future Conditions Explanatory Report and accompanying files to the TWDB. Groundwater Management Area 1 adopted four geographically defined desired future conditions for the Ogallala (inclusive of the Rita Blanca) Aquifer, and three geographically defined desired future conditions for the Dockum Aquifer, as presented above. TWDB staff reviewed the model files associated with the desired future conditions and some of the desired future conditions were initially not mutually compatible with the groundwater availability model results for the High Plains Aquifer System.

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

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

METHODS:

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

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

The modeled available groundwater values were determined by extracting pumping rates at the end of each decade from the model results using ZONEBUDGET Version 3.01 (Harbaugh, 2009). Annual pumping rates by aquifer are summarized by county and groundwater conservation district, subtotaled by groundwater conservation district, and then summed for Groundwater Management Area 1 (Tables 1 and 2). Annual pumping rates by aquifer are summarized by county, river basin, and regional water planning area within Groundwater Management Area 1 (Tables 3 and 4) to be consistent with the format used in the regional water planning process.

Modeled Available Groundwater and Permitting

As defined in Chapter 36 of the Texas Water Code (2011), "modeled available groundwater" is the estimated average amount of water that may be produced annually to achieve a desired future condition. Groundwater conservation districts are required to consider modeled available groundwater, along with several other factors, when issuing permits to manage groundwater production that achieves the desired future condition(s). The other factors districts must consider include annual precipitation and production patterns, the estimated amount of pumping exempt from permitting, existing permits, and a reasonable estimate of actual groundwater production under existing permits.

PARAMETERS AND ASSUMPTIONS:

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

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

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

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

RESULTS:

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

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

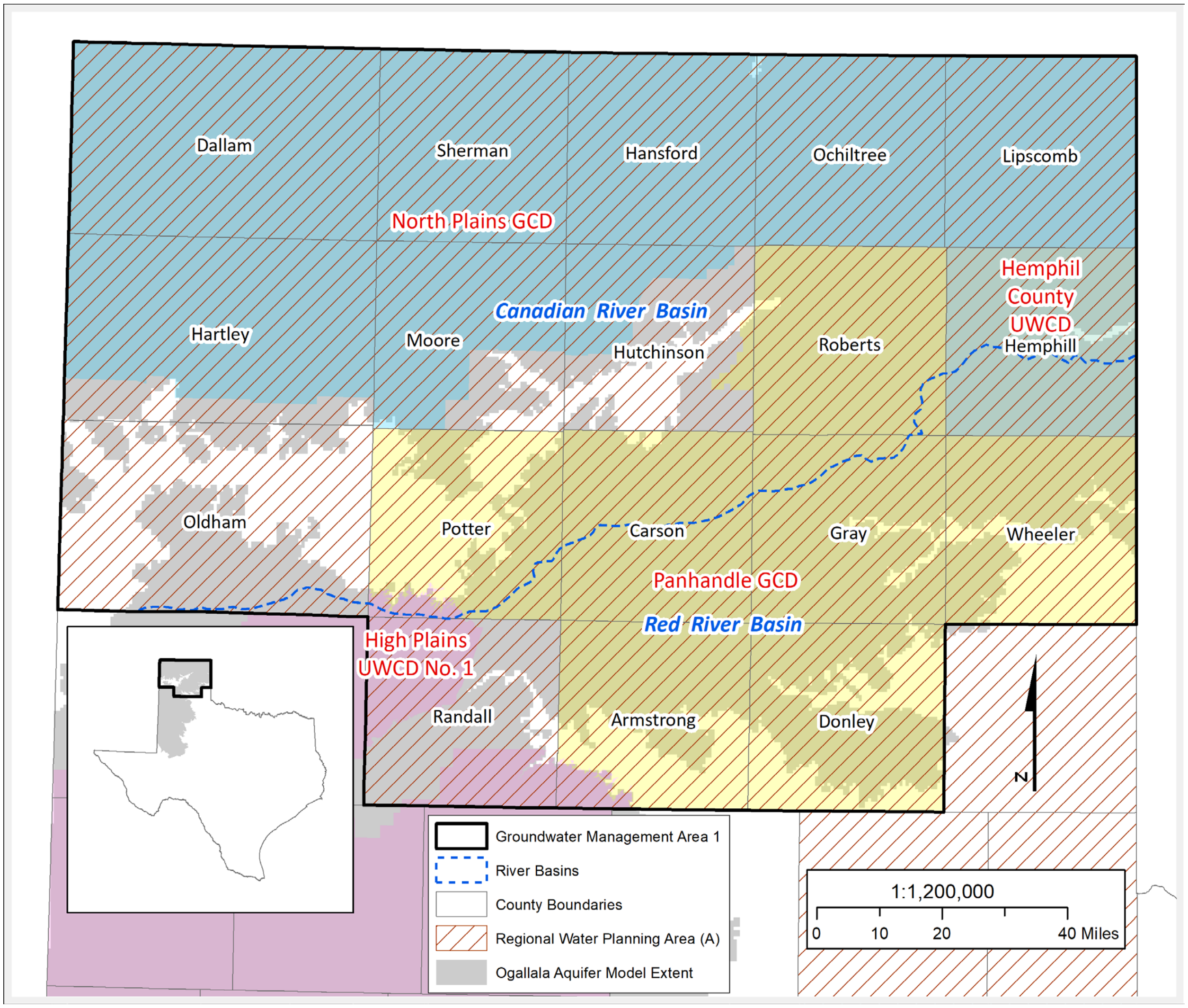

FIGURE 2. GROUNDWATER MANAGEMENT AREA (GMA) 1 BOUNDARY, RIVER BASINS, COUNTIES, REGIONAL WATER PLANNING AREAS (RWPAS), AND GROUNDWATER CONSERVATION DISTRICTS (GCDS) OVERLAIN ON THE MODEL EXTENT OF THE DOCKUM AQUIFER.

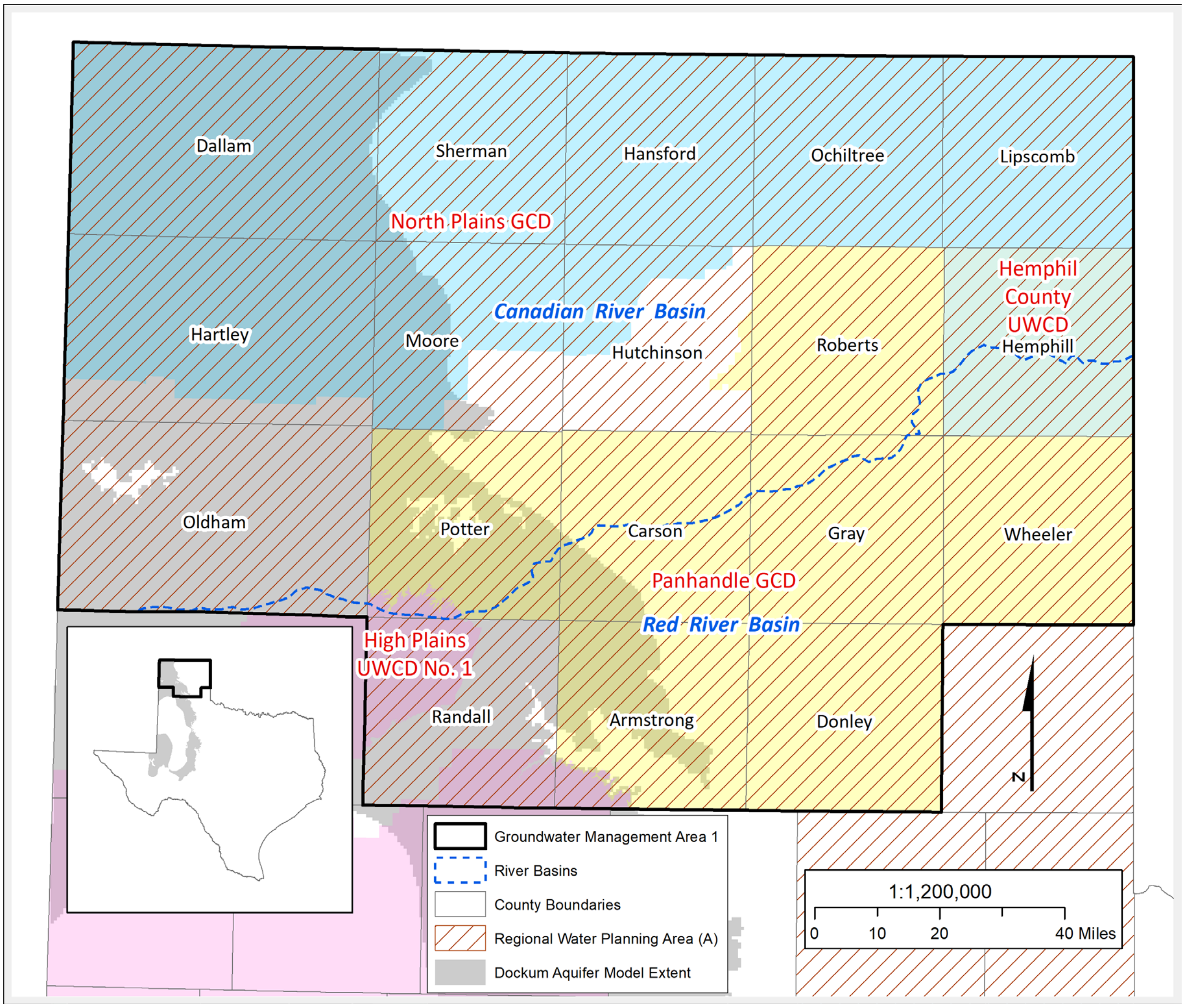

TABLE 1. MODELED AVAILABLE GROUNDWATER FOR THE OGALLALA (INCLUSIVE OF THE RITA BLANCA AQUIFER) AQUIFER IN GROUNDWATER MANAGEMENT AREA 1 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2080. VALUES ARE IN ACRE-FEET PER YEAR.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

LIMITATIONS:

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

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

A key aspect of using the groundwater model to evaluate historic groundwater flow conditions includes the assumptions about the location in the aquifer where historic pumping was placed. Understanding the amount and location of historic pumping is as important as evaluating the volume of groundwater flow into and out of the district, between aquifers within the district (as applicable), interactions with surface water (as applicable), recharge to the aquifer system (as applicable), and other metrics that describe the impacts of that pumping. In addition, assumptions regarding precipitation, recharge, and streamflow are specific to a particular historic time period.
Because the application of the groundwater model was designed to address regional scale questions, the results are most effective on a regional scale. The TWDB makes no warranties or representations relating to the actual conditions of any aquifer at a particular location or at a particular time.

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

REFERENCES:

Deeds, Neil E. and Jigmond, Marius, 2015, Numerical Model Report for the High Plains Aquifer System Groundwater Availability Model: Prepared for Texas Water Development Board, 640 p., http://www.twdb.texas.gov/groundwater/models/gam/hpas/HPAS_GAM_Numerical_Report.pdf.

Groundwater Management Area 1, and Oliver, W., INTERA Inc., 2021, Desired Future Conditions Explanatory Report (Groundwater Management Area 1), December 2021, 595 p.

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 Newton formulation for MODFLOW-2005: United States Geological Survey, Techniques and Methods 6-A37, 44 p.

Texas Water Code, 2011, http://www.statutes.legis.state.tx.us/docs/WA/pdf/WA.36.pdf

APPENDIX A

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

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

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

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

Ogallala (inclusive of Rita Blanca) Aquifer:

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

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

Dockum Aquifer:

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

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

None

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

Informational

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

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

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

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

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

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

NORTH PLAINS
GROUNDWATER
Conservation District

November 10, 2022

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

Dear Mr. Bradley,

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

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

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

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

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

Sincerely,

Steven D. Walthour, PG
General Manager

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

Attachment

GAM Run 21-008 Addendum: Modeled Available Groundwater for the High Plains Aquifer System (Ogallala, Edwards-Trinity (High Plains), and Dockum aquifers) in Groundwater Management Area 2

Grayson Dowlearn, P.G.
Texas Water Development Board
Groundwater Division
Groundwater Modeling Department
512 475-1552
June 3, 2022

ADDENDUM SUMMARY:

Modeled available groundwater for the Ogallala, Edwards-Trinity (High Plains), and Dockum aquifers in Groundwater Management Area 2 was provided on May 2, 2022 in GAM Run 22-008 (Bond and Dowlearn, 2022). However, after the report was released, errors were identified in Tables 1 and 2. The identified errors are listed below:

1) Tables 1 and 2 were missing a column with the modeled available groundwater for the year 2020, and

2) Table 2 incorrectly included Gaines County and its modeled available groundwater values within the High Plains UWCD No. 1 modeled available groundwater totals.

The errors were addressed with the following corrections:

1) A column with modeled available groundwater values for the year 2020 was added to Tables 1 and 2,

2) Gaines County was removed from the High Plains UWCD No. 1 and the modeled available groundwater values were subtracted from the total for the High Plains UWCD No. 1, and

3) Llano Estacado UWCD, which coincides with Gaines County, was added as a separate groundwater conservation district to Table 2.

This addendum contains the corrected Tables 1 and 2.

TABLE 1: MODELED AVAILABLE GROUNDWATER FOR THE OGALLALA AND EDWARDS-TRINITY (HIGH PLAINS) AQUIFERS IN GROUNDWATER MANAGEMENT AREA 2 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2080. VALUES ARE IN ACRE-FEET PER YEAR. (UWCD = UNDERGROUND WATER CONSERVATION DISTRICT)

Groundwater Conservation District	County	2020	2030	2040	2050	2060	2070	2080
Garza County UWCD Total	**Garza**	**15,519**	**13,508**	**12,402**	**11,717**	**11,263**	**10,948**	**10,721**
High Plains UWCD No.1	Bailey	88,271	65,138	50,725	42,532	37,743	34,724	32,675
	Castro	228,996	176,186	116,578	68,325	42,856	30,477	23,914
	Cochran	87,584	73,991	62,095	54,265	48,561	43,632	40,036
	Crosby	145,637	105,559	73,026	51,628	39,354	32,169	27,680
	Deaf Smith	162,070	117,359	80,488	56,872	43,574	35,948	31,405
	Floyd	157,164	93,953	65,087	52,305	44,155	39,232	35,987
	Hale	217,265	116,615	75,108	53,298	41,142	34,308	30,298
	Hockley	141,111	96,747	73,687	62,502	56,622	53,198	51,064
	Lamb	204,808	120,172	77,677	60,088	52,063	47,868	45,425
	Lubbock	135,045	110,472	100,950	95,478	91,655	88,877	86,735
	Lynn	99,629	88,768	82,064	77,033	73,324	70,707	68,886
	Parmer	144,423	92,025	63,568	46,835	37,743	32,290	28,757
	Swisher	119,920	73,407	48,754	35,887	28,541	23,972	20,935
High Plains UWCD No.1 Total		**1,931,923**	**1,330,392**	**969,807**	**757,048**	**637,333**	**567,402**	**523,797**
Llano Estacado UWCD Total	**Gaines**	**254,329**	**205,486**	**177,777**	**159,523**	**147,028**	**138,157**	**131,974**
Mesa UWCD Total	**Dawson**	**156,735**	**121,336**	**98,590**	**84,192**	**75,448**	**70,262**	**66,945**

TABLE 1 (CONTINUED): MODELED AVAILABLE GROUNDWATER FOR THE OGALLALA AND EDWARDS-TRINITY (HIGH PLAINS) AQUIFERS IN GROUNDWATER MANAGEMENT AREA 2 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2080. VALUES ARE IN ACRE-FEET PER YEAR. (UWCD = UNDERGROUND WATER CONSERVATION DISTRICT)

Groundwater Conservation District	County	2020	2030	2040	2050	2060	2070	2080
No District County	Andrews	22,379	19,391	17,897	16,937	16,260	15,764	15,378
	Borden	5,448	4,432	3,893	3,591	3,393	3,227	3,072
	Briscoe	26,813	17,859	12,598	9,600	7,844	6,743	6,016
	Castro	4,726	3,742	2,496	1,874	1,475	1,214	1,039
	Crosby	2,529	2,506	2,276	1,897	1,685	1,562	1,479
	Deaf Smith	20,853	18,024	15,387	13,553	12,267	11,301	10,556
	Floyd	0	0	0	0	0	0	0
	Hockley	15,302	12,402	7,093	3,411	2,028	1,419	1,102
	Howard	483	471	474	483	494	504	513
No District County Total		**98,533**	**78,827**	**62,114**	**51,346**	**45,446**	**41,734**	**39,155**
Permian Basin UWCD	Howard	16,677	15,160	14,344	13,882	13,596	13,411	13,287
	Martin	55,313	48,293	43,032	39,019	36,358	34,521	33,171
Permian Basin UWCD Total		**71,990**	**63,453**	**57,376**	**52,901**	**49,954**	**47,932**	**46,458**
Sandy Land UWCD Total	**Yoakum**	**128,498**	**90,983**	**70,810**	**59,346**	**53,002**	**49,187**	**46,687**
South Plains UWCD	Hockley	4,157	2,638	1,005	493	331	265	234
	Terry	180,555	134,878	108,182	96,190	89,977	86,343	84,043
South Plains UWCD Total		**184,712**	**137,516**	**109,187**	**96,683**	**90,308**	**86,608**	**84,277**
Groundwater Management Area 2 Total		**2,842,239**	**2,041,501**	**1,558,063**	**1,272,756**	**1,109,782**	**1,012,230**	**950,014**

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

Groundwater Conservation District	County	2020	2030	2040	2050	2060	2070	2080
Garza County UWCD Total	**Garza**	**1,038**	**1,038**	**1,038**	**1,038**	**1,038**	**1,038**	**1,038**
High Plains UWCD No.1	Bailey	949	949	949	949	949	949	949
	Castro	484	484	484	484	484	484	484
	Cochran	1,106	1,106	1,106	1,106	1,106	1,106	1,106
	Crosby	4,312	4,312	4,312	4,312	4,312	4,312	4,312
	Deaf Smith	5,006	5,006	5,006	5,006	5,006	5,006	5,006
	Floyd	3,674	3,674	3,674	3,674	3,674	3,674	3,674
	Hale	1,277	1,277	1,277	1,277	1,277	1,277	1,277
	Hockley	1,109	1,109	1,109	1,109	1,109	1,109	1,109
	Lamb	1,051	1,051	1,051	1,051	1,051	1,051	1,051
	Lubbock	1,236	1,236	1,236	1,236	1,236	1,236	1,236
	Lynn	1,039	1,039	1,039	1,039	1,039	1,039	1,039
	Parmer	6,207	6,207	6,207	6,207	5,202	5,188	5,182
	Swisher	1,796	1,796	1,796	1,796	1,796	1,796	1,796
High Plains UWCD No.1 Total		**29,246**	**29,246**	**29,246**	**29,246**	**28,241**	**28,227**	**28,221**
Llano Estacado UWCD	**Gaines**	**880**	**880**	**880**	**880**	**880**	**880**	**880**
Mesa UWCD Total	**Dawson**	**640**	**640**	**640**	**640**	**640**	**640**	**640**

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

Groundwater Conservation District	County	2020	2030	2040	2050	2060	2070	2080
No District County	Andrews	1,503	1,503	1,503	1,503	1,503	1,503	1,503
	Borden	1,026	1,026	1,026	1,026	1,026	1,026	1,026
	Briscoe	0	0	0	0	0	0	0
	Castro	0	0	0	0	0	0	0
	Crosby	81	81	81	81	81	81	81
	Deaf Smith	7	7	7	7	7	7	7
	Floyd	0	0	0	0	0	0	0
	Hockley	95	95	95	95	95	95	95
	Howard	134	134	134	134	134	134	134
No District County Total		**2,846**	**2,846**	**2,846**	**2,846**	**2,846**	**2,846**	**2,846**
Permian Basin UWCD	Howard	6,636	6,636	6,636	6,636	6,636	6,636	6,636
	Martin	11,449	11,449	11,449	11,449	11,449	11,449	11,449
Permian Basin UWCD Total		**18,085**	**18,085**	**18,085**	**18,085**	**18,085**	**18,085**	**18,085**
Sandy Land UWCD Total	**Yoakum**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
South Plains UWCD	Hockley	0	0	0	0	0	0	0
	Terry	0	0	0	0	0	0	0
South Plains UWCD Total		**0**	**0**	**0**	**0**	**0**	**0**	**0**
Groundwater Management Area 2 Total		**52,735**	**52,735**	**52,735**	**52,735**	**51,730**	**51,716**	**51,710**

REFERENCES:

Bond, S. and Dowlearn, R. G., 2022, GAM Run 22-008: Modeled Available Groundwater for the High Plains Aquifer System (Ogallala, Edwards-Trinity (High Plains), and Dockum aquifers) in Groundwater Management Area 2, GAM Run Report, 23 p. http://www.twdb.texas.gov/groundwater/docs/GAMruns/GR21-008_MAG.pdf

GAM Run 21-008 MAG: Modeled Available Groundwater for the High Plains Aquifer System (Ogallala, Edwards-Trinity (High Plains), and Dockum aquifers) in Groundwater Management Area 2

Stephen Bond, P.G. and Grayson Dowlearn
Texas Water Development Board
Groundwater Division
Groundwater Availability Modeling Section
(512) 475-1552
May 2, 2022

STATE OF TEXAS
STEPHEN BOND
GEOLOGY
11208
LICENSED
PROFESSIONAL GEOSCIENTIST

5/2/2022

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GAM RUN 21-008 MAG: MODELED AVAILABLE GROUNDWATER FOR THE HIGH PLAINS AQUIFER SYSTEM (OGALLALA, EDWARDS-TRINITY (HIGH PLAINS), AND DOCKUM AQUIFERS) IN GROUNDWATER MANAGEMENT AREA 2

Stephen Bond, P.G. and Grayson Dowlearn
Texas Water Development Board
Groundwater Division
Groundwater Availability Modeling Section
(512) 475-1552
May 2, 2022

EXECUTIVE SUMMARY:

Modeled available groundwater for the Ogallala and Edwards-Trinity (High Plains) aquifers in Groundwater Management Area 2 decreases from 2,041,501 acre-feet per year in 2030 to 950,014 acre-feet per year in 2080. Modeled available groundwater for the Dockum Aquifer decreases from 52,735 acre-feet per year in 2030 to 51,710 acre-feet per year in 2080. The modeled available groundwater for the Ogallala and Edwards-Trinity (High Plains) aquifers is summarized by groundwater conservation districts and counties in Table 1, and by river basins, regional planning areas, and counties in Table 3. The modeled available groundwater for the Dockum Aquifer is summarized by groundwater conservation districts and counties in Table 2, and by river basins, regional planning areas, and counties in Table 4.

The estimates are based on the desired future conditions for the High Plains Aquifer System (the Ogallala, Edwards-Trinity (High Plains), and Dockum aquifers) adopted by groundwater conservation district representatives in Groundwater Management Area 2 on August 17, 2021. The Pecos Valley Alluvium and Edwards-Trinity (Plateau) aquifers were declared not relevant for the purpose of joint planning. The Texas Water Development Board (TWDB) determined that the explanatory report and other materials submitted by the district representatives were administratively complete on February 25, 2022.

Please note that, for the High Plains Underground Water Conservation District No. 1, only the portion of relevant aquifers within Groundwater Management Area 2 is covered in this report.

REQUESTOR:

Mr. Jason Coleman, General Manager of High Plains Underground Water Conservation District No. 1 and Coordinator of Groundwater Management Area 2.

DESCRIPTION OF REQUEST:

In an email dated August 26, 2021, Dr. William Hutchison, on behalf of Groundwater Management Area (GMA) 2, provided the TWDB with the desired future conditions of the High Plains Aquifer System. The desired future conditions (defined by drawdown) were determined using several predictive groundwater flow simulations (Hutchison, 2021a). The predictive simulations were developed from the groundwater availability model for the High Plains Aquifer System (Version 1.01; Deeds and Jigmond, 2015) from 2013 through 2080 under different pumping scenarios, with an initial water level equal to that of the model's last stress period (i.e., year 2012). The drawdown was calculated as the water level difference between 2012 and 2080.

The desired future conditions for the High Plains Aquifer System, as described in Resolution No. 21-01, were adopted on August 17, 2021 by the groundwater conservation district representatives in Groundwater Management Area 2. The desired future conditions are described below:

Ogallala and Edwards-Trinity (High Plains) Aquifers
- An average drawdown of 28 feet for all of GMA 2 between the years 2013 and 2080.

Dockum Aquifer
- An average drawdown of 31 feet for all of GMA 2 between the years 2013 and 2080.

After review of the submittal, TWDB sent an email on November 16, 2021 to Mr. Jason Coleman, Coordinator of Groundwater Management Area 2, to clarify if Groundwater Management Area 2 accepted the tolerance of three (3) feet and assumptions used to calculate average drawdown. On November 19, 2021 TWDB received the final clarification email from Mr. Jason Coleman confirming the three (3) feet of tolerance and drawdown calculation assumptions, specified in the Methods and Parameters and Assumptions sections below, can be used. TWDB then proceeded with the calculation of the modeled available groundwater which is summarized in the following sections.

METHODS:

To estimate the modeled available groundwater, TWDB used the predictive simulation for Scenario 19 (Hutchison, 2021a). TWDB reviewed the submitted model files and attempted to replicate the adopted desired future conditions using these files. Since groundwater conservation districts in GMA 2 manage groundwater with total dissolved solids concentrations above 3,000 mg/L (Hutchison, 2021b), active model cells, rather than official aquifer boundaries, were used for the basis of the average drawdown calculations. Cell-by-cell drawdowns were calculated based on the difference between modeled head values at the end of 2012 and model heads extracted for the year 2080. Average heads were calculated by summing cell-by-cell heads and dividing by the total number of cells in each aquifer or set of aquifers considered.

Average drawdown results matched the adopted desired future conditions precisely if all active cells were included in the calculations. Excluding cells that went dry during the model run, or cells that were part of the Pecos Alluvium or Edwards-Trinity (Plateau) aquifers changed the results by less than half a foot. Excluding pass-through cells, modeled cells which are not representative of a rock unit but hydraulically connect two model layers when one or more layers between the two is no longer present (for example, the Lower Dockum is connected to the Ogallala Aquifer through two layers of pass-through cells where the Upper Dockum and Edwards-Trinity (High Plains) aquifers are absent) reduced average drawdown for the Ogallala and Edwards-Trinity (High Plains) aquifers from 28 feet to 25 feet.

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 were then divided by county, river basin, regional water planning area, and groundwater conservation district within Groundwater Management Area 2 (Figure 5 and Tables 1 through 4).

Modeled Available Groundwater and Permitting
As defined in Chapter 36 of the Texas Water Code, "modeled available groundwater" is the estimated average amount of water that may be produced annually to achieve a desired future condition. Groundwater conservation districts are required to consider modeled available groundwater, along with several other factors, when issuing permits to manage groundwater production to achieve the desired future condition(s). The districts must also consider 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 by Deeds and Jigmond (2015) was revised to construct the predictive model simulation for this analysis. See Hutchison (2021b) for details of the initial assumptions.

- The model has four layers which represent the Ogallala and Pecos Valley Alluvium aquifers (Layer 1), the Edwards-Trinity (High Plains) and Edwards-Trinity (Plateau) aquifers (Layer 2), the Upper Dockum Aquifer (Layer 3), and the Lower Dockum Aquifer (Layer 4). The Pecos Valley Alluvium and Edwards-Trinity (Plateau) aquifers were declared not relevant for the purpose of joint planning and were excluded from the modeled available groundwater calculation. Model layers are shown in Figures 1 through 4.

- Where the Upper Dockum and Edwards-Trinity (High Plains) aquifers are absent in layers 3 and 2, respectively, pass-through cells hydraulically connect the Ogallala Aquifer to the Upper or Lower Dockum, or connect the Edwards-Trinity (High Plains) Aquifer to the Lower Dockum. These pass-through cells contain no pumping and were excluded from the drawdown calculation.

- The model was run with MODFLOW-NWT (Niswonger and others, 2011). The model uses the Newton Formulation and the upstream weighting package which automatically reduces pumping as heads drop in a particular cell as defined by the user. This feature may simulate the declining production of a well as saturated thickness decreases. Deeds and Jigmond (2015) modified the MODFLOW-NWT code to use a saturated thickness of 30 feet as the threshold (instead of percent of the saturated thickness) when pumping reductions occur during a simulation.

- During the predictive model run, some model cells within Groundwater Management Area 2 went dry in each model layer by the end of the simulation in the year 2080.

- Drawdown averages and modeled available groundwater volumes were calculated based on the extent of the model area. The most recent available model grid file (dated January 6,2020) was used to determine which model cells were assigned to specific county, groundwater management area, groundwater conservation district, river basin, or regional water planning area.

- A tolerance of three feet was assumed when comparing desired future conditions to modeled drawdown results.

- For the High Plains Underground Water Conservation District No. 1, only the portion within Groundwater Management Area 2 is covered in this report.

- Estimates of modeled drawdown and available groundwater from the model simulation were rounded to nearest whole numbers.

RESULTS:

The modeled available groundwater for the Ogallala and Edwards-Trinity (High Plains) aquifers combined that achieves the desired future condition adopted by Groundwater Management Area 2 decreases from 2,041,501 to 950,014 acre-feet per year between 2030 and 2080. The modeled available groundwater is summarized by groundwater conservation district and county in Table 1. Table 3 summarizes the modeled available groundwater by county, river basin, and regional water planning area for use in the regional water planning process.

The modeled available groundwater for the Dockum Group and Aquifer that achieves the desired future condition adopted by Groundwater Management Area 2 decreases from 52,735 to 51,710 acre-feet per year between 2030 and 2080. The modeled available groundwater is summarized by groundwater conservation district and county in Table 2. Table 4 summarizes the modeled available groundwater by county, river basin, and regional water planning area for use in the regional water planning process.

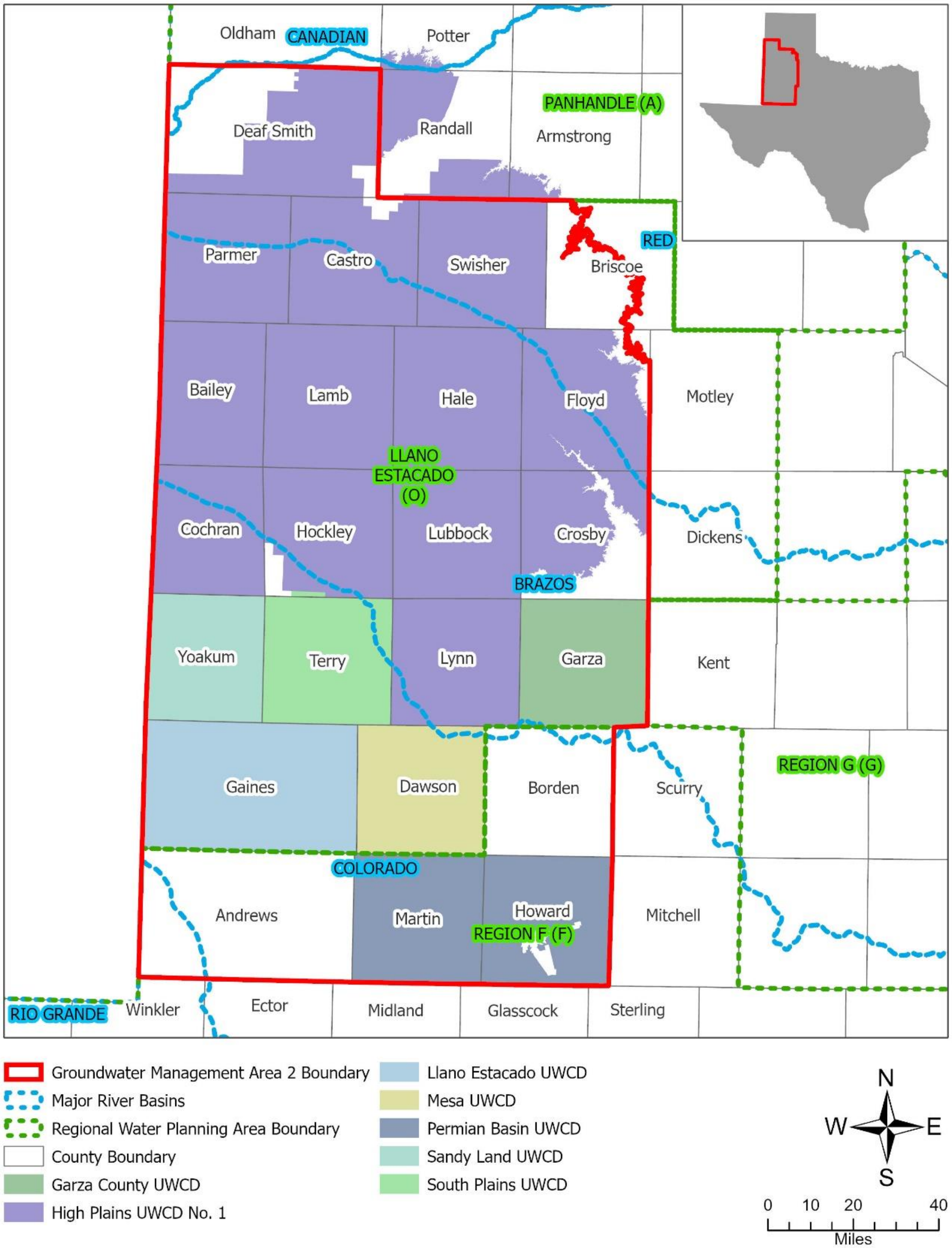

FIGURE 1. MAP SHOWING REGIONAL WATER PLANNING AREAS, GROUNDWATER CONSERVATION DISTRICTS (ALSO KNOWN AS UNDERGROUND WATER CONSERVATION DISTRICT OR UWCD), COUNTIES, AND RIVER BASINS IN GROUNDWATER MANAGEMENT AREA 2

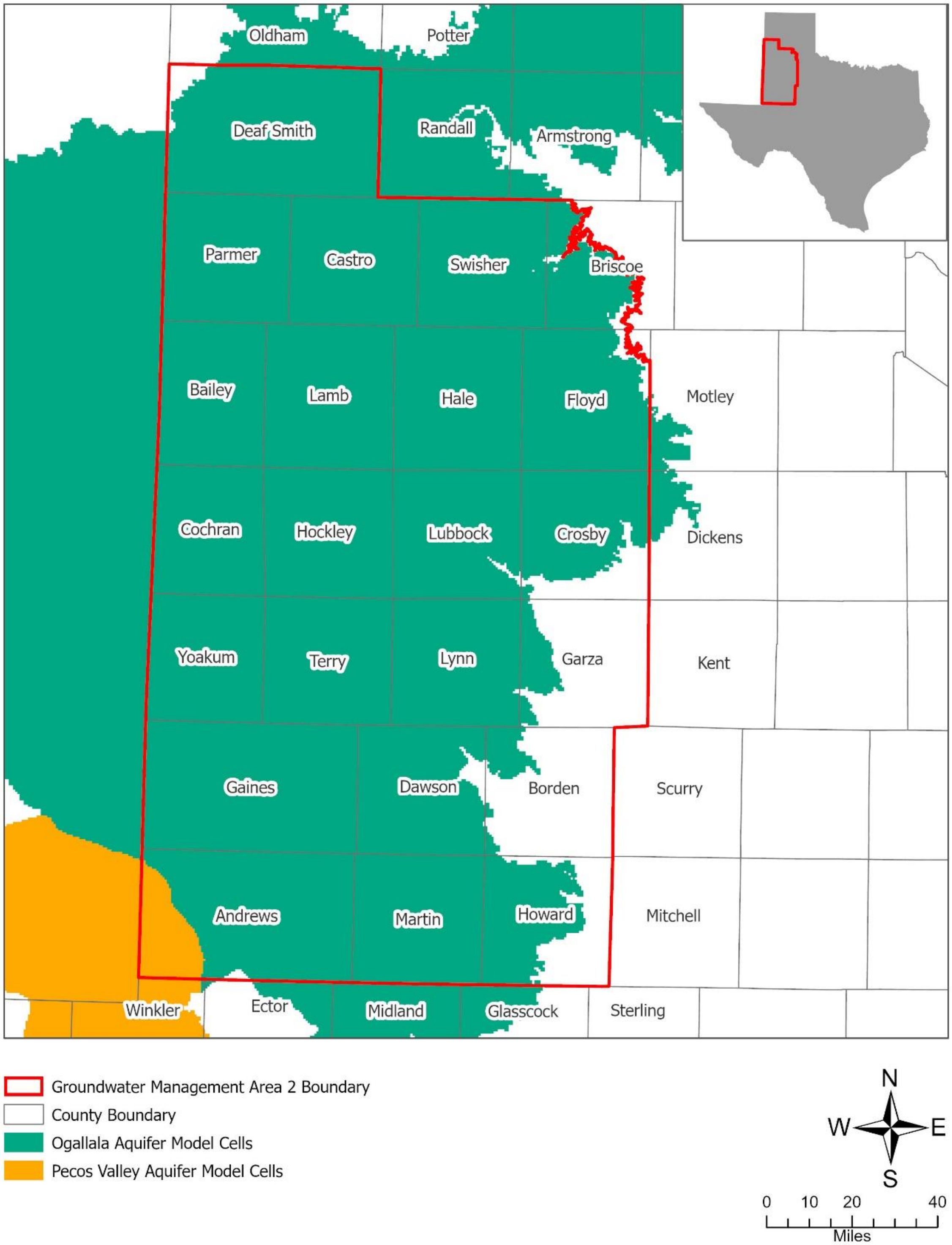

FIGURE 2. MAP SHOWING THE ACTIVE MODEL CELLS REPRESENTING THE OGALLALA AQUIFER AND THE PECOS VALLEY AQUIFER IN LAYER 1 OF THE HIGH PLAINS AQUIFER SYSTEM GROUNDWATER AVAILABILITY MODEL

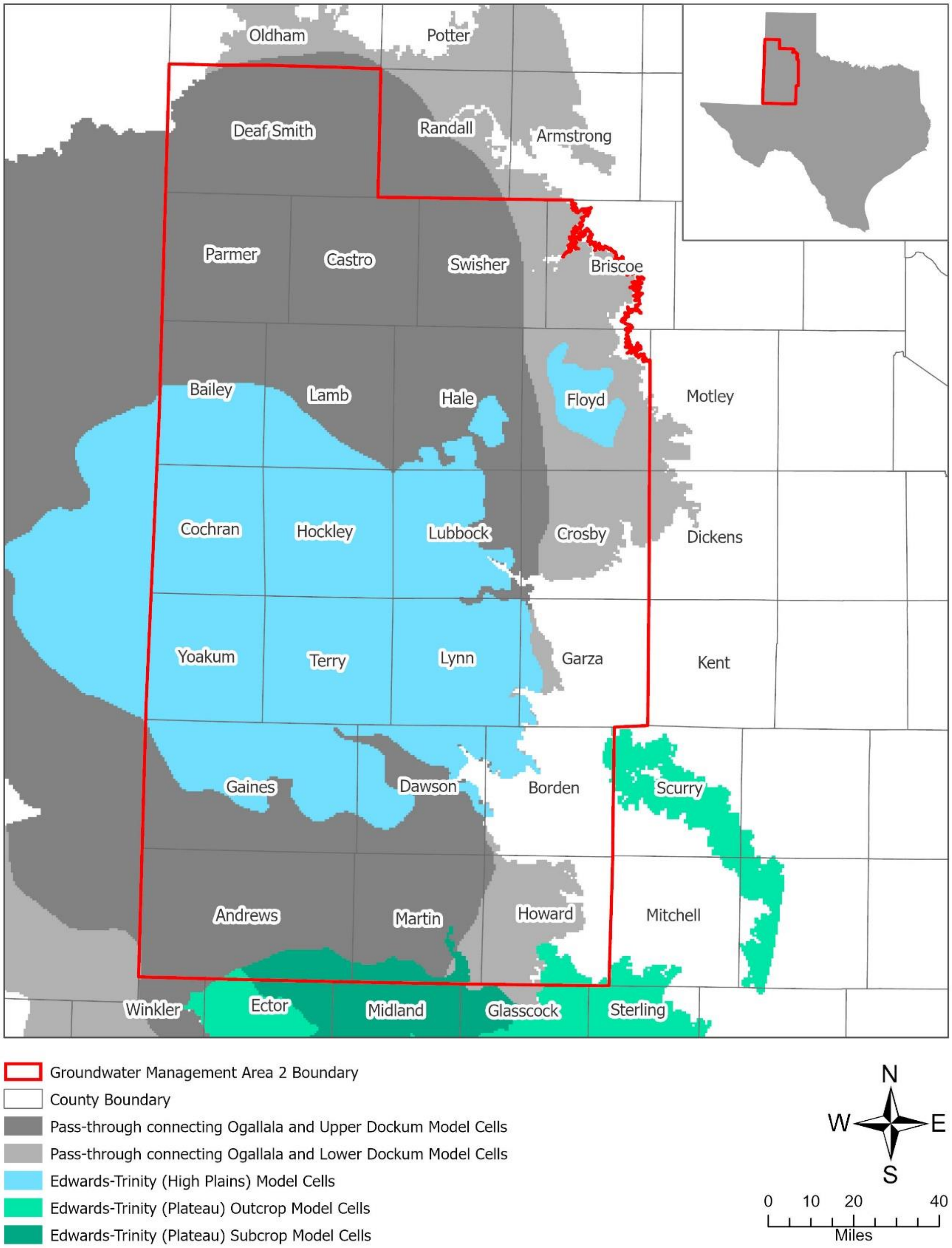

FIGURE 3. MAP SHOWING THE ACTIVE MODEL CELLS REPRESENTING THE EDWARDS-TRINITY (HIGH PLAINS) AQUIFER, THE EDWARDS-TRINITY (PLATEAU) AQUIFER, AND PASS-THROUGH CELLS IN LAYER 2 OF THE HIGH PLAINS AQUIFER SYSTEM GROUNDWATER AVAILABILITY MODEL

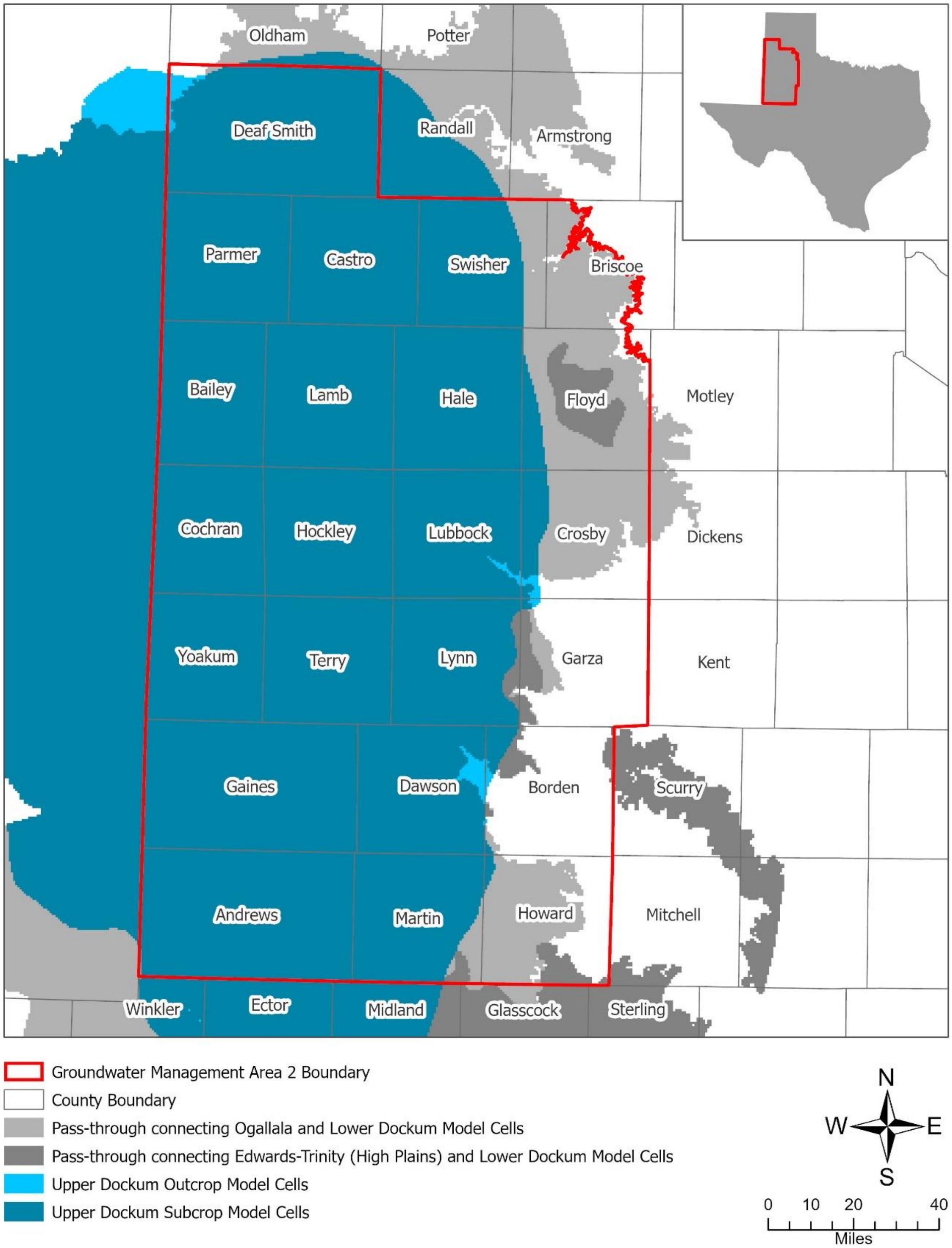

FIGURE 4. MAP SHOWING THE ACTIVE MODEL CELLS REPRESENTING THE UPPER PORTION OF THE DOCKUM AQUIFER AND PASS-THROUGH CELLS IN LAYER 3 OF THE HIGH PLAINS AQUIFER SYSTEM GROUNDWATER AVAILABILITY MODEL

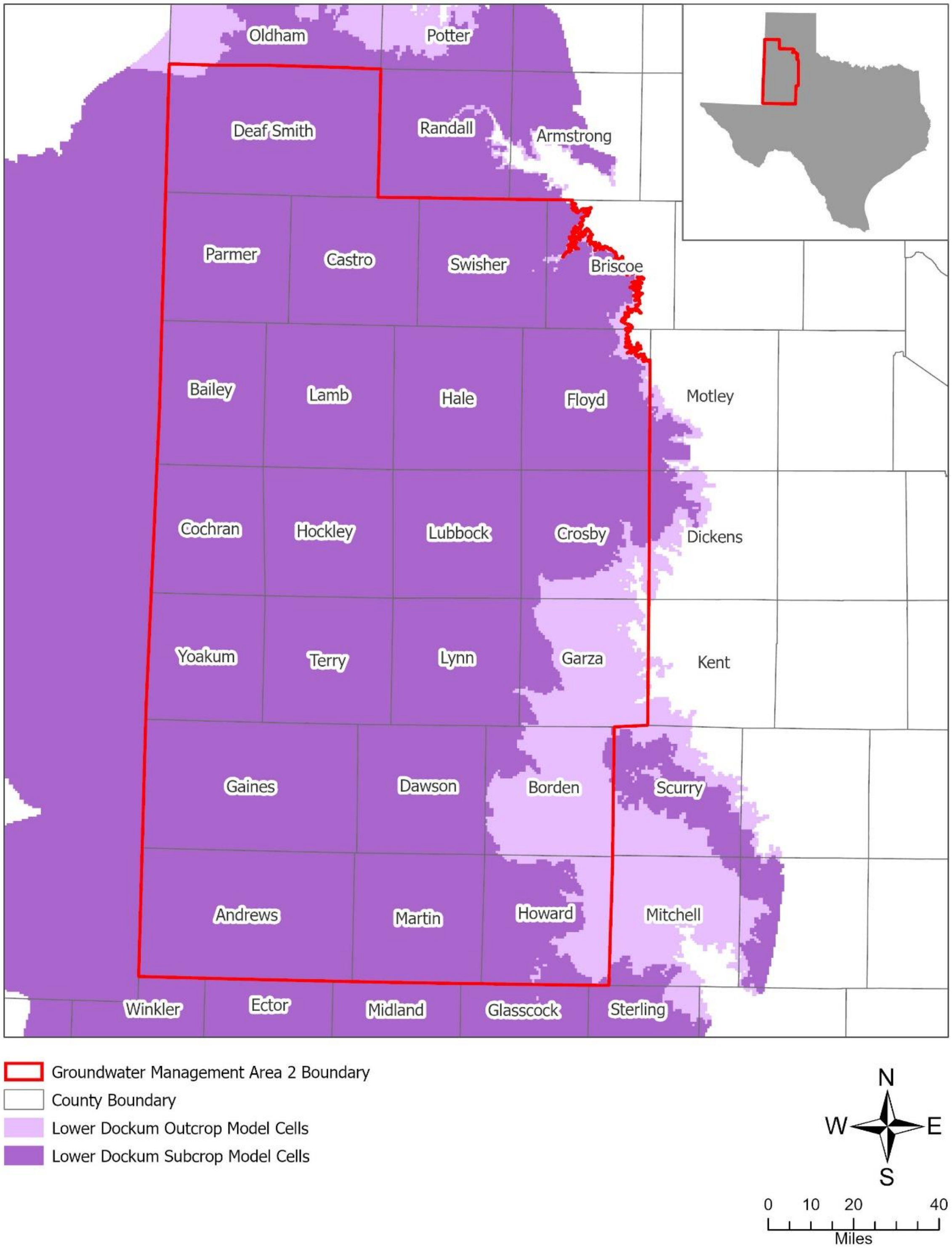

FIGURE 5. MAP SHOWING ACTIVE MODEL CELLS REPRESENTING THE LOWER PORTION OF THE DOCKUM AQUIFER IN LAYER 4 OF THE HIGH PLAINS AQUIFER SYSTEM GROUNDWATER AVAILABILITY MODEL

TABLE 1. MODELED AVAILABLE GROUNDWATER FOR THE OGALLALA AND EDWARDS-TRINITY (HIGH PLAINS) AQUIFERS IN GROUNDWATER MANAGEMENT AREA 2 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT AND COUNTY FOR EACH DECADE BETWEEN 2030 AND 2080. VALUES ARE IN ACRE-FEET PER YEAR. (UWCD = UNDERGROUND WATER CONSERVATION DISTRICT)

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Llano Estacado UWCD Total	**Gaines**	**205,486**	**177,777**	**159,523**	**147,028**	**138,157**	**131,974**
Mesa UWCD Total	**Dawson**	**121,336**	**98,590**	**84,192**	**75,448**	**70,262**	**66,945**

Groundwater Conservation District	County	2030	2040	2050	2060	2070	2080
No District County	Andrews	19,391	17,897	16,937	16,260	15,764	15,378
	Borden	4,432	3,893	3,591	3,393	3,227	3,072
	Briscoe	17,859	12,598	9,600	7,844	6,743	6,016
	Castro	3,742	2,496	1,874	1,475	1,214	1,039
	Crosby	2,506	2,276	1,897	1,685	1,562	1,479
	Deaf Smith	18,024	15,387	13,553	12,267	11,301	10,556
	Floyd	0	0	0	0	0	0
	Hockley	12,402	7,093	3,411	2,028	1,419	1,102
	Howard	471	474	483	494	504	513
No District County Total		**78,827**	**62,114**	**51,346**	**45,446**	**41,734**	**39,155**
Permian Basin UWCD	Howard	15,160	14,344	13,882	13,596	13,411	13,287
	Martin	48,293	43,032	39,019	36,358	34,521	33,171
Permian Basin UWCD Total		**63,453**	**57,376**	**52,901**	**49,954**	**47,932**	**46,458**
Sandy Land UWCD Total	**Yoakum**	**90,983**	**70,810**	**59,346**	**53,002**	**49,187**	**46,687**
South Plains UWCD	Hockley	2,638	1,005	493	331	265	234
	Terry	134,878	108,182	96,190	89,977	86,343	84,043
South Plains UWCD Total		**137,516**	**109,187**	**96,683**	**90,308**	**86,608**	**84,277**
Groundwater Management Area 2 Total		**2,041,501**	**1,558,063**	**1,272,756**	**1,109,782**	**1,012,230**	**950,014**

TABLE 2. MODELED AVAILABLE GROUNDWATER FOR THE DOCKUM AQUIFER IN GROUNDWATER MANAGEMENT AREA 2 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT AND COUNTY FOR EACH DECADE BETWEEN 2030 AND 2080. VALUES ARE IN ACRE-FEET PER YEAR. (UWCD = UNDERGROUND WATER CONSERVATION DISTRICT)

Groundwater Conservation District	County	2030	2040	2050	2060	2070	2080
Garza County UWCD Total	**Garza**	**1,038**	**1,038**	**1,038**	**1,038**	**1,038**	**1,038**
High Plains UWCD No.1	Bailey	949	949	949	949	949	949
	Castro	484	484	484	484	484	484
	Cochran	1,106	1,106	1,106	1,106	1,106	1,106
	Crosby	4,312	4,312	4,312	4,312	4,312	4,312
	Deaf Smith	5,006	5,006	5,006	5,006	5,006	5,006
	Floyd	3,674	3,674	3,674	3,674	3,674	3,674
	Hale	1,277	1,277	1,277	1,277	1,277	1,277
	Hockley	1,109	1,109	1,109	1,109	1,109	1,109
	Lamb	1,051	1,051	1,051	1,051	1,051	1,051
	Lubbock	1,236	1,236	1,236	1,236	1,236	1,236
	Lynn	1,039	1,039	1,039	1,039	1,039	1,039
	Parmer	6,207	6,207	6,207	5,202	5,188	5,182
	Swisher	1,796	1,796	1,796	1,796	1,796	1,796
	Gaines	880	880	880	880	880	880
High Plains UWCD No.1 Total		**30,126**	**30,126**	**30,126**	**29,121**	**29,107**	**29,101**
Mesa UWCD Total	**Dawson**	**640**	**640**	**640**	**640**	**640**	**640**

Groundwater Conservation District	County	2030	2040	2050	2060	2070	2080
No District County	Andrews	1,503	1,503	1,503	1,503	1,503	1,503
	Borden	1,026	1,026	1,026	1,026	1,026	1,026
	Briscoe	0	0	0	0	0	0
	Castro	0	0	0	0	0	0
	Crosby	81	81	81	81	81	81
	Deaf Smith	7	7	7	7	7	7
	Floyd	0	0	0	0	0	0
	Hockley	95	95	95	95	95	95
	Howard	134	134	134	134	134	134
No District County Total		**2,846**	**2,846**	**2,846**	**2,846**	**2,846**	**2,846**
Permian Basin UWCD	Howard	6,636	6,636	6,636	6,636	6,636	6,636
	Martin	11,449	11,449	11,449	11,449	11,449	11,449
Permian Basin UWCD Total		**18,085**	**18,085**	**18,085**	**18,085**	**18,085**	**18,085**
Sandy Land UWCD Total	**Yoakum**	**0**	**0**	**0**	**0**	**0**	**0**
South Plains UWCD	Hockley	0	0	0	0	0	0
	Terry	0	0	0	0	0	0
South Plains UWCD Total		**0**	**0**	**0**	**0**	**0**	**0**
Groundwater Management Area 2 Total		**52,735**	**52,735**	**52,735**	**51,730**	**51,716**	**51,710**

TABLE 3. MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE OGALLALA AND EDWARDS-TRINITY (HIGH PLAINS) AQUIFERS IN GROUNDWATER MANAGEMENT AREA 2. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN.

County	RWPA	River Basin	2030	2040	2050	2060	2070	2080
Andrews	Region F	Colorado	19,391	17,897	16,937	16,260	15,764	15,378
Andrews	Region F	Rio Grande	0	0	0	0	0	0
Bailey	Llano Estacado	Brazos	65,138	50,725	42,532	37,743	34,724	32,675
Borden	Region F	Brazos	673	615	581	559	543	532
Borden	Region F	Colorado	3,759	3,278	3,010	2,834	2,684	2,540
Briscoe	Llano Estacado	Red	17,859	12,598	9,600	7,844	6,743	6,016
Castro	Llano Estacado	Brazos	106,971	71,565	40,493	24,591	17,282	13,530
Castro	Llano Estacado	Red	72,957	47,509	29,706	19,740	14,409	11,423
Cochran	Llano Estacado	Brazos	20,220	18,297	17,034	16,204	15,655	15,283
Cochran	Llano Estacado	Colorado	53,771	43,798	37,231	32,357	27,977	24,753
Crosby	Llano Estacado	Brazos	105,148	72,526	50,976	38,890	31,952	27,655
Crosby	Llano Estacado	Red	2,917	2,776	2,549	2,149	1,779	1,504
Dawson	Llano Estacado	Brazos	1,390	1,294	1,230	1,187	1,156	1,134
Dawson	Llano Estacado	Colorado	119,946	97,296	82,962	74,261	69,106	65,811
Deaf Smith	Llano Estacado	Canadian	0	0	0	0	0	0
Deaf Smith	Llano Estacado	Red	135,383	95,875	70,425	55,841	47,249	41,961

County	RWPA	River Basin	2030	2040	2050	2060	2070	2080
Floyd	Llano Estacado	Brazos	73,465	45,024	32,571	24,708	20,244	17,492
Floyd	Llano Estacado	Red	20,488	20,063	19,734	19,447	18,988	18,495
Gaines	Llano Estacado	Colorado	205,486	177,777	159,523	147,028	138,157	131,974
Garza	Llano Estacado	Brazos	13,508	12,402	11,717	11,263	10,948	10,721
Garza	Llano Estacado	Colorado	0	0	0	0	0	0
Hale	Llano Estacado	Brazos	116,240	74,782	53,039	40,940	34,150	30,172
Hale	Llano Estacado	Red	375	326	259	202	158	126
Hockley	Llano Estacado	Brazos	84,987	67,316	58,259	53,255	50,258	48,358
Hockley	Llano Estacado	Colorado	26,800	14,469	8,147	5,726	4,624	4,042
Howard	Region F	Colorado	15,631	14,818	14,365	14,090	13,915	13,800
Lamb	Llano Estacado	Brazos	120,172	77,677	60,088	52,063	47,868	45,425
Lubbock	Llano Estacado	Brazos	110,472	100,950	95,478	91,655	88,877	86,735
Lynn	Llano Estacado	Brazos	82,425	76,194	71,817	68,689	66,499	64,962
Lynn	Llano Estacado	Colorado	6,343	5,870	5,216	4,635	4,208	3,924
Martin	Region F	Colorado	48,293	43,032	39,019	36,358	34,521	33,171
Parmer	Llano Estacado	Brazos	51,129	37,132	28,030	22,549	19,129	16,878

County	RWPA	River Basin	2030	2040	2050	2060	2070	2080
Parmer	Llano Estacado	Red	40,896	26,436	18,805	15,194	13,161	11,879
Swisher	Llano Estacado	Brazos	11,508	6,845	4,598	3,421	2,759	2,360
Swisher	Llano Estacado	Red	61,899	41,909	31,289	25,120	21,213	18,575
Terry	Llano Estacado	Brazos	6,825	6,322	5,998	5,776	5,612	5,487
Terry	Llano Estacado	Colorado	128,053	101,860	90,192	84,201	80,731	78,556
Yoakum	Llano Estacado	Colorado	90,983	70,810	59,346	53,002	49,187	46,687
Groundwater Management Area 2 Total			**2,041,501**	**1,558,063**	**1,272,756**	**1,109,782**	**1,012,230**	**950,014**

TABLE 4. MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE DOCKUM AQUIFER IN GROUNDWATER MANAGEMENT AREA 2. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN.

County	RWPA	River Basin	2030	2040	2050	2060	2070	2080
Andrews	Region F	Colorado	1,503	1,503	1,503	1,503	1,503	1,503
Andrews	Region F	Rio Grande	0	0	0	0	0	0
Bailey	Llano Estacado	Brazos	949	949	949	949	949	949
Borden	Region F	Brazos	323	323	323	323	323	323
Borden	Region F	Colorado	703	703	703	703	703	703
Briscoe	Llano Estacado	Red	0	0	0	0	0	0
Castro	Llano Estacado	Brazos	0	0	0	0	0	0
Castro	Llano Estacado	Red	484	484	484	484	484	484
Cochran	Llano Estacado	Brazos	118	118	118	118	118	118
Cochran	Llano Estacado	Colorado	988	988	988	988	988	988
Crosby	Llano Estacado	Brazos	4,393	4,393	4,393	4,393	4,393	4,393
Crosby	Llano Estacado	Red	0	0	0	0	0	0
Dawson	Llano Estacado	Brazos	0	0	0	0	0	0
Dawson	Llano Estacado	Colorado	640	640	640	640	640	640
Deaf Smith	Llano Estacado	Canadian	0	0	0	0	0	0
Deaf Smith	Llano Estacado	Red	5,013	5,013	5,013	5,013	5,013	5,013
Floyd	Llano Estacado	Brazos	3,389	3,389	3,389	3,389	3,389	3,389
Floyd	Llano Estacado	Red	285	285	285	285	285	285
Gaines	Llano Estacado	Colorado	880	880	880	880	880	880
Garza	Llano Estacado	Brazos	1,038	1,038	1,038	1,038	1,038	1,038
Garza	Llano Estacado	Colorado	0	0	0	0	0	0
Hale	Llano Estacado	Brazos	1,244	1,244	1,244	1,244	1,244	1,244
Hale	Llano Estacado	Red	33	33	33	33	33	33
Hockley	Llano Estacado	Brazos	1,013	1,013	1,013	1,013	1,013	1,013
Hockley	Llano Estacado	Colorado	191	191	191	191	191	191

County	RWPA	River Basin	2030	2040	2050	2060	2070	2080
Howard	Region F	Colorado	6,770	6,770	6,770	6,770	6,770	6,770
Lamb	Llano Estacado	Brazos	1,051	1,051	1,051	1,051	1,051	1,051
Lubbock	Llano Estacado	Brazos	1,236	1,236	1,236	1,236	1,236	1,236
Lynn	Llano Estacado	Brazos	901	901	901	901	901	901
Lynn	Llano Estacado	Colorado	138	138	138	138	138	138
Martin	Region F	Colorado	11,449	11,449	11,449	11,449	11,449	11,449
Parmer	Llano Estacado	Brazos	3,590	3,590	3,590	2,585	2,571	2,565
Parmer	Llano Estacado	Red	2,617	2,617	2,617	2,617	2,617	2,617
Swisher	Llano Estacado	Brazos	29	29	29	29	29	29
Swisher	Llano Estacado	Red	1,767	1,767	1,767	1,767	1,767	1,767
Terry	Llano Estacado	Brazos	0	0	0	0	0	0
Terry	Llano Estacado	Colorado	0	0	0	0	0	0
Yoakum	Llano Estacado	Colorado	0	0	0	0	0	0
Groundwater Management Area 2 Total			**52,735**	**52,735**	**52,735**	**51,730**	**51,716**	**51,710**

LIMITATIONS:

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

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

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

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

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

REFERENCES:

Deeds, Neil E. and Jigmond, Marius, 2015, Numerical Model Report for the High Plains Aquifer System Groundwater Availability Model: Prepared for Texas Water Development Board, 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 sub-regional water budgets for MODFLOW ground-water flow models, U.S. Geological Survey Groundwater Software.

Hutchison, William, 2021a, GMA 2 Technical Memorandum 20-01 (Final): Joint Planning Simulations with High Plains Aquifer System Groundwater Availability Model: Updated Dockum Aquifer Pumping (Scenarios 16 to 21)

Hutchison, William, 2021b, Explanatory Report For Desired Future Conditions, Ogallala, Edwards-Trinity (High Plains), and Dockum Aquifers, Groundwater Management Area 2 (Final)

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 Newton formulation for MODFLOW-2005: United States Geological Survey, Techniques and Methods 6-A37, 44 p.

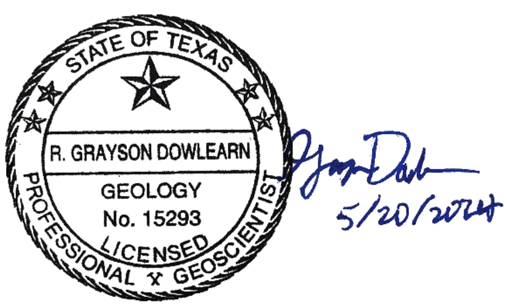
Texas Water Code, 2011, http://www.statutes.legis.state.tx.us/docs/WA/pdf/WA.36.pdf.

Appendix B

GAM RUN 24-006: HIGH PLAINS UNDERGROUND WATER CONSERVATION DISTRICT NO. 1 GROUNDWATER MANAGEMENT PLAN

Saheli Majumdar, Ph.D. and Grayson Dowlearn, P.G.
Texas Water Development Board
Groundwater Division
Groundwater Modeling Department
512-936-6079

May 20, 2024



GAM RUN 24-006: HIGH PLAINS UNDERGROUND WATER CONSERVATION DISTRICT NO. 1 GROUNDWATER MANAGEMENT PLAN

Saheli Majumdar, Ph.D. and Grayson Dowlearn, P.G.
Texas Water Development Board
Groundwater Division
Groundwater Modeling Department
512-936-6079
May 20, 2024

EXECUTIVE SUMMARY

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

The TWDB provides data and information to the High Plains Underground Water Conservation District No. 1 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, which includes:

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

2. the annual volume of water that discharges from the aquifer to springs and any surface-water bodies, including lakes, streams, and rivers for each aquifer within the district; 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 High Plains Underground Water Conservation District No. 1 should be adopted by the district on or before July 27, 2024 and submitted to the Executive Administrator of the TWDB on or before August 26,

2024. The current management plan for the High Plains Underground Water Conservation District No. 1 expires on October 25, 2024.

The management plan information for the aquifers within High Plains Underground Water Conservation District No. 1 was extracted from the groundwater availability model for the High Plains Aquifer System (Deeds and Jigmond, 2015).

This report replaces the results of GAM Run 19-002 (Shi, 2019). Values may differ from the previous report as a result of routine updates to the spatial grid file used to define county, groundwater conservation district, and aquifer boundaries, which can impact the calculated water budget values. Additionally, the approach used for analyzing model results is reviewed during each update and may have been refined to better delineate groundwater flows.

Tables 1 through 3 summarize the groundwater availability model data required by statute. Figures 1, 3, and 5 show the area of the models from which the values in Tables 1 through 3 were extracted. Figures 2, 4, and 6 provide a generalized diagram of the groundwater flow components provided in Tables 1 through 3. If the High Plains Underground Water Conservation District No. 1 determines that the district boundaries used in the assessment do not reflect current conditions after reviewing the figures, please notify the TWDB Groundwater Modeling Department at your earliest convenience.

The flow components presented in this report do not represent the full groundwater budget. If additional inflow and outflow information would be helpful for planning purposes, the district may submit a request in writing to the TWDB Groundwater Modeling Department for the full groundwater budget.

METHODS

In accordance with the provisions of the Texas Water Code, Section 36.1071(h), the groundwater availability model of the High Plains Aquifer System was used to estimate information for the High Plains Underground Water Conservation District No. 1 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

Groundwater availability model for the High Plains Aquifer System

- We used version 1.01 of the groundwater availability model for the High Plains Aquifer System to analyze the Ogallala, Edwards-Trinity (High Plains), and Dockum aquifers. See Deeds and Jigmond (2015) for assumptions and limitations of the model.
- The groundwater availability model for the High Plains Aquifer System contains the following four layers:
  - Layer 1 represents the Ogallala and Pecos Valley aquifers.
  - Layer 2 represents the Rita Blanca Aquifer and Edwards-Trinity (High Plains & Plateau) aquifers.
  - Layer 3 represents the upper Dockum Aquifer.
  - Layer 4 represents the lower Dockum Aquifer.
- The model was run with MODFLOW-NWT (Niswonger and others, 2011).
- Water budgets for the district were determined for the Ogallala Aquifer (Layer 1), the Edwards-Trinity (High Plains) Aquifer (Layer 2) and the Dockum Aquifer (Layers 3 and 4 combined).
- Additionally, flow between aquifers within High Plains Underground Water Conservations District No. 1 and equivalent units in New Mexico were determined and included within the annual flow between each aquifer in district portion of Tables 1, 2, and 3.
- Water budget terms were averaged for the period from 1980 through 2012.

RESULTS

A groundwater budget summarizes the amount of water entering and leaving the aquifer according to the groundwater availability model. Selected groundwater budget components listed below were extracted from the groundwater availability model results for the aquifers located within the High Plains Underground Water Conservation District No. 1 and averaged over the historical calibration period, as shown in Tables 1 through 3.

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

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

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

- Flow between aquifers—the net flow between the aquifer and adjacent hydrostratigraphic units. This amount of flow is controlled by the relative water levels in each hydrostratigraphic unit.

The information needed for the district's management plan is summarized in Tables 1 through 3. Figures 1, 3, and 5 show the area of the model from which the values in Tables 1 through 3 were extracted. Figures 2, 4, and 6 provide a generalized diagram of the groundwater flow components provided in Tables 1 through 3. It is important to note that sub-regional water budgets are not exact. This is due to the size of the model cells and the approach used to extract data from the model.

To avoid double accounting, a model cell that straddles a political boundary, such as a district or county boundary, is assigned to one side of the boundary based on the location of the centroid of the model cell. For example, if a cell contains two counties, the cell is assigned to the county where the centroid of the cell is located.

Table 1: Summarized information for the Ogallala Aquifer that is needed for the High Plains Underground Water Conservation District No. 1'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	269,799
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams and rivers	Ogallala Aquifer	11,791
Estimated annual volume of flow into the district within each aquifer in the district	Ogallala Aquifer	37,257
Estimated annual volume of flow out of the district within each aquifer in the district	Ogallala Aquifer	45,719
Estimated net annual volume of flow between each aquifer in the district	To Ogallala Aquifer from Edwards-Trinity (High Plains) Aquifer	308
	From Ogallala Aquifer to Dockum Aquifer	2,217
	To Ogallala Aquifer from Dockum equivalent units	12,608
	From Ogallala Aquifer to Ogallala equivalent units in New Mexico	2,839

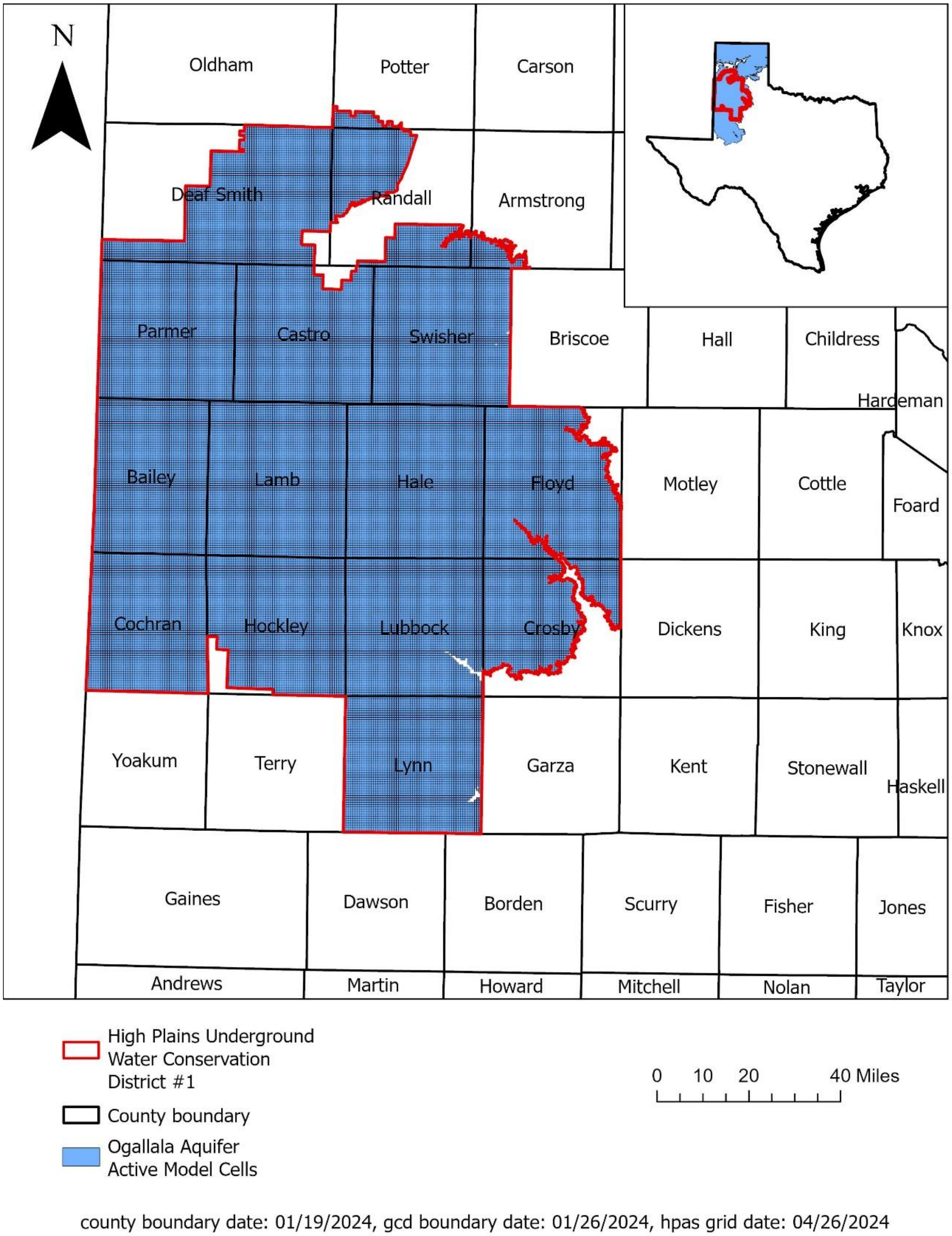
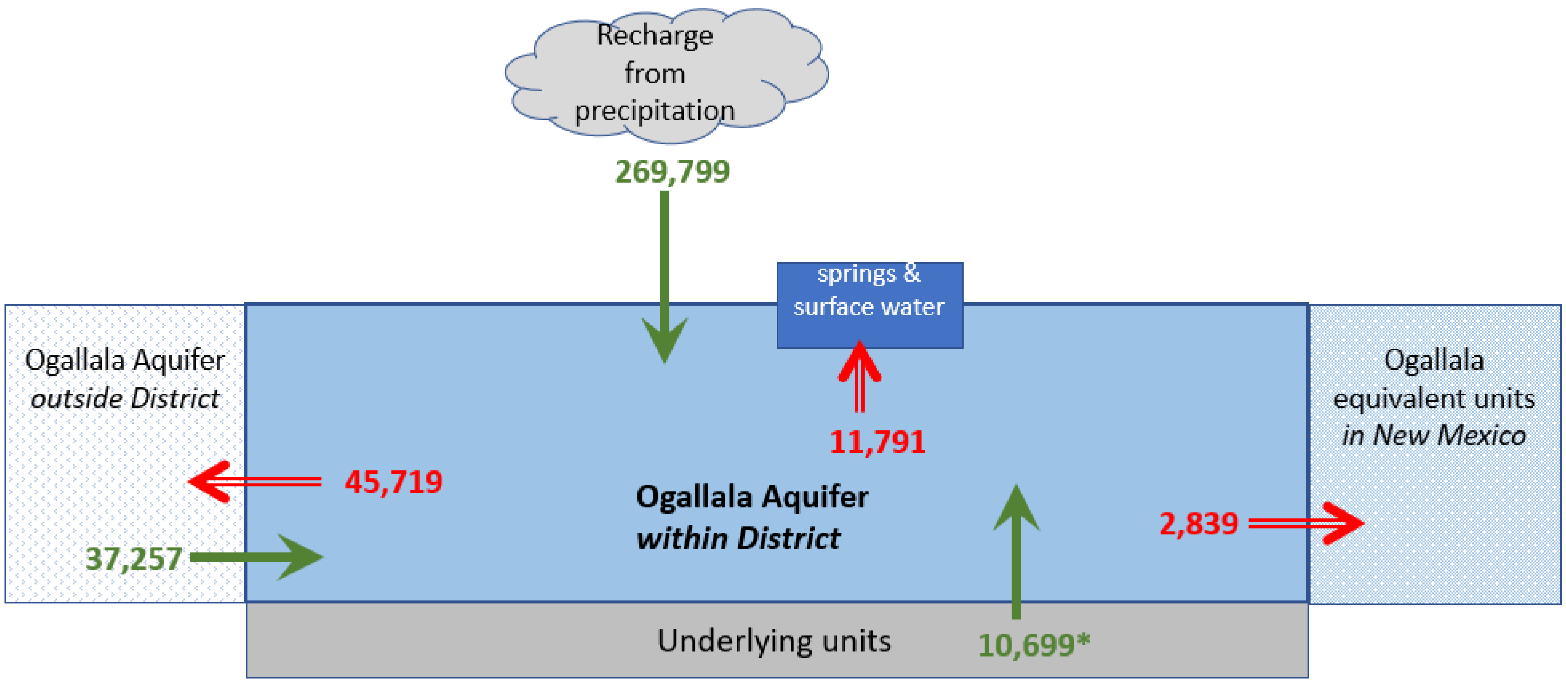


Figure 1: Area of the groundwater availability model for the High Plains Aquifer System from which the information in Table 1 was extracted (the Ogallala Aquifer extent within the district boundary).



*Flow from underlying units includes net inflow of 308 acre-ft per year to the Ogallala Aquifer from the Edwards-Trinity (High Plains) Aquifer, net outflow of 2,217 acre-ft per year from the Ogallala Aquifer to the Dockum Aquifer, and net inflow of 12,608 acre-ft per year to the Ogallala Aquifer from the Dockum equivalent units.

Caveat: This diagram only includes the water budget items provided in Table 1. A complete water budget would include additional inflows and outflows. For a full groundwater budget, please submit a request in writing to the Groundwater Modeling Department.

Figure 2: Generalized diagram of the summarized budget information from Table 1, representing directions of flow for the Ogallala Aquifer within High Plains Underground Water Conservation District No.1. Flow values are expressed in acre-feet per year.

Table 2: Summarized information for the Edwards-Trinity (High Plains) Aquifer that is needed for the High Plains Underground Water Conservation District No. 1'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	4,469
Estimated annual volume of flow out of the district within each aquifer in the district	Edwards-Trinity (High Plains) Aquifer	9,182
Estimated net annual volume of flow between each aquifer in the district	From Edwards-Trinity (High Plains) Aquifer to the Ogallala Aquifer	308
	From Edwards-Trinity (High Plains) Aquifer to Dockum Aquifer	331
	To Edwards-Trinity (High Plains) Aquifer from Edwards-Trinity equivalent units in New Mexico	3,718
	To Edwards-Trinity (High Plains) Aquifer from Dockum equivalent units	1,820

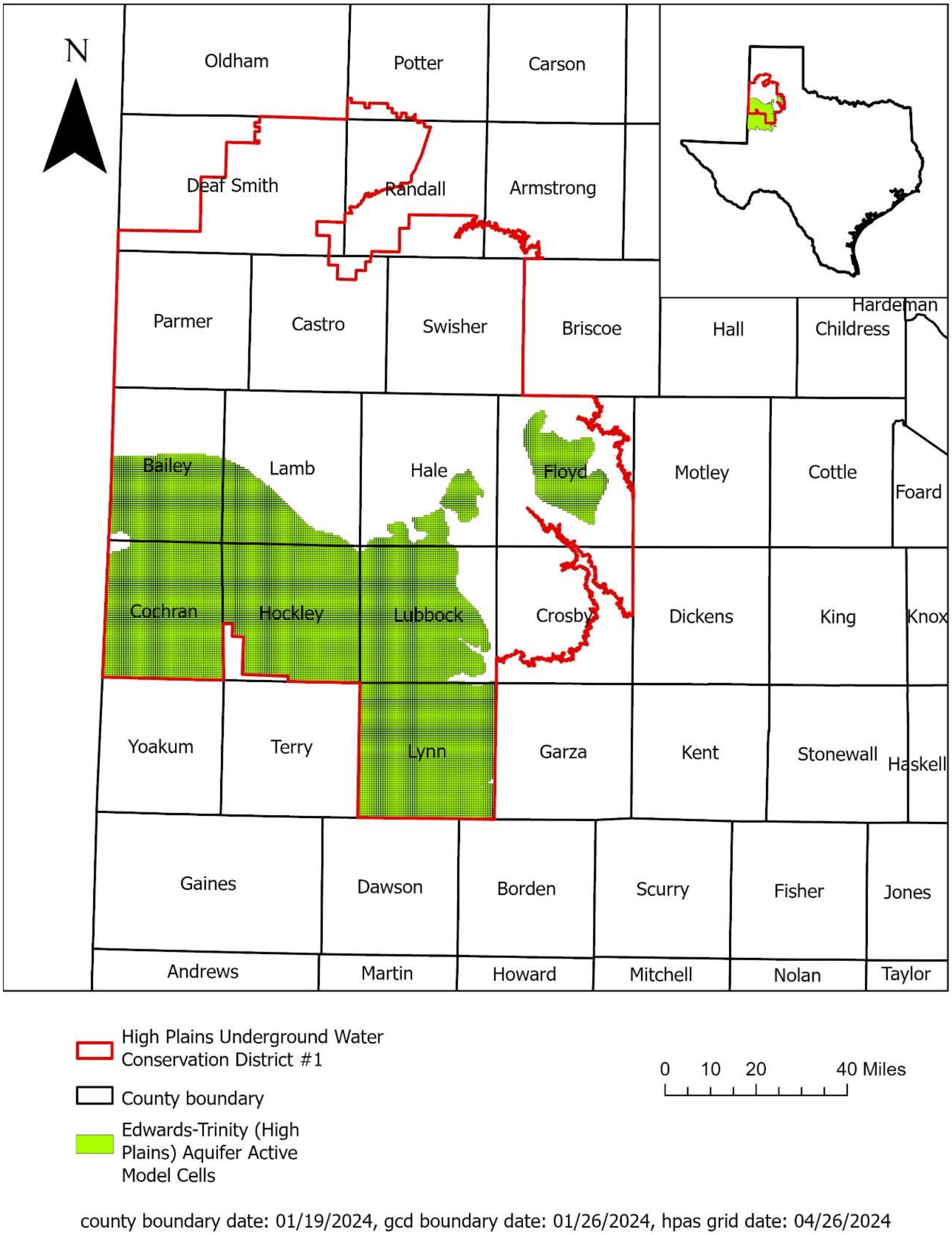
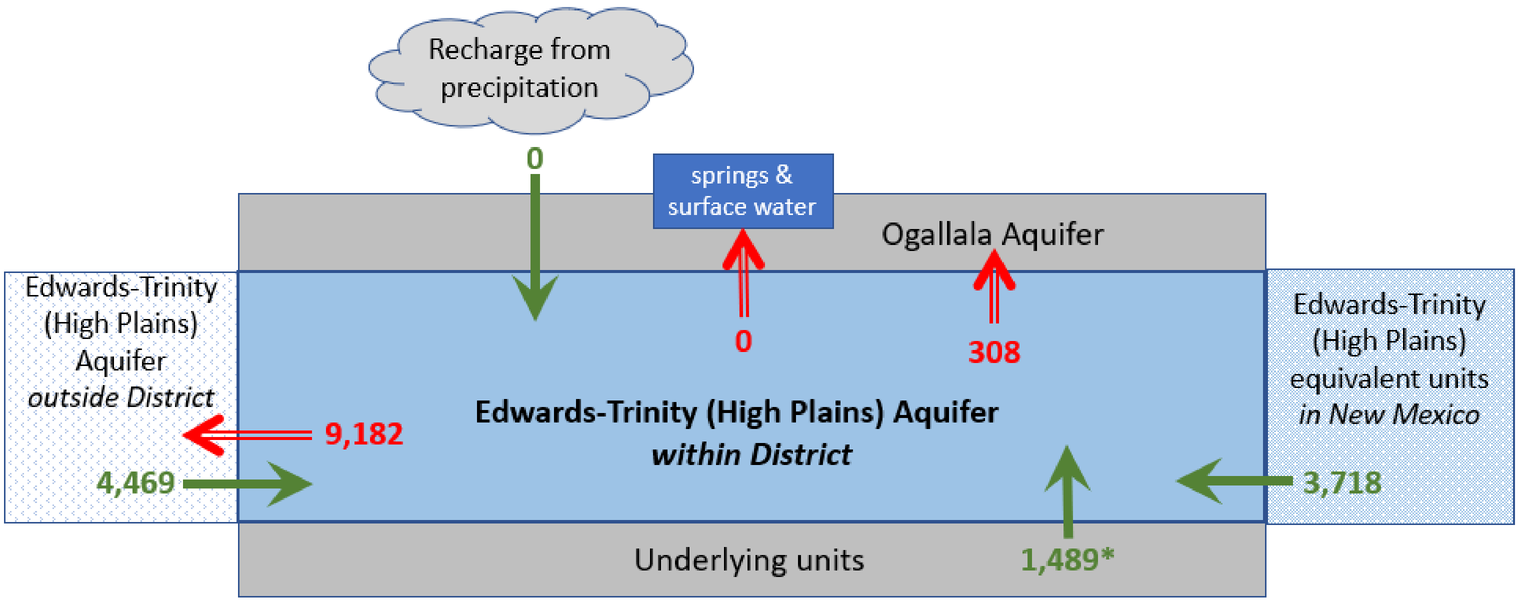


Figure 3: Area of the groundwater availability model for the High Plains Aquifer System from which the information in Table 2 was extracted (the Edwards-Trinity [High Plains] Aquifer extent within the district boundary).



*Flow from underlying units includes net outflow of 331 acre-ft per year from the Edwards-Trinity (High Plains) Aquifer to the Dockum Aquifer, and net inflow of 1,820 acre-ft per year to the Edwards-Trinity (High Plains) Aquifer from the Dockum equivalent units.

Caveat: This diagram only includes the water budget items provided in Table 2. A complete water budget would include additional inflows and outflows. For a full groundwater budget, please submit a request in writing to the Groundwater Modeling Department.

Figure 4: Generalized diagram of the summarized budget information from Table 2, representing directions of flow for the Edwards-Trinity (High Plains) Aquifer within High Plains Underground Water Conservation District No. 1. Flow values are expressed in acre-feet per year.

Table 3: Summarized information for the Dockum Aquifer that is needed for the High Plains Underground Water Conservation District No. 1's groundwater management plan. All values are reported in acre-feet per year and rounded to the nearest 1 acre-foot.

Management Plan requirement	Aquifer or Confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Dockum Aquifer	15
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams and rivers	Dockum Aquifer	124
Estimated annual volume of flow into the district within each aquifer in the district	Dockum Aquifer	4,218
Estimated annual volume of flow out of the district within each aquifer in the district	Dockum Aquifer	14,461
Estimated net annual volume of flow between each aquifer in the district	To Dockum Aquifer from Ogallala aquifer	2,217
	To Dockum Aquifer from Edwards Trinity (High Plains) aquifer	331
	To Dockum Aquifer from Dockum equivalent units in New Mexico	7
	To Dockum Aquifer from Dockum equivalent units in the District	826

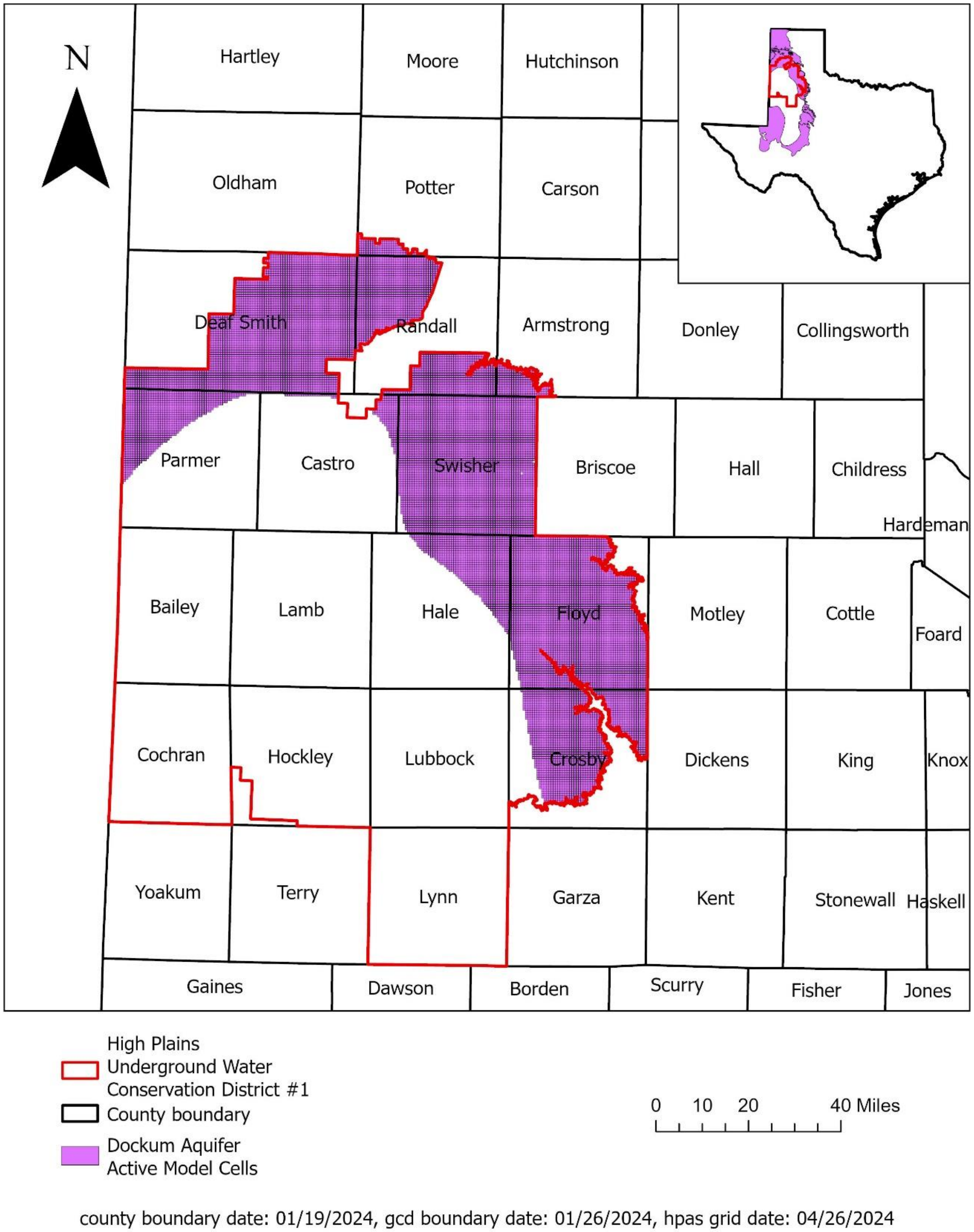
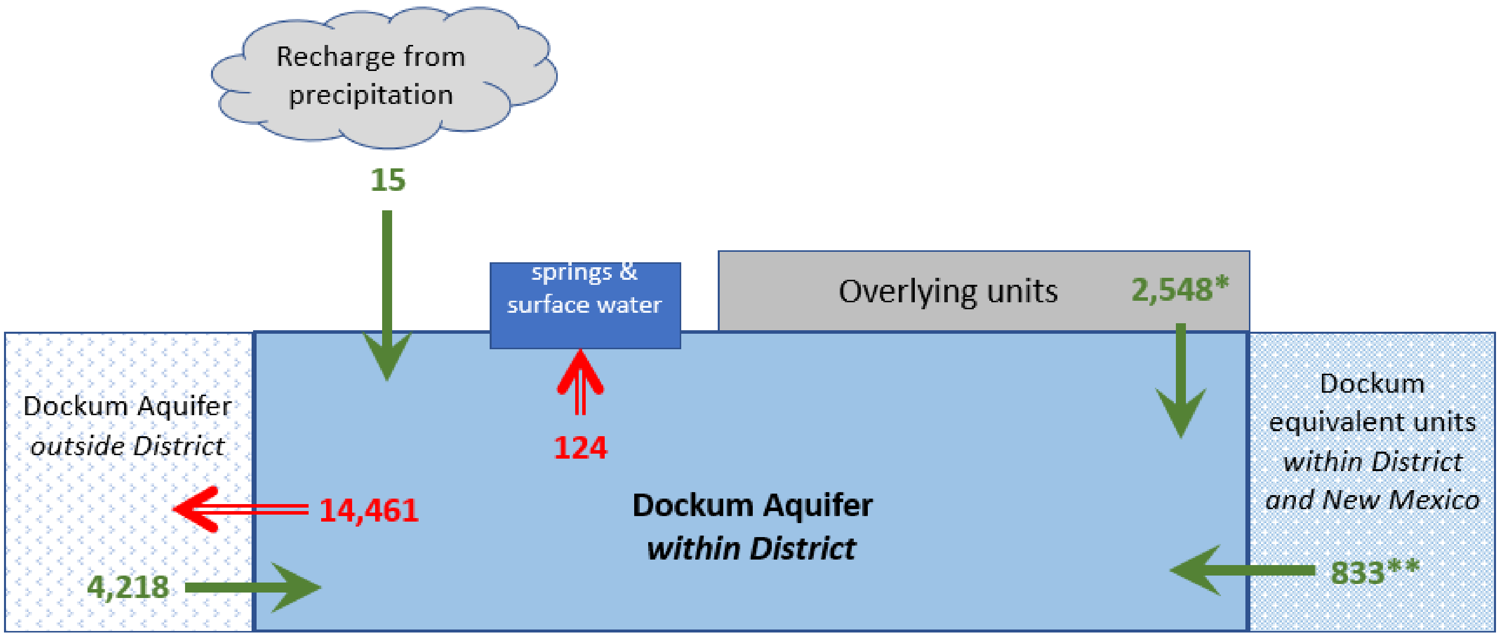


Figure 5: Area of the groundwater availability model for the High Plains Aquifer System from which the information in Table 3 was extracted (the Dockum Aquifer extent within the district boundary).



*Flow from overlying units includes net inflow of 2,217 acre-ft per year to the Dockum Aquifer from the Ogallala Aquifer, and net inflow of 331 acre-ft per year to the Dockum Aquifer from the Edwards-Trinity (High Plains) Aquifer.
**Flow from Dockum equivalent units includes net inflow of 826 acre-ft per year to the Dockum Aquifer from the Dockum equivalent units in the District and 7 acre-ft per year to the Dockum Aquifer from the Dockum equivalent units in New Mexico.

Caveat: This diagram only includes the water budget items provided in Table 3. A complete water budget would include additional inflows and outflows. For a full groundwater budget, please submit a request in writing to the Groundwater Modeling Department.

Figure 6: Generalized diagram of the summarized budget information from Table 3, representing directions of flow for the Dockum Aquifer within High Plains Underground Water Conservation District No. 1. Flow values are expressed in acre-feet per year.

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.

Shi, J., 2019, GAM Run 19-002: High Plains Underground Water Conservation District No. 1 Management Plan, 13 p., http://www.twdb.texas.gov/groundwater/docs/GAMruns/GR19-002.pdf

Texas Water Code § 36.1071

Appendix C

Estimated Historical Groundwater Use And 2022 State Water Plan Datasets:

High Plains Underground Water Conservation District No. 1

Texas Water Development Board
Groundwater Division
Groundwater Technical Assistance Section
stephen.allen@twdb.texas.gov
(512) 463-7317
June 23, 2024

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 2022 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 Grayson Dowlearn, grayson.dowlearn@twdb.texas.gov, (512) 475-1552.

DISCLAIMER:

The data presented in this report represents the most up to date WUS and 2022 SWP data available as of 6/23/2024. 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 2022 SWP. District personnel must review these datasets and correct any discrepancies 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 2022 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 if they wish).

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 though must "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 ideal 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 2020. TWDB staff anticipates the calculation and posting of these estimates at a later date.

ARMSTRONG COUNTY *7.63% (multiplier)* All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2019	GW	22	0	0	0	451	45	518
	SW	0	0	0	0	0	5	5
2018	GW	30	0	0	0	436	45	511
	SW	0	0	0	0	0	5	5
2017	GW	25	0	0	0	370	43	438
	SW	0	0	0	0	0	5	5
2016	GW	25	0	0	0	520	20	565
	SW	0	0	0	0	0	2	2
2015	GW	24	0	0	0	342	20	386
	SW	0	0	0	0	0	2	2
2014	GW	26	0	0	0	414	19	459
	SW	0	0	0	0	0	2	2
2013	GW	29	0	0	0	592	19	640
	SW	0	0	0	0	0	2	2
2012	GW	33	0	0	0	726	36	795
	SW	0	0	0	0	0	4	4
2011	GW	35	0	0	0	640	38	713
	SW	0	0	0	0	0	4	4
2010	GW	27	0	0	0	335	34	396
	SW	0	0	0	0	0	4	4
2009	GW	29	0	0	0	457	41	527
	SW	0	0	0	0	0	5	5
2008	GW	31	0	0	0	539	41	611
	SW	0	0	0	0	0	5	5
2007	GW	30	0	0	0	441	39	510
	SW	0	0	0	0	0	4	4
2006	GW	36	0	0	0	502	70	608
	SW	0	0	0	0	0	8	8
2005	GW	29	0	0	0	585	63	677
	SW	0	0	0	0	0	7	7
2004	GW	30	0	0	0	549	59	638
	SW	0	0	0	0	0	15	15

BAILEY COUNTY

100% (multiplier)

All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2019	GW	923	0	0	0	69,033	3,240	73,196
	SW	0	0	0	0	0	360	360
2018	GW	967	0	0	0	82,147	3,180	86,294
	SW	0	0	0	0	0	353	353
2017	GW	875	0	0	0	51,639	3,071	55,585
	SW	0	0	0	0	0	341	341
2016	GW	1,031	0	0	0	64,783	2,614	68,428
	SW	0	0	0	0	0	290	290
2015	GW	940	0	0	0	54,952	2,585	58,477
	SW	0	0	0	0	0	287	287
2014	GW	1,020	0	0	0	76,333	2,956	80,309
	SW	0	0	0	0	0	328	328
2013	GW	1,145	0	0	0	89,383	2,837	93,365
	SW	0	0	0	0	0	315	315
2012	GW	1,284	0	0	0	103,617	2,951	107,852
	SW	0	0	0	0	0	328	328
2011	GW	1,386	0	0	0	109,351	2,720	113,457
	SW	0	0	0	0	0	302	302
2010	GW	1,112	0	0	0	61,429	2,454	64,995
	SW	0	0	0	0	0	273	273
2009	GW	1,106	0	0	0	123,620	2,866	127,592
	SW	0	0	0	0	0	318	318
2008	GW	1,168	0	0	0	164,328	2,498	167,994
	SW	0	0	0	0	0	278	278
2007	GW	1,120	0	0	0	161,030	2,145	164,295
	SW	0	0	0	0	0	238	238
2006	GW	1,244	0	0	0	96,024	3,531	100,799
	SW	0	0	0	0	0	392	392
2005	GW	1,138	0	0	0	64,963	2,175	68,276
	SW	0	0	0	0	0	242	242
2004	GW	1,332	0	0	0	151,583	1,547	154,462
	SW	0	0	0	0	0	387	387

CASTRO COUNTY

96.33% (multiplier)

All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2019	GW	1,052	51	0	0	234,133	8,979	244,215
	SW	0	0	0	0	0	998	998
2018	GW	949	21	0	0	274,616	8,824	284,410
	SW	0	0	0	0	0	980	980
2017	GW	1,041	59	0	0	289,804	8,531	299,435
	SW	0	0	0	0	0	948	948
2016	GW	1,113	54	0	0	315,815	8,556	325,538
	SW	0	0	0	0	0	951	951
2015	GW	1,277	56	0	0	237,265	8,352	246,950
	SW	0	0	0	0	0	928	928
2014	GW	1,339	57	0	0	337,762	9,230	348,388
	SW	0	0	0	0	0	1,026	1,026
2013	GW	1,394	47	0	0	336,400	8,735	346,576
	SW	0	0	0	0	0	971	971
2012	GW	1,589	59	0	0	415,905	9,693	427,246
	SW	0	0	0	0	0	1,077	1,077
2011	GW	1,587	57	0	0	400,227	9,590	411,461
	SW	0	0	0	0	0	1,066	1,066
2010	GW	1,304	58	0	0	339,316	8,411	349,089
	SW	0	0	0	0	0	935	935
2009	GW	1,301	61	0	0	376,930	10,013	388,305
	SW	0	0	0	0	0	1,113	1,113
2008	GW	1,390	105	0	0	488,087	10,641	500,223
	SW	0	0	0	0	0	1,148	1,148
2007	GW	1,273	104	0	0	482,824	7,920	492,121
	SW	0	0	0	0	0	844	844
2006	GW	1,570	104	0	0	313,015	12,462	327,151
	SW	0	0	0	0	0	1,373	1,373
2005	GW	1,383	177	0	0	282,327	7,677	291,564
	SW	0	0	0	0	0	842	842
2004	GW	1,249	1,563	0	0	378,879	2,779	384,470
	SW	0	0	0	0	0	4,124	4,124

COCHRAN COUNTY

100% (multiplier)

All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2019	GW	410	0	67	0	108,091	158	108,726
	SW	0	0	0	0	0	17	17
2018	GW	449	0	82	0	98,020	158	98,709
	SW	0	0	0	0	0	17	17
2017	GW	466	0	161	0	85,019	152	85,798
	SW	0	0	0	0	0	17	17
2016	GW	471	0	44	0	85,102	377	85,994
	SW	0	0	0	0	0	42	42
2015	GW	478	0	13	0	74,529	366	75,386
	SW	0	0	0	0	0	40	40
2014	GW	521	0	42	0	98,148	363	99,074
	SW	0	0	0	0	0	41	41
2013	GW	538	0	4	0	109,500	360	110,402
	SW	0	0	0	0	0	40	40
2012	GW	624	0	4	0	123,608	446	124,682
	SW	0	0	0	0	0	49	49
2011	GW	841	0	10	0	99,504	444	100,799
	SW	0	0	0	0	0	49	49
2010	GW	618	0	14	0	66,485	360	67,477
	SW	0	0	3	0	0	40	43
2009	GW	681	0	163	0	99,287	416	100,547
	SW	0	0	41	0	0	46	87
2008	GW	659	0	312	0	118,899	416	120,286
	SW	0	0	78	0	0	46	124
2007	GW	688	0	0	0	155,577	477	156,742
	SW	0	0	0	0	0	53	53
2006	GW	712	0	0	0	86,849	622	88,183
	SW	0	0	0	0	0	69	69
2005	GW	504	0	0	0	71,037	159	71,700
	SW	0	0	0	0	0	18	18
2004	GW	701	0	0	0	137,669	65	138,435
	SW	0	0	0	0	0	86	86

CROSBY COUNTY

64.16% (multiplier)

All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2019	GW	138	0	1	0	47,458	82	47,679
	SW	311	0	280	0	515	35	1,141
2018	GW	131	0	1	0	37,196	82	37,410
	SW	305	0	284	0	510	35	1,134
2017	GW	166	1	3	0	39,047	79	39,296
	SW	300	0	282	0	367	33	982
2016	GW	171	0	608	0	65,162	73	66,014
	SW	301	0	269	0	404	31	1,005
2015	GW	241	0	3	0	24,027	73	24,344
	SW	311	0	197	0	221	31	760
2014	GW	209	0	8	0	50,216	71	50,504
	SW	214	0	287	0	497	31	1,029
2013	GW	224	0	5	0	71,743	69	72,041
	SW	282	0	262	0	504	29	1,077
2012	GW	242	0	3	0	84,831	92	85,168
	SW	378	0	273	0	510	39	1,200
2011	GW	367	1	0	0	85,728	101	86,197
	SW	398	0	282	0	445	43	1,168
2010	GW	326	1	124	0	50,357	98	50,906
	SW	303	0	311	0	297	42	953
2009	GW	202	1	186	0	80,869	127	81,385
	SW	275	0	299	0	520	55	1,149
2008	GW	260	1	129	0	107,747	105	108,242
	SW	272	0	289	0	507	45	1,113
2007	GW	304	1	119	0	98,108	119	98,651
	SW	137	1	259	0	316	51	764
2006	GW	231	1	119	0	56,188	123	56,662
	SW	342	1	263	0	522	53	1,181
2005	GW	235	1	119	0	46,877	104	47,336
	SW	337	1	285	0	515	45	1,183
2004	GW	226	0	128	0	88,121	94	88,569
	SW	339	2	258	0	422	34	1,055

DEAF SMITH COUNTY

58.64% (multiplier)

All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2019	GW	1,721	790	0	0	98,081	6,499	107,091
	SW	0	0	0	0	0	722	722
2018	GW	1,526	800	0	0	95,915	6,440	104,681
	SW	0	0	0	0	0	715	715
2017	GW	1,443	664	0	0	84,675	6,213	92,995
	SW	0	0	0	0	0	690	690
2016	GW	2,489	637	0	0	109,806	5,462	118,394
	SW	0	0	0	0	0	607	607
2015	GW	2,354	608	0	0	64,090	5,350	72,402
	SW	0	0	0	0	0	595	595
2014	GW	2,406	585	0	0	106,029	5,777	114,797
	SW	0	0	0	0	0	642	642
2013	GW	2,794	588	0	0	130,911	5,761	140,054
	SW	0	0	0	0	0	640	640
2012	GW	2,148	564	0	0	140,443	6,877	150,032
	SW	0	0	0	0	0	764	764
2011	GW	2,457	277	0	0	133,670	6,784	143,188
	SW	0	0	0	0	0	754	754
2010	GW	2,402	279	0	0	104,713	5,867	113,261
	SW	0	0	0	0	0	652	652
2009	GW	2,383	279	0	0	120,120	6,409	129,191
	SW	0	0	0	0	0	712	712
2008	GW	2,368	279	0	0	165,389	7,089	175,125
	SW	0	0	0	0	0	750	750
2007	GW	1,626	278	0	0	145,340	6,346	153,590
	SW	0	0	0	0	0	665	665
2006	GW	1,676	280	0	0	71,530	10,290	83,776
	SW	0	0	0	0	0	1,106	1,106
2005	GW	1,769	169	0	0	83,248	5,744	90,930
	SW	0	0	0	0	0	605	605
2004	GW	1,645	274	0	0	135,947	4,288	142,154
	SW	0	0	0	0	0	1,576	1,576

FLOYD COUNTY

93.14% (multiplier)

All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2019	GW	496	0	7	0	100,416	792	101,711
	SW	41	0	0	0	0	139	180
2018	GW	522	0	0	0	113,868	792	115,182
	SW	79	0	0	0	0	139	218
2017	GW	447	0	0	0	73,778	764	74,989
	SW	147	0	0	0	0	135	282
2016	GW	527	0	0	0	114,266	1,044	115,837
	SW	91	0	0	0	0	184	275
2015	GW	462	0	0	0	76,579	1,031	78,072
	SW	100	0	0	0	0	181	281
2014	GW	592	0	0	0	106,688	1,004	108,284
	SW	78	0	0	0	0	178	256
2013	GW	737	0	0	0	131,097	1,015	132,849
	SW	104	0	0	0	0	179	283
2012	GW	745	0	0	0	110,134	1,047	111,926
	SW	156	0	0	0	0	186	342
2011	GW	711	0	0	0	156,644	1,060	158,415
	SW	225	0	0	0	0	187	412
2010	GW	386	0	170	0	95,430	915	96,901
	SW	221	0	176	0	0	162	559
2009	GW	652	0	155	0	159,455	1,164	161,426
	SW	258	0	159	0	0	205	622
2008	GW	649	0	139	0	176,513	1,051	178,352
	SW	269	0	143	0	0	186	598
2007	GW	645	0	0	0	154,796	904	156,345
	SW	193	0	0	0	0	160	353
2006	GW	730	0	0	0	117,448	1,647	119,825
	SW	177	0	0	0	0	291	468
2005	GW	726	0	0	0	108,279	1,011	110,016
	SW	182	0	0	0	0	179	361
2004	GW	579	0	0	0	159,885	581	161,045
	SW	312	0	0	0	0	704	1,016

HALE COUNTY

100% (multiplier)

All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2019	GW	3,751	667	0	29	237,419	3,040	244,906
	SW	590	0	0	0	132	338	1,060
2018	GW	4,009	625	0	2	250,168	2,980	257,784
	SW	645	0	0	0	79	331	1,055
2017	GW	3,810	616	0	2	183,309	2,918	190,655
	SW	401	0	0	0	79	324	804
2016	GW	3,988	643	0	5	289,742	3,343	297,721
	SW	378	0	0	0	79	371	828
2015	GW	4,215	622	0	0	204,294	3,284	212,415
	SW	0	0	0	0	120	365	485
2014	GW	4,581	618	1	0	248,628	3,695	257,523
	SW	0	0	0	0	240	411	651
2013	GW	4,210	2,270	0	0	330,365	3,454	340,299
	SW	0	0	0	0	198	384	582
2012	GW	5,911	1,048	0	0	364,360	2,999	374,318
	SW	0	0	0	0	107	333	440
2011	GW	6,327	973	0	0	389,019	3,063	399,382
	SW	275	1,347	0	0	154	340	2,116
2010	GW	2,727	1,125	215	0	219,525	2,792	226,384
	SW	859	1,343	56	0	118	310	2,686
2009	GW	3,350	2,463	151	0	368,617	3,190	377,771
	SW	2,154	105	39	0	37	354	2,689
2008	GW	4,824	2,372	87	0	530,510	3,180	540,973
	SW	734	129	22	0	50	353	1,288
2007	GW	4,451	2,365	0	0	491,650	2,244	500,710
	SW	329	139	0	0	117	249	834
2006	GW	4,687	2,300	0	0	277,885	3,747	288,619
	SW	1,091	176	0	0	246	416	1,929
2005	GW	4,431	2,269	0	0	242,795	2,277	251,772
	SW	1,069	354	0	0	244	253	1,920
2004	GW	4,414	2,423	0	0	354,210	1,767	362,814
	SW	1,054	0	0	0	1,399	450	2,903

HOCKLEY COUNTY

93.43% (multiplier)

All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2019	GW	764	26	2	0	131,748	144	132,684
	SW	1,605	1	0	0	0	16	1,622
2018	GW	838	271	1	0	120,395	144	121,649
	SW	1,644	1	0	0	0	16	1,661
2017	GW	757	437	0	0	92,045	139	93,378
	SW	1,675	2	0	0	0	15	1,692
2016	GW	1,224	532	41	0	127,650	329	129,776
	SW	1,524	5	0	0	0	37	1,566
2015	GW	1,053	1,047	16	0	106,756	327	109,199
	SW	1,775	3	0	0	0	37	1,815
2014	GW	1,404	528	49	0	102,700	315	104,996
	SW	1,646	4	0	0	0	35	1,685
2013	GW	1,859	529	17	0	129,159	309	131,873
	SW	1,518	3	0	0	0	34	1,555
2012	GW	1,750	531	2	0	149,755	321	152,359
	SW	1,392	7	0	0	0	37	1,436
2011	GW	1,824	529	0	0	140,060	381	142,794
	SW	1,678	3	0	0	0	43	1,724
2010	GW	1,291	530	12	0	92,442	335	94,610
	SW	1,549	1	3	0	0	38	1,591
2009	GW	1,305	529	729	0	140,537	323	143,423
	SW	1,707	1	179	0	0	37	1,924
2008	GW	1,329	497	1,445	0	121,218	339	124,828
	SW	1,390	83	356	0	0	38	1,867
2007	GW	2,130	369	0	0	184,522	296	187,317
	SW	584	0	0	0	0	32	616
2006	GW	1,535	370	0	0	101,752	425	104,082
	SW	1,700	0	0	0	0	48	1,748
2005	GW	1,480	370	0	0	84,420	218	86,488
	SW	1,692	0	0	0	0	24	1,716
2004	GW	1,461	370	0	0	173,395	146	175,372
	SW	1,398	0	0	0	0	93	1,491

LAMB COUNTY

100% (multiplier)

All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2019	GW	1,933	2	0	6,647	186,787	4,703	200,072
	SW	0	0	0	0	0	248	248
2018	GW	1,838	2	0	8,465	208,074	4,575	222,954
	SW	0	0	0	0	0	241	241
2017	GW	1,705	2	0	8,824	146,986	4,483	162,000
	SW	0	0	0	0	0	236	236
2016	GW	1,716	0	0	9,834	224,511	4,616	240,677
	SW	0	0	0	0	0	243	243
2015	GW	1,532	363	0	11,351	169,494	4,534	187,274
	SW	0	0	0	0	0	239	239
2014	GW	1,899	363	0	11,760	207,750	5,178	226,950
	SW	0	0	0	0	0	273	273
2013	GW	2,056	415	0	15,666	271,563	4,571	294,271
	SW	0	0	0	0	0	241	241
2012	GW	2,404	404	0	14,748	325,693	3,980	347,229
	SW	0	0	0	0	0	209	209
2011	GW	2,551	414	0	13,448	308,578	3,902	328,893
	SW	0	0	0	0	0	205	205
2010	GW	1,843	388	108	13,945	182,763	3,554	202,601
	SW	0	0	28	0	0	187	215
2009	GW	1,734	361	59	13,750	323,337	4,265	343,506
	SW	0	0	15	0	0	224	239
2008	GW	2,464	513	10	14,557	404,946	3,928	426,418
	SW	0	0	3	0	0	207	210
2007	GW	2,377	512	0	14,527	470,827	3,352	491,595
	SW	0	0	0	0	0	177	177
2006	GW	2,569	459	0	11,964	249,209	4,657	268,858
	SW	0	0	0	0	0	245	245
2005	GW	2,523	459	0	14,197	241,431	3,478	262,088
	SW	0	0	0	0	0	183	183
2004	GW	2,572	459	0	18,295	372,046	2,631	396,003
	SW	0	0	0	0	0	657	657

LUBBOCK COUNTY

100% (multiplier)

All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2019	GW	29,900	549	0	215	155,606	756	187,026
	SW	12,511	491	0	207	60	15	13,284
2018	GW	31,659	483	0	241	138,765	756	171,904
	SW	12,999	489	0	253	117	15	13,873
2017	GW	32,077	592	0	156	104,393	730	137,948
	SW	10,218	525	0	119	34	15	10,911
2016	GW	31,494	372	0	165	135,927	582	168,540
	SW	12,633	742	0	163	263	12	13,813
2015	GW	32,090	298	2	258	168,005	572	201,225
	SW	9,200	712	0	164	106	12	10,194
2014	GW	35,412	263	5	396	104,666	569	141,311
	SW	9,308	313	0	151	156	12	9,940
2013	GW	41,122	327	5	1,221	156,414	561	199,650
	SW	7,406	332	0	139	196	11	8,084
2012	GW	48,406	397	0	950	171,326	794	221,873
	SW	1,544	309	0	129	0	16	1,998
2011	GW	52,448	448	0	1,260	158,755	821	213,732
	SW	4,361	340	0	118	0	17	4,836
2010	GW	30,753	598	982	452	106,030	716	139,531
	SW	13,361	337	970	537	0	15	15,220
2009	GW	26,886	451	717	0	178,181	683	206,918
	SW	14,939	252	708	723	0	14	16,636
2008	GW	27,735	602	451	18	241,393	708	270,907
	SW	12,265	344	446	884	0	14	13,953
2007	GW	24,140	388	0	17	219,928	825	245,298
	SW	13,527	270	0	740	6,000	17	20,554
2006	GW	30,627	396	0	12	123,243	1,532	155,810
	SW	16,928	1,241	0	885	6,500	31	25,585
2005	GW	26,642	423	0	4	109,686	922	137,677
	SW	19,647	301	0	836	6,000	19	26,803
2004	GW	29,149	342	0	5	199,872	605	229,973
	SW	14,501	277	0	148,487	5,650	151	169,066

LYNN COUNTY

100% (multiplier)

All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2019	GW	573	0	0	0	78,596	131	79,300
	SW	61	0	0	0	0	23	84
2018	GW	615	0	0	0	76,961	131	77,707
	SW	82	0	0	0	0	23	105
2017	GW	682	0	0	0	69,338	126	70,146
	SW	43	0	0	0	0	22	65
2016	GW	706	0	0	0	90,708	64	91,478
	SW	65	0	0	0	0	11	76
2015	GW	549	0	0	0	65,587	63	66,199
	SW	137	0	0	0	0	11	148
2014	GW	724	0	0	0	88,606	60	89,390
	SW	102	0	0	0	0	11	113
2013	GW	356	0	11	0	87,787	64	88,218
	SW	385	0	0	0	0	11	396
2012	GW	469	0	0	0	100,642	70	101,181
	SW	355	0	0	0	0	12	367
2011	GW	349	0	0	0	99,511	77	99,937
	SW	586	0	0	0	0	14	600
2010	GW	298	0	249	0	53,247	75	53,869
	SW	471	0	63	0	0	13	547
2009	GW	419	0	145	0	88,008	167	88,739
	SW	427	0	37	0	0	29	493
2008	GW	431	0	41	0	111,548	75	112,095
	SW	403	0	10	0	0	13	426
2007	GW	643	0	0	0	105,698	94	106,435
	SW	136	0	0	0	5,000	16	5,152
2006	GW	572	0	0	0	60,206	141	60,919
	SW	136	0	0	0	5,446	25	5,607
2005	GW	506	0	0	0	60,788	107	61,401
	SW	182	0	0	0	4,659	19	4,860
2004	GW	540	0	0	0	87,583	62	88,185
	SW	106	0	0	0	4,390	27	4,523

PARMER COUNTY

100% (multiplier)

All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2019	GW	1,134	1,991	0	0	162,921	7,239	173,285
	SW	0	0	0	0	0	804	804
2018	GW	1,285	1,969	0	0	156,180	7,138	166,572
	SW	0	0	0	0	0	794	794
2017	GW	1,244	1,962	0	0	131,915	6,941	142,062
	SW	0	0	0	0	0	771	771
2016	GW	1,321	1,830	0	0	173,774	8,177	185,102
	SW	0	0	0	0	0	908	908
2015	GW	1,140	1,643	0	0	145,520	8,102	156,405
	SW	0	0	0	0	0	900	900
2014	GW	1,456	1,624	0	0	210,719	8,821	222,620
	SW	0	0	0	0	0	980	980
2013	GW	1,576	1,666	0	0	222,847	8,703	234,792
	SW	0	0	0	0	0	967	967
2012	GW	1,803	1,404	0	0	260,143	9,709	273,059
	SW	0	0	0	0	0	1,079	1,079
2011	GW	2,137	1,467	0	0	245,279	9,195	258,078
	SW	0	0	0	0	0	1,021	1,021
2010	GW	1,596	1,560	0	0	256,507	7,748	267,411
	SW	0	0	0	0	0	861	861
2009	GW	1,594	1,738	0	0	299,329	8,781	311,442
	SW	0	0	0	0	0	976	976
2008	GW	1,556	1,873	0	0	405,765	9,949	419,143
	SW	0	0	0	0	0	992	992
2007	GW	1,559	1,819	0	0	405,687	7,247	416,312
	SW	0	0	0	0	0	689	689
2006	GW	1,811	1,861	0	0	264,001	12,026	279,699
	SW	0	0	0	0	0	1,211	1,211
2005	GW	1,497	1,917	0	0	291,445	6,613	301,472
	SW	0	0	0	0	0	618	618
2004	GW	2,028	1,961	0	0	467,218	3,531	474,738
	SW	0	0	0	0	0	3,176	3,176

POTTER COUNTY *5.87% (multiplier)* All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2019	GW	1,023	362	11	55	213	24	1,688
	SW	161	1	8	0	0	4	174
2018	GW	1,235	326	6	47	141	24	1,779
	SW	221	1	3	0	0	4	229
2017	GW	1,199	377	11	50	72	24	1,733
	SW	110	1	4	0	0	4	119
2016	GW	1,241	382	5	51	90	24	1,793
	SW	166	3	2	0	0	4	175
2015	GW	1,195	346	9	64	31	23	1,668
	SW	0	3	3	0	0	4	10
2014	GW	1,424	332	9	66	153	23	2,007
	SW	0	3	3	0	0	4	10
2013	GW	1,488	273	6	76	241	26	2,110
	SW	0	3	2	0	0	5	10
2012	GW	1,631	240	7	46	210	33	2,167
	SW	0	3	2	0	0	6	11
2011	GW	1,656	323	8	82	140	42	2,251
	SW	95	3	0	0	0	7	105
2010	GW	1,104	357	26	31	70	38	1,626
	SW	380	15	29	0	0	7	431
2009	GW	1,037	310	25	42	206	37	1,657
	SW	390	24	27	0	0	6	447
2008	GW	1,224	342	24	78	182	35	1,885
	SW	292	13	25	0	0	6	336
2007	GW	1,012	341	8	83	345	37	1,826
	SW	392	22	0	11	0	7	432
2006	GW	1,219	331	9	56	247	32	1,894
	SW	509	27	0	108	0	5	649
2005	GW	1,052	286	9	95	323	32	1,797
	SW	564	15	0	221	0	5	805
2004	GW	1,121	314	9	79	290	3	1,816
	SW	441	19	0	275	0	28	763

RANDALL COUNTY *47.32% (multiplier)* All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2019	GW	7,831	316	0	0	6,699	1,432	16,278
	SW	1,441	4	0	0	34	358	1,837
2018	GW	9,466	300	0	0	7,037	1,431	18,234
	SW	1,907	5	0	0	42	358	2,312
2017	GW	8,981	288	0	0	6,647	1,371	17,287
	SW	1,201	5	0	0	30	343	1,579
2016	GW	9,614	289	0	0	8,340	1,214	19,457
	SW	1,545	5	0	0	40	303	1,893
2015	GW	8,917	273	0	0	2,827	1,199	13,216
	SW	436	6	0	0	37	300	779
2014	GW	10,494	316	0	0	7,487	1,165	19,462
	SW	437	4	0	0	38	291	770
2013	GW	10,938	268	0	0	9,843	1,095	22,144
	SW	475	13	0	0	43	274	805
2012	GW	12,077	255	0	0	11,531	1,339	25,202
	SW	375	13	0	0	0	335	723
2011	GW	12,287	265	0	0	12,961	1,424	26,937
	SW	920	14	0	0	41	356	1,331
2010	GW	8,776	244	0	0	8,673	1,165	18,858
	SW	2,488	13	0	0	43	291	2,835
2009	GW	7,955	137	0	0	10,298	1,437	19,827
	SW	2,891	0	0	0	42	359	3,292
2008	GW	8,817	259	0	0	12,005	1,408	22,489
	SW	2,229	0	0	0	41	352	2,622
2007	GW	7,246	236	0	0	11,554	1,182	20,218
	SW	2,738	0	0	0	25	295	3,058
2006	GW	8,541	253	0	0	10,903	2,070	21,767
	SW	3,386	0	0	0	54	518	3,958
2005	GW	7,625	262	0	0	15,438	1,054	24,379
	SW	3,709	0	0	0	58	263	4,030
2004	GW	7,820	252	0	0	12,888	1,158	22,118
	SW	3,143	0	0	0	93	319	3,555

SWISHER COUNTY *100% (multiplier)* All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2019	GW	820	0	0	0	68,356	3,724	72,900
	SW	94	0	0	0	0	76	170
2018	GW	1,002	0	0	0	74,814	3,724	79,540
	SW	111	0	0	0	0	76	187
2017	GW	908	0	0	0	59,245	3,639	63,792
	SW	126	0	0	0	0	75	201
2016	GW	889	0	0	0	83,585	3,270	87,744
	SW	106	0	0	0	0	67	173
2015	GW	847	0	0	0	71,839	3,230	75,916
	SW	95	0	0	0	0	66	161
2014	GW	1,016	0	0	0	110,225	3,146	114,387
	SW	17	0	0	0	0	64	81
2013	GW	1,031	0	0	0	134,191	3,072	138,294
	SW	59	0	0	0	0	63	122
2012	GW	1,033	0	0	0	163,750	3,333	168,116
	SW	128	0	0	0	0	68	196
2011	GW	1,151	0	0	0	155,342	3,467	159,960
	SW	134	0	0	0	0	71	205
2010	GW	905	0	0	0	113,473	2,918	117,296
	SW	181	0	0	0	0	60	241
2009	GW	950	0	0	0	240,117	3,990	245,057
	SW	162	0	0	0	0	81	243
2008	GW	944	0	0	0	246,525	3,687	251,156
	SW	226	0	0	0	0	76	302
2007	GW	854	0	0	0	227,875	3,003	231,732
	SW	227	0	0	0	0	62	289
2006	GW	1,051	0	0	0	147,700	6,093	154,844
	SW	163	0	0	0	0	124	287
2005	GW	903	0	0	0	165,346	3,872	170,121
	SW	419	0	0	0	0	79	498
2004	GW	912	0	0	0	168,500	2,532	171,944
	SW	200	0	0	0	0	1,194	1,394

Projected Surface Water Supplies
TWDB 2022 State Water Plan Data

ARMSTRONG COUNTY

7.63% (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	9	9	9	9	9	9
	Sum of Projected Surface Water Supplies (acre-feet)			**9**	**9**	**9**	**9**	**9**	**9**

CROSBY COUNTY

64.16% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070
O	Irrigation, Crosby	Brazos	Brazos Run-of-River	0	0	0	0	0	0
	Sum of Projected Surface Water Supplies (acre-feet)			**0**	**0**	**0**	**0**	**0**	**0**

FLOYD COUNTY

93.14% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070
O	Floydada	Brazos	Mackenzie Lake/Reservoir	155	155	155	155	155	155
O	Irrigation, Floyd	Red	Red Run-of-River	17	17	17	17	17	17
O	Lockney	Brazos	Mackenzie Lake/Reservoir	75	75	75	75	75	75
	Sum of Projected Surface Water Supplies (acre-feet)			**247**	**247**	**247**	**247**	**247**	**247**

HALE COUNTY

100% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070
O	Plainview	Brazos	Meredith Lake/Reservoir	613	675	692	712	707	705
	Sum of Projected Surface Water Supplies (acre-feet)			**613**	**675**	**692**	**712**	**707**	**705**

HOCKLEY COUNTY

93.43% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070
O	Levelland	Brazos	Meredith Lake/Reservoir	564	540	532	527	540	553
	Sum of Projected Surface Water Supplies (acre-feet)			**564**	**540**	**532**	**527**	**540**	**553**

LUBBOCK COUNTY

100% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070

O	County-Other, Lubbock	Brazos	Alan Henry Lake/Reservoir	202	202	202	202	202	202
O	Lubbock	Brazos	Alan Henry Lake/Reservoir	7,630	7,630	7,630	7,630	7,630	7,630
O	Lubbock	Brazos	Meredith Lake/Reservoir	8,723	8,769	9,264	9,565	9,494	9,470
O	Ransom Canyon	Brazos	Alan Henry Lake/Reservoir	143	143	143	143	143	143
O	Ransom Canyon	Brazos	Brazos Run-of-River	0	0	0	0	0	0
O	Slaton	Brazos	Meredith Lake/Reservoir	344	322	310	301	298	298
	Sum of Projected Surface Water Supplies (acre-feet)			**17,042**	**17,066**	**17,549**	**17,841**	**17,767**	**17,743**

LYNN COUNTY

100% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070
O	Irrigation, Lynn	Brazos	Brazos Run-of-River	0	0	0	0	0	0
O	ODonnell	Brazos	Meredith Lake/Reservoir	26	24	22	21	22	23
O	Tahoka Public Water System	Brazos	Meredith Lake/Reservoir	117	109	102	96	99	101
	Sum of Projected Surface Water Supplies (acre-feet)			**143**	**133**	**124**	**117**	**121**	**124**

PARMER COUNTY

100% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070
O	Irrigation, Parmer	Red	Red Run-of-River	0	0	0	0	0	0
	Sum of Projected Surface Water Supplies (acre-feet)			**0**	**0**	**0**	**0**	**0**	**0**

POTTER COUNTY

5.87% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070
A	Amarillo	Canadian	Meredith Lake/Reservoir	3,278	3,264	3,125	3,010	3,056	3,072
A	Amarillo	Red	Meredith Lake/Reservoir	2,158	2,149	2,057	1,983	2,012	2,022
A	Livestock, Potter	Canadian	Canadian Livestock Local Supply	29	29	29	29	29	29
A	Livestock, Potter	Red	Red Livestock Local Supply	4	4	4	4	4	4
A	Manufacturing, Potter	Red	Meredith Lake/Reservoir	65	65	57	51	47	43
	Sum of Projected Surface Water Supplies (acre-feet)			**5,534**	**5,511**	**5,272**	**5,077**	**5,148**	**5,170**

RANDALL COUNTY

47.32% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070
A	Amarillo	Red	Meredith Lake/Reservoir	4,414	4,422	4,232	4,088	4,149	4,165
A	Canyon	Red	Meredith	199	182	160	142	0	0

			Lake/Reservoir						
A	County-Other, Randall	Red	Meredith Lake/Reservoir	2	2	2	2	1	1
A	Irrigation, Randall	Red	Red Run-of-River	103	103	103	103	103	103
A	Livestock, Randall	Red	Red Livestock Local Supply	621	621	621	621	621	621
A	Manufacturing, Randall	Red	Meredith Lake/Reservoir	54	50	44	39	36	33
	Sum of Projected Surface Water Supplies (acre-feet)			**5,393**	**5,380**	**5,162**	**4,995**	**4,910**	**4,923**

SWISHER COUNTY

100% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070
O	Tulia	Red	Mackenzie Lake/Reservoir	210	210	210	210	210	210
	Sum of Projected Surface Water Supplies (acre-feet)			**210**	**210**	**210**	**210**	**210**	**210**

Projected Water Demands
TWDB 2022 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

7.63% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
A	Claude Municipal Water System	Red	360	354	349	347	347	347
A	County-Other, Armstrong	Red	7	6	6	6	6	6
A	Irrigation, Armstrong	Red	476	476	476	476	476	476
A	Livestock, Armstrong	Red	25	34	36	37	38	40
		Sum of Projected Water Demands (acre-feet)	**868**	**870**	**867**	**866**	**867**	**869**

BAILEY COUNTY

100% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
O	County-Other, Bailey	Brazos	277	296	320	351	381	411
O	Irrigation, Bailey	Brazos	88,108	88,108	72,000	63,505	58,659	55,616
O	Livestock, Bailey	Brazos	2,428	2,821	3,070	3,341	3,639	3,958
O	Muleshoe	Brazos	1,173	1,283	1,397	1,523	1,655	1,787
		Sum of Projected Water Demands (acre-feet)	**91,986**	**92,508**	**76,787**	**68,720**	**64,334**	**61,772**

CASTRO COUNTY

96.33% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
O	County-Other, Castro	Brazos	197	205	213	223	231	237
O	County-Other, Castro	Red	158	165	171	179	185	191
O	Dimmitt	Brazos	1,091	1,159	1,205	1,254	1,299	1,335
O	Hart Municipal Water System	Brazos	175	183	188	197	203	209
O	Irrigation, Castro	Brazos	237,849	237,849	188,153	158,426	145,629	139,567
O	Irrigation, Castro	Red	128,073	128,073	101,312	85,306	78,415	75,151
O	Livestock, Castro	Brazos	4,791	5,410	5,831	6,288	6,785	7,315
O	Livestock, Castro	Red	1,683	1,901	2,048	2,208	2,383	2,569
O	Manufacturing, Castro	Red	59	64	64	64	64	64
O	Nazareth	Red	134	144	150	157	163	168
		Sum of Projected Water Demands (acre-feet)	**374,210**	**375,153**	**299,335**	**254,302**	**235,357**	**226,806**

COCHRAN COUNTY

100% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
O	County-Other, Cochran	Brazos	182	204	211	212	221	224

O	County-Other, Cochran	Colorado	124	139	143	144	150	152
O	Irrigation, Cochran	Brazos	67,626	67,626	57,664	51,479	46,346	42,821
O	Irrigation, Cochran	Colorado	31,823	31,823	27,136	24,225	21,810	20,151
O	Livestock, Cochran	Brazos	70	73	75	78	81	81
O	Livestock, Cochran	Colorado	32	33	34	35	36	37
O	Mining, Cochran	Brazos	8	11	11	8	6	4
O	Mining, Cochran	Colorado	146	197	199	155	109	77
O	Morton PWS	Brazos	477	477	471	459	469	472
O	Whiteface	Brazos	118	122	121	120	123	124
		Sum of Projected Water Demands (acre-feet)	**100,606**	**100,705**	**86,065**	**76,915**	**69,351**	**64,143**

CROSBY COUNTY

64.16% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
O	County-Other, Crosby	Brazos	96	98	103	107	112	118
O	County-Other, Crosby	Red	1	1	1	1	1	1
O	Crosbyton	Brazos	301	313	323	340	359	376
O	Irrigation, Crosby	Brazos	66,291	66,291	66,291	52,462	45,499	41,712
O	Irrigation, Crosby	Red	2,734	2,734	2,734	2,164	1,877	1,721
O	Livestock, Crosby	Brazos	107	112	118	123	130	131
O	Livestock, Crosby	Red	3	3	3	3	3	3
O	Lorenzo	Brazos	231	246	258	275	296	310
O	Manufacturing, Crosby	Brazos	1	2	2	2	2	2
O	Mining, Crosby	Brazos	402	396	352	306	265	230
O	Mining, Crosby	Red	236	233	207	180	156	135
O	Ralls	Brazos	311	322	331	345	362	379
		Sum of Projected Water Demands (acre-feet)	**70,714**	**70,751**	**70,723**	**56,308**	**49,062**	**45,118**

DEAF SMITH COUNTY

58.64% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
O	County-Other, Deaf Smith	Canadian	1	1	1	1	1	1
O	County-Other, Deaf Smith	Red	345	381	424	481	527	578
O	Hereford	Red	3,857	4,354	4,917	5,589	6,136	6,739
O	Irrigation, Deaf Smith	Canadian	1,232	1,232	955	811	736	694
O	Irrigation, Deaf Smith	Red	121,921	121,921	94,453	80,273	72,826	68,630
O	Livestock, Deaf Smith	Canadian	66	72	76	81	86	92
O	Livestock, Deaf Smith	Red	6,484	7,057	7,508	7,991	8,511	9,058
O	Manufacturing, Deaf Smith	Red	588	649	649	649	649	649
		Sum of Projected Water Demands (acre-feet)	**134,494**	**135,667**	**108,983**	**95,876**	**89,472**	**86,441**

FLOYD COUNTY

93.14% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070

O	County-Other, Floyd	Brazos	120	135	147	161	172	182
O	County-Other, Floyd	Red	59	66	73	80	85	89
O	Floydada	Brazos	572	554	546	545	544	544
O	Irrigation, Floyd	Brazos	43,198	43,198	34,368	29,770	27,124	25,561
O	Irrigation, Floyd	Red	76,800	76,800	61,101	52,928	48,222	45,444
O	Livestock, Floyd	Brazos	833	848	864	882	900	904
O	Livestock, Floyd	Red	255	260	265	270	276	277
O	Lockney	Brazos	277	283	285	295	303	310
O	Mining, Floyd	Brazos	199	202	200	199	198	199
O	Mining, Floyd	Red	253	256	255	253	252	252
		Sum of Projected Water Demands (acre-feet)	**122,566**	**122,602**	**98,104**	**85,383**	**78,076**	**73,762**

HALE COUNTY

100% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
O	Abernathy	Brazos	536	547	549	540	553	559
O	County-Other, Hale	Brazos	1,031	1,048	1,040	1,013	1,044	1,058
O	Hale Center	Brazos	281	271	264	260	259	259
O	Irrigation, Hale	Brazos	307,440	307,440	263,617	241,892	231,023	225,295
O	Irrigation, Hale	Red	3,102	3,102	2,660	2,441	2,331	2,273
O	Livestock, Hale	Brazos	2,752	3,111	3,325	3,561	3,820	4,098
O	Manufacturing, Hale	Brazos	4,383	5,076	5,076	5,076	5,076	5,076
O	Mining, Hale	Brazos	1,168	1,152	1,022	886	766	662
O	Petersburg Municipal Water System	Brazos	321	329	329	325	333	336
O	Plainview	Brazos	4,587	4,664	4,650	4,562	4,672	4,722
O	Steam-Electric Power, Hale	Brazos	31	31	31	31	31	31
		Sum of Projected Water Demands (acre-feet)	**325,632**	**326,771**	**282,563**	**260,587**	**249,908**	**244,369**

HOCKLEY COUNTY

93.43% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
O	Anton	Brazos	160	164	165	165	171	176
O	County-Other, Hockley	Brazos	832	854	861	855	890	915
O	County-Other, Hockley	Colorado	28	29	29	29	30	31
O	Irrigation, Hockley	Brazos	114,647	114,647	84,985	72,828	67,090	63,980
O	Irrigation, Hockley	Colorado	8,555	8,555	6,342	5,435	5,006	4,774
O	Levelland	Brazos	2,441	2,520	2,553	2,547	2,654	2,727
O	Livestock, Hockley	Brazos	106	110	115	120	124	125
O	Livestock, Hockley	Colorado	19	19	20	21	21	21
O	Manufacturing, Hockley	Brazos	538	646	646	646	646	646
O	Mining, Hockley	Brazos	15	15	14	14	13	12
O	Mining, Hockley	Colorado	2	2	2	2	2	2
O	Sundown	Colorado	417	435	447	449	469	482
		Sum of Projected Water Demands (acre-feet)	**127,760**	**127,996**	**96,179**	**83,111**	**77,116**	**73,891**

LAMB COUNTY

100% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
O	Amherst	Brazos	102	107	110	113	119	124
O	County-Other, Lamb	Brazos	401	434	451	447	477	492
O	Earth	Brazos	191	190	186	183	186	186
O	Irrigation, Lamb	Brazos	259,451	259,451	218,589	203,951	197,509	194,185
O	Littlefield	Brazos	987	956	927	916	914	914
O	Livestock, Lamb	Brazos	3,940	4,529	4,910	5,325	5,780	6,271
O	Manufacturing, Lamb	Brazos	807	940	940	940	940	940
O	Mining, Lamb	Brazos	586	579	513	445	385	333
O	Olton	Brazos	466	461	451	437	438	436
O	Steam-Electric Power, Lamb	Brazos	13,450	13,450	13,450	13,450	13,450	13,450
O	Sudan	Brazos	250	264	273	278	292	301
		Sum of Projected Water Demands (acre-feet)	**280,631**	**281,361**	**240,800**	**226,485**	**220,490**	**217,632**

LUBBOCK COUNTY

100% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
O	Abernathy	Brazos	186	203	220	239	258	278
O	County-Other, Lubbock	Brazos	3,797	3,580	3,229	4,169	5,129	6,339
O	Idalou	Brazos	434	441	451	467	485	503
O	Irrigation, Lubbock	Brazos	144,866	144,866	132,596	124,312	118,397	114,260
O	Livestock, Lubbock	Brazos	1,088	1,138	1,173	1,212	1,253	1,287
O	Lubbock	Brazos	46,775	51,386	56,443	60,464	64,576	68,389
O	Manufacturing, Lubbock	Brazos	856	1,011	1,011	1,011	1,011	1,011
O	Mining, Lubbock	Brazos	6,354	6,425	5,913	5,302	4,763	4,314
O	New Deal	Brazos	113	120	128	137	147	158
O	Ransom Canyon	Brazos	336	355	376	400	424	448
O	Shallowater	Brazos	422	464	507	558	610	662
O	Slaton	Brazos	745	725	712	711	717	725
O	Steam-Electric Power, Lubbock	Brazos	5,694	5,694	5,694	5,694	5,694	5,694
O	Wolfforth	Brazos	765	912	1,061	1,223	1,384	1,546
		Sum of Projected Water Demands (acre-feet)	**212,431**	**217,320**	**209,514**	**205,899**	**204,848**	**205,614**

LYNN COUNTY

100% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
O	County-Other, Lynn	Brazos	302	305	296	289	303	309
O	County-Other, Lynn	Colorado	9	9	9	9	9	10
O	Irrigation, Lynn	Brazos	82,991	82,991	82,991	82,991	82,991	82,991
O	Irrigation, Lynn	Colorado	5,930	5,930	5,930	5,930	5,930	5,930
O	Livestock, Lynn	Brazos	60	63	66	69	72	73
O	Livestock, Lynn	Colorado	5	5	5	5	6	6

O	Mining, Lynn	Brazos	1,084	1,234	1,167	960	768	614
O	Mining, Lynn	Colorado	82	93	88	73	58	46
O	ODonnell	Brazos	106	107	105	105	109	112
O	Tahoka Public Water System	Brazos	476	486	477	470	492	503
	Sum of Projected Water Demands (acre-feet)		**91,045**	**91,223**	**91,134**	**90,901**	**90,738**	**90,594**

PARMER COUNTY

100% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
O	Bovina	Brazos	373	402	429	458	496	531
O	County-Other, Parmer	Brazos	385	415	443	475	514	551
O	County-Other, Parmer	Red	276	298	317	340	368	394
O	Farwell	Brazos	393	426	457	490	531	569
O	Friona	Red	801	864	922	985	1,067	1,143
O	Irrigation, Parmer	Brazos	191,424	191,424	165,947	153,526	146,303	142,274
O	Irrigation, Parmer	Red	47,801	47,801	41,439	38,338	36,534	35,528
O	Livestock, Parmer	Brazos	5,871	6,654	7,173	7,739	8,355	9,020
O	Livestock, Parmer	Red	1,468	1,664	1,794	1,935	2,089	2,256
O	Manufacturing, Parmer	Red	1,666	1,841	1,841	1,841	1,841	1,841
	Sum of Projected Water Demands (acre-feet)		**250,458**	**251,789**	**220,762**	**206,127**	**198,098**	**194,107**

POTTER COUNTY

5.87% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
A	Amarillo	Canadian	16,458	17,919	19,536	21,251	23,234	25,346
A	Amarillo	Red	10,835	11,797	12,863	13,991	15,297	16,687
A	County-Other, Potter	Canadian	89	97	106	115	126	137
A	County-Other, Potter	Red	48	52	57	62	67	73
A	Irrigation, Potter	Canadian	60	60	60	60	60	60
A	Irrigation, Potter	Red	126	126	126	126	126	126
A	Livestock, Potter	Canadian	25	26	27	28	29	30
A	Livestock, Potter	Red	5	5	6	6	6	6
A	Manufacturing, Potter	Canadian	40	44	44	44	44	44
A	Manufacturing, Potter	Red	423	469	469	469	469	469
A	Mining, Potter	Canadian	38	46	54	58	65	73
A	Mining, Potter	Red	18	22	25	27	31	34
A	Steam-Electric Power, Potter	Canadian	1,089	1,089	1,089	1,089	1,089	1,089
	Sum of Projected Water Demands (acre-feet)		**29,254**	**31,752**	**34,462**	**37,326**	**40,643**	**44,174**

RANDALL COUNTY

47.32% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
A	Amarillo	Red	22,161	24,276	26,462	28,851	31,543	34,369
A	Canyon	Red	3,632	3,981	4,342	4,735	5,178	5,642

A	County-Other, Randall	Red	1,461	1,599	1,743	1,901	2,079	2,267
A	Happy	Red	10	11	12	13	14	16
A	Irrigation, Randall	Red	8,385	8,385	8,385	8,385	8,385	8,385
A	Lake Tanglewood	Red	438	433	429	427	427	427
A	Livestock, Randall	Red	1,260	1,280	1,297	1,315	1,334	1,354
A	Manufacturing, Randall	Red	294	339	339	339	339	339
		Sum of Projected Water Demands (acre-feet)	**37,641**	**40,304**	**43,009**	**45,966**	**49,299**	**52,799**

SWISHER COUNTY

100% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
O	County-Other, Swisher	Brazos	50	51	50	50	52	53
O	County-Other, Swisher	Red	307	308	306	303	317	324
O	Happy	Red	99	100	100	98	102	105
O	Irrigation, Swisher	Brazos	24,372	24,372	19,808	17,581	16,340	15,578
O	Irrigation, Swisher	Red	111,024	111,024	90,233	80,087	74,435	70,962
O	Livestock, Swisher	Brazos	136	143	150	158	166	173
O	Livestock, Swisher	Red	2,592	2,721	2,857	2,999	3,148	3,296
O	Tulia	Red	865	883	876	863	903	923
		Sum of Projected Water Demands (acre-feet)	**139,445**	**139,602**	**114,380**	**102,139**	**95,463**	**91,414**

Projected Water Supply Needs
TWDB 2022 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 Municipal Water System	Red	224	183	115	55	7	7
A	County-Other, Armstrong	Red	12	16	18	18	18	18
A	Irrigation, Armstrong	Red	54	78	99	119	136	136
A	Livestock, Armstrong	Red	0	0	0	0	0	0
	Sum of Projected Water Supply Needs (acre-feet)		**0**	**0**	**0**	**0**	**0**	**0**

BAILEY COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
O	County-Other, Bailey	Brazos	134	115	91	60	30	0
O	Irrigation, Bailey	Brazos	-15,298	-45,670	-45,670	-45,670	-45,670	-45,670
O	Livestock, Bailey	Brazos	649	256	7	-264	-562	-881
O	Muleshoe	Brazos	1,883	1,773	1,659	1,533	1,401	1,269
	Sum of Projected Water Supply Needs (acre-feet)		**-15,298**	**-45,670**	**-45,670**	**-45,934**	**-46,232**	**-46,551**

CASTRO COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
O	County-Other, Castro	Brazos	51	42	34	24	15	9
O	County-Other, Castro	Red	41	34	28	19	13	7
O	Dimmitt	Brazos	2,832	2,764	2,718	2,669	2,624	2,588
O	Hart Municipal Water System	Brazos	384	376	371	362	356	350
O	Irrigation, Castro	Brazos	-95,483	-143,175	-141,731	-140,716	-139,529	-138,651
O	Irrigation, Castro	Red	-29,559	-64,690	-66,134	-67,149	-68,336	-69,214
O	Livestock, Castro	Brazos	2,622	1,980	1,543	1,068	553	2
O	Livestock, Castro	Red	1,996	1,770	1,617	1,451	1,269	1,076
O	Manufacturing, Castro	Red	34	29	29	29	29	29
O	Nazareth	Red	418	408	402	395	389	384
	Sum of Projected Water Supply Needs (acre-feet)		**-125,042**	**-207,865**	**-207,865**	**-207,865**	**-207,865**	**-207,865**

COCHRAN COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
O	County-Other, Cochran	Brazos	46	24	17	16	7	4

O	County-Other, Cochran	Colorado	31	16	12	11	5	3
O	Irrigation, Cochran	Brazos	-42,778	-47,340	-40,014	-35,349	-31,132	-28,190
O	Irrigation, Cochran	Colorado	17,989	17,989	17,731	13,066	8,849	5,907
O	Livestock, Cochran	Brazos	237	234	232	229	226	226
O	Livestock, Cochran	Colorado	335	334	333	332	331	330
O	Mining, Cochran	Brazos	82	79	79	82	84	86
O	Mining, Cochran	Colorado	76	25	23	67	113	145
O	Morton PWS	Brazos	121	121	127	139	129	126
O	Whiteface	Brazos	195	191	192	193	190	189
	Sum of Projected Water Supply Needs (acre-feet)		**-42,778**	**-47,340**	**-40,014**	**-35,349**	**-31,132**	**-28,190**

CROSBY COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
O	County-Other, Crosby	Brazos	38	34	27	20	12	3
O	County-Other, Crosby	Red	0	0	0	0	0	0
O	Crosbyton	Brazos	81	69	59	42	23	6
O	Irrigation, Crosby	Brazos	60,033	13,346	-26,621	-26,815	-26,778	-26,700
O	Irrigation, Crosby	Red	-1,056	-1,246	-1,681	-1,487	-1,524	-1,602
O	Livestock, Crosby	Brazos	38	30	21	13	3	1
O	Livestock, Crosby	Red	2	2	2	1	1	1
O	Lorenzo	Brazos	673	658	646	629	608	594
O	Manufacturing, Crosby	Brazos	1	0	0	0	0	0
O	Mining, Crosby	Brazos	557	566	634	706	770	825
O	Mining, Crosby	Red	-368	-363	-322	-280	-243	-210
O	Ralls	Brazos	-78	-89	-98	-112	-129	-146
	Sum of Projected Water Supply Needs (acre-feet)		**-1,502**	**-1,698**	**-28,722**	**-28,694**	**-28,674**	**-28,658**

DEAF SMITH COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
O	County-Other, Deaf Smith	Canadian	1	1	1	1	1	0
O	County-Other, Deaf Smith	Red	397	336	263	166	87	0
O	Hereford	Red	2,902	2,405	1,842	1,170	623	20
O	Irrigation, Deaf Smith	Canadian	-2,101	-2,101	-1,628	-1,383	-1,255	-1,183
O	Irrigation, Deaf Smith	Red	-16,735	-85,668	-86,141	-86,386	-86,464	-86,486
O	Livestock, Deaf Smith	Canadian	-112	-122	-130	-138	-147	-157
O	Livestock, Deaf Smith	Red	1,031	54	-714	-1,539	-2,425	-3,358
O	Manufacturing, Deaf Smith	Red	-998	-1,103	-1,103	-1,103	-1,103	-1,103
	Sum of Projected Water Supply Needs (acre-feet)		**-19,946**	**-88,994**	**-89,716**	**-90,549**	**-91,394**	**-92,287**

FLOYD COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070

O	County-Other, Floyd	Brazos	67	51	38	23	11	1
O	County-Other, Floyd	Red	36	28	21	13	8	3
O	Floydada	Brazos	1,384	1,402	1,410	1,411	1,412	1,412
O	Irrigation, Floyd	Brazos	22,294	19,458	3,120	-4,998	-9,119	-11,216
O	Irrigation, Floyd	Red	-41,938	-42,645	-26,307	-18,189	-14,068	-11,971
O	Livestock, Floyd	Brazos	77	61	43	24	5	0
O	Livestock, Floyd	Red	394	389	384	378	372	371
O	Lockney	Brazos	262	256	254	244	236	229
O	Mining, Floyd	Brazos	3	0	2	3	4	3
O	Mining, Floyd	Red	3	0	1	3	4	4
	Sum of Projected Water Supply Needs (acre-feet)		**-41,938**	**-42,645**	**-26,307**	**-23,187**	**-23,187**	**-23,187**

HALE COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
O	Abernathy	Brazos	843	808	777	748	714	682
O	County-Other, Hale	Brazos	258	241	249	276	245	231
O	Hale Center	Brazos	675	685	692	696	697	697
O	Irrigation, Hale	Brazos	-103,952	-209,118	-209,463	-209,590	-209,631	-209,642
O	Irrigation, Hale	Red	-2,630	-2,647	-2,302	-2,175	-2,134	-2,123
O	Livestock, Hale	Brazos	1,346	987	773	537	278	0
O	Manufacturing, Hale	Brazos	-2,967	-3,660	-3,660	-3,660	-3,660	-3,660
O	Mining, Hale	Brazos	-953	-937	-807	-671	-551	-447
O	Petersburg Municipal Water System	Brazos	273	265	265	269	261	258
O	Plainview	Brazos	3,846	3,997	3,955	3,964	3,677	3,623
O	Steam-Electric Power, Hale	Brazos	0	0	0	0	0	0
	Sum of Projected Water Supply Needs (acre-feet)		**-110,502**	**-216,362**	**-216,232**	**-216,096**	**-215,976**	**-215,872**

HOCKLEY COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
O	Anton	Brazos	675	671	670	670	664	659
O	County-Other, Hockley	Brazos	223	200	192	199	161	135
O	County-Other, Hockley	Colorado	8	7	7	7	6	5
O	Irrigation, Hockley	Brazos	2,037	-43,079	-30,841	-27,041	-25,744	-25,183
O	Irrigation, Hockley	Colorado	4,830	4,830	3,745	-55	-1,352	-1,913
O	Levelland	Brazos	2,773	2,608	2,456	2,333	2,146	2,114
O	Livestock, Hockley	Brazos	236	231	226	221	216	215
O	Livestock, Hockley	Colorado	39	39	38	37	36	36
O	Manufacturing, Hockley	Brazos	124	9	9	9	9	9
O	Mining, Hockley	Brazos	1,295	1,295	1,296	1,296	1,297	1,298
O	Mining, Hockley	Colorado	234	234	234	234	234	234
O	Sundown	Colorado	443	425	413	411	391	378
	Sum of Projected Water Supply Needs (acre-feet)		**0**	**-43,079**	**-30,841**	**-27,096**	**-27,096**	**-27,096**

LAMB COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
O	Amherst	Brazos	132	127	124	121	115	110
O	County-Other, Lamb	Brazos	174	141	124	128	98	83
O	Earth	Brazos	499	500	504	507	504	504
O	Irrigation, Lamb	Brazos	-75,376	-186,771	-186,771	-186,771	-186,771	-186,771
O	Littlefield	Brazos	1,391	1,422	1,451	1,462	1,464	1,464
O	Livestock, Lamb	Brazos	1,285	696	315	-100	-555	-1,046
O	Manufacturing, Lamb	Brazos	193	60	60	60	60	60
O	Mining, Lamb	Brazos	-478	-471	-405	-337	-277	-225
O	Olton	Brazos	886	891	901	915	914	916
O	Steam-Electric Power, Lamb	Brazos	2,216	2,216	2,216	2,216	2,216	2,216
O	Sudan	Brazos	169	155	146	141	127	118
		Sum of Projected Water Supply Needs (acre-feet)	**-75,854**	**-187,242**	**-187,176**	**-187,208**	**-187,603**	**-188,042**

LUBBOCK COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
O	Abernathy	Brazos	293	300	312	331	333	339
O	County-Other, Lubbock	Brazos	2,543	2,760	3,111	2,171	1,211	1
O	Idalou	Brazos	872	865	855	839	821	803
O	Irrigation, Lubbock	Brazos	-3,892	-40,264	-41,064	-41,064	-41,064	-41,064
O	Livestock, Lubbock	Brazos	202	152	117	78	37	3
O	Lubbock	Brazos	-3,716	-8,472	-13,818	-19,356	-26,501	-32,370
O	Manufacturing, Lubbock	Brazos	-521	-676	-676	-676	-676	-676
O	Mining, Lubbock	Brazos	-5,372	-5,443	-4,931	-4,320	-3,781	-3,332
O	New Deal	Brazos	373	366	358	349	339	328
O	Ransom Canyon	Brazos	233	214	193	169	145	121
O	Shallowater	Brazos	244	202	159	108	56	4
O	Slaton	Brazos	1,334	1,273	1,190	1,098	1,015	1,006
O	Steam-Electric Power, Lubbock	Brazos	4,404	4,404	4,404	2,164	2,164	2,164
O	Wolfforth	Brazos	415	268	119	-43	-204	-366
		Sum of Projected Water Supply Needs (acre-feet)	**-13,501**	**-54,855**	**-60,489**	**-65,459**	**-72,226**	**-77,808**

LYNN COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
O	County-Other, Lynn	Brazos	76	73	82	89	75	69
O	County-Other, Lynn	Colorado	2	2	2	2	2	1
O	Irrigation, Lynn	Brazos	19,657	3,925	-5,465	-11,325	-14,937	-17,273
O	Irrigation, Lynn	Colorado	1,115	1,115	45	-986	-1,629	-2,001
O	Livestock, Lynn	Brazos	98	95	92	89	86	85
O	Livestock, Lynn	Colorado	4	4	4	4	3	3

O	Mining, Lynn	Brazos	-635	-785	-718	-511	-319	-165
O	Mining, Lynn	Colorado	11	0	5	20	35	47
O	ODonnell	Brazos	86	78	70	63	56	55
O	Tahoka Public Water System	Brazos	389	352	317	283	250	245
	Sum of Projected Water Supply Needs (acre-feet)		**-635**	**-785**	**-6,183**	**-12,822**	**-16,885**	**-19,439**

PARMER COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
O	Bovina	Brazos	198	169	142	113	75	40
O	County-Other, Parmer	Brazos	166	136	108	76	37	0
O	County-Other, Parmer	Red	119	97	78	55	27	1
O	Farwell	Brazos	465	432	401	368	327	289
O	Friona	Red	1,362	1,299	1,241	1,178	1,096	1,020
O	Irrigation, Parmer	Brazos	-122,909	-150,296	-140,764	-137,234	-135,074	-134,135
O	Irrigation, Parmer	Red	22,078	-11,452	-20,984	-24,514	-25,914	-26,752
O	Livestock, Parmer	Brazos	3,192	2,409	1,890	1,324	708	43
O	Livestock, Parmer	Red	798	602	472	331	177	10
O	Manufacturing, Parmer	Red	200	25	25	25	25	25
	Sum of Projected Water Supply Needs (acre-feet)		**-122,909**	**-161,748**	**-161,748**	**-161,748**	**-160,988**	**-160,887**

POTTER COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
A	Amarillo	Canadian	662	-1,881	-4,567	-7,764	-10,652	-12,695
A	Amarillo	Red	437	-1,239	-3,005	-5,111	-7,013	-8,359
A	County-Other, Potter	Canadian	900	900	900	900	900	900
A	County-Other, Potter	Red	0	0	0	0	0	0
A	Irrigation, Potter	Canadian	291	291	291	291	291	291
A	Irrigation, Potter	Red	570	570	570	570	570	570
A	Livestock, Potter	Canadian	95	78	60	41	20	0
A	Livestock, Potter	Red	0	0	0	0	0	0
A	Manufacturing, Potter	Canadian	0	-119	-174	-225	-278	-278
A	Manufacturing, Potter	Red	313	-510	-1,297	-2,102	-2,673	-2,931
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)		**0**	**-3,749**	**-9,043**	**-15,202**	**-20,616**	**-24,263**

RANDALL COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
A	Amarillo	Red	894	-2,550	-6,184	-10,540	-14,463	-17,216
A	Canyon	Red	560	-54	-696	-1,364	-2,578	-3,171

A	County-Other, Randall	Red	714	711	708	705	703	701
A	Happy	Red	0	0	0	0	0	0
A	Irrigation, Randall	Red	863	1,029	1,154	1,282	1,419	1,488
A	Lake Tanglewood	Red	172	154	134	117	105	105
A	Livestock, Randall	Red	0	0	0	0	0	0
A	Manufacturing, Randall	Red	5	-151	-225	-300	-354	-379
		Sum of Projected Water Supply Needs (acre-feet)	**0**	**-2,755**	**-7,105**	**-12,204**	**-17,395**	**-20,766**

SWISHER COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
O	County-Other, Swisher	Brazos	13	12	13	13	11	10
O	County-Other, Swisher	Red	77	76	78	81	67	60
O	Happy	Red	377	375	374	375	370	365
O	Irrigation, Swisher	Brazos	-1,927	-16,395	-16,504	-16,328	-16,104	-15,578
O	Irrigation, Swisher	Red	-11,251	-54,427	-54,318	-54,494	-54,718	-54,922
O	Livestock, Swisher	Brazos	2,657	2,650	2,643	2,635	2,627	2,298
O	Livestock, Swisher	Red	704	575	439	297	148	0
O	Tulia	Red	939	921	928	941	901	881
		Sum of Projected Water Supply Needs (acre-feet)	**-13,178**	**-70,822**	**-70,822**	**-70,822**	**-70,822**	**-70,500**

Projected Water Management Strategies
TWDB 2022 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 Municipal Water System, Red (A)							
Municipal Conservation - Claude	DEMAND REDUCTION [Armstrong]	4	4	4	4	4	4
		4	**4**	**4**	**4**	**4**	**4**
Irrigation, Armstrong, Red (A)							
Irrigation Conservation - Armstrong County	DEMAND REDUCTION [Armstrong]	290	542	1,014	1,200	1,314	1,415
		290	**542**	**1,014**	**1,200**	**1,314**	**1,415**
Sum of Projected Water Management Strategies (acre-feet)		**294**	**546**	**1,018**	**1,204**	**1,318**	**1,419**

BAILEY COUNTY

WUG, Basin (RWPG)

All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
Irrigation, Bailey, Brazos (O)							
Bailey County Irrigation Water Conservation	DEMAND REDUCTION [Bailey]	2,643	4,405	5,040	4,445	4,106	3,893
		2,643	**4,405**	**5,040**	**4,445**	**4,106**	**3,893**
Muleshoe, Brazos (O)							
Bailey County - Muleshoe Local Groundwater Development	Ogallala and Edwards-Trinity-High Plains Aquifers [Bailey]	0	240	240	240	240	240
Bailey County - Muleshoe Municipal Water Conservation	DEMAND REDUCTION [Bailey]	40	22	10	7	13	23
		40	**262**	**250**	**247**	**253**	**263**
Sum of Projected Water Management Strategies (acre-feet)		**2,683**	**4,667**	**5,290**	**4,692**	**4,359**	**4,156**

CASTRO COUNTY

WUG, Basin (RWPG)

All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
Dimmitt, Brazos (O)							
Castro County - Dimmitt Municipal Water Conservation	DEMAND REDUCTION [Castro]	39	23	11	7	13	19
		39	**23**	**11**	**7**	**13**	**19**
Irrigation, Castro, Brazos (O)							
Castro County Irrigation Water Conservation	DEMAND REDUCTION [Castro]	7,407	12,346	13,672	11,512	10,582	10,142

		2020	2030	2040	2050	2060	2070
		7,407	**12,346**	**13,672**	**11,512**	**10,582**	**10,142**
Irrigation, Castro, Red (O)							
Castro County Irrigation Water Conservation	DEMAND REDUCTION [Castro]	3,989	6,648	7,362	6,199	5,698	5,461
		3,989	**6,648**	**7,362**	**6,199**	**5,698**	**5,461**
Nazareth, Red (O)							
Castro County - Nazareth Municipal Water Conservation	DEMAND REDUCTION [Castro]	7	7	6	7	8	9
		7	**7**	**6**	**7**	**8**	**9**
Sum of Projected Water Management Strategies (acre-feet)		**11,442**	**19,024**	**21,051**	**17,725**	**16,301**	**15,631**

COCHRAN COUNTY

WUG, Basin (RWPG)

All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
County-Other, Cochran, Brazos (O)							
Cochran County-Other Municipal Water Conservation	DEMAND REDUCTION [Cochran]	9	8	9	10	11	12
		9	**8**	**9**	**10**	**11**	**12**
County-Other, Cochran, Colorado (O)							
Cochran County-Other Municipal Water Conservation	DEMAND REDUCTION [Cochran]	6	6	6	6	8	8
		6	**6**	**6**	**6**	**8**	**8**
Irrigation, Cochran, Brazos (O)							
Cochran County Irrigation Water Conservation	DEMAND REDUCTION [Cochran]	2,029	3,381	4,036	3,604	3,244	2,997
		2,029	**3,381**	**4,036**	**3,604**	**3,244**	**2,997**
Irrigation, Cochran, Colorado (O)							
Cochran County Irrigation Water Conservation	DEMAND REDUCTION [Cochran]	955	1,591	1,900	1,696	1,527	1,410
		955	**1,591**	**1,900**	**1,696**	**1,527**	**1,410**
Morton PWS, Brazos (O)							
Cochran County - Morton Municipal Water Conservation	DEMAND REDUCTION [Cochran]	15	6	4	5	7	9
		15	**6**	**4**	**5**	**7**	**9**
Whiteface, Brazos (O)							
Cochran County - Whiteface Municipal Water Conservation	DEMAND REDUCTION [Cochran]	4	2	1	2	2	3
		4	**2**	**1**	**2**	**2**	**3**
Sum of Projected Water Management Strategies (acre-feet)		**3,018**	**4,994**	**5,956**	**5,323**	**4,799**	**4,439**

CROSBY COUNTY

WUG, Basin (RWPG)

All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
Irrigation, Crosby, Brazos (O)							
Crosby County Irrigation Water	DEMAND REDUCTION	3,100	5,166	7,232	5,724	4,964	4,551

Conservation	[Crosby]						
		3,100	**5,166**	**7,232**	**5,724**	**4,964**	**4,551**
Irrigation, Crosby, Red (O)							
Crosby County Irrigation Water Conservation	DEMAND REDUCTION [Crosby]	128	213	298	236	205	188
		128	**213**	**298**	**236**	**205**	**188**
Lorenzo, Brazos (O)							
Crosby County - Lorenzo Municipal Water Conservation	DEMAND REDUCTION [Crosby]	6	0	0	0	0	0
		6	**0**	**0**	**0**	**0**	**0**
Mining, Crosby, Brazos (O)							
Crosby County - Mining Water Conservation	DEMAND REDUCTION [Crosby]	6	18	28	24	21	18
		6	**18**	**28**	**24**	**21**	**18**
Mining, Crosby, Red (O)							
Crosby County - Mining Additional Groundwater Development	Ogallala and Edwards-Trinity-High Plains Aquifers [Crosby]	480	480	480	480	480	480
Crosby County - Mining Water Conservation	DEMAND REDUCTION [Crosby]	4	11	16	14	12	10
		484	**491**	**496**	**494**	**492**	**490**
Ralls, Brazos (O)							
Crosby County - Ralls Additional Groundwater Development	Ogallala and Edwards-Trinity-High Plains Aquifers [Crosby]	160	160	160	160	160	160
Crosby County - Ralls Municipal Conservation	DEMAND REDUCTION [Crosby]	6	0	0	0	0	0
		166	**160**	**160**	**160**	**160**	**160**
Sum of Projected Water Management Strategies (acre-feet)		**3,890**	**6,048**	**8,214**	**6,638**	**5,842**	**5,407**

DEAF SMITH COUNTY

WUG, Basin (RWPG)

All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
Hereford, Red (O)							
Deaf Smith County - Hereford Municipal Water Conservation	DEMAND REDUCTION [Deaf Smith]	135	79	42	36	62	98
		135	**79**	**42**	**36**	**62**	**98**
Irrigation, Deaf Smith, Canadian (O)							
Deaf Smith County Irrigation Water Conservation	DEMAND REDUCTION [Deaf Smith]	63	105	114	97	88	83
		63	**105**	**114**	**97**	**88**	**83**
Irrigation, Deaf Smith, Red (O)							
Deaf Smith County Irrigation Water Conservation	DEMAND REDUCTION [Deaf Smith]	6,237	10,396	11,275	9,582	8,693	8,193
		6,237	**10,396**	**11,275**	**9,582**	**8,693**	**8,193**
Manufacturing, Deaf Smith, Red (O)							
Deaf Smith County - Manufacturing Additional Groundwater Development	Ogallala and Edwards-Trinity-High Plains	1,250	1,250	1,250	1,250	1,250	1,250

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
	Aquifers [Deaf Smith]						
Deaf Smith County - Manufacturing Water Conservation	DEMAND REDUCTION [Deaf Smith]	10	33	55	55	55	55
		1,260	**1,283**	**1,305**	**1,305**	**1,305**	**1,305**
Sum of Projected Water Management Strategies (acre-feet)		**7,695**	**11,863**	**12,736**	**11,020**	**10,148**	**9,679**

FLOYD COUNTY

WUG, Basin (RWPG)

All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
Floydada, Brazos (O)							
Floyd County - Floydada Municipal Water Conservation	DEMAND REDUCTION [Floyd]	12	0	0	0	0	0
		12	**0**	**0**	**0**	**0**	**0**
Irrigation, Floyd, Brazos (O)							
Floyd County Irrigation Water Conservation	DEMAND REDUCTION [Floyd]	1,391	2,319	2,583	2,237	2,039	1,921
		1,391	**2,319**	**2,583**	**2,237**	**2,039**	**1,921**
Irrigation, Floyd, Red (O)							
Floyd County Irrigation Water Conservation	DEMAND REDUCTION [Floyd]	2,474	4,123	4,592	3,978	3,624	3,415
		2,474	**4,123**	**4,592**	**3,978**	**3,624**	**3,415**
Sum of Projected Water Management Strategies (acre-feet)		**3,877**	**6,442**	**7,175**	**6,215**	**5,663**	**5,336**

HALE COUNTY

WUG, Basin (RWPG)

All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
Abernathy, Brazos (O)							
Hale County - Abernathy Municipal Water Conservation	DEMAND REDUCTION [Hale]	22	13	9	7	9	12
		22	**13**	**9**	**7**	**9**	**12**
Irrigation, Hale, Brazos (O)							
Hale County Irrigation Water Conservation	DEMAND REDUCTION [Hale]	9,223	15,372	18,453	16,932	16,172	15,771
		9,223	**15,372**	**18,453**	**16,932**	**16,172**	**15,771**
Irrigation, Hale, Red (O)							
Hale County Irrigation Water Conservation	DEMAND REDUCTION [Hale]	93	155	186	171	163	159
		93	**155**	**186**	**171**	**163**	**159**
Manufacturing, Hale, Brazos (O)							
Hale County - Manufacturing Additional Groundwater Development	Ogallala and Edwards-Trinity-High Plains Aquifers [Hale]	4,000	4,000	4,000	4,000	4,000	4,000
Hale County - Manufacturing Water Conservation	DEMAND REDUCTION [Hale]	44	152	254	254	254	254
		4,044	**4,152**	**4,254**	**4,254**	**4,254**	**4,254**
Mining, Hale, Brazos (O)							

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
Hale County - Mining Additional Groundwater Development	Ogallala and Edwards-Trinity-High Plains Aquifers [Hale]	965	965	965	965	965	965
Hale County - Mining Water Conservation	DEMAND REDUCTION [Hale]	12	35	51	44	38	33
		977	**1,000**	**1,016**	**1,009**	**1,003**	**998**
Petersburg Municipal Water System, Brazos (O)							
Hale County - Petersburg Municipal Water Conservation	DEMAND REDUCTION [Hale]	13	10	6	6	7	9
		13	**10**	**6**	**6**	**7**	**9**
Plainview, Brazos (O)							
CRMWA ASR	Ogallala Aquifer ASR [Lubbock]	0	200	500	500	500	500
Expand Capacity CRMWA 2	Ogallala Aquifer [Roberts]	0	354	298	530	527	441
Hale County - Plainview ASR	Ogallala Aquifer ASR [Hale]	0	987	987	987	987	987
Hale County - Plainview Municipal Water Conservation	DEMAND REDUCTION [Hale]	130	38	0	0	0	0
Hale County - Plainview Reuse	Direct Reuse [Hale]	0	0	560	560	560	560
Replace Well Capacity	Ogallala Aquifer [Roberts]	0	0	53	151	330	419
		130	**1,579**	**2,398**	**2,728**	**2,904**	**2,907**
Sum of Projected Water Management Strategies (acre-feet)		**14,502**	**22,281**	**26,322**	**25,107**	**24,512**	**24,110**

HOCKLEY COUNTY

WUG, Basin (RWPG)

All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
Irrigation, Hockley, Brazos (O)							
Hockley County Irrigation Water Conservation	DEMAND REDUCTION [Hockley]	3,681	6,135	6,367	5,456	5,027	4,794
		3,681	**6,135**	**6,367**	**5,456**	**5,027**	**4,794**
Irrigation, Hockley, Colorado (O)							
Hockley County Irrigation Water Conservation	DEMAND REDUCTION [Hockley]	275	458	475	407	375	358
		275	**458**	**475**	**407**	**375**	**358**
Levelland, Brazos (O)							
CRMWA ASR	Ogallala Aquifer ASR [Lubbock]	0	100	500	500	500	500
Expand Capacity CRMWA 2	Ogallala Aquifer [Roberts]	0	343	298	530	527	441
Hockley County - Levelland Municipal Water Conservation	DEMAND REDUCTION [Hockley]	45	0	0	0	0	0
Replace Well Capacity	Ogallala Aquifer [Roberts]	0	0	41	111	252	328
		45	**443**	**839**	**1,141**	**1,279**	**1,269**
Sundown, Colorado (O)							
Hockley County - Sundown Municipal Water Conservation	DEMAND REDUCTION [Hockley]	17	11	10	11	14	17
		17	**11**	**10**	**11**	**14**	**17**
Sum of Projected Water Management Strategies (acre-feet)		**4,018**	**7,047**	**7,691**	**7,015**	**6,695**	**6,438**

LAMB COUNTY

WUG, Basin (RWPG)

All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
Irrigation, Lamb, Brazos (O)							
Lamb County Irrigation Water Conservation	DEMAND REDUCTION [Lamb]	7,784	12,973	15,301	14,277	13,826	13,593
		7,784	**12,973**	**15,301**	**14,277**	**13,826**	**13,593**
Littlefield, Brazos (O)							
Lamb County - Littlefield Additional Groundwater Development	Ogallala and Edwards-Trinity-High Plains Aquifers [Lamb]	0	240	240	240	240	240
		0	**240**	**240**	**240**	**240**	**240**
Mining, Lamb, Brazos (O)							
Lamb County - Mining Additional Groundwater Development	Ogallala and Edwards-Trinity-High Plains Aquifers [Lamb]	480	480	480	480	480	480
Lamb County - Mining Water Conservation	DEMAND REDUCTION [Lamb]	6	17	26	22	19	17
		486	**497**	**506**	**502**	**499**	**497**
Olton, Brazos (O)							
Lamb County - Olton Municipal Water Conservation	DEMAND REDUCTION [Lamb]	17	9	3	1	2	5
		17	**9**	**3**	**1**	**2**	**5**
Sudan, Brazos (O)							
Lamb County - Sudan Municipal Water Conservation	DEMAND REDUCTION [Lamb]	10	6	3	3	5	5
		10	**6**	**3**	**3**	**5**	**5**
Sum of Projected Water Management Strategies (acre-feet)		**8,297**	**13,725**	**16,053**	**15,023**	**14,572**	**14,340**

LUBBOCK COUNTY

WUG, Basin (RWPG)

All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
Abernathy, Brazos (O)							
Hale County - Abernathy Municipal Water Conservation	DEMAND REDUCTION [Lubbock]	7	5	4	3	4	6
		7	**5**	**4**	**3**	**4**	**6**
Idalou, Brazos (O)							
Lubbock County - Idalou Municipal Water Conservation	DEMAND REDUCTION [Lubbock]	13	3	0	0	0	0
		13	**3**	**0**	**0**	**0**	**0**
Irrigation, Lubbock, Brazos (O)							
Lubbock County Irrigation Water Conservation	DEMAND REDUCTION [Lubbock]	4,346	7,243	9,282	8,702	8,288	7,998
		4,346	**7,243**	**9,282**	**8,702**	**8,288**	**7,998**
Lubbock, Brazos (O)							

	Expand Capacity CRMWA 2	Ogallala Aquifer [Roberts]	0	7,201	10,679	13,812	13,792	12,642
	Lubbock County - Lubbock Bailey County Well Field Capacity Maintenance	Ogallala and Edwards-Trinity-High Plains Aquifers [Bailey]	2,431	2,431	2,431	2,431	2,431	2,431
	Lubbock County - Lubbock CRMWA Aquifer Storage and Recovery	Ogallala Aquifer ASR [Lubbock]	0	0	0	0	10,920	10,920
	Lubbock County - Lubbock Direct Potable Reuse to North Water Treatment Plant	Direct Reuse [Lubbock]	0	0	0	0	0	8,064
	Lubbock County - Lubbock Jim Bertram Lake 7	Lake 7 (Jim Bertram Lake/Reservoir System) [Reservoir]	0	0	11,975	11,975	11,975	11,975
	Lubbock County - Lubbock Lake Alan Henry Phase 2	Alan Henry Lake/Reservoir [Reservoir]	0	5,100	5,100	5,100	5,100	5,100
	Lubbock County - Lubbock Municipal Water Conservation	DEMAND REDUCTION [Lubbock]	1,289	393	0	0	0	0
	Replace Well Capacity	Ogallala Aquifer [Roberts]	0	0	711	2,024	4,431	5,627
			3,720	**15,125**	**30,896**	**35,342**	**48,649**	**56,759**
Manufacturing, Lubbock, Brazos (O)								
	Lubbock County - Manufacturing Additional Groundwater Development	Ogallala and Edwards-Trinity-High Plains Aquifers [Lubbock]	800	800	800	800	800	800
	Lubbock County - Manufacturing Water Conservation	DEMAND REDUCTION [Lubbock]	9	30	51	51	51	51
			809	**830**	**851**	**851**	**851**	**851**
Mining, Lubbock, Brazos (O)								
	Lubbock County - Mining Additional Groundwater Development	Ogallala and Edwards-Trinity-High Plains Aquifers [Lubbock]	5,560	5,560	5,560	5,560	5,560	5,560
	Lubbock County - Mining Water Conservation	DEMAND REDUCTION [Lubbock]	64	193	296	265	238	216
			5,624	**5,753**	**5,856**	**5,825**	**5,798**	**5,776**
Ransom Canyon, Brazos (O)								
	Lubbock County - Ransom Canyon Municipal Water Conservation	DEMAND REDUCTION [Lubbock]	17	14	13	14	17	20
			17	**14**	**13**	**14**	**17**	**20**
Slaton, Brazos (O)								
	Expand Capacity CRMWA 2	Ogallala Aquifer [Roberts]	0	264	357	435	433	397
	Replace Well Capacity	Ogallala Aquifer [Roberts]	0	0	24	64	139	177
			0	**264**	**381**	**499**	**572**	**574**
Wolfforth, Brazos (O)								
	Lubbock County - Wolfforth Local Groundwater Development	Ogallala and Edwards-Trinity-High Plains Aquifers [Lubbock]	0	0	800	800	800	800
	Lubbock County - Wolfforth Municipal Water Conservation	DEMAND REDUCTION [Lubbock]	21	10	4	4	9	17
			21	**10**	**804**	**804**	**809**	**817**
	Sum of Projected Water Management Strategies (acre-feet)		**14,557**	**29,247**	**48,087**	**52,040**	**64,988**	**72,801**

LYNN COUNTY

WUG, Basin (RWPG)

All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
Irrigation, Lynn, Brazos (O)							
Lynn County Irrigation Water Conservation	DEMAND REDUCTION [Lynn]	2,490	4,150	5,809	5,809	5,809	5,809
		2,490	**4,150**	**5,809**	**5,809**	**5,809**	**5,809**
Irrigation, Lynn, Colorado (O)							
Lynn County Irrigation Water Conservation	DEMAND REDUCTION [Lynn]	178	297	415	415	415	415
		178	**297**	**415**	**415**	**415**	**415**
Mining, Lynn, Brazos (O)							
Lynn County - Mining Additional Groundwater Supply	Ogallala and Edwards-Trinity-High Plains Aquifers [Lynn]	800	800	800	800	800	800
Lynn County - Mining Water Conservation	DEMAND REDUCTION [Lynn]	11	37	59	48	38	31
		811	**837**	**859**	**848**	**838**	**831**
Mining, Lynn, Colorado (O)							
Lynn County - Mining Water Conservation	DEMAND REDUCTION [Lynn]	1	3	4	4	3	2
		1	**3**	**4**	**4**	**3**	**2**
ODonnell, Brazos (O)							
Expand Capacity CRMWA 2	Ogallala Aquifer [Roberts]	0	20	26	31	32	31
Replace Well Capacity	Ogallala Aquifer [Roberts]	0	0	2	4	10	14
		0	**20**	**28**	**35**	**42**	**45**
Tahoka Public Water System, Brazos (O)							
Expand Capacity CRMWA 2	Ogallala Aquifer [Roberts]	0	90	117	138	144	135
Lynn County - Tahoka Municipal Water Conservation	DEMAND REDUCTION [Lynn]	10	0	0	0	0	0
Replace Well Capacity	Ogallala Aquifer [Roberts]	0	0	8	20	46	60
		10	**90**	**125**	**158**	**190**	**195**
Sum of Projected Water Management Strategies (acre-feet)		**3,490**	**5,397**	**7,240**	**7,269**	**7,297**	**7,297**

PARMER COUNTY

WUG, Basin (RWPG)

All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
Bovina, Brazos (O)							
Parmer County - Bovina Municipal Water Conservation	DEMAND REDUCTION [Parmer]	9	1	0	0	0	0
		9	**1**	**0**	**0**	**0**	**0**
County-Other, Parmer, Brazos (O)							
Parmer County-Other Municipal Water Conservation	DEMAND REDUCTION [Parmer]	10	2	0	0	0	0
		10	**2**	**0**	**0**	**0**	**0**
County-Other, Parmer, Red (O)							
Parmer County-Other Municipal Water Conservation	DEMAND REDUCTION [Parmer]	8	2	0	0	0	0

		8	2	0	0	0	0
Farwell, Brazos (O)							
Parmer County - Farwell Municipal Water Conservation	DEMAND REDUCTION [Parmer]	16	11	8	8	11	15
		16	**11**	**8**	**8**	**11**	**15**
Friona, Red (O)							
Parmer County - Friona Municipal Water Conservation	DEMAND REDUCTION [Parmer]	21	4	0	0	0	0
		21	**4**	**0**	**0**	**0**	**0**
Irrigation, Parmer, Brazos (O)							
Parmer County Irrigation Water Conservation	DEMAND REDUCTION [Parmer]	5,743	9,571	11,616	10,747	10,241	9,959
		5,743	**9,571**	**11,616**	**10,747**	**10,241**	**9,959**
Irrigation, Parmer, Red (O)							
Parmer County Irrigation Water Conservation	DEMAND REDUCTION [Parmer]	1,434	2,390	2,901	2,684	2,557	2,487
		1,434	**2,390**	**2,901**	**2,684**	**2,557**	**2,487**
Sum of Projected Water Management Strategies (acre-feet)		**7,241**	**11,981**	**14,525**	**13,439**	**12,809**	**12,461**

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)							
Advanced Metering Infrastructure - Amarillo	DEMAND REDUCTION [Potter]	494	549	608	666	729	796
Amarillo ASR	Ogallala Aquifer ASR [Randall]	0	1,660	2,158	2,155	2,155	2,156
Develop Potter/Carson County Well Field (Ogallala Aquifer) - Amarillo	Ogallala Aquifer [Carson]	0	3,319	3,319	6,631	6,631	6,635
Develop Roberts County Well Field (Ogallala Aquifer) - Amarillo	Ogallala Aquifer [Roberts]	0	0	0	0	0	3,719
Direct Potable Reuse - Amarillo	Direct Reuse [Potter]	0	664	664	663	663	663
Expand Capacity CRMWA 2	Ogallala Aquifer [Roberts]	0	1,633	1,816	2,279	2,186	1,686
Municipal Conservation - Amarillo	DEMAND REDUCTION [Potter]	325	361	399	437	479	522
Replace Well Capacity	Ogallala Aquifer [Roberts]	0	0	271	714	1,563	1,986
Water Audit And Leak Repair - Amarillo	DEMAND REDUCTION [Potter]	691	753	820	893	976	1,065
		1,510	**8,939**	**10,055**	**14,438**	**15,382**	**19,228**
Amarillo, Red (A)							
Advanced Metering Infrastructure - Amarillo	DEMAND REDUCTION [Potter]	326	362	400	438	480	524
Amarillo ASR	Ogallala Aquifer ASR [Randall]	0	1,092	1,420	1,419	1,419	1,420
Develop Potter/Carson County Well Field (Ogallala Aquifer) - Amarillo	Ogallala Aquifer [Carson]	0	2,185	2,185	4,366	4,366	4,368
Develop Roberts County Well Field (Ogallala Aquifer) - Amarillo	Ogallala Aquifer [Roberts]	0	0	0	0	0	2,448
Direct Potable Reuse - Amarillo	Direct Reuse [Potter]	0	437	437	437	437	437

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
Expand Capacity CRMWA 2	Ogallala Aquifer [Roberts]	0	1,075	1,196	1,501	1,439	1,110
Municipal Conservation - Amarillo	DEMAND REDUCTION [Potter]	214	238	263	288	315	344
Replace Well Capacity	Ogallala Aquifer [Roberts]	0	0	179	470	1,029	1,307
Water Audit And Leak Repair - Amarillo	DEMAND REDUCTION [Potter]	455	496	541	588	642	701
		995	**5,885**	**6,621**	**9,507**	**10,127**	**12,659**
Irrigation, Potter, Canadian (A)							
Irrigation Conservation - Potter County	DEMAND REDUCTION [Potter]	39	88	164	190	204	214
		39	**88**	**164**	**190**	**204**	**214**
Irrigation, Potter, Red (A)							
Irrigation Conservation - Potter County	DEMAND REDUCTION [Potter]	81	184	341	395	427	447
		81	**184**	**341**	**395**	**427**	**447**
Manufacturing, Potter, Canadian (A)							
Develop Ogallala Aquifer Supplies - Potter County Manufacturing	Ogallala Aquifer [Potter]	0	0	13	13	13	13
Expand Capacity CRMWA 2	Ogallala Aquifer [Roberts]	0	119	161	212	265	265
		0	**119**	**174**	**225**	**278**	**278**
Manufacturing, Potter, Red (A)							
Develop Ogallala Aquifer Supplies - Potter County Manufacturing	Ogallala Aquifer [Potter]	0	0	137	137	137	137
Expand Capacity CRMWA 2	Ogallala Aquifer [Roberts]	0	524	1,269	2,023	2,540	2,799
		0	**524**	**1,406**	**2,160**	**2,677**	**2,936**
Sum of Projected Water Management Strategies (acre-feet)		**2,625**	**15,739**	**18,761**	**26,915**	**29,095**	**35,762**

RANDALL COUNTY

WUG, Basin (RWPG)

All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
Amarillo, Red (A)							
Advanced Metering Infrastructure - Amarillo	DEMAND REDUCTION [Randall]	665	744	823	904	989	1,078
Amarillo ASR	Ogallala Aquifer ASR [Randall]	0	2,248	2,922	2,926	2,926	2,924
Develop Potter/Carson County Well Field (Ogallala Aquifer) - Amarillo	Ogallala Aquifer [Carson]	0	4,496	4,496	9,003	9,003	8,997
Develop Roberts County Well Field (Ogallala Aquifer) - Amarillo	Ogallala Aquifer [Roberts]	0	0	0	0	0	5,043
Direct Potable Reuse - Amarillo	Direct Reuse [Potter]	0	899	899	900	900	900
Expand Capacity CRMWA 2	Ogallala Aquifer [Roberts]	0	2,213	2,460	3,094	2,967	2,287
Municipal Conservation - Amarillo	DEMAND REDUCTION [Randall]	437	488	540	594	650	709
Replace Well Capacity	Ogallala Aquifer [Roberts]	0	0	367	969	2,122	2,693
Water Audit And Leak Repair - Amarillo	DEMAND REDUCTION [Randall]	931	1,019	1,111	1,211	1,325	1,443
		2,033	**12,107**	**13,618**	**19,601**	**20,882**	**26,074**
Canyon, Red (A)							

Develop Dockum/Ogallala Aquifer Supplies - Canyon	Dockum Aquifer [Randall]	0	750	750	750	1,500	1,500
Develop Dockum/Ogallala Aquifer Supplies - Canyon	Ogallala Aquifer [Randall]	0	750	750	750	1,500	1,500
Expand Capacity CRMWA 2	Ogallala Aquifer [Roberts]	0	105	234	365	0	0
Municipal Conservation - Canyon	DEMAND REDUCTION [Randall]	45	51	56	89	98	107
Water Audit And Leak Repair - Canyon	DEMAND REDUCTION [Randall]	174	191	208	227	249	271
		219	**1,847**	**1,998**	**2,181**	**3,347**	**3,378**
County-Other, Randall, Red (A)							
Expand Capacity CRMWA 2	Ogallala Aquifer [Roberts]	0	3	6	9	11	13
		0	**3**	**6**	**9**	**11**	**13**
Irrigation, Randall, Red (A)							
Irrigation Conservation - Randall County	DEMAND REDUCTION [Randall]	1,003	2,027	3,820	4,454	4,810	5,089
		1,003	**2,027**	**3,820**	**4,454**	**4,810**	**5,089**
Lake Tanglewood, Red (A)							
Municipal Conservation - Lake Tanglewood	DEMAND REDUCTION [Randall]	3	3	3	3	3	3
		3	**3**	**3**	**3**	**3**	**3**
Manufacturing, Randall, Red (A)							
Develop Ogallala Aquifer Supplies - Randall County Manufacturing	Ogallala Aquifer [Randall]	0	100	100	100	100	100
Expand Capacity CRMWA 2	Ogallala Aquifer [Roberts]	0	61	135	210	264	289
		0	**161**	**235**	**310**	**364**	**389**
Sum of Projected Water Management Strategies (acre-feet)		**3,258**	**16,148**	**19,680**	**26,558**	**29,417**	**34,946**

SWISHER COUNTY

WUG, Basin (RWPG)

All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
Irrigation, Swisher, Brazos (O)							
Swisher County Irrigation Water Conservation	DEMAND REDUCTION [Swisher]	731	1,219	1,387	1,231	1,144	1,090
		731	**1,219**	**1,387**	**1,231**	**1,144**	**1,090**
Irrigation, Swisher, Red (O)							
Swisher County Irrigation Water Conservation	DEMAND REDUCTION [Swisher]	3,331	5,551	6,316	5,606	5,210	4,967
		3,331	**5,551**	**6,316**	**5,606**	**5,210**	**4,967**
Tulia, Red (O)							
Swisher County - Tulia Municipal Water Conservation	DEMAND REDUCTION [Swisher]	22	2	0	0	0	0
		22	**2**	**0**	**0**	**0**	**0**
Sum of Projected Water Management Strategies (acre-feet)		**4,084**	**6,772**	**7,703**	**6,837**	**6,354**	**6,057**