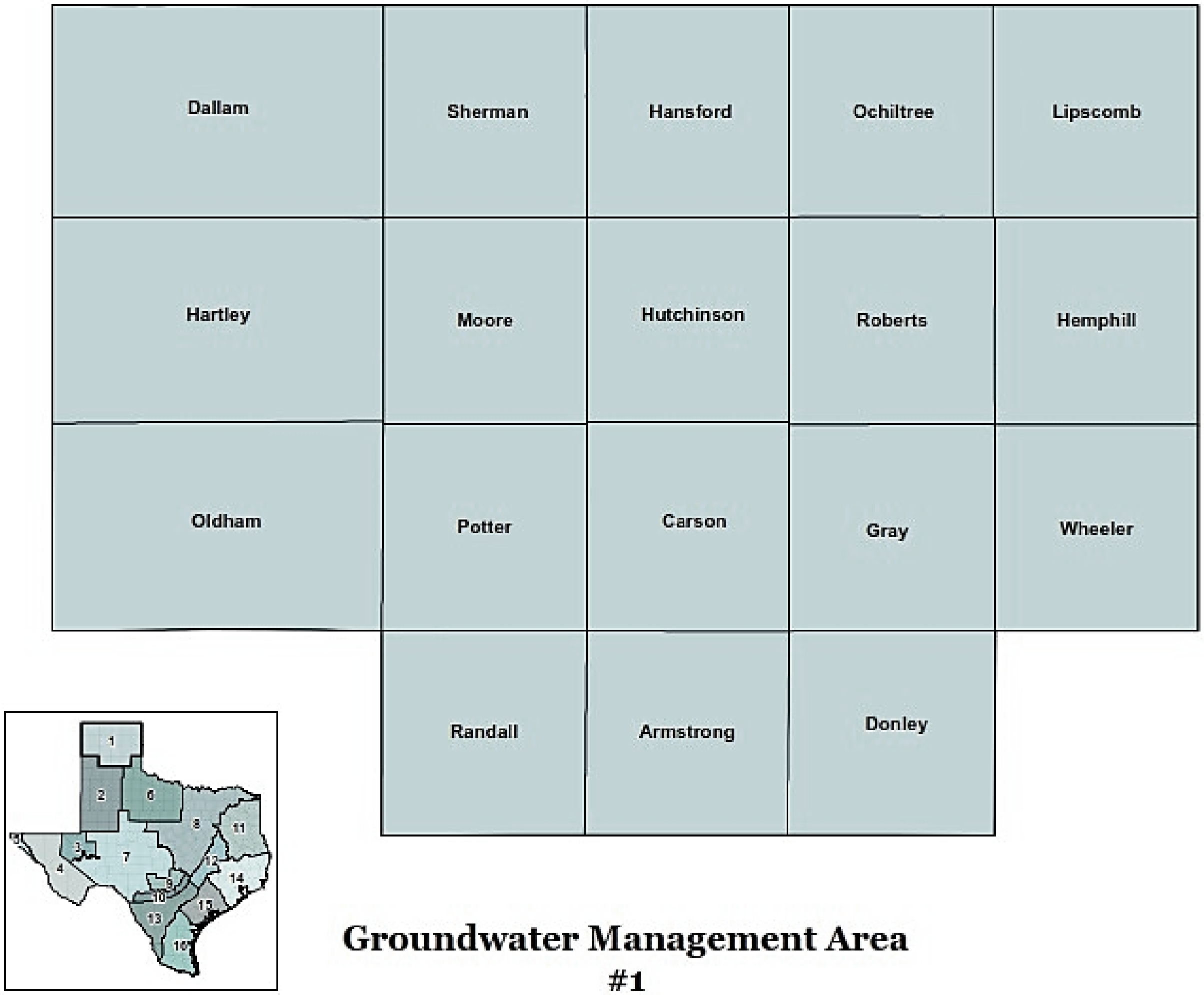

DESIRED FUTURE CONDITIONS EXPLANATORY REPORT

December 2021

PREPARED BY GROUNDWATER MANAGEMENT AREA 1
WITH ASSISTANCE FROM: INTERA INC.

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DESIRED FUTURE CONDITIONS EXPLANATORY REPORT

Prepared by Groundwater Management Area 1

The following explanatory report was prepared by Groundwater Management Area 1 with technical assistance from Wade Oliver, a licensed Professional Geoscientist with INTERA Inc.

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[signature] 12/27/2021

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ACRONYMS AND ABBREVIATIONS

CRMWA	Canadian River Municipal Water Authority
DFC	Desired Future Conditions
Districts	Groundwater Conservation Districts
ET	evapotranspiration
GAM	groundwater availability model
GCD	Groundwater Conservation Districts
GMA 1	Groundwater Management Area 1
GMA 2	Groundwater Management Area 2
gpm	gallons per minute
Hemphill UWCD	Hemphill County Underground Water Conservation District
High Plains UWCD	High Plains Underground Water Conservation District No. 1
HPASGAM	High Plains Aquifer System GAM
INTERA	INTERA Incorporated
MAG	modeled available groundwater
North Plains GCD	North Plains Groundwater Conservation District
Panhandle GCD	Panhandle Groundwater Conservation District
PRWP	Panhandle Regional Water Plan
PWPA	Panhandle Water Planning Area
TERS	total estimated recoverable storage
TWC	Texas Water Code
TWDB	Texas Water Development Board
TWDB	Texas Administrative Code
WUG	water user group
WUSGPE	Water Use Survey Groundwater Pumpage Estimates

EXECUTIVE SUMMARY

Groundwater Management Area 1 (GMA 1) Groundwater Conservation Districts (GCDs or Districts) prepared this Explanatory Report for Desired Future Conditions (DFCs) for the Ogallala, Rita Blanca, and Dockum aquifers to comply with the requirements of Texas Water Code (TWC), Section 36.108. The Districts include all of Hemphill County Underground Water Conservation District (Hemphill UWCD), North Plains Groundwater Conservation District (North Plains GCD), Panhandle Groundwater Conservation District (Panhandle GCD), and part of High Plains Underground Water Conservation District No. 1 (High Plains UWCD). GMA 1 Districts prepared this Explanatory Report in compliance with the TWC and administrative rules of the Texas Water Development Board (TWDB) found in Title 31 Texas Administrative Code (TAC) Chapter 356.

The GCDs located in GMA 1 are local political subdivisions of the state pursuant to TWC Chapter 36 and their specific enabling statutes. GMA 1 Districts fulfilled the requirements for adopting DFCs through cooperation and joint planning efforts.

On August 26, 2021, GMA 1 Districts Representatives unanimously adopted DFCs for the relevant aquifers within the management area.

The Ogallala Aquifer and the Rita Blanca Aquifer are combined for joint-planning purposes. Any references to the “Ogallala Aquifer” in this document shall also include and apply to any groundwater in the Rita Blanca Aquifer in GMA 1.

Ogallala Aquifer (Inclusive of Rita Blanca):

- 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, Hutchinson, 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 in Potter Counties.

Dockum Aquifer:

- At least 40 percent of the average available drawdown remaining for each 50-year period between 2018 and 2080 for 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; and

- 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.

Additionally, GMA 1 District Representatives determined that the Blaine Aquifer in Wheeler County is non-relevant for joint planning purposes, as provided by in Title 31, TAC Chapter 356. This Explanatory Report incorporates the requisite documentation regarding the Blaine Aquifer's non-relevant determination by GMA 1.

GMA 1 District Representatives held 15 meetings over a three-year period for the purposes of joint planning in the management area, including October 23, 2018; January 11, 2019; March 28, 2019; August 26, 2019; October 28, 2019; December 12, 2019; February 18, 2020; May 21, 2020; June 25, 2020; July 23, 2020; September 24, 2020; November 19, 2020; January 21, 2021; February 18, 2021; and March 18, 2021.

1 GROUNDWATER MANAGEMENT AREA 1 JOINT PLANNING

TWC Section 36.108(d-2) requires that DFCs proposed as part of joint planning in a management area must provide a balance between the highest practicable level of groundwater production and the conservation, preservation, protection, recharging, and prevention of waste of groundwater and control of subsidence in the management area. GMA 1 Districts established different DFCs throughout the management area based on a combination of policy and technical considerations that provide continued economic development of the area while providing for the reasonable long-term management of groundwater resources.

GMA 1 Districts are local political subdivisions of the state pursuant to TWC Chapter 36 and their specific enabling statutes. Each GMA 1 District fulfills the requirements of TWC Section 36 through cooperation and joint planning efforts. Oldham County, along with portions of Hartley, Hutchinson, Moore, and Randall counties are not within the jurisdiction of a GCD but are served for joint planning purposes by the GMA 1 Districts. The GMA 1 Districts last adopted DFCs within GMA 1 for the Ogallala Aquifer and the Dockum Aquifer on November 2, 2016.

TWC Section 36.108(d-3) requires that district representatives in a groundwater management area adopt DFCs for all relevant aquifers in the management area. The districts must also produce an Explanatory Report documenting the process and factors considered and submit it to the TWDB. This Explanatory Report provides documentation that GMA 1 District Representatives considered during this round of joint planning all required Factors included in TWC Section 36.108(d)(1–9).

TWC Chapter 36 requires districts within a management area to consider groundwater availability models (GAMs) and other data or information for the management area when proposing DFCs for the relevant aquifers within the management area for adoption. GMA 1 proposed DFCs for adoption on March 18, 2021, as required by TWC Section 36.108 (d-5). Consistent with TWC Section 36.108(d), before proposing DFCs as required under TWC Section 36.108(d-2), GMA 1 District Representatives considered the following factors:

(1) aquifer uses or conditions within the management area, including conditions that differ substantially from one geographic area to another.

(2) the water supply needs and water management strategies included in the state water plan.

(3) hydrological conditions, including for each aquifer in the management area the total estimated recoverable storage as provided by the executive administrator, and the average annual recharge, inflows, and discharge.

(4) other environmental impacts, including impacts on spring flow and other interactions between groundwater and surface water.

(5) the impact on subsidence.

(6) socioeconomic impacts reasonably expected to occur.

(7) the impact on the interests and rights in private property, including ownership and the rights of management area landowners and their lessees and assigns in groundwater.

(8) the feasibility of achieving the desired future condition.

All information considered by GMA 1 District Representatives was determined to be applicable to one or more of the factors listed above.

After considering and documenting each of the factors described above and other relevant scientific and hydrogeological data, if available, the Districts may establish different DFCs for:

(1) each aquifer, subdivision of an aquifer, or geologic strata located in whole or in part within the boundaries of the management area; or

(2) each geographic area overlying an aquifer in whole or in part or subdivision of an aquifer within the boundaries of the management area.

This Explanatory Report:

(1) identifies each DFC.

(2) provides the policy and technical justifications for each desired future condition.

(3) includes documentation that the Factors under Section 36.108(d) were considered by the districts and a discussion of how the adopted DFCs impact each factor.

(4) lists other DFC options considered, if any, and the reasons why those options were not adopted.

(5) discusses reasons why recommendations from public comments received by the districts were or were not incorporated into the DFCs.

GMA 1 District Representatives held 16 meetings over a three-year period for the purposes of joint planning in the management area including October 23, 2018; January 11, 2019; March 28, 2019; August 26, 2019; October 28, 2019; December 12, 2019; February 18, 2020; May 21, 2020; June 25, 2020; July 23, 2020; September 24, 2020; November 19, 2020; January 21, 2021; February 18, 2021; March 18, 2021; and August 26, 2021. Table 1.1 shows the meeting dates during which the GMA 1 District Representatives considered each of the above required factors. During the January 21, 2021 meeting, the District Representatives considered Factor 8 (Feasibility of achieving DFCs) and Factor 9 (other relevant information) in addition to reviewing factors 1 through 7.

Table 1.1 Schedule for GMA 1 Joint Planning including meeting dates dedicated to reviewing and considering each of the required factors under TWC Section 36.108(d).

GMA 1 Joint Planning Schedule

	2019						**2020**												**2021**							
Main Joint Planning Topics for Meetings	July	August	September	October	November	December	January	February	March	April	May	June	July	August	September	October	November	December	January	February	March	April	May	June	July	August
Factor 1: Aquifer Uses and Conditions				■															■							
Factor 2: Water Supply Needs and Management Strategies						■													■							
Factor 3: Hydrological Conditions						■													■							
Factor 4: Environmental Impacts															■				■							
Factor 5: Impact on Subsidence																	■		■							
Factor 6: Socioeconomic Impacts																	■		■							
Factor 7: Private Property Interests and Rights															■				■							
Factor 8: Feasibility of Achieving the DFCs																			■							
Factor 9: Other Relevant Information																			■							
Pumping Update to 2018 and Calibration Verification								■																		
Selection of Model Runs and Metrics for Evaluation								■																		
Model Runs, Presentation and Documentation											■	■	■													
Propose DFC(s) for Adoption (Deadline May 1, 2021)																					■					
Public Comment Period																						■	■	■	■	
Final Adoption of DFCs (Deadline January 5, 2022)																										■

2 GROUNDWATER MANAGEMENT AREA 1 DESCRIPTION

TWC Chapter 36 requires GCDs located entirely or partially within a GMA designated by TWDB to propose for adoption DFCs for the relevant aquifers within each groundwater management area by May 1, 2021. A DFC is defined as a quantitative description, adopted in accordance with TWC Section 36.108, of the desired condition of the groundwater resources in a management area at one or more specified future times. GMA 1 includes: Armstrong, Carson, Dallam, Donley, Gray, Hansford, Hartley, Hemphill, Hutchinson, Lipscomb, Moore, Ochiltree, Oldham, Potter, Randall, Roberts, Sherman, and Wheeler counties in the Texas Panhandle.

GMA 1 is located entirely within and consists of 18 out of the 21 counties in TWDB Region A, also referred to as the Panhandle Water Planning Area (PWPA). According to the 2017 State Water Plan, GMA 1 is among the largest groundwater producing areas in the State. The 2021 Panhandle Regional Water Plan (PRWP) estimates over 92 percent of water is used for agricultural purposes. The area included 1.5% of the total state population in 2016, while accounting for about fifteen percent of the State's annual water use. According to the 2021 PRWP, in 2020, groundwater provided 97 percent of total supply, surface water accounted less than one percent, and other supplies (e.g., reuse and surface water supplies that cannot be easily quantified—stock ponds) accounted for two percent of total supply in the PWPA. Due to the scarcity of locally developable surface water supplies, any additional water needed for the basin will likely come from groundwater or reuse of existing supplies.

Future irrigation water use is expected to decline due to a combination of factors, including projected insufficient quantities of groundwater to meet irrigation water demands, implementation of conservation practices, implementation of new crop types, and the use of more efficient irrigation technology.

All or parts of 17 counties in GMA 1 are served by four GCDs as follows:

- Hemphill UWCD, established in 1997, serving Hemphill County.
- High Plains UWCD, established in 1951, serving portions of Potter, Randall, & Armstrong counties with the remainder of the district located in Groundwater Management Area 2.
- North Plains GCD, established in 1955, serving all or part of Dallam, Hansford, Hartley, Hutchison, Lipscomb, Moore, Ochiltree, and Sherman counties.
- Panhandle GCD, established in 1956, serving all or part of Armstrong, Carson, Donley, Gray, Hutchinson, Potter, Roberts, and Wheeler counties.

Oldham County and portions of Hartley, Hutchinson, Moore, and Randall counties are not served by a GCD. The GCDs are collectively referenced to in this report as "GMA 1 Districts." A map of GMA 1 District boundaries is shown in Figure 2.1. TWDB has identified one major aquifer (Ogallala Aquifer) and three minor aquifers (Blaine, Dockum and Rita Blanca aquifers) in GMA 1. Figure 2.2 is a map of the major aquifers in GMA 1. Figure 2.3 is a map of the minor aquifers in GMA 1.

Figure 2.1 GMA 1 District boundaries (TWDB, 2021).

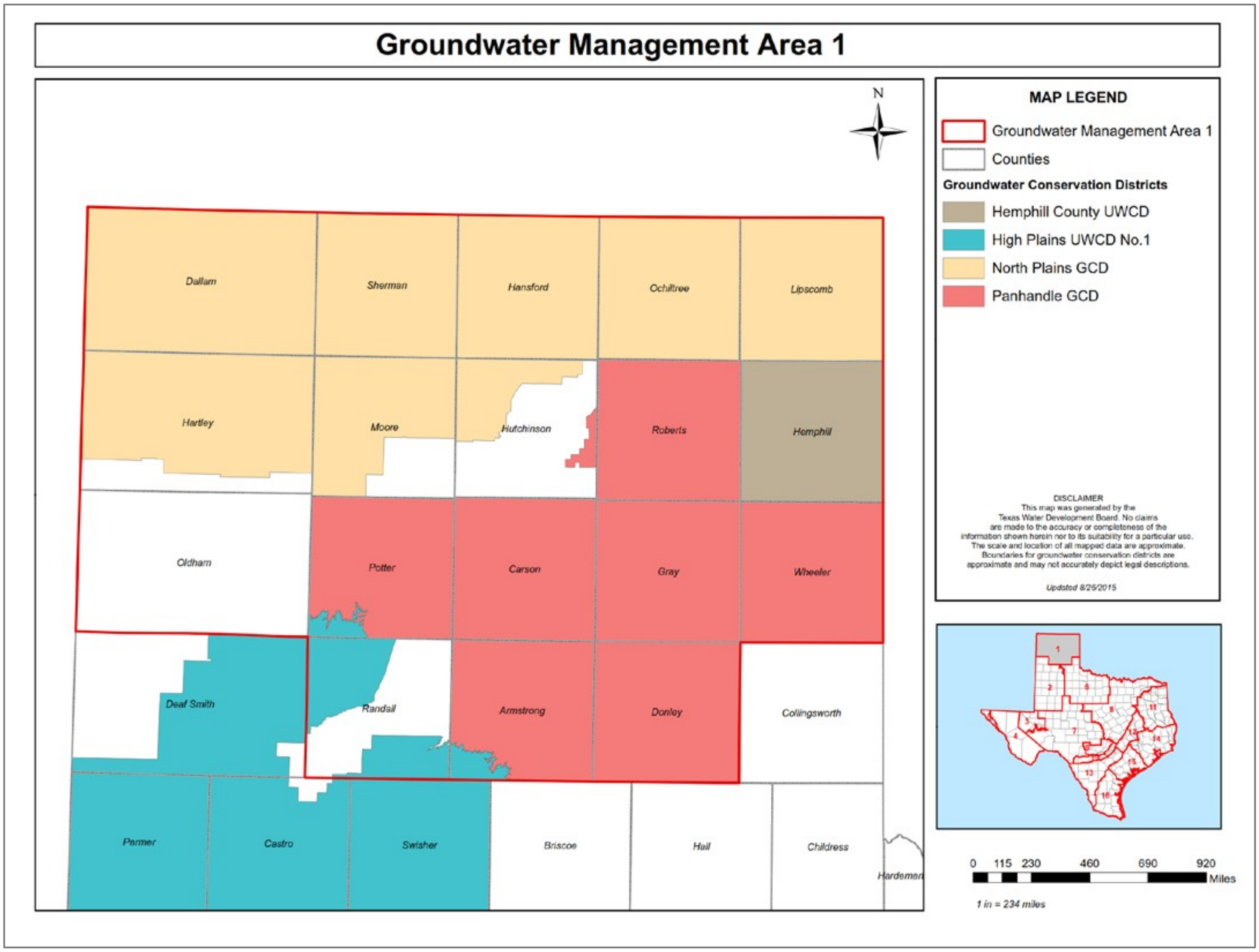


Figure 2.2 GMA 1 Major Aquifers (TWDB, 2021)

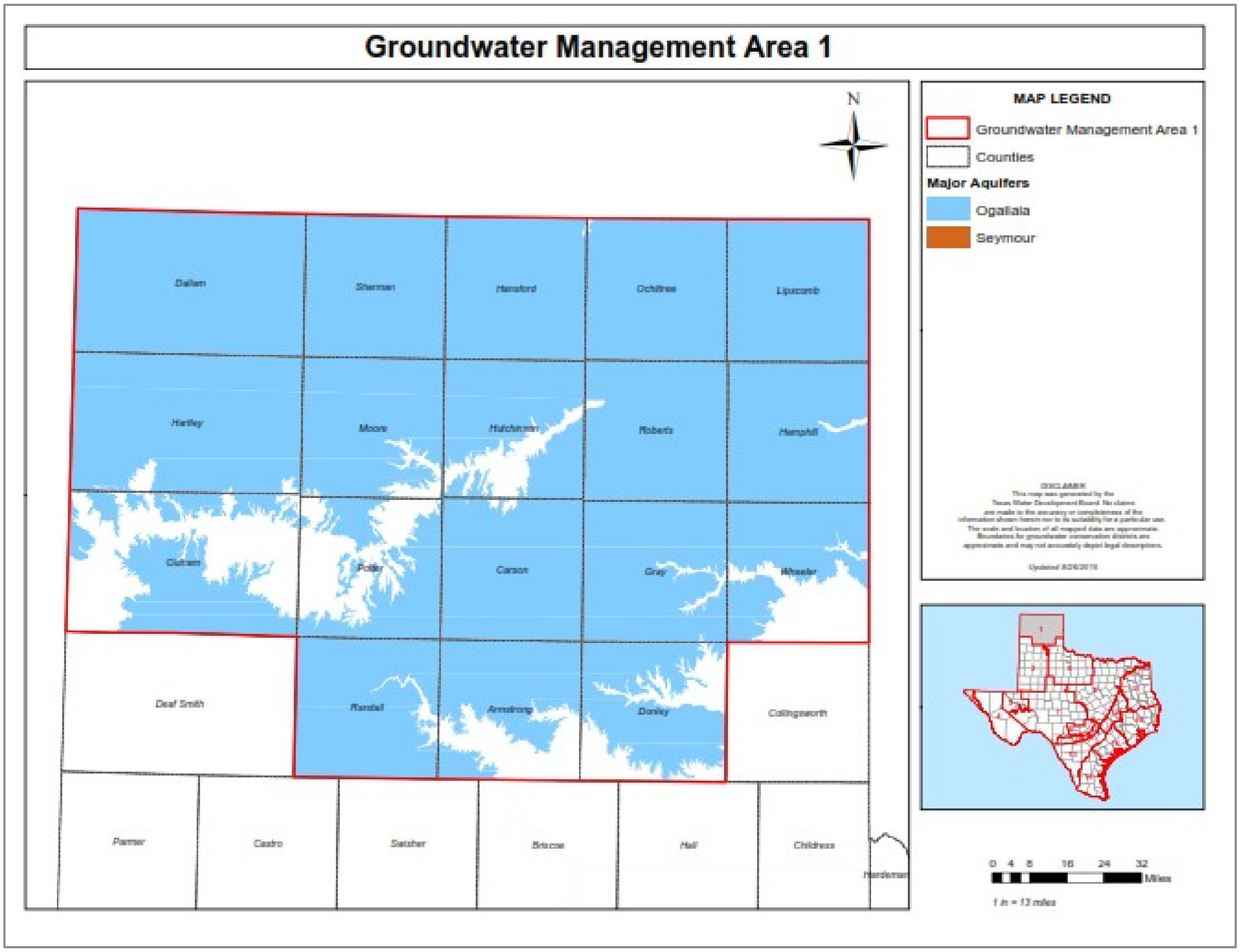
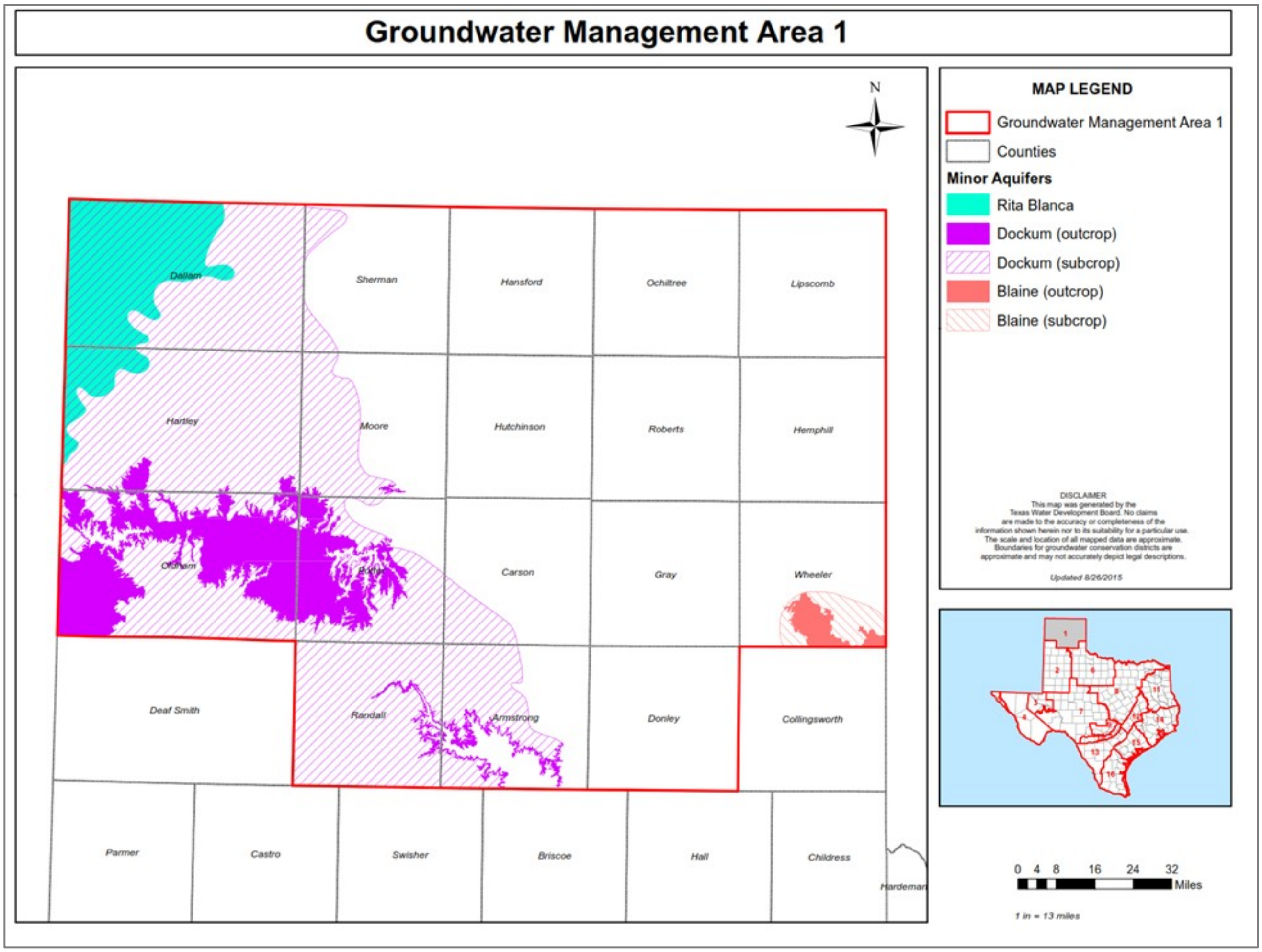


Figure 2.3 GMA 1 Minor Aquifers (TWDB, 2021).



3 OGALLALA AQUIFER DESCRIPTION AND DESIRED FUTURE CONDITIONS

3.1 Ogallala Aquifer and Rita Blanca Aquifer Description

3.1.1 Ogallala Aquifer

The Ogallala Aquifer is the largest water resource in the Great Plains. It is primarily an unconfined or water table aquifer that extends approximately 174,000 square miles from South Dakota, through Wyoming, Nebraska, Colorado, Kansas, New Mexico, and Oklahoma, to the Texas South Plains. In Texas, the Ogallala covers about 36,000 square miles through all or parts of 48 counties and contains approximately 233 million acre-feet of groundwater in storage in GMA 1 (Kohlrenken, 2015).

As the Southern Rocky Mountains began to uplift and the Cretaceous seas retreated, streams flowing east and southeast from the mountains cut channels into the pre-Ogallala surface of Permian, Triassic, Jurassic and Cretaceous strata. These streams along with eolian processes transported large sediment quantities east and southeast from the Rocky Mountains filling in the channels and creating a thick blanket of coalescing clay, silt and sand deposits of the Ogallala and associated formations. Eventually, a combination of the climate becoming more arid and the Pecos River incising northward through the Ogallala Formation in New Mexico, isolated the Ogallala in Texas from its Southern Rocky Mountains water and sediment source. Uplift continued and the Texas High Plains surface tilted southeastward (Knowles and others, 1984). Today, the Ogallala formation's thickness ranges from zero to more than 900 feet in the Texas High Plains and is controlled, in part, by the depth of the sediment filled channels (paleochannels) at the base of the formation as well as by dissolution of salt in older rock strata below the formation. Today, the Ogallala's greatest sediment thicknesses and groundwater saturated thicknesses in Texas occur in the northeastern part of the Panhandle.

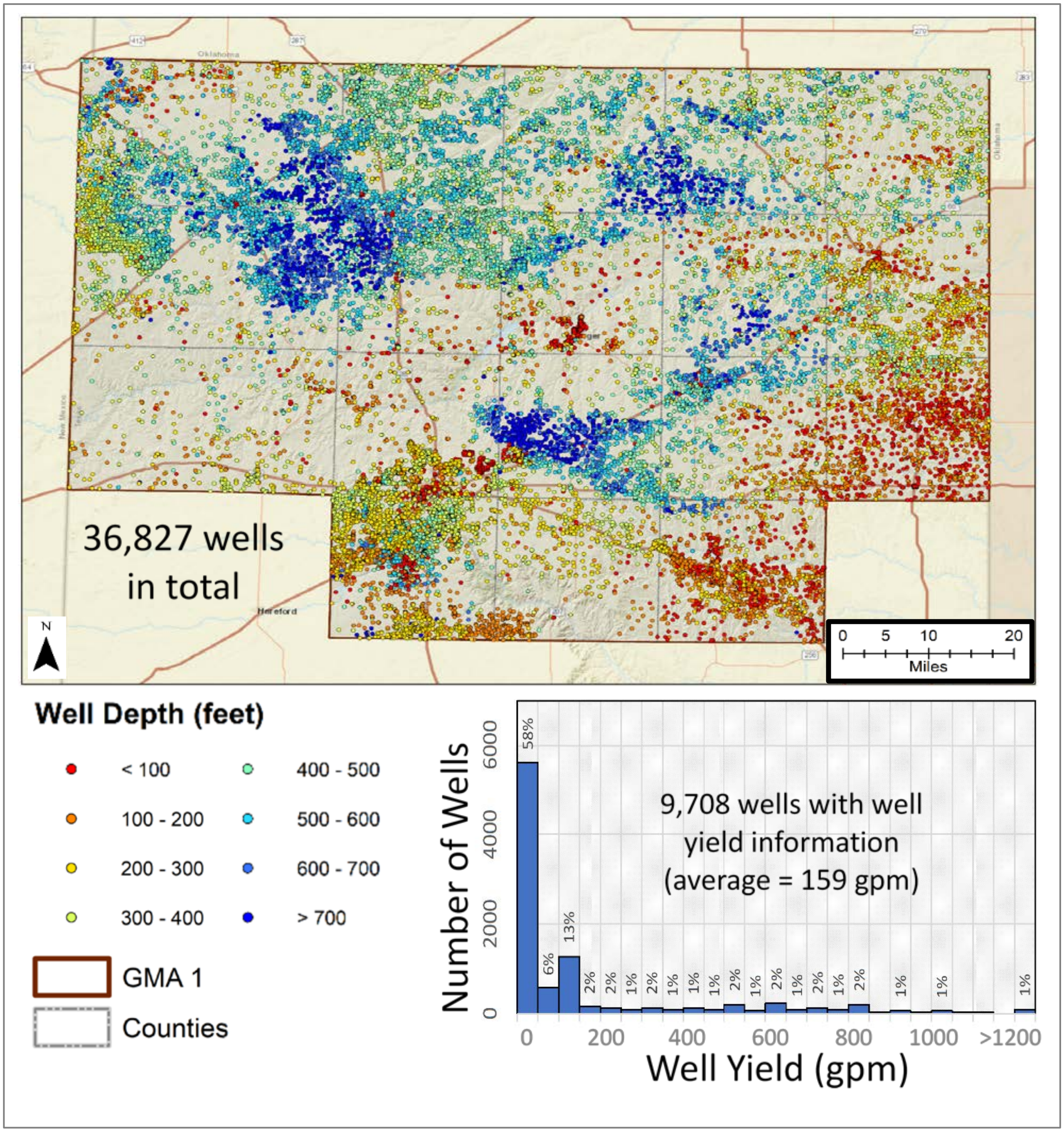
Interbedded sequences of unconsolidated to poorly consolidated clay, silt, and sands with minor sequences of gravel constitute most of the sediment deposited in the Ogallala Formation. The sands are generally tan, cream, yellow, or reddish brown, very fine to coarse-grained, sub-angular to sub-rounded, and poorly to well sorted. The gravel is usually associated with sand, silt, and clay. On the Texas High Plains, the Ogallala Formation is generally capped by caliche near the surface. In addition to these caliche layers, caliche also occurs at depth and may represent older soil horizons.

Driller's logs describe Permian and Triassic sediment beneath the Ogallala formation as a combination of red clay, red sand and silt or red beds. Where Cretaceous sediment underlies the Ogallala, widespread yellow, blue, or black clay marks the unconformity. In local areas, the base of the Ogallala can be obscured by pre-Ogallala sediment with similar characteristics to basal Ogallala sand and gravel. The Ogallala Aquifer is partially hydraulically connected to underlying sandstones of the Cretaceous and Jurassic age Rita Blanca Aquifer in Dallam and Hartley counties; to the Santa Rosa sandstone at the base of the Triassic age Dockum Group and to Cretaceous age limestone of the Edwards Trinity Aquifer near Lubbock.

The Ogallala Aquifer is segregated into northern and southern portions by Palo Duro Canyon and a groundwater divide; both located along the Prairie Dog Town Fork of the Red River.

Groundwater in the aquifer's northern portion generally flows eastward and discharges through wells, into the Canadian and tributaries of the Red River in the eastern Panhandle or flows into Oklahoma. The aquifer is laterally hydraulically connected except where the Canadian River has eroded through the formation. The distribution of the depths of wells is shown in Figure 3.1 Over 36,000 wells are shown in Figure 3.1 using data from the Texas Water Development Board Groundwater Database and Submitted Drillers Reports Database. Most, though not all, of these wells are completed into the Ogallala Aquifer. Well yields are also shown in Figure 3.1 and ranged from a few gallons per minute (gpm) to over 1,000 gpm.

Figure 3.1 Map of well depths in GMA 1 and the range of well yields.



3.1.2 Rita Blanca Aquifer

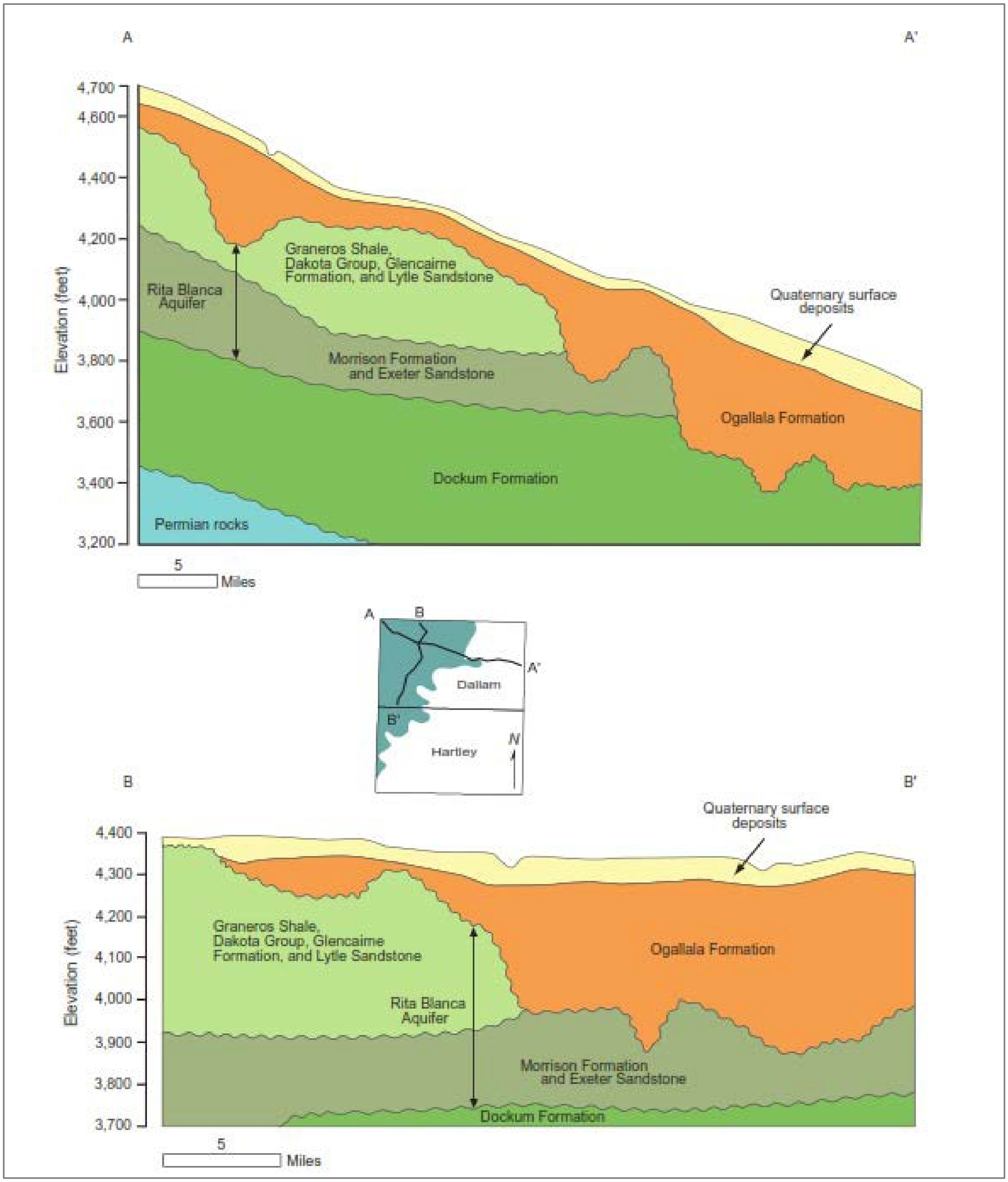
The Rita Blanca Aquifer, in Texas, is in northwest Dallam and Hartley counties. The aquifer is composed of Jurassic to Cretaceous age sediments that subcrop or truncate below the Ogallala sediments and overlie the older Dockum sediments. Christian (1989) described the sediments within the Rita Blanca Aquifer as follows:

- Graneros Shale: Marine shale with fine grained mixed clastic sediment and limestone. (Cretaceous).
- Dakota Group: (Undifferentiated, Glencairn Formation & Lytle Sandstone) fine- to coarse-grained sandstone, variegated clay, and pebbly beds. (Cretaceous).
- Morrison Formation: mudstone, sandstone, siltstone and limestone (Jurassic); and
- Exeter Sandstone: Coarse, evenly laminated, sandstone. (Jurassic).

Cross-sections of geologic strata that comprise the Rita Blanca Aquifer modified from Christian (1989) are shown in Figure 3.2. The irregular lines between the rock strata in the cross-sections show unconformities, buried erosional surfaces where part of the geologic record has been removed. The cross-sections illustrate the paleochannels (ancient sediment filled stream and river channels) created at the base of the Ogallala sediments.

According to TWDB Report 380 (George and others, 2011), groundwater production occurs from the coarse-grained sand and gravel layers of the Lytle and Dakota sediments as well as in the Exeter Sandstone and the Morrison Formation. In places, the Rita Blanca Aquifer is hydraulically connected to the overlying Ogallala Aquifer and the underlying Dockum Aquifer. Though the report goes on to say that irrigation accounts for most of the groundwater use from this aquifer, it notes that Texline uses the aquifer for municipal water supply.

Figure 3.2 Cross Sections of the Rita Blanca Aquifer compared to the Ogallala Aquifer and Dockum Aquifer (modified from Christian, 1989).



3.2 Desired Future Conditions

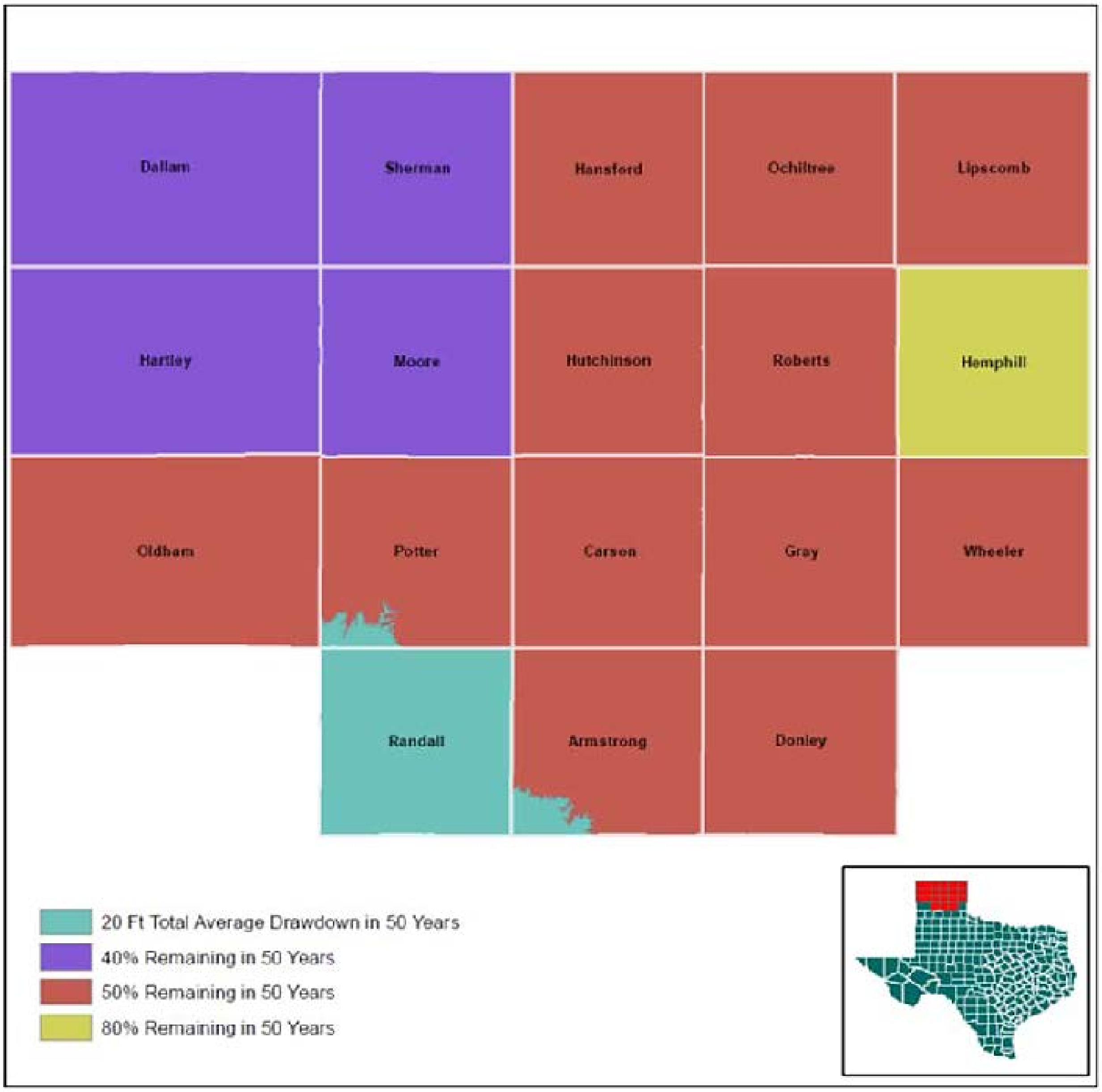
GMA 1 District Representatives unanimously adopted DFCs for the Ogallala Aquifer by resolution on August 26, 2021.

The Ogallala Aquifer (inclusive of Rita Blanca) DFCs adopted by GMA 1 are as follows:

- 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, Hutchinson, 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 in Potter Counties.

The resolution adopting DFCs for the Ogallala Aquifer is provided in Appendix I – DFC Documents. Documentation for this meeting including meeting postings, agenda package, and meeting supplements are provided in Appendix II - Meeting Documentation. The areas described by the DFCs above are shown in Figure 3.3.

Figure 3.3 GMA 1 Ogallala Aquifer DFCs Map



3.3 Policy and Technical Justification

TWC Section 36.108(d-2) requires that DFCs proposed as part of joint planning in the management area must provide "a balance between the highest practicable level of groundwater production and the conservation, preservation, protection, recharging, and prevention of waste of groundwater and control of subsidence in the management area." GMA 1 District Representatives established different DFCs throughout the management area based on a combination of policy and technical considerations that support continued economic development of the area, while providing for the reasonable long-term management of groundwater resources consistent with Texas Water Code Section 36.1071(a).

3.3.1 Policy Justification

GMA 1 Districts are local political subdivisions of the state pursuant to Chapter 36 and their specific enabling statutes created under Section 52, Article III, or Section 59, Article XVI, Texas Constitution. GMA 1 Districts collectively average over 50 years of management to provide for the conservation, preservation, protection, recharging, and prevention of waste of groundwater, and of groundwater reservoirs or their subdivisions consistent with the objectives of the Texas Constitution within their jurisdiction. In consideration of DFCs, each of the GMA 1 Districts reviewed their management plans and regulatory structures used in each of their jurisdictional areas based on their collective groundwater management experience. Each GMA 1 District fulfills the requirements of TWC Section 36.108 through cooperation and joint planning efforts with other GCDs in the GMA. Oldham County and portions of Hartley, Hutchinson, Moore, and Randall counties are not within the jurisdiction of a GCD but are served for joint planning purposes by the GMA 1 District Representatives. The GMA 1 Districts last adopted DFCs within GMA 1 for the Ogallala Aquifer in 2016.

The GMA 1 Districts understand the relevance of the different adopted DFCs for the management area and that DFCs are not just numbers. The Ogallala Aquifer is the only groundwater supply in eight out of eighteen counties and is the primary water supply in the remaining ten counties in GMA 1. The aquifer is essentially the only reliable water source for most of GMA 1, as well as a water source for water transported out of the management area. The development of different Ogallala DFCs across the management area strikes a balance between the highest practicable level of groundwater production and the conservation, preservation, protection, recharging, and prevention of waste.

The DFCs balance the need for water regarding agriculture, municipal and industrial uses as well as address spring flow and ecotourism, all drivers for the Texas Panhandle economy. GMA 1 Districts are aware of the relationship of water to current and future property values as well as the economic and social value of leaving water for future generations when the GMA 1 Districts address current and future needs.

3.3.2 Technical Justification

GMA 1 District Representatives combine the Rita Blanca Aquifer and Ogallala Aquifer because of their functional relationship from a hydrogeological perspective. Any references to the "Ogallala Aquifer" in this report shall also include and apply to any groundwater in the Rita Blanca Aquifer. GMA 1 District Representatives adopted an Ogallala DFC for Dallam, Hartley, Moore and Sherman counties, collectively, based on at least 40 percent of volume in storage remaining for each 50-year period between 2018 and 2080 because those counties are experiencing:

- High agriculture usage of the aquifer,
- Above average rate of decline,
- Very limited stream flow, and
- High agriculture economic impacts.

Setting a higher percent of volume in storage remaining would require massive reductions in agriculture groundwater pumping, increasing the adverse economic impacts to the area and individual property owners.

GMA 1 Districts adopted an Ogallala Aquifer DFC of at least 50 percent of the volume in storage remaining for each 50-year period between 2018 and 2080 in Hansford, Hutchinson, Lipscomb, Ochiltree, Carson, Donley, Gray, Roberts, Wheeler, and Oldham counties because these areas are experiencing and are projected to continue to experience:

- Moderate agriculture usage of the aquifer,
- Significant municipal groundwater pumping in the area,
- Average rates of decline,
- Minimal stream flow, and
- Moderate agriculture and municipal economic impact.

GMA 1 District Representatives adopted an Ogallala Aquifer DFC in Randall County and within the High Plains UWCD in Armstrong and in Potter counties, collectively, of approximately 20 feet of total average drawdown for each 50-year period between 2012 and 2080 for the same conditions listed above and to provide the same consistent management framework that is used within the High Plains UWCD in Groundwater Management Area 2 (GMA 2). Based on current water use and projected future water user group (WUG) demand and needs, the adopted DFCs for these counties collectively should provide adequate water available for current and future growth while encouraging conservation.

GMA 1 District Representatives adopted an Ogallala Aquifer DFC in Hemphill County of at least 80 percent of volume in storage remaining for each 50-year period between 2018 and 2080 because of its profound differences from the rest of the management area. Some of these conditions include:

- Minimal agriculture usage of the aquifer,

- Minimal rate of decline,
- Relatively extensive stream flow for the planning area, and
- Water related ecotourism economic impact.

Hemphill County groundwater use is generally far less than use in adjacent counties and that of most of the rest of the management area. Hemphill County contains more spring and other natural discharge to streams and rivers than any other county in the GMA because of local hydrogeological conditions. The adopted DFC allows for substantial growth in groundwater demand over the next fifty years, while protecting spring discharge, stream flow and ecotourism. The DFC will provide groundwater availability at least two times higher than the TWDB estimated water use in the area, while protecting springs and seeps that enhance Canadian River flow.

Except for Randall County and portions of High Plains UWCD in Potter and Armstrong counties, GMA 1 District Representatives adopted "percent of volume in storage remaining for each 50-year period between 2018 and 2080." This is similar to previous Region A planning goals, but differs in that it extends beyond the previous 50-year planning period out to 2080 so that it aligns with the regional water planning process. Today, over 80 percent of all non-exempt aquifer withdrawals are volumetrically measured in GMA 1. GMA 1 Districts have incorporated DFCs into management plans, rules, and procedures for monitoring and tracking the achievement of adopted DFCs.

GMA 1 District Representatives adopted aquifer drawdown for those portions of the High Plains UWCD, and all of Randall County. Aquifer drawdown is the preferred joint planning metric for groundwater management in GMA 2 where over 90 percent of the High Plains UWCD is located. GMA 1 District Representatives adopted different DFCs to allow for future growth while promoting conservation. In considering the nine factors under TWC Section 36.108(d), GMA 1 District Representatives utilized numerous information sources while considering DFC options and before adopting final DFCs. To evaluate the DFC options and the adopted DFCs, INTERA Incorporated (INTERA) used the High Plains Aquifer System GAM (HPASGAM; Deeds and Jigmond, 2015) that it developed for TWDB. The HPASGAM is a regional groundwater flow model that incorporates the Ogallala, Rita Blanca, Edwards-Trinity (High Plains), and Dockum aquifers.

In December 2015, TWDB accepted the HPASGAM as the official GAM for the region. The GMA 1 Districts provided INTERA with pumping data through 2018, which INTERA incorporated into the HPASGAM to update the base year of the historical period of the model to 2018. The model was used to understand the anticipated pumping and impacts associated with the DFCs. Links to the model input files associated with the DFCs are included in Appendix III – Model Run Documentation so the Executive Administrator of TWDB can use them to confirm predictive run results and estimate modeled available groundwater (MAG).

The last year of the historical portion of the model described in Deeds and Jigmond (2015) is 2012. To incorporate the effects of pumping that has occurred since this time, the model files were updated through 2018. For development of DFCs, 2018 was used as the reference year except for Randall County and the High Plains UWCD portions of GMA 1. For the predictive simulation, the last simulated year is 2080. The HPASGAM predictive run input file shows that to achieve the adopted DFCs in GMA 1, the Ogallala Aquifer (and Rita Blanca Aquifer) pumping will decline from approximately 3,186,000 acre-feet/year in 2020 to 1,987,000 acre-feet/year by 2080. Table 3.1 is a compilation of modeled pumping levels based on the adopted DFCs.

Documentation for GMA 1 meetings identified in Table 1.1 including meeting postings, agenda package, sign-in sheets and meeting supplements are provided in Appendix II - Meeting Documentation.

Table 3.1 Ogallala/Rita Blanca Aquifer modeled pumping levels based on the adopted DFCs in acre- feet/year.

	2020	2030	2040	2050	2060	2070	2080
Hemphill County UWCD	**37,182**	**45,846**	**52,100**	**55,658**	**57,918**	**59,295**	**60,051**
Hemphill	37,182	45,846	52,100	55,658	57,918	59,295	60,051
High Plains UWCD No.1	**44,925**	**41,951**	**35,006**	**28,530**	**23,152**	**19,144**	**16,114**
Armstrong	5,667	4,716	3,001	1,878	1,179	969	784
Potter	2,343	2,539	2,357	2,051	1,631	1,075	801
Randall	36,915	34,697	29,648	24,601	20,343	17,100	14,529
North Plains GCD	**1,988,622**	**1,875,121**	**1,697,404**	**1,533,765**	**1,381,478**	**1,239,976**	**1,111,652**
Dallam	319,323	269,752	228,251	195,016	165,443	144,455	127,992
Hansford	296,868	295,895	281,027	264,464	247,229	229,951	211,025
Hartley	354,907	270,408	207,323	170,002	144,264	124,448	108,128
Hutchinson	77,759	80,242	77,674	74,510	70,462	67,541	63,950
Lipscomb	250,966	270,997	262,931	250,133	235,071	219,119	201,565
Moore	140,116	139,837	132,461	121,696	105,913	88,223	72,976
Ochiltree	259,136	260,144	246,760	231,654	215,169	199,455	180,919
Sherman	289,546	287,846	260,978	226,290	197,926	166,784	145,097
Panhandle GCD	**979,448**	**1,053,106**	**1,013,268**	**949,684**	**879,583**	**813,865**	**734,607**
Armstrong	56,821	51,760	45,662	40,268	35,017	30,705	27,080
Carson	162,975	166,133	159,424	149,866	140,958	134,453	121,522
Donley	72,596	78,318	76,996	72,649	66,893	60,955	53,227
Gray	177,264	181,767	173,242	160,488	146,740	133,890	121,683
Hutchinson	8,506	10,596	11,774	11,792	11,403	10,782	9,586
Potter	23,972	22,260	19,549	16,487	13,579	10,997	8,803
Roberts	357,959	409,569	394,109	369,578	343,395	317,738	285,999
Wheeler	119,354	132,702	132,512	128,557	121,599	114,345	106,707
Non-District Areas	**136,155**	**134,059**	**120,162**	**103,627**	**87,940**	**74,965**	**64,550**
Hartley	15,523	16,391	15,601	14,319	12,962	11,654	10,413
Hutchinson	33,885	32,988	28,313	24,075	20,934	18,588	17,168
Moore	8,685	9,687	9,395	8,251	7,107	6,202	5,506
Oldham	40,412	39,092	36,116	31,239	25,989	21,407	18,004
Randall	37,650	35,901	30,736	25,742	20,948	17,114	13,460
GMA 1 Total	**3,186,332**	**3,150,084**	**2,917,940**	**2,671,264**	**2,430,072**	**2,207,245**	**1,986,974**

3.4 Ogallala Aquifer Factor Consideration

Presentations associated with the consideration of required factors under TWC Section 36.108(d) are included in Appendix IV – Factor Analysis. Each of these factors is described individually for the Ogallala Aquifer below.

3.4.1 Aquifer Uses or Conditions

TWC Section 36.108(d)(1) requires district representatives to consider aquifer uses and conditions within the management area, including conditions that differ substantially from one geographic area to another.

District Representatives adopted different DFCs within GMA 1 based on varying aquifer uses and conditions including: physical landscape and land use, concentrated pumping centers, estimated groundwater use and predicted demands by county and by WUG; differing aquifer elevations, water level declines, saturated thicknesses, and depth to base of the aquifer differ substantially from one geographic area to another. GMA 1 District Representatives considered aquifer uses and conditions for the aquifers within the management area during meetings identified in Table 1.1.

GMA 1 District Representatives considered aquifer uses by WUGs collectively including: municipal, irrigated agriculture, livestock, manufacturing, steam electric, and mining. As part of the consideration, the representatives reviewed TWDB Water Use Survey Groundwater Pumpage Estimates (WUSGPE) and GMA 1 Districts information. Figure 3.4(a) shows the projected distribution of water demand by use type between 2020-2070. Figure 3.4(b) shows the projected demands developed by TWDB for both the 2017 and 2022 state water plans compared to historical TWDB WUSGPE.

Water demand projections developed for the 2022 State Water Plan indicate that the total water demand in GMA 1 will decrease from 2.1 million acre-feet in 2020 to 1.5 million acre-feet by 2070. This decline is mostly due to the expectation that irrigation water demand will decrease over time (primarily in Dallam, Hartley, Moore, and Sherman counties) because of reduced irrigation well yield, implementation of conservation practices, transition to new more efficient crops types, and the use of more efficient irrigation technology. According to the TWDB WUSGPE, irrigation use represents between 90 and 93 percent of the total aquifer pumping in GMA 1 during the 12-year period from 2005 to 2017. Because irrigation accounts for most of the water used in GMA 1 it is important to consider the uncertainty associated with irrigation demand projections. The methodology used to develop irrigation projections is based on current and expected trends in the agricultural sector, which are contingent upon many factors including market forces, government subsides, fuel prices, and resource availability. Figure 3.5 shows historical irrigation estimates and projected water demands based on estimates made for the 2017 and 2022 State Water Plans for GMA 1.

Figure 3.4 Projected total water use for GMA 1 by use type from 2020 to 2070 (PRWPG, 2021).

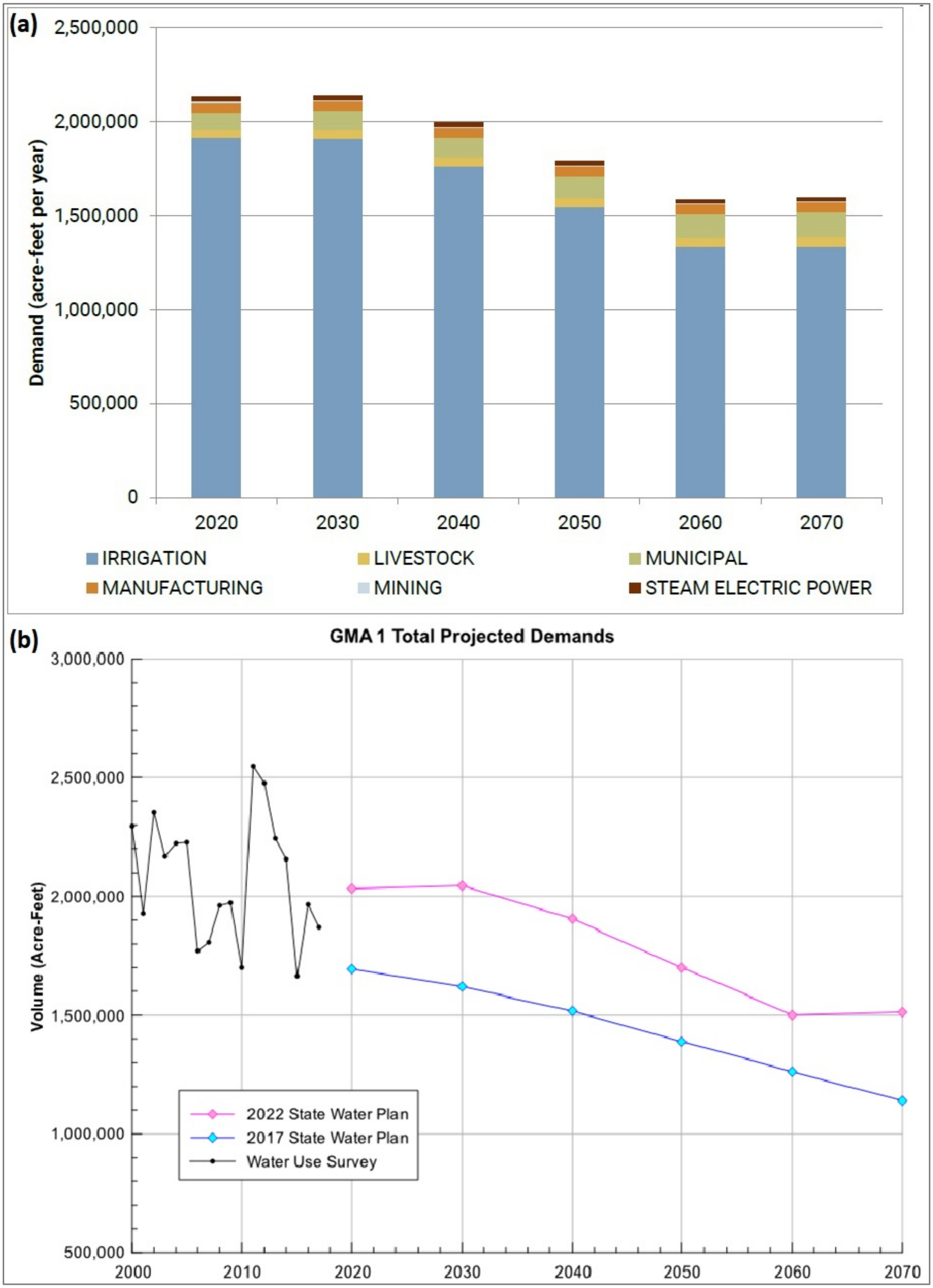
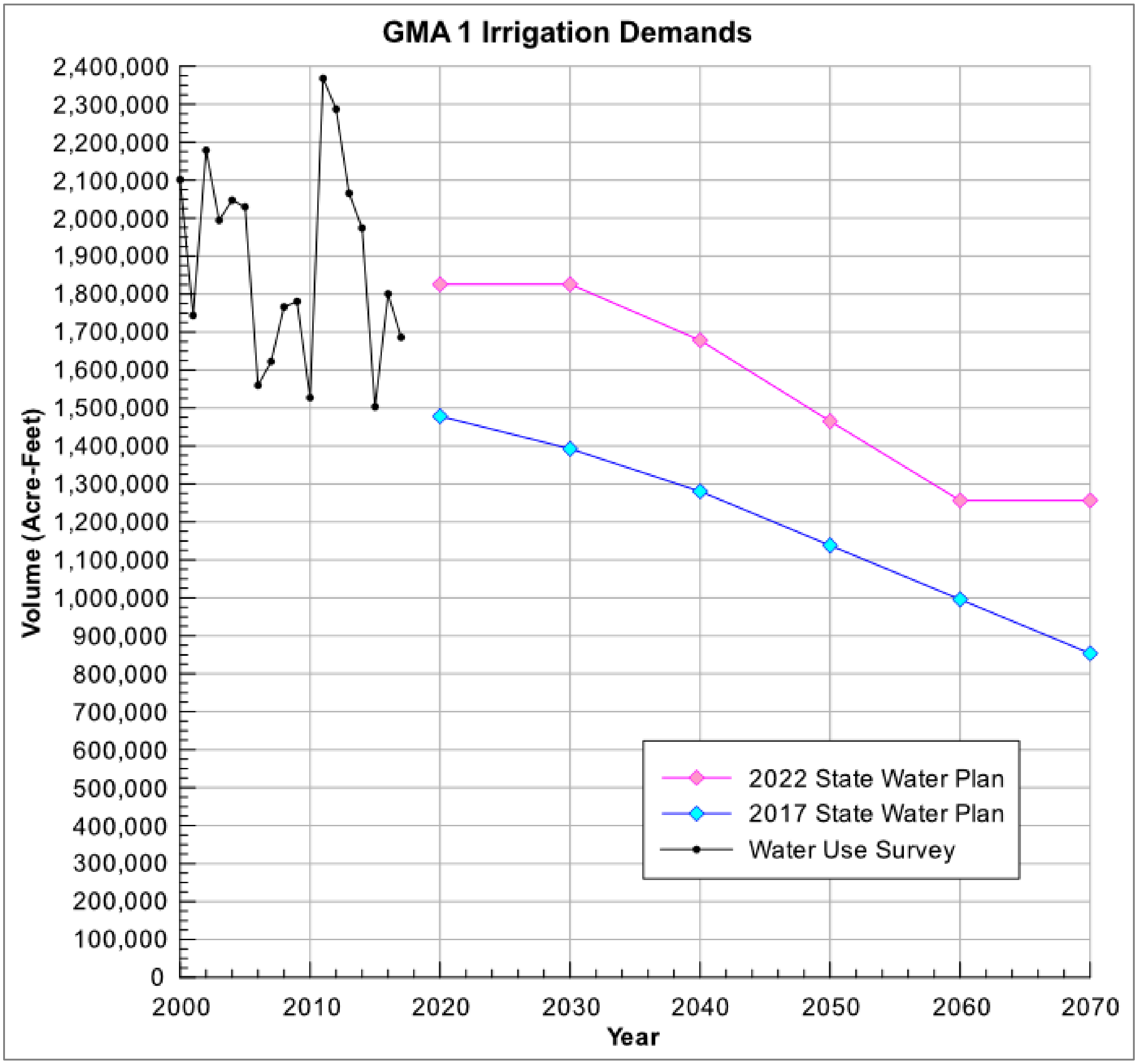
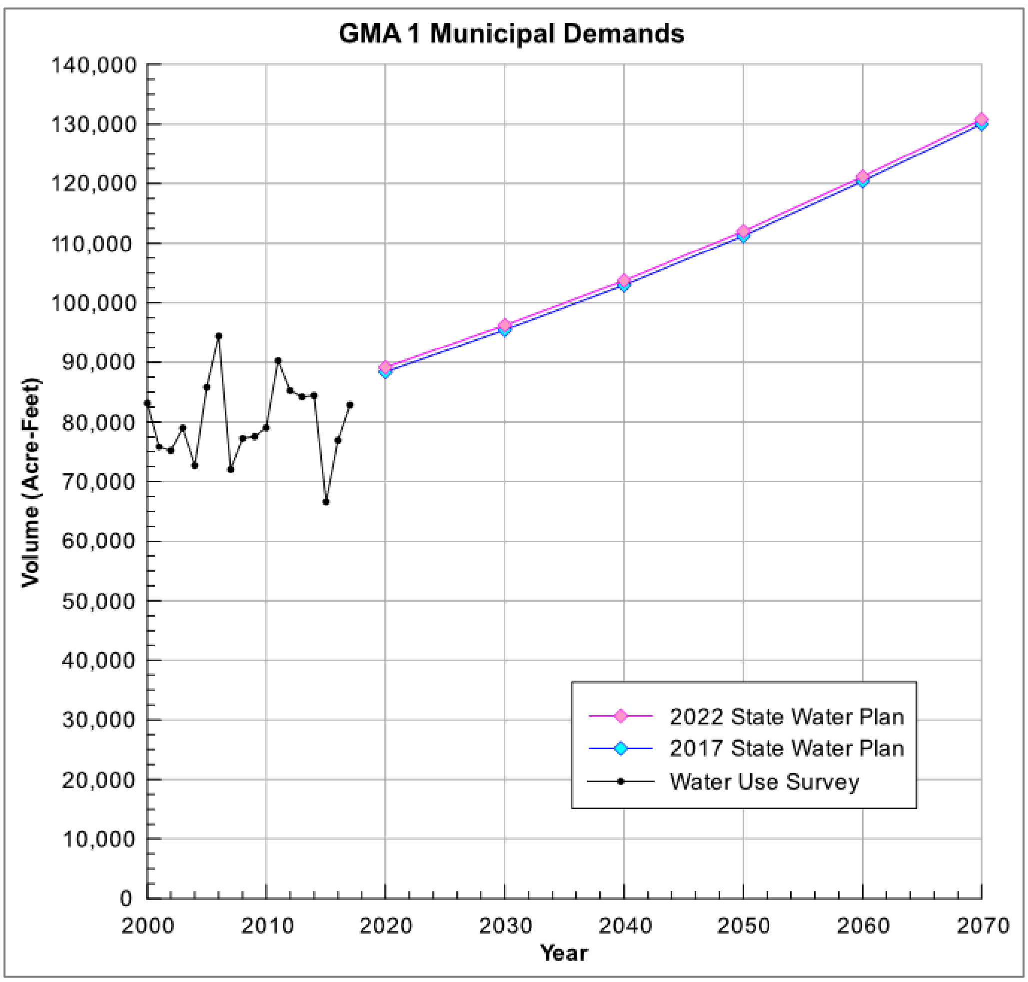


Figure 3.5 Historical water use for irrigation and projected irrigation demand for GMA 1 from 2020 to 2070.



Municipal groundwater use represents the second largest water demand category (between 4 and 8 percent annually) during the t-year period from 2005 to 2017. Projections from the 2021 PRWP suggest that municipal demand will increase from 90,00 acre-feet per year in 2020 to 130,000 acre-feet per year in 2070. The population of GMA 1 is projected to increase from approximately 418,000 in 2020 to 637,000 in 2070, an average annual growth rate of 0.85 percent (PRWPG, 2021). Based on the TWDB WUSGPE, the total municipal water use in GMA 1 was 83,500 acre-feet in 2010, which is approximately five percent of total water demand in the management area (Table 3.2). Potter and Randall counties, which contain the cities of Amarillo and Canyon, comprised 65 percent of the municipal water use in GMA 1, while collectively Armstrong, Donley, Hemphill, Roberts, and Sherman counties comprise approximately three percent. Though Roberts County has relatively little municipal use within the county, groundwater pumping from well fields to replace diminishing surface water supplies is a significant source of the water pumped for municipal purposes in Potter and Randall counties through the City of Amarillo as well as for the member cities of CRMWA both inside and outside of GMA 1. Historical municipal water use and projected municipal water demand from the 2017 and 2022 State Water Plan is shown in Figure 3.6.

Figure 3.6 Historical municipal water use and projected municipal demand for GMA 1 from 2020 to 2070.



Industrial water use includes mining, manufacturing, and power generation activities, which all represent relatively small proportions of the water demand in GMA 1. Historical water use associated with mining activities and projected future activity are shown in Figure 3.7. Mining activities in GMA 1 consist primarily of oil and gas extraction and removal of industrial minerals such as sand, gravel, and gypsum. Recent development of natural gas within GMA 1 has increased mining water use in several of the northeastern counties. These mining activities are expected to continue over the next two decades, but then decrease over time. Even with mining activities at a historical high over the past decade, mining groundwater demand accounted for less than 1% of the total water demand in GMA 1.

Figure 3.7 Historical mining water use and projected mining demand for GMA 1 from 2020 to 2070.

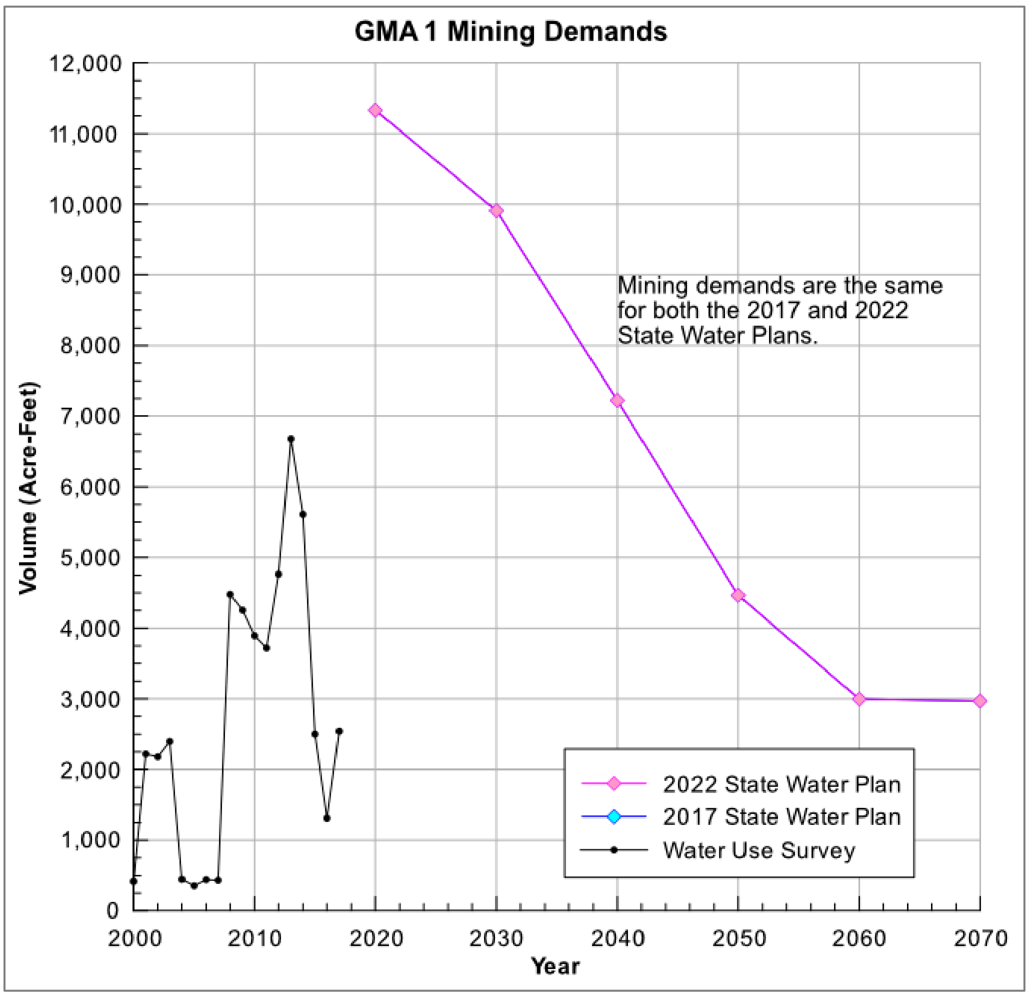


Figure 3.8 shows the projected water demand of manufacturing users in GMA 1. Manufacturing demand in the 2022 State Water Plan is expected to increase over the next decade from approximately 49,000 acre-feet per year to 53,000 acre-feet per year and then is expected to remain constant over time. Power generation demand is expected to stay constant at approximately 18,5000 acre-feet per year.

Figure 3.8 Historical manufacturing water use and projected manufacturing demand for GMA 1 from 2020 to 2070.

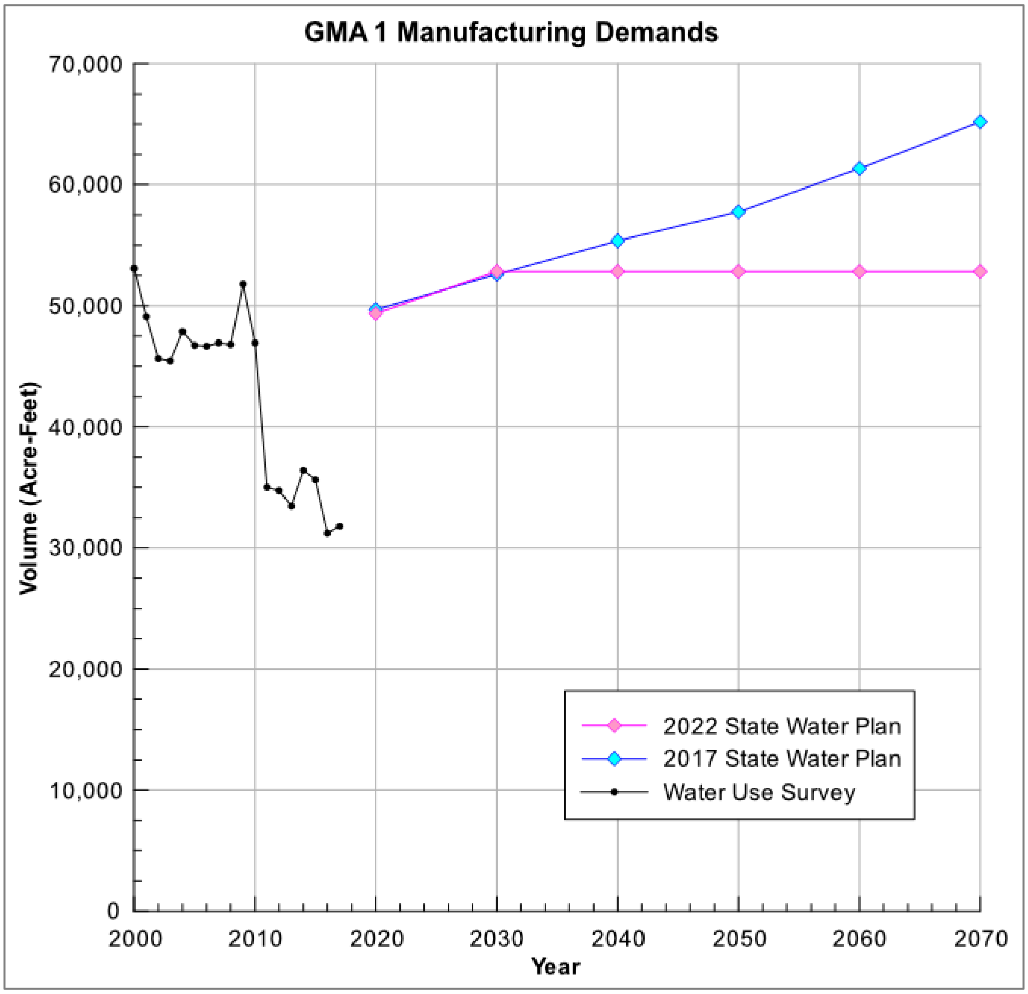


Figure 3.9 shows historical livestock water use and projected future demand. Currently, livestock use accounts for about 2 percent of the total groundwater pumped in GMA 1. The 2021 PRWP used livestock projections developed by Texas A&M AgriLife and current water use estimates to forecast livestock water use. Livestock water use is expected to increase from about 40,000 acre-feet per year in 2020 to 54,000 acre-feet per year in 2070.

Figure 3.9 Historical livestock water use and projected livestock demand for GMA 1 from 2020 to 2070.

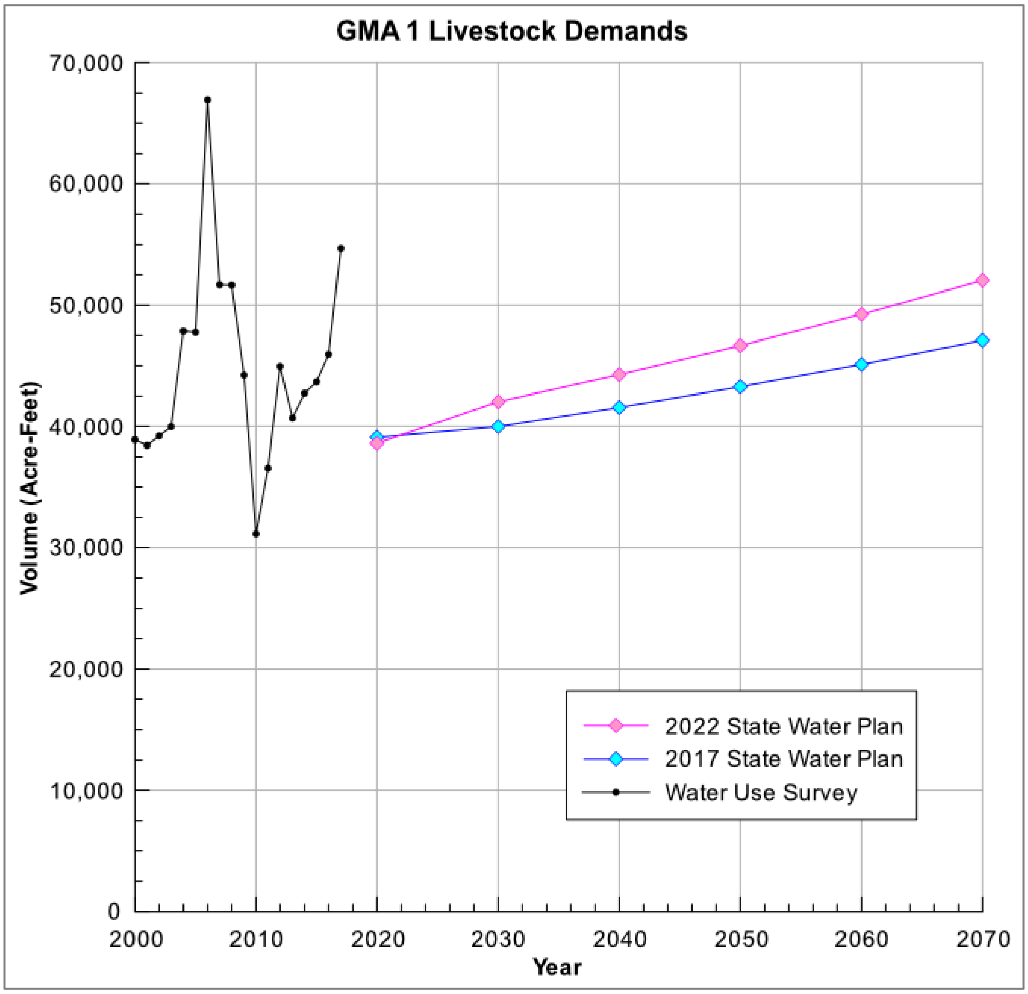


Table 3.2 Projected water demands for GMA 1 in acre-feet/year (2017 State Water Plan). The highlighted records represent over ten percent of the GMA 1 total water use or demand by decade in each of those counties.

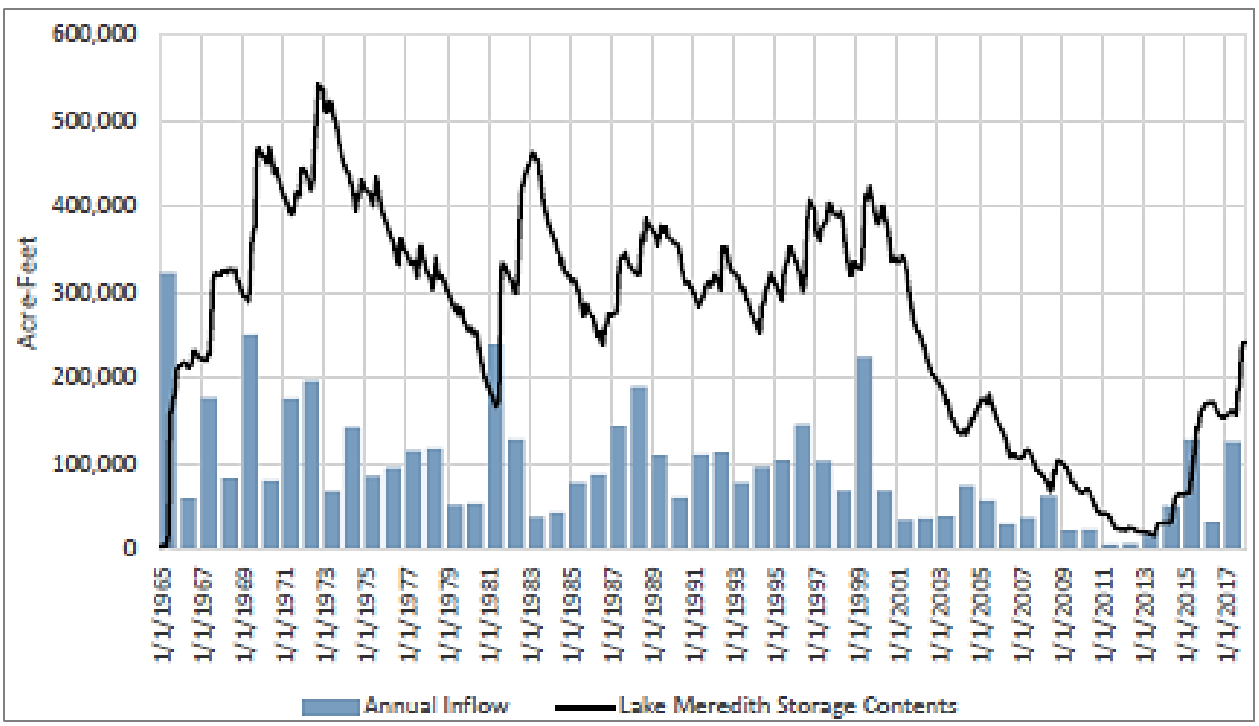
County	2010	2020	2030	2040	2050	2060	2070
Armstrong	5,243	5,286	5,077	4,792	4,381	3,971	3,563
Carson	62,756	58,106	55,294	51,273	45,880	40,508	35,140
Dallam	368,553	376,493	354,620	326,399	291,512	256,648	221,798
Donley	27,031	26,033	25,141	23,771	21,338	18,912	16,486
Gray	29,480	33,086	33,051	32,205	31,540	30,024	28,652
Hansford	133,757	140,089	132,184	121,356	108,403	95,471	82,824
Hartley	347,481	353,384	334,432	309,381	276,600	243,876	211,204
Hemphill	7,095	6,446	5,885	5,308	4,692	4,075	3,809
Hutchinson	74,882	71,534	70,823	69,150	66,497	64,678	63,046
Lipscomb	33,223	23,142	21,891	20,273	18,089	16,086	14,184
Moore	178,277	161,328	153,840	144,155	131,884	119,984	108,181
Ochiltree	64,351	65,358	61,562	57,102	51,612	46,367	41,271
Oldham	6,353	6,288	6,239	6,066	5,708	5,384	5,067
Potter	48,137	69,374	74,224	79,447	84,518	92,870	100,990
Randall	45,591	50,260	52,200	53,904	55,268	57,048	59,012
Roberts	8,090	8,102	7,295	6,408	5,413	4,672	4,083
Sherman	239,462	225,104	212,287	195,370	174,359	153,357	132,400
Wheeler	17,332	14,195	13,156	11,711	10,014	8,872	8,078
TOTAL	**1,697,094**	**1,693,608**	**1,619,201**	**1,518,071**	**1,387,708**	**1,262,803**	**1,139,788**

GMA 1 District Representatives also considered that pumping locations in the management area may not necessarily be the same as the location of use because groundwater can be pumped from a well or well field and transported by pipeline to another geographic location within or outside the management area. GMA 1 District Representatives reviewed and considered aquifer uses as described in the regional planning process and considered both the places of use and points of withdrawal. In 2011, groundwater use peaked because of a regional and statewide drought, further development of agriculture water use, and an ongoing regional trend of switching from surface water sources to groundwater from the Ogallala Aquifer. The Canadian River Municipal Water Authority's (CRMWA) development of groundwater resources to offset declining surface water availability is an example of this trend. CRMWA historically has provided water from Lake Meredith on the Canadian River to its member cities in the Texas Panhandle in GMA 1 and the Texas High Plains in GMA 2 as far south as Lamesa, Texas. Beginning in late 2001, CRMWA began supplementing water from Lake Meredith by blending groundwater from well fields in Roberts County to meet its water supply obligations to its member cities. Those member cities also supplement CRMWA supplies locally with groundwater from their own wells. In 2018, approximately 75 percent of the water used by the CRMWA member cities was groundwater. The remaining 25 percent was surface water. For a period from 2012 to 2014 CRMWA relied solely on groundwater due to low lake levels and water quality issues at Lake Meredith, but has since made small diversions from Lake Meredith (Figure 3.10). Table 3.3 shows CRMWA's surface water and groundwater use in 2018.

Table 3.3 Canadian River Water Municipal Authority surface water and groundwater use in 2018 in acre-feet (PRWPG, 2021).

City	Municipal Water Supplied by CRMWA (ac ft/yr)		
	Surface Water CRMWA	Groundwater CRMWA	Total
Amarillo	8,076	22,007	30,083
Borger	662	2,895	3,557
Pampa	535	1,887	2,422
Total	**9,273**	**26,789**	**36,062**

Figure 3.10 Annual inflows and historical change in Lake Meredith water storage (PRWPG, 2021).



3.4.2 Water Supply Needs and Water Management Strategies Included in the State Water Plan.

TWC Section 36.108(d)(2) requires that District Representatives consider the water supply needs and water management strategies included in the state water plan. GMA 1 Districts considered water demand data developed for the 2017 and 2022 State Water Plans and water supply needs and management strategies from the 2017 State Water Plan. Information from both regional and state plans are provided in the supporting documentation; however, because the 2022 State Water Plan is in development, only the 2017 State Water Plan is referenced when discussing the water supply needs and water management strategies for GMA 1.

GMA 1 District Representatives considered water supply needs and water management strategies within GMA 1 during meetings identified in Table 1.1.

Water Supply Needs

A water supply need occurs when currently developed supplies are not sufficient to meet projected demands. The 2017 State Water Plan identified 33 WUGs (accounting for basin and county designations) with identified needs during the planning period (2020-2070). Of these, there are 25 cities and other WUGs in 14 counties that are projected to experience water needs before 2070. The largest volumetric needs are attributed to high irrigation demand in Dallam, Hartley, and Moore counties and an increase in municipal demand and comparably limited groundwater resources in Potter and Randall counties. Water supply needs are shown for the county that has demand, which may differ from the county of the supply source.

In GMA 1, the total needs for all WUGs are projected to be 161,822 acre-feet per year in 2020, increasing to 233,847 acre-feet per year in 2040 and 245,751 acre-feet per year by 2070. In assessing water supply needs, the 2017 State Water Plan allocates water to WUGs considering geographical availabilities, infrastructure constraints, legal limits, and contractual limits, as appropriate. With these considerations, the projected developed supplies total 1.57 million acre-feet per year in 2020, which is about 40 percent of the total water available. This indicates that there is sufficient water available in 2020 to users in GMA 1 that has not yet been developed (2017 State Water Plan). However, for some WUGs, the available water cannot be economically produced for the intended purpose to meet WUG needs. This is the case for irrigation users that rely on locally developed supplies and cannot economically use water that is located many miles away. Municipal WUGs can develop and transport water to meet their needs from outside the county. GMA 1 water surpluses/needs by county are detailed in Table 3.6. A summary of when the individual WUG needs begin by county and demand type is presented in Table 3.7.

Table 3.6 GMA 1 Water surpluses/needs by county in acre-feet per year (2017 State Water Plan).

County	2020	2030	2040	2050	2060	2070
Armstrong	116	67	22	-18	-55	-93
Carson	946	369	191	101	-28	-176
Dallam	-79,909	-92,468	-95,342	-88,952	-79,729	-70,514
Donley	186	194	201	203	204	204
Gray	1,356	-816	-1,546	-1,384	-2,280	-3,214
Hansford	177	109	-16	-388	-651	-896
Hartley	-77,545	-93,712	-99,092	-93,227	-84,020	-74,803
Hemphill	64	65	67	64	61	58
Hutchinson	137	-1,402	-2,850	-4,329	-5,632	-6,930
Lipscomb	94	91	-6	-240	-365	-483
Moore	-2,600	-4,352	-6,003	-8,931	-15,697	-20,759
Ochiltree	-454	-938	-1,414	-1,856	-2,322	-2,771
Oldham	828	796	801	800	798	795
Potter	-4,895	-11,184	-18,316	-25,217	-31,490	-38,529
Randall	-3,118	-7,716	-12,976	-18,328	-23,677	-28,921
Roberts	451	448	451	369	302	234
Sherman	813	785	773	615	416	219
Wheeler	1,531	1,315	1,208	1,079	951	828
Total	**-161,822**	**-208,349**	**-233,847**	**-239,639**	**-243,214**	**-245,751**

Table 3.7 Summary of when the individual WUG needs located in each county begin and demand type (2017 State Water Plan).

County	Irrigation	Municipal	Manufacturing	Mining	Steam Electric Power	Livestock
Armstrong	-	2050	-	-	-	-
Carson	-	2020	-	-	-	-
Dallam	2020	2020	-	-	-	
Donley	-	-	-	-	-	-
Gray	-	2030	-	-	-	-
Hansford		2040	-	-	-	-
Hartley	2020	2020	-	-	-	
Hemphill	-	-	-	-	-	-
Hutchinson		2020	2030	-	-	-
Lipscomb	-	2040	2040	-	-	-
Moore	2060	2020	2020			-
Ochiltree	-	2020	-	-	-	-
Oldham	-		-	-	-	-
Potter	-	2020	2020	-	-	-
Randall	-	2020	2020	-	-	-
Roberts	-	-	-	-	-	-
Sherman		-	-	-	-	
Wheeler	-	2070	-	-	-	-

Water Management Strategies Included in the State Water Plan.

The 2017 State Water Plan provides key findings and recommendations regarding addressing water supply needs with water management strategies. These findings are as follows:

- Significant reductions in surface water supplies have resulted in additional water needs in the PWPA. This is especially true for CRMWA member cities. With the development of additional groundwater in Roberts County, CRMWA can better manage their sources conjunctively to continue to utilize Lake Meredith.
- Ogallala groundwater supplies were allocated to irrigation and municipal water users such that the regional water planning goal was met both spatially and temporally. This results in immediate needs for some users that have geographical constraints for using groundwater. The actual distribution of water supplies over time may differ from these assumptions.
- Large irrigation needs are concentrated in Dallam and Hartley counties. Most of these needs are due to the spatial constraints for supply for irrigated agriculture. The recommended strategies are conservation.
- Four wholesale water providers are projected to have needs over the planning period. The recommended strategies for each provider are to develop additional groundwater.
- Conservation is a critical strategy to the region, as it can be used to reduce water needs as well as preserve limited water sources for future generations.

3.4.3 Hydrological Conditions

GMA 1 District Representatives considered hydrological conditions; including for each aquifer in the management area the total estimated recoverable storage (TERS) as provided by the TWDB Executive Administrator, as well as the average annual recharge, inflows, and discharge during meetings identified in Table 1.1.

Total Estimated Recoverable Storage (provided by TWDB)

TWDB defines TERS as the estimated amount of groundwater within an aquifer that accounts for recovery scenarios that range between 25 percent and 75 percent of the porosity-adjusted aquifer volume. In other words, TWDB assumes that between 25 and 75 percent of groundwater held within an aquifer can be removed by pumping. TERS does not account for a variety of important conditions and aquifer characteristics that limit groundwater production such as well withdrawal rate, well density, hydraulic conductivity, withdrawal costs, aquifer petrology, permeability, and potential water quality degradation. In practice, the TERS calculation represents the approximate percentage of the total storage volume in the water-producing zones of an aquifer; however, not all the water in those zones is “practicably recoverable.” The basis of the TERS calculation does not require an amount that could be recovered during any planning period. Recovery of all water from TERS would take longer than the joint planning time horizon and at a cost impractical for regional uses. Therefore, TERS accounts for water that cannot be practicably produced for beneficial use at any level in the GMA 1. Unlike TERS which simply measures volume, the highest practicable level of groundwater production is defined as a rate by measuring a volume produced through time. Table 3.8 through Table 3.11 identify Ogallala Aquifer and Rita Blanca TERS by county and district in GMA 1 from TWDB GAM Task Report 15-006 (Kohlrenken, 2015). Differences in county TERS magnitudes are illustrated by county in Figure 3.11.

GMA 1 District Representatives evaluated TERS provided by the TWDB and found that though TERS provides a total amount of groundwater that can possibly be produced given the discussion above, only a portion of groundwater in storage can be feasibly withdrawn to address the current uses and future anticipated groundwater demands. GMA 1 District Representatives selected DFCs that allow for substantial storage to remain for future demands after the planning period while ensuring that water is available to meet most WUG water demands outlined in the 2017 State Water Plan.

Table 3.8 Ogallala Aquifer TERS by county for GMA 1 (Kohlrenken, 2015)

County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Armstrong	4,600,000	1,150,000	3,450,000
Carson	15,000,000	3,750,000	11,250,000
Dallam	15,000,000	3,750,000	11,250,000
Donley	4,400,000	1,100,000	3,300,000
Gray	14,000,000	3,500,000	10,500,000
Hansford	24,000,000	6,000,000	18,000,000
Hartley	17,000,000	4,250,000	12,750,000
Hemphill	15,000,000	3,750,000	11,250,000
Hutchinson	11,000,000	2,750,000	8,250,000
Lipscomb	18,000,000	4,500,000	13,500,000
Moore	10,000,000	2,500,000	7,500,000
Ochiltree	21,000,000	5,250,000	15,750,000
Oldham	2,000,000	500,000	1,500,000
Potter	1,900,000	475,000	1,425,000
Randall	4,800,000	1,200,000	3,600,000
Roberts	30,000,000	7,500,000	22,500,000
Sherman	18,000,000	4,500,000	13,500,000
Wheeler	7,000,000	1,750,000	5,250,000
Total	**232,700,000**	**58,175,000**	**174,525,000**

Table 3.9 Ogallala Aquifer TERS by GCD in GMA 1 (Kohlrenken, 2015).

Groundwater Conservation District	***Total Storage (acre-feet)***	***25% of Total Storage (acre-feet)***	***75% of Total Storage (acre-feet)***
Hemphill County UWCD[5]	15,000,000	3,750,000	11,250,000
High Plains UWCD No.1	3,100,000	775,000	2,325,000
North Plains GCD	130,000,000	32,500,000	97,500,000
Panhandle GCD	77,000,000	19,250,000	57,750,000
No District	9,600,000	2,400,000	7,200,000
Total	**234,700,000**	**58,675,000**	**176,025,000**

Figure 3.11 Ogallala Aquifer TERS by county for GMA 1 (Kohlrenken, 2015).

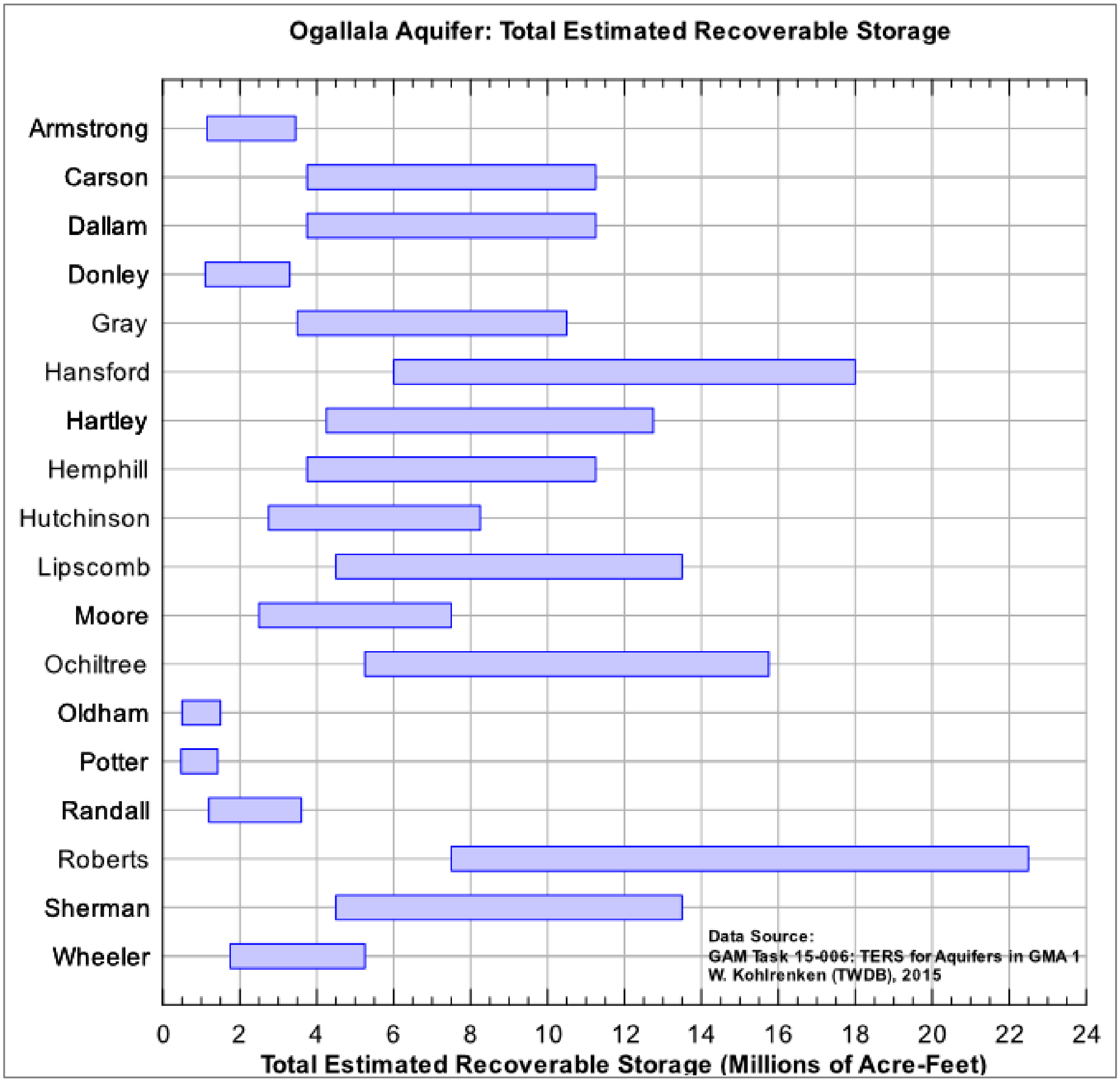


Table 3.10 Rita Blanca Aquifer TERS by county for GMA 1 (Kohlrenken, 2015).

County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Dallam	9,800,000	2,450,000	7,350,000
Hartley	1,300,000	325,000	975,000
Total	**11,100,000**	**2,775,000**	**8,325,000**

Table 3.11 Rita Blanca Aquifer TERS by GCD in GMA 1 (Kohlrenken, 2015).

Groundwater Conservation District	*Total Storage (acre-feet)*	*25% of Total Storage (acre-feet)*	*75% of Total Storage (acre-feet)*
North Plains GCD	11,000,000	2,750,000	8,250,000
No District	5,500	1,375	4,125
Total	**11,005,500**	**2,751,375**	**8,254,125**

Average Annual Recharge, Inflows, and Discharge

In groundwater models, a water budget reflects the relationship between input and output of water through a given area modeled. Water budgets for the Ogallala Aquifer and Rita Blanca Aquifer were developed using the HPASGAM. The HPASGAM calculates a water budget for recharge, evapotranspiration, discharge to springs, draws, and escarpments, flows associated with rivers and reservoirs, aquifer storage, lateral flow, and cross-formational flow. Water budget information using the HPASGAM for the steady state (predevelopment) period is shown in Table 3.12 and Table 3.13 for the Ogallala and Rita Blanca aquifers, respectively. Before pumping began in GMA 1, water inflows generally balanced outflows for the Ogallala Aquifer and the Rita Blanca Aquifer without significant aquifer storage (i.e. water level) change. The HPASGAM estimates recharge for the Ogallala was 324,889 acre-feet per year before pumping began. Before development, the Ogallala Aquifer discharged water as evapotranspiration (ET), springs, rivers, draws, escarpments, lateral and cross-formational flow.

The Rita Blanca Aquifer within GMA 1 does not recharge directly from precipitation or receive inflow from rivers because it is not exposed at the surface or intersect rivers in the area to receive water. The lack of exposure at the surface also prevents the aquifer from discharging water through evapotranspiration, springs, rivers, draws, and escarpments. The aquifer received lateral flow from outside of GMA 1 and discharged the water to other aquifers including the Ogallala and Dockum aquifers.

Additional information on average historical recharge, inflows, discharge and lateral flows are provided to each of the GMA 1 Districts by TWDB for development of the Districts' management plans.

Table 3.12 HPASGAM Water budget for the Ogallala Aquifer by county for the steady-state model (HPASGAM Report).

County	Recharge	ET	Springs	Rivers	Draws	Escarpments	Lateral	Cross-Formational
Armstrong	9,499	-28	-227	-4,313	0	-2,822	127	-2,235
Carson	12,471	-583	0	4,018	0	-206	-15,986	287
Dallam	24,489	-2,416	0	11,778	-389	0	-33,912	451
Donley	17,217	-2,417	-1,567	-15,735	-129	-7,035	9,666	0
Gray	26,145	-1,094	0	-4,840	0	-6,305	-13,907	0
Hansford	11,525	-4,540	0	-13,446	-133	0	6,594	0
Hartley	29,125	-7,346	-69	-14,320	0	-1,825	-4,325	-1,240
Hemphill	33,925	-24,895	-196	-21,966	-112	-3,600	16,844	0
Hutchinson	6,962	-5,977	-426	-18,842	-3,728	-12,165	34,176	0
Lipscomb	29,600	-8,292	0	-3,849	0	0	-17,459	0
Moore	17,353	-1,054	0	-3,600	-1,056	-3,809	-7,535	-298
Ochiltree	12,379	-487	0	1,938	0	0	-13,830	0
Oldham	18,225	-867	-262	-9,361	-1,183	-8,967	6,244	-3,830
Potter	7,110	-577	-199	-184	-263	-2,874	-1,311	-1,703
Randall	10,140	-1,784	-346	-10,779	-1,070	-1,524	8,607	-3,243
Roberts	13,084	-29,422	-4	-18,220	-3,014	-2,785	40,361	0
Sherman	17,547	-406	0	5,975	0	0	-23,170	54
Wheeler	28,093	-4,020	-1,194	-9,592	-2,223	-12,521	1,458	0
Total	324,889	-96,205	-4,490	-125,338	-13,300	-66,438	-7,358	-11,757

Table 3.13 HPASGAM Water budget for the Rita Blanca Aquifer by county for the steady-state model (HPASGAM Report).

County	Recharge	ET	Springs	Rivers	Draws	Escarpments	Lateral	Cross- Formational
Dallam	0	0	0	0	0	0	500	-500
Hartley	0	0	0	0	0	0	65	-65

Additional information on average historical recharge, inflows, discharge and lateral flows are provided to each of the GMA 1 Districts by TWDB for development of the Districts' management plans.

3.4.4 Environmental Impacts

GMA 1 District Representatives considered environmental impacts, including impacts on spring flow and other interactions between groundwater and surface water. Since groundwater and surface water are hydrologically linked, reductions in groundwater levels can lead to either reduced outflow to surface water or increased inflow from surface water (or both). Based on the HPASGAM, annual recharge to the Ogallala Aquifer remained between 325,000 and 327,000 acre-feet per year between 1930 and 2018. Annual Ogallala Aquifer discharge to springs, rivers, and draws declined from 210,000 to 57,008 acre-feet per year from predevelopment through 2018. These reductions to discharge adversely affect stream flow in the management area. Hemphill UWCD illustrated the relationship between aquifer pumping and surface water impacts shown in Figures 3.12 through 3.15.

Figure 3.12 2008-2009 groundwater level elevation impact on surface water in Hemphill County (from Hemphill UWCD 3-D Visualization Model). Areas in blue are river/stream segments where groundwater flows from the aquifer to the river/stream.

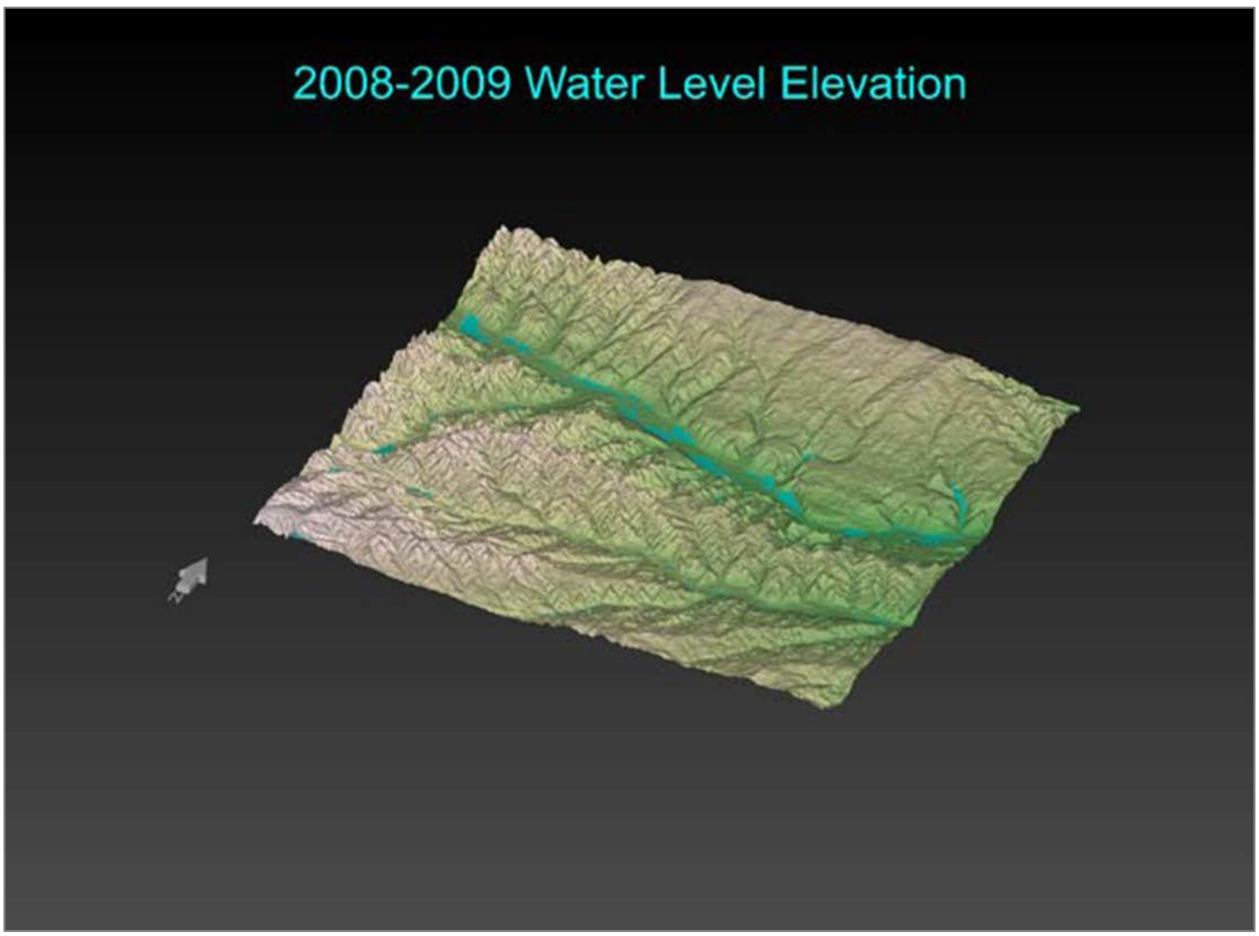


Figure 3.13 Impact to natural discharge with 80 percent remaining in storage (from Hemphill UWCD 3-D Visualization Model).

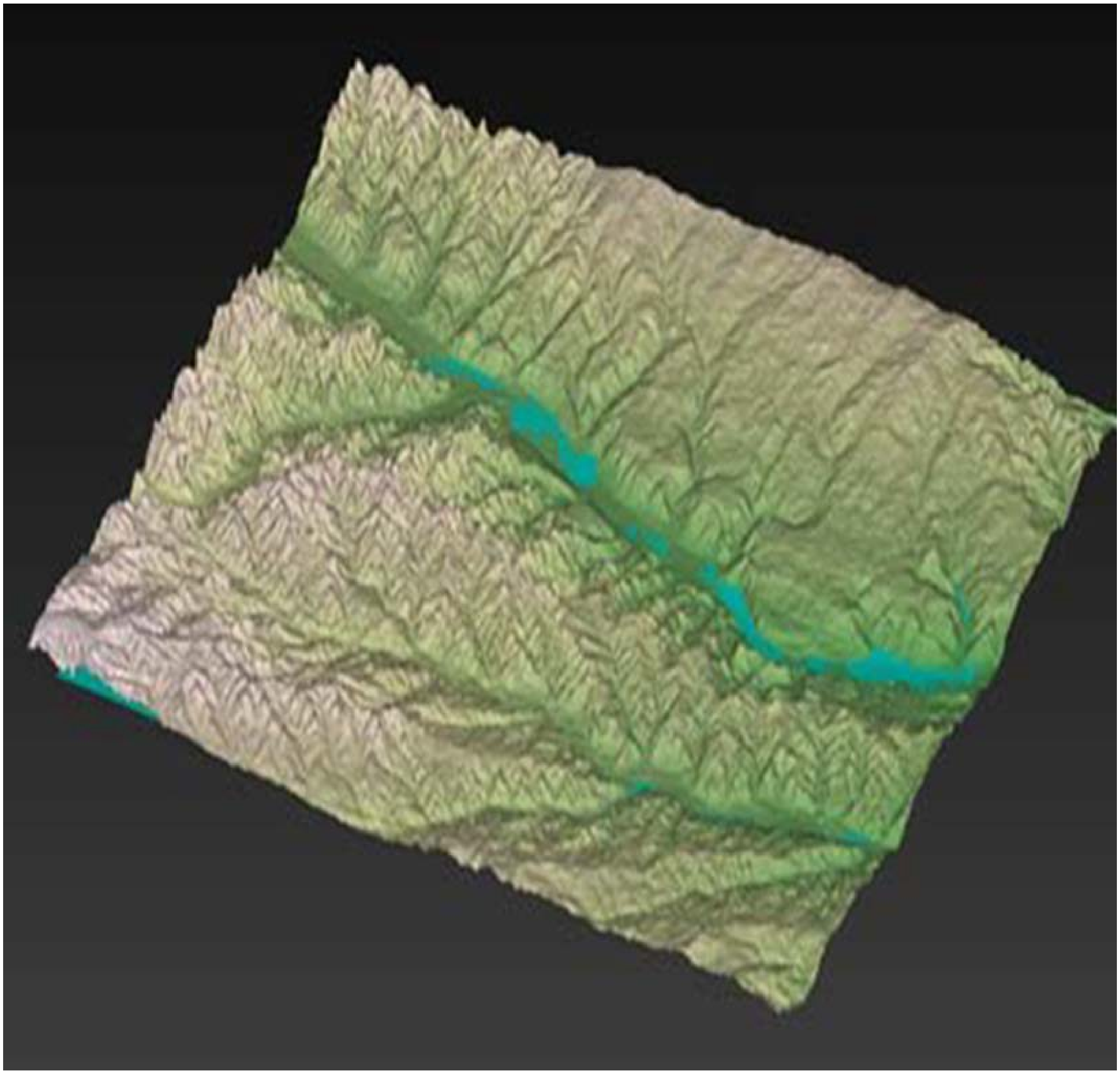


Figure 3.14 Impact to natural discharge with 70 percent remaining in storage (from Hemphill UWCD 3-D Visualization Model).

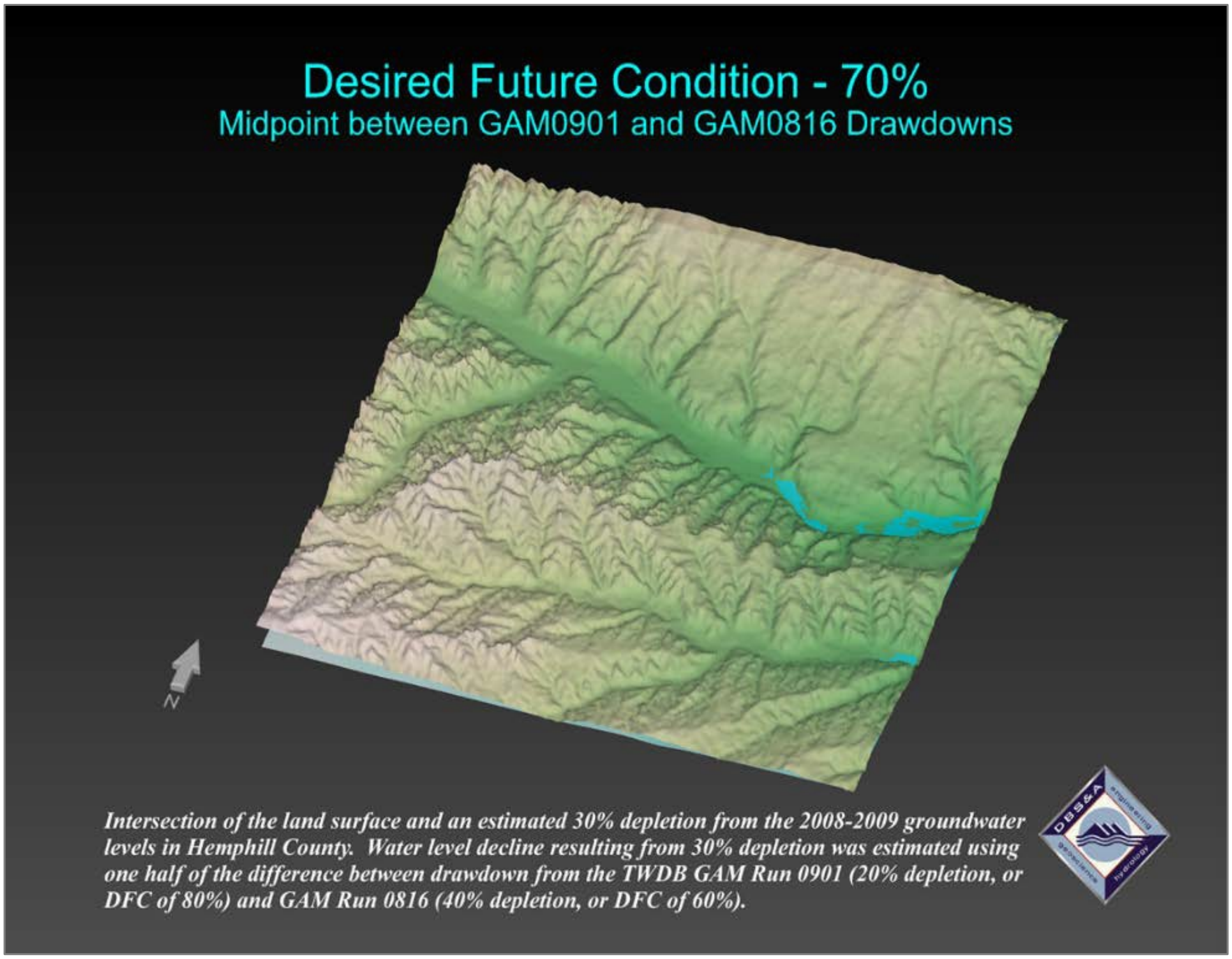
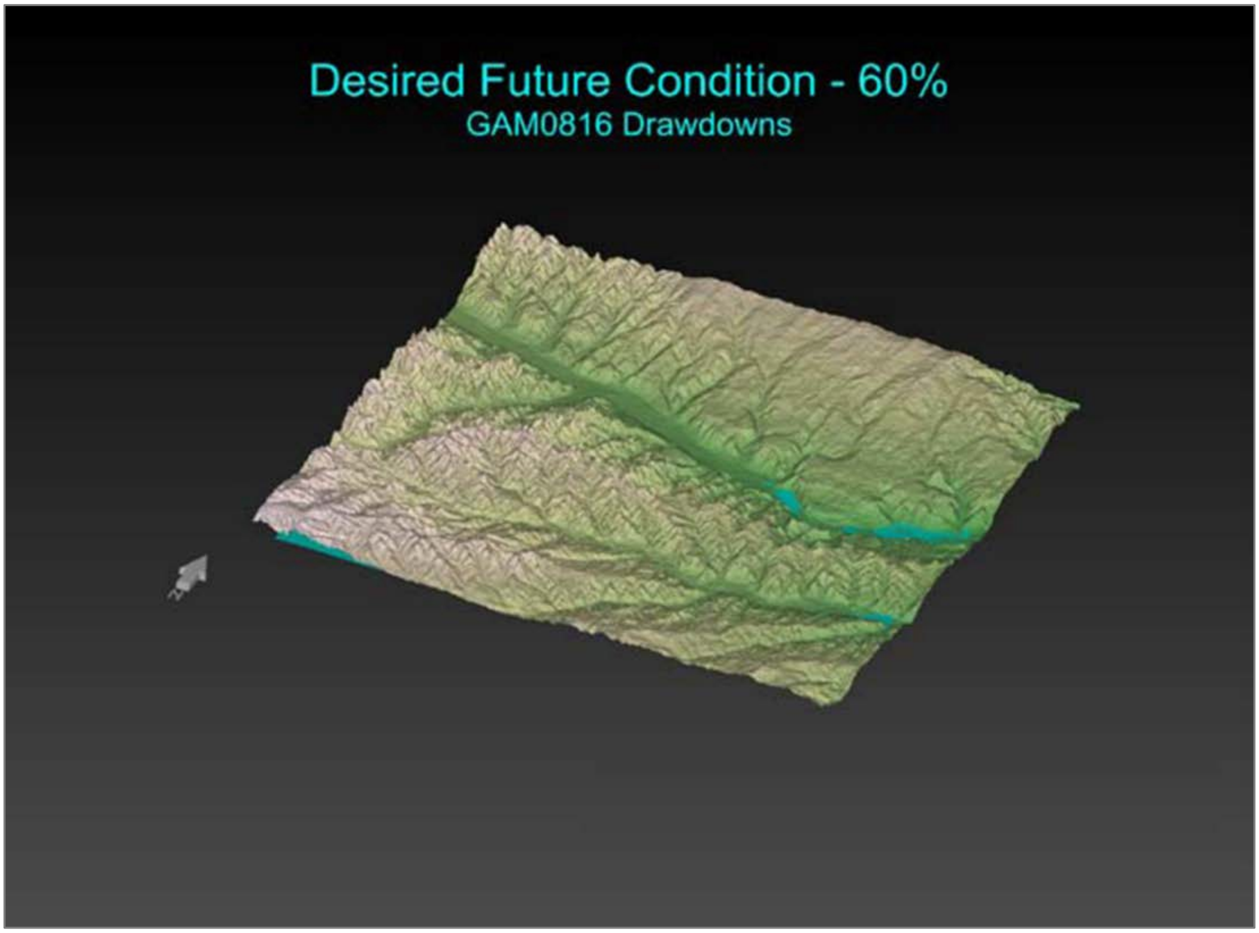


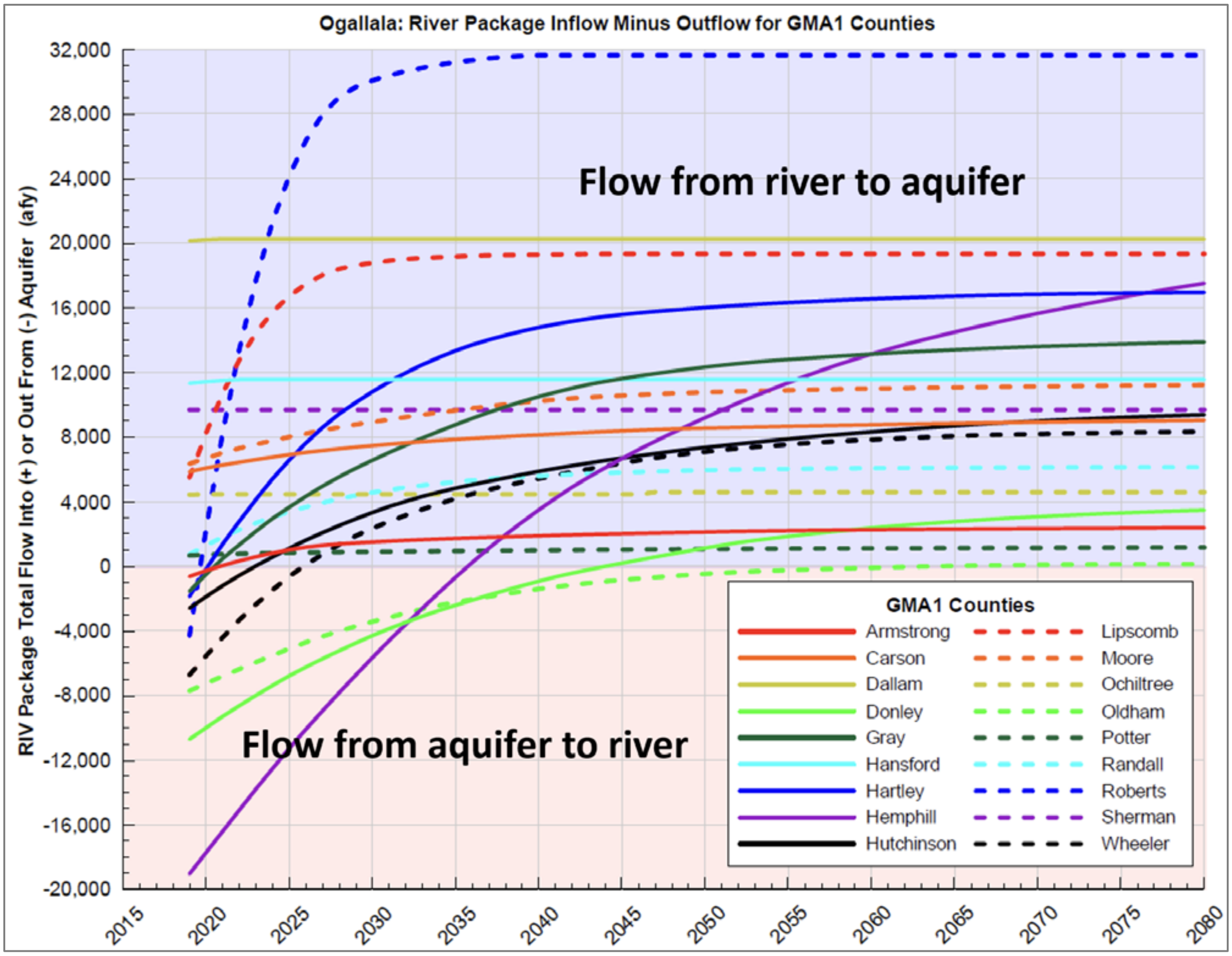
Figure 3.15 Impact to natural discharge with 60 percent remaining in storage (from Hemphill UWCD 3-D Visualization Model).



The 2011 PRWP articulates that reservoir development, groundwater development, and invasion by brush have altered natural stream flow patterns in the area. Spring flows in the area have generally declined over the past several decades. Much of the impact to springs is due to groundwater development, the spread of high water use plant species such as mesquite and salt cedar, or the loss of native grasses and other plant cover. High water use plant species have reduced reliable flows for many tributary streams. Reservoir development also changes natural hydrology by diminishing flood flows and capturing low flows. The DFCs considered by the GMA 1 will not change these issues.

GMA 1 Districts anticipate that groundwater pumping in the Ogallala Aquifer may continue to diminish the groundwater discharge to springs, rivers, draws and escarpments. This expected trend is shown in Figure 3.16, which reflects expected changes to interaction between groundwater and surface water associated with the DFCs. In most of the GMA 1 counties groundwater currently does not contribute to river flow. In the counties where groundwater does contribute to river flow (Hemphill, Donley, Oldham, Wheeler, Roberts, Hutchinson, Gray, Potter, and Armstrong) future drawdown due to pumping may induce inflow from perennial surface water bodies during the planning period.

Figure 3.16 Projected interactions between surface water and groundwater, based on the effects of predicted groundwater pumping from the adopted DFCs.



3.4.5 Subsidence Impacts

GMA 1 District Representatives considered potential impacts of the adopted DFCs on land subsidence. This included a review of the causes and mechanisms of land surface subsidence and the results of a recent study on subsidence risk throughout Texas (Furnans and others, 2017). The Furnans and others (2017) study concluded that the Ogallala Aquifer presented a "high" risk of compaction leading to subsidence and the Dockum Aquifer presented a "medium" risk of compaction leading to subsidence. The study was based on review of driller's lithologic logs, historical water level changes, and hydraulic properties in the groundwater availability models.

As noted by the GMA 1 Districts and the US Geological Survey fact sheet on subsidence in the United States (Galloway and others, 2000), substantial subsidence has not historically been observed or linked to groundwater production in GMA 1 despite substantial water level declines in historically. After considering the data and methods used in Furnans and others (2017) subsidence study in the context of other available information on subsidence in the area, the GMA 1 Districts concluded that subsidence has not been an issue and is unlikely to be an issue in GMA 1 in the future under the adopted DFCs.

3.4.6 Socioeconomic Impacts

GMA 1 District Representatives considered socioeconomic impact studies prepared by the TWDB for regional water planning purposes, along with multiple other studies that target areas in GMA 1 based on the DFCs options during joint planning meetings identified in Table 1.1.

In the regional water planning process, there is a quantitative evaluation of socioeconomic impacts, but the impact is limited to what would occur if a water demand were not met during a repeat of the drought of record. Analysis is limited to the categories of users with an identified water need (i.e. potential shortage). GMA 1 District Representatives reviewed this analysis during the November 19, 2020 meeting; however, this analysis does not directly translate to the evaluation of potential socioeconomic effects of the proposed DFC. For this reason, the consideration including discussion on balancing the socioeconomic impacts of developing higher amounts of groundwater (both positive and negative) with the socioeconomic impacts of impacts of developing lesser amounts of groundwater (again, both positive and negative).

In addition to the socioeconomic information provided in the 2017 State Water Plan, the GMA 1 Districts reviewed other information that included:

- Economic Impacts of Selected Water Conservation Policies in the Ogallala Aquifer Report (Amosson and others, 2014a).
- Economic Impacts of Groundwater Management Standards in the Panhandle Groundwater Conservation District of Texas (Weinheimer, 2012).
- Evaluation of Changing Land Use and Potential Water Conservation Strategies: North Plains Groundwater Conservation District (Amosson and others, 2014b).
- Farm Level Financial Impacts of Water Policy on the Southern Ogallala Aquifer (Weinheimer, 2008).

- Multi-year water allocation: an economic approach towards future planning and management of declining groundwater resources in the Texas Panhandle (Tewari et.al, 2014).
- Socioeconomic Impacts of Projected Water Shortages for the Panhandle (Region A) Regional Water Planning Area Prepared in Support of the 2011 Panhandle Regional Water Plan (Norvell et.al, 2010).
- Water Conservation Policy Alternatives for the Ogallala Aquifer in Texas (Johnson, et.al, 2007).
- Letter of Opinion Concerning Texas Panhandle Land Values: Hemphill UWCD (Scott Land Company LLC, Clift Land Brokers and the USFMRA Land Trends, 2016).

3.4.7 Private Property Impacts

GMA 1 District Representatives considered the impact on the interests and rights in private property, including ownership and the rights of landowners and their lessees and assigns in groundwater during the joint planning meetings described in Table 1.1. In 2015, GMA 1 District Representatives received a presentation by Keith Good, attorney with Lemon, Shearer, Phillips and Good, P.C., regarding possible DFC impacts on private property rights (Good, 2015). Mr. Good's commentary remains relevant to the current round of joint planning. The highlights of Mr. Good's presentation were reviewed and considered again during the joint planning process and are summarized as follows:

The consideration of impacts on private property rights is not new in groundwater management in Texas. Even before it was a required consideration for joint planning, the TWDB under its rules considered the impact on private property rights as one of the Factors to determine if an adopted DFC was reasonable if that DFC were petitioned. In EAA vs. Day, the Texas Supreme Court sent a variety of signals regarding regulation by GCDs including:

- "Unquestionably, the State is empowered to regulate groundwater production."
- "Regulation is essential to groundwater conservation and use."
- The rule of ownership must be considered with the law of capture and is subject to police regulation.
- Each landowner "owns separately, distinctly, and exclusively all the water under his land."
- "Landowners do have a constitutionally compensable interest in groundwater."
- "Groundwater rights are property rights subject to constitutional protection; whatever difficulties may lie in determining adequate compensation for a taking."
- Any meaningful Rules adopted by a District to achieve a DFC may have a potential impact on property rights.
- "Considerations" analyze how property rights could be impacted.
- Impacts are not equated as "takings" in this process.

- Impacts may be viewed as both restricting and benefitting property rights.

Mr. Good condensed the interest groups with property interests and rights related to the production and conservation of groundwater in GMA 1 including:

- Interests and rights that are benefitted or enhanced by the present use of groundwater.
- Interests and rights that are benefitted or enhanced using groundwater soon.
- Interests and rights that are benefitted or enhanced by the ability to use groundwater over the long-term.
- Interests and rights that are benefitted or enhanced by leaving a significant amount of groundwater in place.

By statute and under EAA vs. Day, all landowners have constitutionally protected property rights in groundwater beneath their property. A GMA must consider the rights of all owners of private property, including all owners of groundwater within the GMA. All identified interests have the potential to be "impacted" by groundwater regulation (or the absence of regulation). Existing GCD rules that implement DFCs adopted by GMA 1 impact or affect private property rights by setting well spacing requirements and production limits. Spacing requirements impact where landowners may drill wells. Spacing requirements may also positively impact the property interests of neighboring landowners by reducing the potential for interference between wells. Production limitations currently exist in the GMA 1 Districts. Such rules are designed to prolong the groundwater supply and reduce the drainage of groundwater owned by neighboring landowners.

Some of the potential impacts to private property rights of DFCs associated with higher levels of production include:

- Unobtrusive production restrictions, allowing users to produce more groundwater with limited acreage.
- Could limit water available for future users.
- Increased drainage of groundwater from neighboring landowners.

Some of the potential impacts to private property rights of DFCs associated with lower levels of production include:

- Production limits that may force users to reduce groundwater production or acquire additional groundwater rights.
- Greater water available to meet future needs.
- Minimized well interference and induced drainable from neighboring landowners.

A GMA is expressly allowed to adopt DFCs for the "establishment of DFCs that provide for the reasonable long-term management of groundwater resources. GMA 1 must consider the impact of GMA 1 DFCs on private property rights in groundwater as recognized under TWC Section 36.002. Owners are entitled to drill for and produce groundwater (subject to regulation by GCDs).

Owners are not entitled to capture any amount of groundwater they choose. Section 36.002 does not grant a GCD the authority to deprive or divest an owner of the rights described by Section 36.002. It is unlikely that GMA 1 DFCs will result in an owner being prohibited from drilling for and producing groundwater; and it is unlikely that GMA 1 DFCs will result in an owner being deprived or divested of groundwater rights described in Section 36.002.

Different DFCs, rules, and policy decisions by the Districts within GMA 1 may impact private property rights differently. Each District's management plan and rules and the implementation thereof, likely have more potential to "impact" private property rights in groundwater than the DFCs.

3.4.8 Achievement Feasibility

GMA 1 District Representatives considered the feasibility of achieving the adopted DFCs. Conceptually, there are two elements to the feasibility of achieving the DFCs: regulatory feasibility and physical feasibility.

Regulatory feasibility refers to whether the GMA 1 Districts have within the Texas Water Code and their respective enabling legislation the regulatory tools necessary to achieve the DFCs. For example, some uses of groundwater (such as for rural domestic, livestock, or drilling for oil and gas) are generally exempt from production limits by a GCD. If the total expected pumping of these combined uses exceeded the groundwater availability associated with the DFC, then the DFC would clearly not be regulatorily feasible. That is, the Districts would not have the authority to manage groundwater production to achieve the DFCs. As described above, most of the groundwater pumping in GMA 1 is for irrigation and is generally subject to regulatory by GCDs. Further, the groundwater availability associated with the adopted DFCs allows for considerable continued production for both exempt and non-exempt uses. The GMA 1 Districts considered this information and determined that the adopted DFCs are regulatorily feasible.

Physical feasibility refers to whether the various DFCs in the GMA can be achieved concurrently. The physical feasibility is demonstrated by use of the model. The model run associated with the adopted DFCs shows that each of the DFCs for the Ogallala Aquifer (inclusive of the Rita Blanca) as well as the Dockum Aquifer can be achieved concurrently.

3.4.9 Other Information

TWC Section 36.108(d)(9) requires the districts to consider any other information relevant to the specific DFCs. The GMA 1 Districts considered whether other information existed that was necessary to review to inform the DFCs and determined that all information necessary was considered under the other eight factors.

3.5 Discussion of Other DFCs considered

In the current round of joint planning, the GMA 1 Districts elected to continue with percent of storage remaining in all areas within GMA 1 except for Randall County and within the High Plains UWCD in Armstrong and in Potter counties. High Plains District's jurisdiction primarily lies within

GMA-2 and has only 4.6 percent (345,722 acres) of its jurisdiction is within GMA 1. The High Plains UWCD requested that GMA 1 adopt DFCs using feet of drawdown instead of percent storage in the Districts' jurisdictional areas. By establishing DFCs based on feet of aquifer drawdown, High Plains UWCD can better manage the Ogallala Aquifer DFC in GMA-1 with the DFCs set for the rest of its district in GMA 2.

During consideration of the DFC adopted in 2016, Hemphill UWCD evaluated different potential DFCs ranging from 60 percent to 80 percent of the Ogallala Aquifer remaining in storage in 50 years. Hemphill UWCD's 3-D Visualization Model shows that leaving 80 percent of the Ogallala Aquifer in storage is a good balance of addressing stream flow while providing for groundwater withdrawals. As shown in Figure 3.13 of this report, even at 80 percent of the aquifer remaining, part of the Canadian River becomes a losing stream, and subsequent figures show continuing decline of stream flow as pumping is increased. The 80 percent DFC provides the desired balance between production and conservation within the Hemphill UWCD.

3.6 Discussion of Other Recommendations

GMA 1 District Representatives provided the public opportunity to comment on the DFC Joint Planning Process or recommend other DFCs at each joint planning meeting. Each District also held respective public hearings to discuss the Proposed DFCs with the public in their local service areas.

3.6.1 Advisory Committees

GMA 1 Districts did not establish advisory committees for this round of planning and therefore no comment from such committees were filed.

3.6.2 Public Comments

On March 18, 2021, the GMA 1 Districts unanimously voted to adopt Proposed DFCs for the major aquifers in the Joint Planning Area.

A public comment period of not less than 90 days began on March 18, 2021. During the public comment period and after posting notice as required by TWC Section 36.063, each district held at least one public hearing on proposed DFCs relevant to that district. During the public comment period, the districts made available in its office a copy of the proposed DFCs and any supporting materials. All documents considered in the joint planning process were organized and posted for the convenience of the public and GMA 1 membership. This included posting materials online at www.panhandlewater.org/gma-1. Individual districts held public hearings during the statutorily required not less than 90-day public input phase prior to the final adoption of DFCs.

After the public hearings and public comment period, the GMA 1 Districts reviewed relevant public comments received at the August 26, 2021 Joint Planning meeting prior to adopting DFCs.

Through the public input process, GMA 1 Districts received 3 public comments, all of which were submitted to High Plains District. These summary reports documenting the public hearings conducted and comments received are included in Appendix V – Summary Reports and Public Comments Received.

4 DOCKUM AQUIFER DESCRIPTION AND DESIRED FUTURE CONDITIONS

4.1 Dockum Aquifer Description

The TWDB defines the Dockum Aquifer as the water-bearing units of the Triassic-aged Dockum Group. The Dockum Group extends through multiple TWDB Regional Water Planning Areas and parts of four GMAs. TWDB Report 359 (Bradley and Kalaswad, 2003) estimated that the Dockum Group's total areal extent is approximately 42,000 square miles in Texas. Figure 4.1 shows geologic cross sections of the Dockum Group, modified from Bradley and Kalaswad (2003). Though regionally extensive, TWDB classifies the Dockum Aquifer as a minor aquifer because of its generally poor water quality and limited production capacity. Based on water quality data from North Plains GCD, the Lower Dockum Aquifer appears to be of higher water quality in Dallam, Hartley, and Moore counties than further south in the Dockum basin. Figure 4.2 shows the areal extent of the Dockum Aquifer in Texas (George et.al. 2011).

The Dockum Aquifer is in nine counties, primarily in the western portion of GMA 1. The HPASGAM segregates the aquifer into the Upper Dockum and the Lower Dockum. The Lower Dockum is present in the management area and includes:

- the Tecovas Formation, a variegated, sometimes sandy mudstone with interbedded fine to medium grained sandstone.
- the Santa Rosa Formation, a red to reddish-brown sandstone and conglomerate.

Groundwater located in the Santa Rosa sandstone and conglomerate provides the highest yields in the aquifer with the Tecovas sands yielding lesser amounts of water. Locally, all water-bearing sands within the Dockum Aquifer are informally referred to as "Santa Rosa," regardless of whether they are in the Tecovas or Santa Rosa formations of the Dockum Aquifer.

Figure 4.1 Geologic cross sections of the Dockum Group along (A-A') and across (B-B') (modified from Bradley and Kalaswad, 2003)

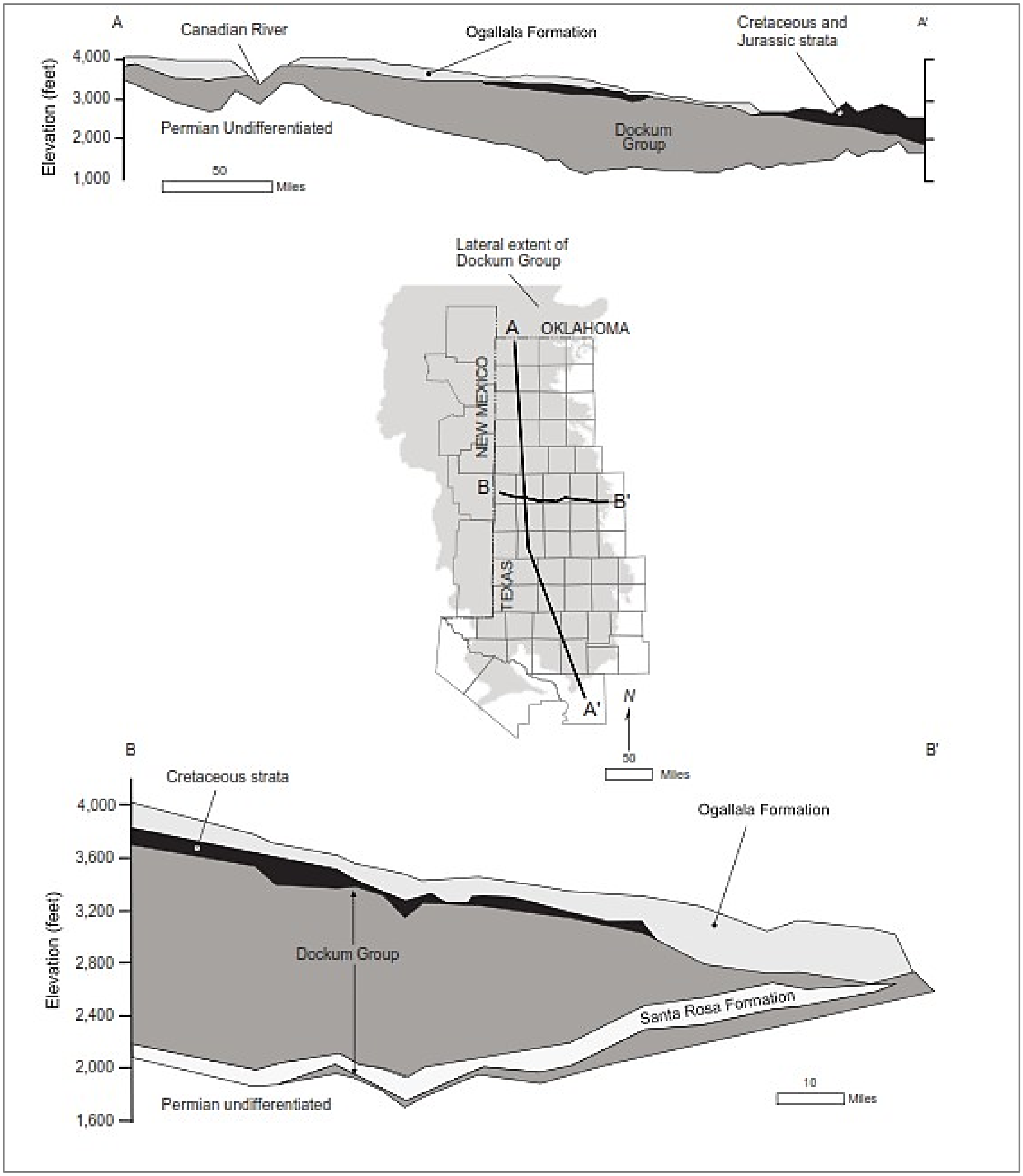
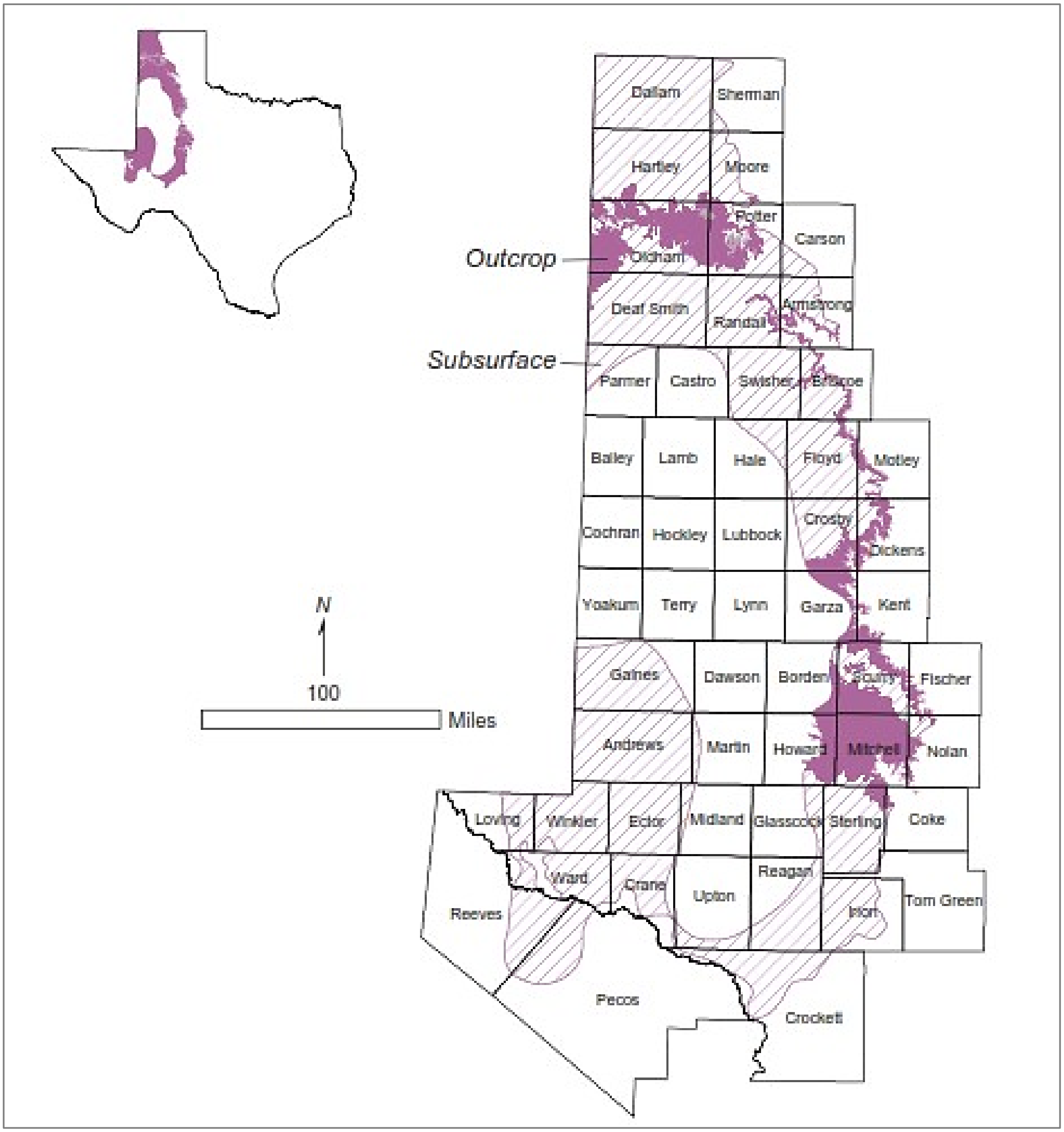


Figure 4.2 Dockum Aquifer areal extent in Texas (George et.al. 2011)



4.2 Dockum Aquifer Desired Future Conditions

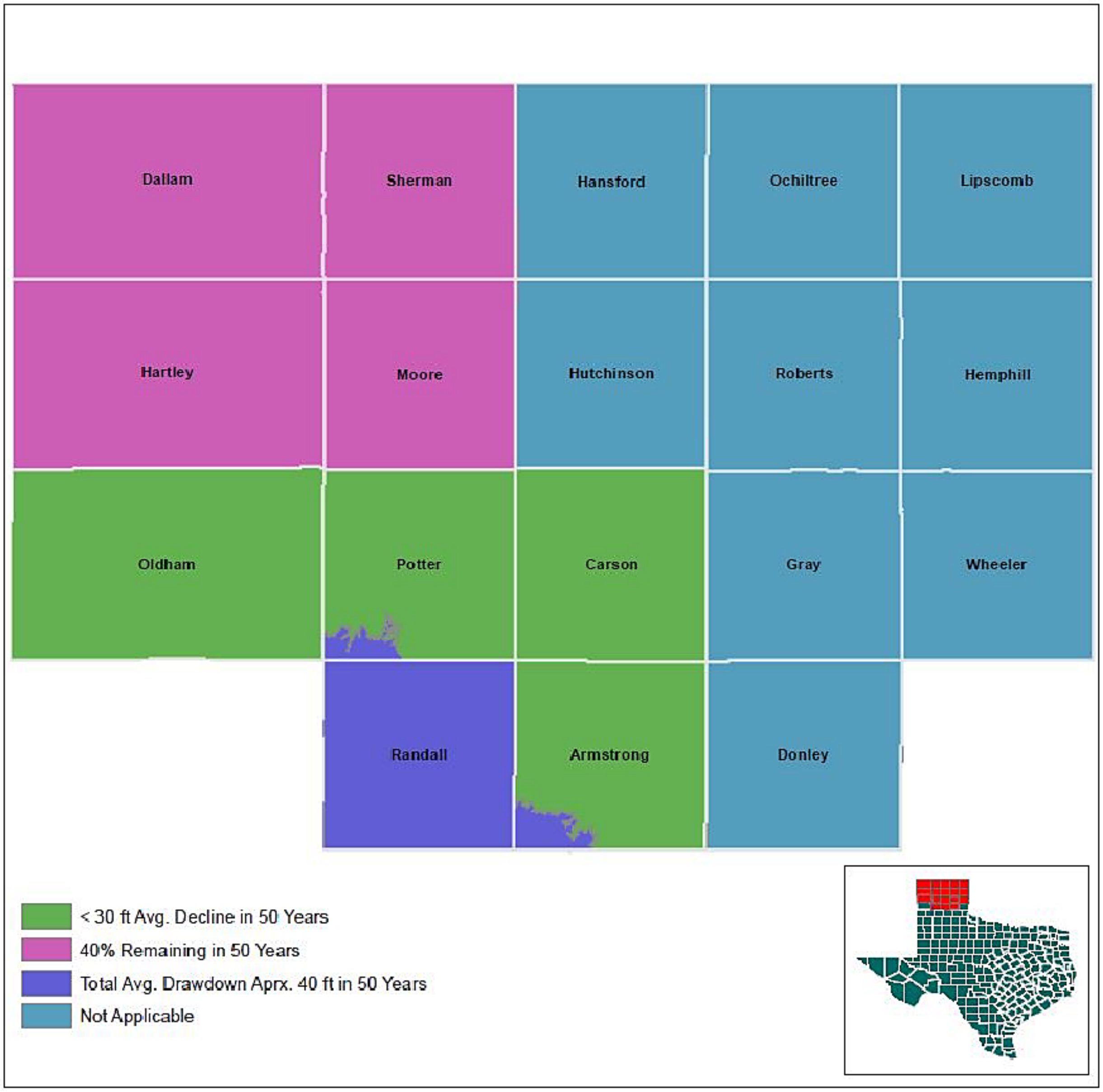
GMA 1 District Representatives unanimously adopted DFCs for the Dockum Aquifer by resolution on August 26, 2021.

The Dockum Aquifer DFCs adopted by GMA 1 are as follows:

- At least 40 percent of the average available drawdown remaining for each 50-year period between 2018 and 2080 for 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; and
- 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.

The resolution adopting DFCs is provided in Appendix I – DFC Documents. Documentation for this meeting including meeting postings, agenda package, sign-in sheet and meeting supplements is provided in Appendix II- Meeting Documentation.

Figure 4.3 GMA 1 Dockum Aquifer DFC Map (provided by PRPC, 2016)



4.3 Policy and Technical Justification

TWC Section 36.108(d-2) requires that DFCs proposed as part of joint planning in the management area must provide a balance between the highest practicable level of groundwater production and the conservation, preservation, protection, recharging, and prevention of waste of groundwater and control of subsidence in the management area. GMA 1 District Representatives established different DFCs throughout the management area based on a combination of policy and technical considerations that provide continued economic development of the area while providing for the reasonable long-term management of groundwater resources consistent with the management goals under TWC Section 36.1071(a).

4.3.1 Policy Justification

The Dockum Aquifer is in the nine western counties in GMA 1 and is currently designated as a minor regional water supply that will more than likely be tapped more to offset diminishing Ogallala Aquifer supplies in the future. The development of different Dockum Aquifer DFCs in GMA 1 strikes a balance between the highest practicable level of groundwater production and conservation, preservation, protection, recharging, and prevention of waste.

The estimated modeled pumping levels from the adopted Dockum DFCs significantly exceed the current groundwater pumping and will be used to meet future needs over the planning period while leaving substantial water in the ground for the future in GMA 1.

4.3.2 Technical Justification

The Dockum Aquifer DFCs passed in 2016 allowed for future growth while promoting conservation. GMA 1 District Representatives reviewed the 2016 DFCs and numerous current information sources during consideration of whether amendments to the 2016 DFCs were needed. To reevaluate the 2016 DFCs, the GMA 1 Districts first updated the reference year from 2012 to 2018 in the HPASGAM (Deeds and Jigmond, 2015) and extended the projection period from 2012-2062 to 2018-2080. With slight modifications to the Dockum Aquifer DFC wording to accommodate the changes above, the GMA 1 Districts evaluated the Dockum Aquifer DFCs. Table 4.1 shows a compilation of the modeled pumping consistent with these DFCs, which declines from approximately 287,000 acre-feet per year in 2020 to 241,000 acre-feet per year in 2080. These pumping estimates far exceed estimates of current use of the Dockum Aquifer and represent a balance that allows for significant future development of the aquifer while conserving water for the future.

Table 4.1 Dockum Aquifer modeled pumping levels based on the adopted DFCs in acre- feet/year.

	2020	2030	2040	2050	2060	2070	2080
High Plains UWCD No.1	**11,489**	**12,235**	**12,305**	**10,971**	**10,179**	**10,085**	**10,155**
Armstrong	1,849	835	221	221	221	221	221
Potter	2,658	2,658	2,402	2,316	2,276	2,249	2,168
Randall	6,982	8,742	9,683	8,434	7,682	7,615	7,766
North Plains GCD	**33,262**	**33,170**	**31,424**	**29,745**	**28,304**	**26,928**	**25,715**
Dallam	15,953	15,549	14,687	14,045	13,502	12,920	12,406
Hartley	12,379	11,802	11,031	10,343	9,737	9,242	8,815
Moore	4,487	5,402	5,398	5,068	4,773	4,477	4,204
Sherman	444	416	309	289	293	288	290
Panhandle GCD	**35,405**	**44,836**	**45,885**	**45,599**	**44,643**	**43,623**	**42,403**
Armstrong	5,302	7,107	8,105	8,607	8,830	8,909	8,895
Carson	6	6	6	6	6	6	6
Potter	30,097	37,723	37,774	36,987	35,806	34,707	33,501
Non-District Areas	**207,317**	**236,532**	**231,191**	**218,086**	**200,544**	**179,456**	**162,332**
Hartley	44,168	52,833	52,986	50,465	46,810	43,002	39,229
Moore	241	560	593	617	641	645	624
Oldham	143,936	153,889	145,622	135,482	124,602	114,645	105,122
Randall	18,974	29,250	31,990	31,523	28,491	21,163	17,357
GMA 1 Total	**287,474**	**326,773**	**320,806**	**304,402**	**283,670**	**260,092**	**240,605**

4.4 Dockum Aquifer Factor Consideration

4.4.1 Aquifer Uses or Conditions

The GMA 1 districts considered information on aquifer uses and conditions including the estimated pumping by aquifer, the distribution of well depths and the distribution of well yields in each county in GMA 1. The Districts also considered water demands throughout GMA 1, which are independent of the aquifer and more fully presented in the discussion in Section 3.4.1.

Table 4.2 below shows the estimated Dockum Aquifer pumping by WUG in GMA 1 between 2005 and 2017. In general, recent pumping of the Dockum Aquifer ranges from between 5,000 and 8,000 acre-feet per year. This is approximately evenly split among use for irrigation, livestock, and municipal supply.

Table 4.3 below shows the estimated Dockum Aquifer pumping by county over the same 2005-2017 time period. Moore, Oldham and Randall counties had higher rates of Dockum production than other counties in GMA 1, though it still represents only a small fraction of water used in these counties. As water levels decline in the Ogallala Aquifer, use of the Dockum Aquifer may increase as conditions become more favorable for development.

Table 4.2 GMA 1 Dockum Aquifer pumping in acre-feet by year and by WUG from 2005-2014 (TWDB, 2020). Values shown as ".%" represent no estimated water use.

Year	Irrigation	Livestock	Manufacturing	Mining	Municipal	Power	Total Dockum Pumpage
	Units = Acre/feet						
2005	3,221 (58.%)	1,458 (26.2%)	(.%)	(.%)	877 (15.8%)	(.%)	5,556
2006	2,257 (34.7%)	2,450 (37.6%)	(.%)	(.%)	1,802 (27.7%)	(.%)	6,510
2007	2,751 (47.%)	1,667 (28.5%)	(.%)	(.%)	1,435 (24.5%)	(.%)	5,852
2008	2,343 (43.9%)	1,380 (25.9%)	(.%)	(.%)	1,613 (30.2%)	(.%)	5,336
2009	2,293 (42.3%)	1,330 (24.5%)	(.%)	(.%)	1,801 (33.2%)	(.%)	5,423
2010	1,770 (24.5%)	1,393 (19.3%)	(.%)	(.%)	4,074 (56.3%)	(.%)	7,237
2011	2,837 (36.7%)	1,660 (21.5%)	(.%)	(.%)	3,228 (41.8%)	(.%)	7,726
2012	2,579 (37.6%)	1,684 (24.5%)	(.%)	(.%)	2,603 (37.9%)	(.%)	6,866
2013	2,440 (38.3%)	1,468 (23.%)	(.%)	(.%)	2,471 (38.7%)	(.%)	6,379
2014	2,115 (35.1%)	1,555 (25.8%)	(.%)	(.%)	2,362 (39.2%)	(.%)	6,032
2015	1,374 (26.4%)	1,578 (30.4%)	(.%)	(.%)	2,245 (43.2%)	(.%)	5,197
2016	1,992 (33.4%)	1,603 (26.9%)	(.%)	(.%)	2,373 (39.8%)	(.%)	5,967
2017	1,673 (30.5%)	2,099 (38.2%)	(.%)	(.%)	1,716 (31.3%)	(.%)	5,488

Table 4.3 GMA 1 Dockum Aquifer pumping in acre-feet by year and by county from 2005-2017 (TWDB, 2020).

Source County	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
ARMSTRONG	146	164	109	122	114	92	127	131	93	76	69	85	109
CARSON		8	6	7	12	17	19	18	11	7	3	3	3
DALLAM													
HARTLEY	621	1,054	692	831	791	695	948	1,003	983	1,042	1,028	1,013	1,294
MOORE	2,008	1,261	1,733	1,297	1,362	1,129	1,853	1,628	1,544	1,440	1,041	1,280	1,097
OLDHAM	1,224	1,497	1,164	814	757	857	1,135	1,035	962	874	806	912	972
POTTER	627	1,138	1,020	1,022	1,112	1,131	1,012	1,047	1,020	784	574	385	369
RANDALL	930	1,388	1,128	1,242	1,275	3,317	2,631	2,004	1,766	1,807	1,677	2,289	1,643
Total Pumpage	5,556	6,510	5,852	5,336	5,423	7,237	7,726	6,866	6,379	6,032	5,197	5,967	5,488

4.4.2 Water Supply Needs and Water Management Strategies Included in the State Water Plan.

TWC Section 36.108(d)(2) requires that District Representatives consider the water supply needs and water management strategies included in the State Water Plan. GMA 1 Districts considered data from the 2017 State Water Plan. Information from both regional and state plans are provided in the supporting documentation; however, for the purposes of simplicity, the 2017 State Water Plan is referenced in discussing the water supply needs and water management strategies for GMA 1.

The GMA 1 anticipates that the Dockum Aquifer will be used to supplement the water to address regional water supply needs and water management strategies included in the 2017 State Water Plan. GMA 1 District Representatives used the same information for consideration of water supply needs and water management strategies as for consideration of this Factor in adopting Ogallala Aquifer DFCs. For a more thorough discussion of GMA 1 consideration of this Factor please refer to Section 3.4.2 Water Supply Needs and Water Management Strategies in this Explanatory Report.

GMA 1 District Representatives considered water supply needs and water management strategies within GMA 1 during the DFC joint planning meetings identified in Table 1.1.

4.4.3 Hydrological Conditions

GMA 1 District Representatives considered hydrological conditions; including for each aquifer in the management area the TERS as provided by the TWDB Executive Administrator, as well as the average annual recharge, inflows, and discharge during meetings identified in Table 1.1.

Total Estimated Recoverable Storage (provided by TWDB)

TWDB defines TERS as the estimated amount of groundwater within an aquifer that accounts for recovery scenarios that range between 25 percent and 75 percent of the porosity-adjusted aquifer volume. In other words, TWDB assumes that between 25 and 75 percent of groundwater held within an aquifer can be removed by pumping. TERS does not account for a variety of important conditions and aquifer characteristics that limit groundwater production such as well withdrawal rate, well density, hydraulic conductivity, withdrawal costs, aquifer petrology, permeability, and potential water quality degradation. In practice, the TERS calculation represents the approximate percentage of the total storage volume in the water-producing zones of an aquifer; however, not all the water in those zones is "practicably recoverable". The basis of the TERS calculation does not require an amount that could be recovered during any planning period. Recovery of all water from TERS would take longer than the joint planning time horizon and at a cost impractical for regional uses. Therefore, TERS accounts for water that cannot be practicably produced for beneficial use at any level in the GMA 1. Unlike TERS which simply measures volume, the highest practicable level of groundwater production is defined as a rate by measuring a volume produced through time. Table 4.4 and Table 4.5 identify Dockum Aquifer TERS by county and District in GMA 1 from TWDB GAM Task Report 15-006 (Kohlrenken, 2015).

GMA 1 District Representatives evaluated TERS provided by the TWDB and found that though TERS provides a total amount of groundwater that can possibly be produced given the discussion above, only a portion of groundwater in storage can be feasibly withdrawn to address the current uses and future anticipated groundwater demands. GMA 1 District Representatives selected DFCs that allow for substantial storage to remain for future demands after the planning period while ensuring that water is available to meet most WUG water demands outlined in the 2017 State Water Plan.

Table 4.4 Dockum Aquifer TERS by county in GMA 1 (Kohlrenken, 2015)

County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Armstrong	7,000,000	1,750,000	5,250,000
Carson	1,900,000	475,000	1,425,000
Dallam	80,000,000	20,000,000	60,000,000
Hartley	96,000,000	24,000,000	72,000,000
Moore	7,400,000	1,850,000	5,550,000
Oldham	43,000,000	10,750,000	32,250,000
Potter	10,000,000	2,500,000	7,500,000
Randall	46,000,000	11,500,000	34,500,000
Sherman	540,000	135,000	405,000
Total	**291,840,000**	**72,960,000**	**218,880,000**

Table 4.5 Dockum Aquifer TERS by GCD in GMA 1 (Kohlrenken, 2015)

Groundwater Conservation District	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
High Plains UWCD[2] No.1	28,000,000	7,000,000	21,000,000
North Plains GCD	170,000,000	42,500,000	127,500,000
Panhandle GCD	15,000,000	3,750,000	11,250,000
No District	77,000,000	19,250,000	57,750,000
Total	**290,000,000**	**72,500,000**	**217,500,000**

Average Annual Recharge, Inflows and Discharge

In groundwater models, a water budget reflects the relationship between input and output of water through a given area modeled. Water budgets for the upper and lower portions of the Dockum Aquifer were developed using the HPASGAM. The HPASGAM calculates a water budget for recharge, evapotranspiration, discharge to springs, draws, and escarpments, flows associated with rivers and reservoirs, aquifer storage, lateral flow, and cross-formational flow. Water budget information using the HPASGAM for the steady state (predevelopment) period is shown in Table 4.6 and Table 4.7 for the upper and lower portions of the Dockum Aquifer, respectively. Before pumping began in GMA 1, water inflows generally balanced outflows for the Dockum Aquifer without significant aquifer storage (i.e. water level) change. The HPASGAM estimates recharge for the Dockum Aquifer is approximately 8,600 acre-feet per year. This only occurs in the lower portion of the Dockum Aquifer because the upper portion of the Dockum does not outcrop at land surface. Table 4.8 and Table 4.9 show the water budgets for 2012 upper and lower portions of the Dockum Aquifer, respectively. With pumping occurring in the aquifer, the main response is, as shown in the water budget, a reduction in storage (i.e. a water level decline). With continued water level declines over time, other water budget terms such as outflow to surface water may also change in response to pumping. This is discussed in more detail in the Environmental Impacts section.

Additional information on average historical recharge, inflows, discharge and lateral flows are provided to each of the GMA 1 Districts by TWDB for development of the Districts' management plans.

Table 4.6 Water budget for the upper Dockum by county for the steady-state model (modified from Deeds and Jigmond, 2015).

County	Recharge	ET	Springs	Rivers	Draws	Escarpments	Lateral	Cross-Formational
Dallam	0	0	0	0	0	0	3	-3
Hartley	0	0	0	0	0	0	4	-4
Moore	0	0	0	0	0	0	0	0
Oldham	0	0	0	0	0	0	-1	1
Potter	0	0	0	0	0	0	0	0
Randall	0	0	0	0	0	0	0	0
Sherman	0	0	0	0	0	0	0	0

Table 4.7 Water budget for the lower Dockum by county for the steady-state model (modified from Deeds and Jigmond, 2015).

County	Recharge	ET	Springs	Rivers	Draws	Escarpments	Lateral	Cross-Formational
Armstrong	226	0	-295	-509	-2,276	0	619	2,235
Carson	0	0	0	0	0	0	287	-287
Dallam	0	0	0	0	0	0	-51	51
Hartley	205	-314	0	969	0	0	-2,170	1,310
Hutchinson	0	0	0	0	0	0	0	0
Moore	64	0	0	-65	0	0	-298	298
Oldham	5,786	-3,674	-120	-10,130	0	0	4,310	3,828
Potter	2,211	-1,106	-22	-3,561	-395	0	1,171	1,703
Randall	80	0	0	-2,557	-748	0	-18	3,243
Sherman	0	0	0	0	0	0	53	-53
Total	**8572**	**-5094**	**-437**	**-15,853**	**-3419**	**0**	**3903**	**12,328**

Table 4.8 Water budget for the upper Dockum by county for year 2012 of the transient model (modified from Deeds and Jigmond, 2015).

County	Recharge	ET	Springs	Rivers	Draws	Escarp ments	Reservoirs	Wells	Storage	Lateral	Cross-Forma tional
Dallam	0	0	0	0	0	0	0	-23	1,131	5	-1,113
Hartley	0	0	0	0	0	0	0	-2	706	4	-708
Moore	0	0	0	0	0	0	0	0	14	0	-14
Oldham	0	0	0	0	0	0	0	-1	7	-2	-4
Potter	0	0	0	0	0	0	0	0	0	0	0
Randall	0	0	0	0	0	0	0	-22	240	-1	-218
Sherman	0	0	0	0	0	0	0	0	0	0	0

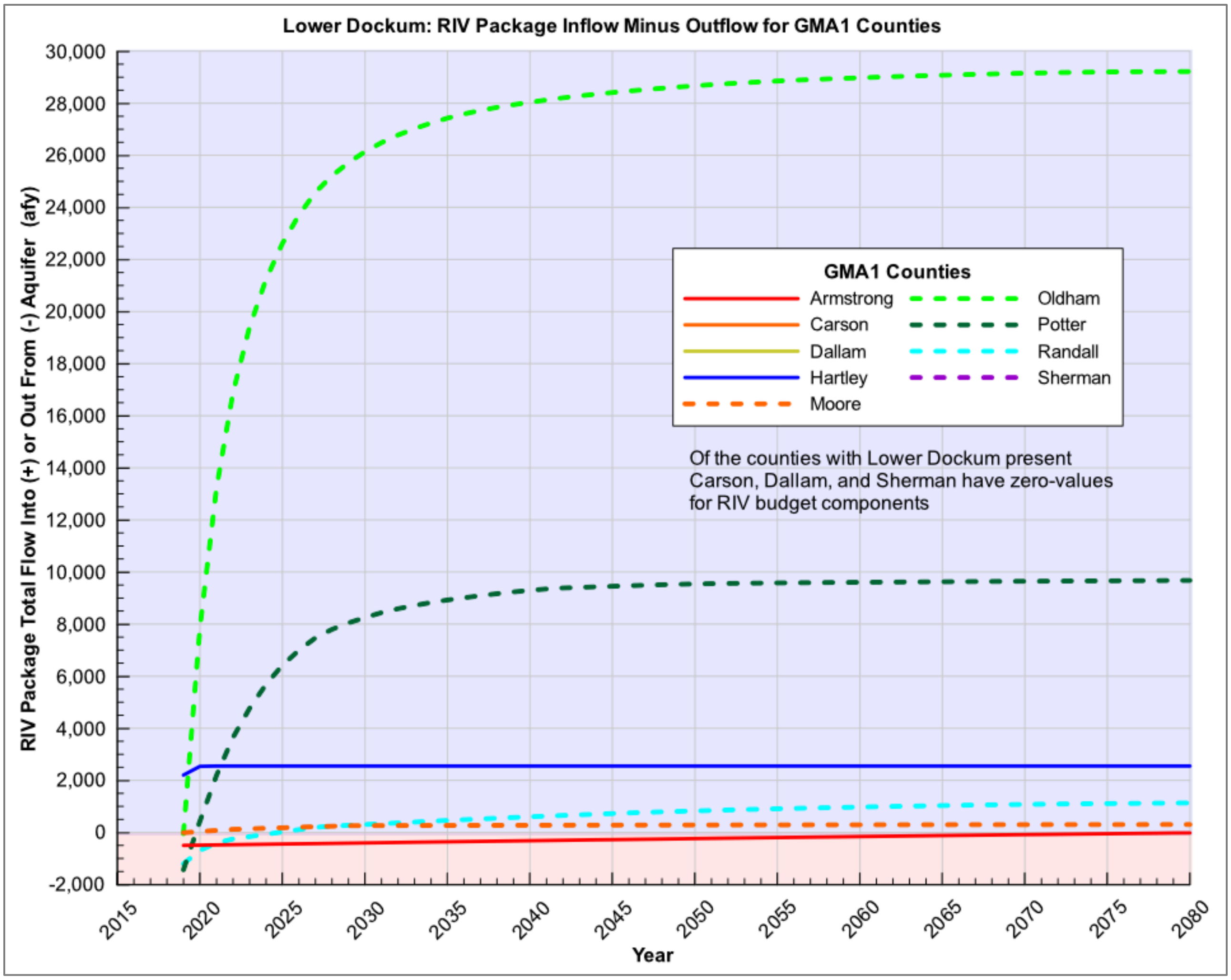
Table 4.9 Water budget for the lower Dockum by county for year 2012 of the transient model (modified from Deeds and Jigmond, 2015).

County	Recharge	ET	Springs	Rivers	Draws	Escarpments	Reservoirs	Wells	Storage	Lateral	Cross-Formational
Armstrong	228	0	-295	-509	-2,261	0	0	-173	274	586	2,150
Carson	0	0	0	0	0	0	0	-138	310	174	-347
Dallam	0	0	0	0	0	0	0	-2,757	3,466	22	-731
Hartley	205	-313	0	985	0	0	0	-2,022	3,826	-2,566	-115
Hutchinson	0	0	0	0	0	0	0	0	0	0	0
Moore	64	0	0	-55	0	0	0	-1,605	222	34	1,340
Oldham	5,906	-3,719	-120	-9,813	0	0	0	-1,129	1,112	4,192	3,571
Potter	2,217	-1,078	-22	-3,392	-395	0	0	-1,472	1,443	1,120	1,580
Randall	86	0	0	-2,328	-747	0	0	-2,634	2,811	336	2,476
Sherman	0	0	0	0	0	0	0	-485	252	241	-8
Total	8,706	-5,110	-437	-15,112	-3403	0	0	-12,415	13,716	4,139	9,916

4.4.4 Environmental Impacts

GMA 1 District Representatives considered environmental impacts, including impacts on spring flow and other interactions between groundwater and surface water. Since groundwater and surface water are hydrologically linked, reductions in groundwater levels can lead to either reduced outflow to surface water or increased inflow from surface water (or both). Figure 4.4 below shows the change in net flow between groundwater in the lower portion of the Dockum Aquifer and perennial surface water features as represented in the MODFLOW River Package in HPASGAM. With the substantial increase in pumping associated with the DFC model run, the flow reverses from a net outflow from the Dockum Aquifer to surface water to a net inflow to the Dockum Aquifer from surface water. The change is greatest in Oldham County where the Dockum Aquifer has a large outcrop area and interacts with the Canadian River.

Figure 4.4 Projected interactions between surface water and groundwater for the Lower Dockum Aquifer, based on the effects of predicted groundwater pumping from the adopted DFCs.



4.4.5 Subsidence Impacts

GMA 1 District Representatives considered potential impacts of the adopted DFCs on land subsidence. This included a review of the causes and mechanisms of land surface subsidence and the results of a recent study on subsidence risk throughout Texas (Furnans and others, 2017). The Furnans and others (2017) study concluded that the Dockum Aquifer presented a "medium" risk of compaction leading to subsidence. The study was based on review of driller's lithologic logs, historical water level changes, and hydraulic properties in the groundwater availability models.

As noted by the GMA 1 Districts and the US Geological Survey fact sheet on subsidence in the United States (Galloway and others, 2000), substantial subsidence has not historically been observed or linked to groundwater production in GMA 1. Though the Dockum Aquifer has not had the substantial development and water level declines historically to the degree the Ogallala Aquifer has, it is also an older (Triassic) geologic unit, more consolidated, and likely less susceptible to subsidence. After considering the data and methods used in Furnans and others (2017) subsidence study in the context of other available information on subsidence in the area, the GMA 1 Districts concluded that subsidence has not been an issue and is unlikely to be an issue in GMA 1 in the future under the adopted DFCs.

4.4.6 Socioeconomic Impacts

GMA 1 District Representatives considered socioeconomic impact studies prepared by the TWDB for regional water planning purposes, along with multiple other studies that target areas in GMA 1 based on the DFCs options during joint planning meetings identified in Table 1.1. Additional information about the sources reviewed and considered is provided in Section 3.4.6 above. Specific to the Dockum Aquifer, the GMA 1 Districts do not anticipate significant negative socioeconomic impacts associated with the adopted DFCs. The adopted DFCs allow for substantial additional development of the aquifer, but with projected aquifer impacts that should not create substantial negative socioeconomic impacts to existing water users.

4.4.7 Private Property Impacts

GMA 1 District Representatives considered the impact on the interests and rights in private property, including ownership and the rights of landowners and their lessees and assigns in groundwater during joint planning meeting described in Table 1.1. A full discussion of GMA 1 consideration of this Factor is provided under Section 3.4.7 Private Property Impacts of this explanatory report.

4.4.8 Achievement Feasibility

GMA 1 District Representatives considered the feasibility of achieving the adopted DFCs. Conceptually, there are two elements to the feasibility of achieving the DFCs: regulatory feasibility and physical feasibility.

Regulatory feasibility refers to whether the GMA 1 Districts have within the Texas Water Code and their respective enabling legislation the regulatory tools necessary to achieve the DFCs. For example, some uses of groundwater (such as for rural domestic, livestock, or drilling for oil and gas) are generally exempt from production limits by a GCD. If the total expected pumping of these combined uses exceeded the groundwater availability associated with the DFC, then the DFC would clearly not be regulatorily feasible. That is, the Districts would not have the authority to manage groundwater production to achieve the DFCs. As described above, current use of the Dockum Aquifer is small, and the pumping associated with the adopted DFCs far exceeds this amount. The GMA 1 Districts considered this information and determined that the adopted DFCs are regulatorily feasible.

Physical feasibility refers to whether the various DFCs in the GMA can be achieved concurrently. The physical feasibility is demonstrated by use of the model. The model run associated with the adopted DFCs shows that each of the DFCs for the Ogallala Aquifer (inclusive of the Rita Blanca) and the Dockum Aquifer can be achieved concurrently.

4.4.9 Other Information

TWC Section 36.108(d)(9) requires the districts to consider any other information relevant to the specific DFCs. The GMA 1 Districts considered whether other information existed that was necessary to review to inform the DFCs and determined that all information necessary was considered under the other eight factors.

4.5 Discussion of Other DFCs Considered

GMA 1 District Representatives chose first to evaluate the appropriateness of the DFCs adopted for the Dockum Aquifer during the 2016 round of joint planning, with minor modifications to the base year and extension to 2080 as discussed above. After reviewing and considering the model results, the GMA 1 representatives determined that the adopted DFCs remain appropriate for the Dockum Aquifer. No other DFC options for the Dockum Aquifer were formally considered.

4.6 Discussion of Other Recommendations

GMA 1 District Representatives provided the public opportunity to comment on the DFC Joint Planning Process or recommend other DFCs at each joint planning meeting. Each District also held respective public hearings to discuss the Proposed DFCs with the public in their local service areas.

4.6.1 Advisory Committees

GMA 1 District Representatives did not establish advisory committees for this round of planning and therefore no comment from such committees were filed.

4.6.2 Public Comments

On March 18, 2021, the GMA 1 Districts unanimously voted to adopt Proposed DFCs for the major aquifers in the Joint Planning Area.

A public comment period of not less than 90 days began on March 18, 2021. During the public comment period and after posting notice as required by TWC Section 36.063, each district held at least one public hearing on proposed DFCs relevant to that district. During the public comment period, the districts made available in its office a copy of the proposed DFCs and any supporting materials. All documents considered in the joint planning process were organized and posted for the convenience of the public and GMA 1 membership. This included posting materials online at www.panhandlewater.org/gma-1. Individual districts held public hearings during the statutorily required not less than 90-day public input phase prior to the final adoption of DFCs.

After the public hearings and public comment period, the GMA 1 Districts reviewed relevant public comments received at the August 26, 2021 Joint Planning meeting prior to adopting DFCs.

Through the public input process, GMA 1 Districts received 3 public comments, all of which were submitted to High Plains District. These summary reports documenting the public hearings conducted and comments received are included in Appendix V – Summary Reports and Public Comments Received.

5 NON-RELEVANT AQUIFERS

GMA 1 District Representatives considered the relevance of the Blaine Aquifer in the overall scheme of joint planning to adopt DFCs for GMA 1. The Blaine Aquifer is in portions of Panhandle GCD in Wheeler County and is managed. However, only a small number of wells are currently permitted in the aquifer. The Panhandle GCD requested that GMA 1 District Representatives classify the Blaine Aquifer in GMA 1 as non-relevant for joint planning purposes.

The Blaine Aquifer, both within Panhandle GCD and in GMA 1, is isolated to the south-southeastern portion of Wheeler County (see Figure 5.1). A more detailed map of the Blaine Aquifer (subcrop only), along with the locations of registered/permitted Blaine Aquifer wells is illustrated in Figure 5.2.

Figure 5.1 Map of minor aquifers designated by the TWDB in GMA 1

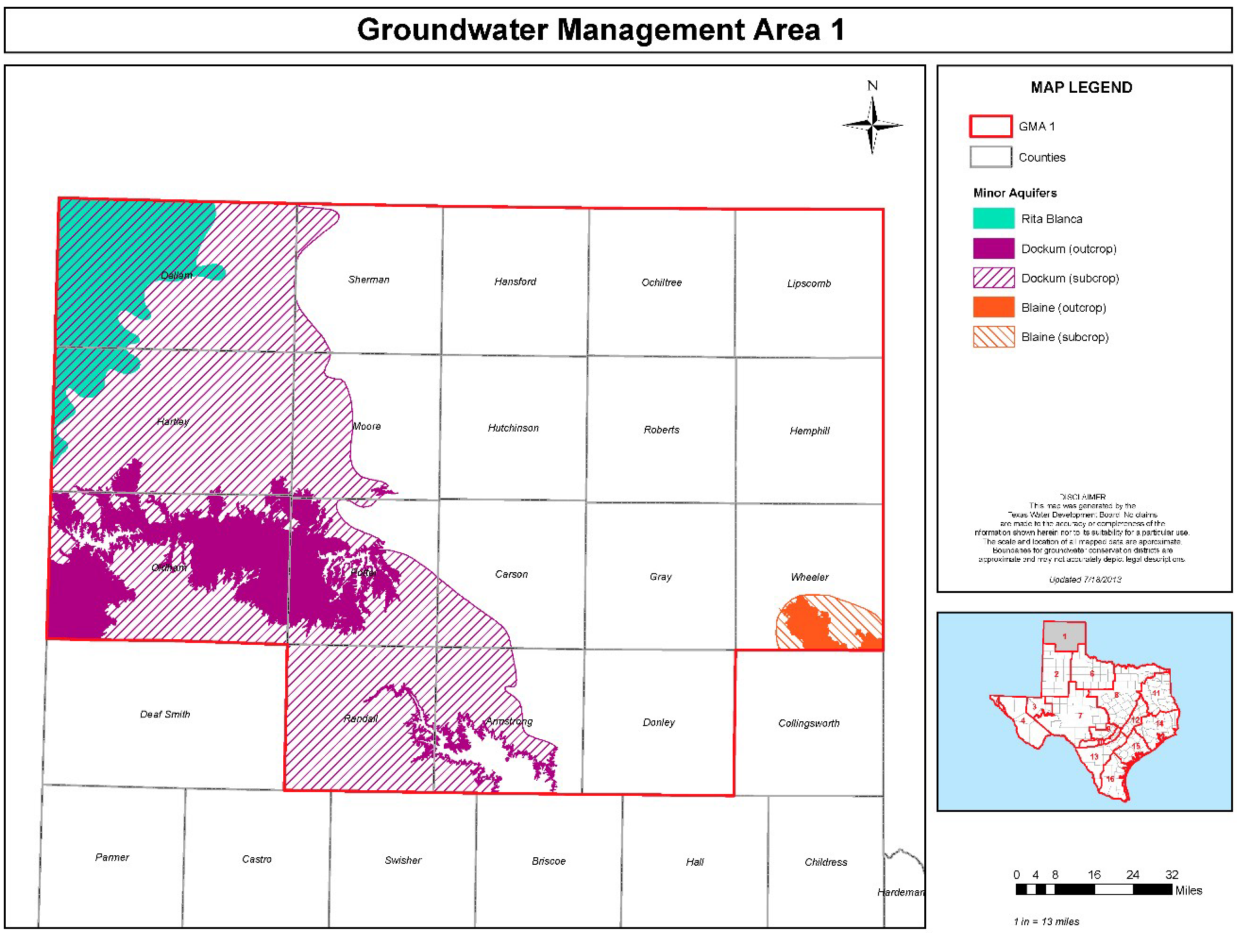
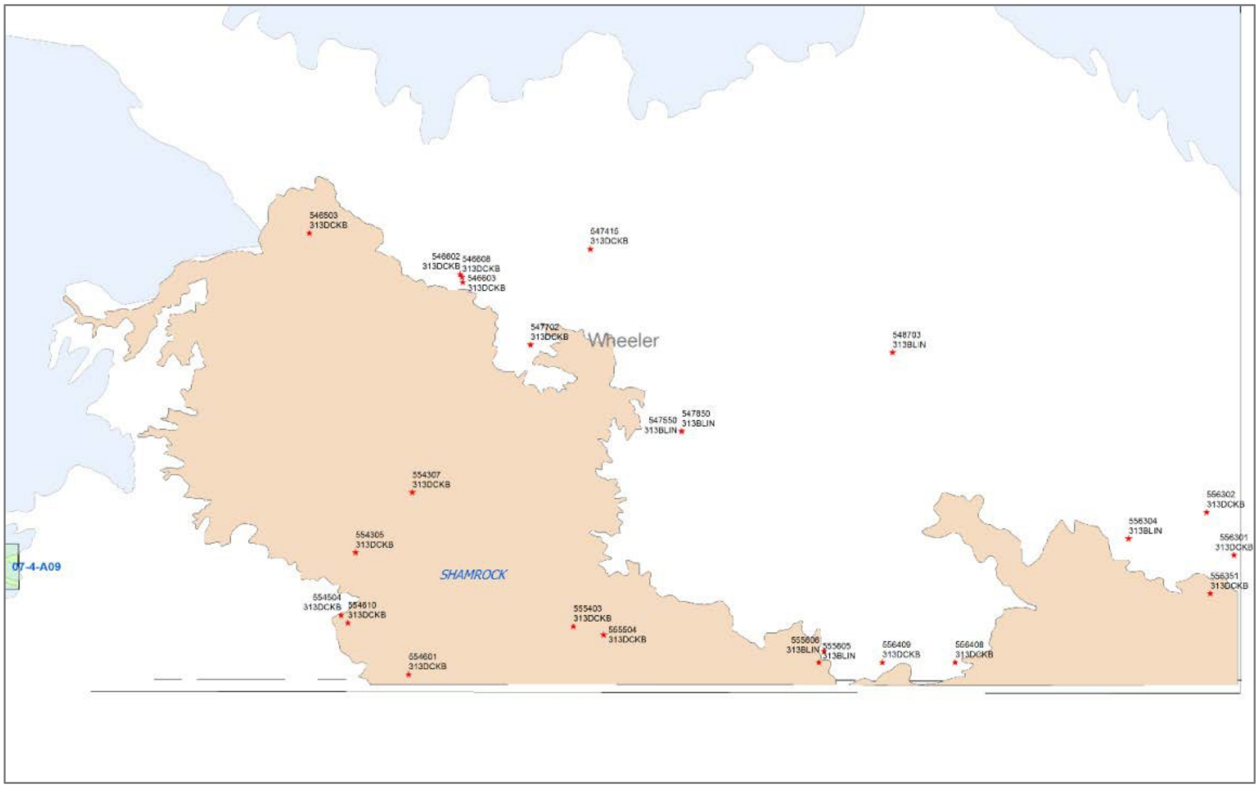


Figure 5.2 Map of the Blaine Aquifer in Wheeler County including locations of registered/permitted Blaine Aquifer wells.



Due primarily to poor water quality, there has been only limited scientific research published on the Blaine Aquifer. A few of the more notable publications on the Blaine Aquifer are George and others (2011), Hopkins and Muller (2011) and Maderak (1973). Another good reference is the 2007 Texas Water Plan (TWDB, 2007). The Blaine Aquifer, one of 21 minor aquifers designated in Texas, is part of the Permian Blaine Formation, which is made up of cycles of marine and non-marine sediments deposited in a broad, shallow sea (George and others, 2011). Groundwater in this aquifer is generally present in solution channels and caverns within strata composed of anhydrite and gypsum. The interaction of groundwater flowing through these calcium-sodium-magnesium-sulfate dominated sediments provides an explanation for the poor water quality of the Blaine Aquifer. According to TWDB (2007), the average saturated thickness for the Blaine Aquifer regionally is 137 feet. The Blaine Aquifer is approximately 20 to 35 miles wide and located along the eastern edge of the Texas Panhandle from Wheeler County in the north to Nolan County in the south. The aquifer occurs in portions of 16 counties. According to Hopkins and Muller (2011) water quality for the Blaine Aquifer in Wheeler County ranges from 1,000 – 3,000 total dissolved solids.

While the Blaine Aquifer is an important water resource to the southeast of GMA 1, in Wheeler County and GMA 1 it has limited use. The Blaine Aquifer in Wheeler County is used primarily for domestic and livestock purposes, which are exempt from permitting by GCDs.

Table 5.3 includes estimates of TERS for the Blaine Aquifer in Wheeler County (from Kohlrenken, 2013). The limitations of the TERS calculations described for the Ogallala and Dockum aquifers above also apply to the Blaine Aquifer.

Due to the very limited use of the Blaine Aquifer in Wheeler County, as described above, at this time we do not feel that sufficient justification exists to develop statements of DFCs, management goals, objectives, performance standards, and rules for the Blaine Aquifer in Wheeler County.

Table 5.3 Total estimated recoverable storage for the Blaine Aquifer in Wheeler County.

County	Total Storage (acre feet)	25 percent of Total Storage (acre feet)	75 percent of Total Storage (acre feet)
Wheeler	6,700,000	1,675,000	5,025,000

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Appendix I

Desired Future Condition Documents

RESOLUTION TO ADOPT DESIRED FUTURE CONDITIONS FOR RELEVANT AQUIFERS IN GROUNDWATER MANAGEMENT AREA 1

THE STATE OF TEXAS §
§
GROUNDWATER MANAGEMENT AREA 1 §
§
GROUNDWATER CONSERVATION DISTRICTS §

WHEREAS, Texas Water Code § 36.108 requires the groundwater conservation districts located in whole or in part in a groundwater management area ("GMA") designated by the Texas Water Development Board to adopt desired future conditions for the relevant aquifers located within the management area;

WHEREAS, the groundwater conservation districts located wholly or partially within Groundwater Management Area 1 ("GMA 1"), as designated by the Texas Water Development Board, as of the date of this resolution are as follows: the Hemphill County Underground Water Conservation District, the High Plains Underground Water Conservation District, the North Plains Groundwater Conservation District, and the Panhandle Groundwater Conservation District. (collectively hereinafter "the GMA 1 Districts");

WHEREAS, the GMA 1 Districts are each governmental agencies and bodies politic and corporate operating under Chapter 36, Water Code;

WHEREAS, the GMA 1 Districts desire to fulfill the requirements of Texas Water Code §36.108 through mutual cooperation and joint planning efforts;

WHEREAS, the GMA 1 Districts have had numerous public meetings, including public hearings and stakeholder meetings for the specific purpose of receiving comments and input from stakeholders within GMA 1, and they have engaged in joint planning efforts to promote comprehensive management of the aquifers located in whole or in part in Groundwater Management Area 1;

WHEREAS, GMA 1 held meetings on October 23, 2018; January 11, 2019; March 28, 2019; August 26, 2019; October 28, 2019; December 12, 2019; February 18, 2020; May 21, 2020; June 25, 2020; July 23, 2020; September 24, 2020; November 19, 2020; January 21, 2021; February 18, 2021, and March 18, 2021 in compliance with its statutory duty to publically consider the desired future conditions considerations listed in § 36.108(d);

WHEREAS, the GMA 1 Districts have considered the following factors, listed in §36.108(d), in establishing the proposed desired future conditions for the aquifer(s), set forth under Appendix B:

(1) groundwater availability models and other data or information for the management area;

(2) aquifer uses or conditions within the management area, including conditions that differ substantially from one geographic area to another;
(3) the water supply needs and water management strategies included in the state water plan;

(4) hydrological conditions, including for each aquifer in the management area the total estimated recoverable storage as provided by the Texas Water Development Board Executive Administrator and the average annual recharge, inflows, and discharge;

(5) other environmental impacts, including impacts on spring flow and other interactions between groundwater and surface water;

(6) the impact of subsidence;

(7) socioeconomic impacts reasonably expected to occur;

(8) the impact on the interests and rights in private property, including ownership and the rights of management area landowners and their lessees and assigns in groundwater as recognized under Texas Water Code §36.002;

(9) the feasibility of achieving the desired future conditions; and

(10) any other information relevant to the specific desired future conditions;

WHEREAS, the proposed desired future conditions provide a balance between the highest practicable level of groundwater production and the conservation, preservation, protection, recharging, and prevention of waste of groundwater in the management area;

WHEREAS, a Draft Explanatory Report of the Proposed Desired Future Conditions considerations related to each factor required by Texas Water Code §36.108 has been developed and was made available to each GMA 1 District and the general public for review and comment.

WHEREAS, the GMA 1 has classified the Blaine Aquifer and Seymour Aquifer as non-relevant to this joint planning process in the GMA 1 Joint Planning Area.

WHEREAS, the Ogallala Aquifer and the Rita Blanca Aquifer are combined for these Joint Planning purposes, any references to the "Ogallala Aquifer" in this document shall also include and apply to any groundwater in the Rita Blanca Aquifer in those portions of GMA 1;

WHEREAS, after considering the factors listed in Texas Water Code 36.108(d), the GMA 1 Districts may establish different desired future conditions for: (1) each aquifer, subdivision of an aquifer, or geologic strata located in whole or in part within the boundaries of GMA 1; or (2) each geographic area overlying an aquifer in whole or in part or subdivision of an aquifer within the boundaries of GMA 1;

WHEREAS, the GMA 1 Districts recognize that GMA 1 includes a geographically and hydrologically diverse area with a variety of land uses and a diverse mix of water users;

WHEREAS, at least two-thirds of the GMA 1 Districts had a voting representative in attendance at the August 26, 2021 meeting in accordance with Section 36.108, Texas Water Code; and;

WHEREAS, it is the intent and purpose of the GMA 1 Districts, by adoption of this resolution, to meet the requirements of Texas Water Code §36.108, and establish "desired future conditions for the relevant aquifers" within GMA 1;

NOW, THEREFORE, BE IT RESOLVED BY THE AUTHORIZED VOTING REPRESENTATIVES OF THE GMA 1 DISTRICTS AS FOLLOWS:

1. The above recitals are true and correct.

2. The GMA 1 Districts and their agents and representatives, individually and collectively, are further authorized to take any and all actions necessary to implement this resolution.

3. Proposed desired future conditions were established on March 18, 2021 by the GMA 1 Districts and each District complied with Texas Water Code Section 36.108(d-2) by receiving public comments during a public comment period of not less than 90 days and holding at least one (1) public hearing regarding the proposed desired future conditions.

4. The members of GMA 1 affirm that the GMA 1 has classified the Blaine Aquifer and Seymour Aquifer as non-relevant to this joint planning process in the GMA 1 Joint Planning Area

5. The authorized voting representatives of the GMA 1 Districts adopt this resolution establishing the following Desired Future Conditions for the aquifers in the GMA 1 Joint Planning Area:

Ogallala (Inclusive of 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, Hutchinson, 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 in Potter Counties.

Dockum Aquifer:

- At least 40 percent of the average available drawdown remaining for each 50-year period between 2018 and 2080 for 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; and
- 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.

PASSED AND APPROVED BY A VOTE OF 4 TO 0 OF THE VOTING MEMBERS OF THE GROUNDWATER MANAGEMENT AREA 1 JOINT PLANNING COMMITTEE THIS 26th DAY OF AUGUST, 2021.

ATTEST:

____

Bob Zimmer
North Plains Groundwater Conservation District

____

~~Tom Isaacs~~ JIM HALEY
Hemphill County Underground Water Conservation District

____

Lynn Tate
High Plains Underground Water Conservation District

____

Danny Hardcastle
Panhandle Groundwater Conservation District

ATTACHMENTS
Copies of notices of August 26, 2021 meeting

- 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; and
- 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.

PASSED AND APPROVED BY A VOTE OF 4 TO 0 OF THE VOTING MEMBERS OF THE GROUNDWATER MANAGEMENT AREA 1 JOINT PLANNING COMMITTEE THIS 26th DAY OF AUGUST, 2021.

ATTEST:

Bob B Zimmer

Bob Zimmer
North Plains Groundwater Conservation District

____

Tom Isaacs
Hemphill County Underground Water Conservation District

____

Lynn Tate
High Plains Underground Water Conservation District

____

Danny Hardcastle
Panhandle Groundwater Conservation District

ATTACHMENTS
Copies of notices of August 26, 2021 meeting

- 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; and
- 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.

PASSED AND APPROVED BY A VOTE OF 4 TO 0 OF THE VOTING MEMBERS OF THE GROUNDWATER MANAGEMENT AREA 1 JOINT PLANNING COMMITTEE THIS 26th DAY OF AUGUST, 2021.

ATTEST:

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Bob Zimmer
North Plains Groundwater Conservation District

____
Tom Isaacs
Hemphill County Underground Water Conservation District

____
Lynn Tate
High Plains Underground Water Conservation District

____
Danny Hardcastle
Panhandle Groundwater Conservation District

ATTACHMENTS
Copies of notices of August 26, 2021 meeting

- 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; and
- 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.

PASSED AND APPROVED BY A VOTE OF 4 TO 0 OF THE VOTING MEMBERS OF THE GROUNDWATER MANAGEMENT AREA 1 JOINT PLANNING COMMITTEE THIS 26th DAY OF AUGUST, 2021.

ATTEST:

Bob Zimmer
North Plains Groundwater Conservation District

Tom Isaacs
Hemphill County Underground Water Conservation District

Lynn Tate
High Plains Underground Water Conservation District

Danny Hardcastle
Panhandle Groundwater Conservation District

ATTACHMENTS
Copies of notices of August 26, 2021 meeting

Appendix II

Meeting Documentation

HEMPHILL COUNTY
Underground Water Conservation District

HPWD
High Plains Underground Water Conservation District

PANHANDLE GROUNDWATER DISTRICT
"Conserving Water for Future Generations"

NORTH PLAINS GROUNDWATER Conservation District

Groundwater Management Area #1 – GMA#1

P.O. Box 9257 Amarillo, TX 79105 (806) 372-3381

Notice of Meeting

Thursday, August 26th, 2021
10:00 AM

Board Meeting to be held via Join Zoom Meeting Video
https://us02web.zoom.us/j/85307005370
Meeting ID: 853 0700 5370

Or by Teleconference at:
+1 346 248 7799
Meeting ID: 824 9467 7061

Due to the Texas Governor's suspension of requirements of the Texas Open Meetings Act and Executive Order GA-08, requirements for physical attendance at the Board Meeting have been suspended. Citizens that wish to participate in the meeting may utilize a call-in telephone number to participate in this public meeting. To receive further information and meeting materials prior to the public meeting, please contact Dustin Meyer at PRPC: 806-372-3381 or dmeyer@theprpc.org.

As required by Chapter 36.108(e) Texas Water Code, notice is hereby given by the Board of Directors of the North Plains Groundwater Conservation District, the High Plains Underground Water Conservation District, the Hemphill County Underground Water Conservation District and the Panhandle Groundwater Conservation District for the Districts' participation in a joint planning meeting, as required by Chapter 36.108. At the joint planning meeting, the presiding officer or the presiding officer's designee as required by Chapter 36.108(c), along with any number of members of the Board of Directors, will convene for the purpose of joint planning only and not to conduct any other District business. The joint planning meeting will be comprised of the Groundwater Conservation Districts (GCDs) located wholly or partially within Groundwater Management Area #1 (GMA #1) as delineated by the Texas Water Development Board. GCDs located in GMA #1 are as follows:

North Plains Groundwater Conservation District, High Plains Underground Water Conservation District No. 1, Hemphill County Underground Water Conservation District, and the Panhandle Groundwater Conservation District

At such time, any Board Members present and/or the designee of the respective District will discuss and may take any action on any items on this agenda (not necessarily in the pre-arranged order) it may determine would be appropriate for joint planning of GCDs in GMA #1.

To receive additional information and meeting materials prior to the public meeting, please visit www.PanhandleWater.org or contact Dustin Meyer at PRPC: 806-372-3381 or dmeyer@theprpc.org.

AGENDA

1. **Call to Order – Welcome**
2. **Roll Call/Introductions/Quorum**
3. **Opening Pledge**
4. **Public Comment** – Members of the general public may speak for 3 minutes on topics related to GMA #1 activities though the GMA #1 membership may not discuss or take action on any items not included on this agenda.
5. **Receive and Discuss** – Update from Texas Water Development Board.
6. **Discuss and Consider** – The Minutes from March 18, 2021 GMA #1 Meeting.
7. **Discuss and Consider** – Summary reports of comments received on proposed Desired Future Conditions
8. **Discuss and Potential Action** – Resolution to adopt Desired Future Conditions for aquifers in GMA #1.
9. **Discuss** – Each GCD in GMA #1 shall provide update on process to amend and implement plans and rules necessary to achieve the various adopted Desired Future Conditions.
10. **Discuss and Consider** – Scheduling of the Next Meetings of the GMA #1.
11. **Adjournment**

I, the undersigned authority of the Panhandle Regional Planning Commission, do hereby certify that the above Notice of Meeting for Joint Planning for Groundwater Management Area #1 of the above named political subdivision is a true and correct copy of said Notice; and that a true and correct copy of said Notice was posted at a place convenient to the public at the office of said political subdivision listed above located at 415 W 8th Ave, Amarillo , and said Notice was posted on or before, August 10, 2021 at 5:00 PM and remained so posted continuously for at least ten days immediately preceding the start time of said meeting. A true and correct copy of said Notice was posted and has been filed with the Secretary of State and the following County Clerks, Armstrong, Carson, Dallam, Donley, Gray, Hansford, Hartley, Hemphill, Hutchinson, Lipscomb, Lubbock, Moore, Ochiltree, Oldham, Potter, Randall, Roberts, Sherman and Wheeler. A true and correct copy of said Notice has been issued to and requested to be posted on the bulletin board of each of the respective County Courthouses on or before, August 10, 2021 and said Notice will remain so posted for at least 10 days immediately preceding the start time of said meeting. Notice has been posted with the Secretary of State.

Dated this the ______day of __________ 2021.

Panhandle Regional Planning Commission

By: ________________________________

Dustin Meyer, LGS Director

POSTED THIS THE _____ *DAY OF* _________, *2021 AT* ____________________

Day Month Location

BY ________________________: ______________________________

Printed Name Signature

Appendix III

Model Run Documentation

Documentation of Model Run Technical Elements

A. Modeling contact information

Neil E. Deeds, Ph.D., P.E.

Email: ndeeds@intera.com

Phone: 512.506.1230

Wade Oliver, P.G.

Email: woliver@intera.com

Phone: 281-560-4562

Lakin Beal, P.G.

Email: lbeal@intera.com

Phone: 737-402-9853

Andrew Osborne

Email: aosborne@intera.com

Phone: (985) 590-2226

B. Date and year of submittal

December 2021

C. Seal by Texas Professional Geoscientist or Engineer

STATE OF TEXAS
WADE A. OLIVER
GEOLOGY
11112
LICENSED
PROFESSIONAL GEOSCIENTIST

Wade Oliver, P.G. 12/27/2021

Wade Oliver, P.G. #11112 was the Project Manager for this project and was responsible for oversight of work completed.

D. Groundwater Management Area and requested by whom

This memorandum provides a summary of the simulation of the High Plains Aquifer System Groundwater Availability Model that is consistent with the Desired Future Conditions (DFCs) adopted by Groundwater Management Area 1 on August 26, 2021. These are described below.

E. Description of Desired Future Conditions (DFCs)

The Ogallala Aquifer (inclusive of Rita Blanca) DFCs adopted by GMA 1 are as follows:

- 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, Hutchinson, 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 in Potter Counties.

- The Dockum Aquifer DFCs adopted by GMA 1 are as follows:
  - At least 40 percent of the average available drawdown remaining for each 50-year period between 2018 and 2080 for 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; and
  - 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.

F. Modeling Methods Document

i. Groundwater availability model (GAM) version or acceptable alternative model, and version of acceptable pre-/post-processor used

To evaluate the DFCs we selected the High Plains Aquifer System Groundwater Availability Model (HPAS GAM) (Deeds and Jigmond, 2015), a regional groundwater flow model that incorporates the Ogallala, Rita Blanca, Edwards-Trinity (High Plains), and Dockum aquifers. In December 2015, TWDB accepted the HPAS GAM as the official GAM for the region. The model was updated in 2020 by Wade Oliver, P.G. and Lakin Beal to extend the calibration period through 2018.

Model run modifications and output processing were done in the Python scripting language. No proprietary pre- or post-processor (such as Groundwater Vistas) was used in the development or running of the model.

ii. Description of stress periods and corresponding years

Deeds and others (2015):

> The High Plains Aquifer System groundwater availability model (HPAS GAM) calibration period has 84 stress periods, starting with a steady-state stress period that represents predevelopment conditions. The second, and all subsequent stress periods are transient. The second stress period represents year 1930, with all transient stress periods lasting one year up to stress period 84, which represents year 2012. Years which correspond to leap years are 366 days long, and the other stress periods are 365 days long.

Model Extension:

> The model update performed in 2020 extends the end of the calibration period of the original HPAS GAM from 2012 through 2018. Stress periods are the same length as those in the original model and are also transient. Years which correspond to leap years are 366 days long, and the other stress periods are 365 days long.

Predictive Model:

> The predictive model has 62 transient stress periods, each one year long, starting with 2019 and ending in 2080. Years which correspond to leap years are 366 days long, and the other stress periods are 365 days long.

iii. If the end of the calibration period is different from the start of the predictive simulations, describe assumptions for projecting model from end of calibration to beginning conditions for predictive simulation including pumping, recharge, and related surface water heads. Include targets and hydrographs, as applicable, in appendix as well as electronic copies.

The original historical model, Deeds and others (2015), was calibrated through the year 2012 using a pumping grid which corresponded to well locations in the study area. The model update performed in 2020 extended the calibration period of the model through 2018 to establish initial water levels in the model. The model update moved the start of the predictive period to match the end of the calibration period. No hydraulic properties or surface water parameters were adjusted during the update. An extended pumping file was created using pumping data provided by Groundwater Conservation Districts and water use survey data. The updated historical model was run, and the simulated water levels were statistically compared to measured water levels between 2012 and 2018 to ensure the model was responding realistically to pumping trends and were still within calibration standards. For the development of DFCs, 2018 was used as the reference year in all cases except for Randall County and the High Plains UWCD portions of GMA 1, which used 2012 as the reference year. The last year of the predictive simulation is 2080. Hydrographs and model-update calibration quality graphs are presented in Appendix IV – Factor Analysis within the presentations slides from the February 18, 2020 GMA 1 Joint Planning Meeting.

Inflow from rivers increases every year during the simulation. The model does not account for surface water availability, so the assumption is that water is always available from rivers throughout the simulation. Outflow due to springs decreases every year during the simulation. Evapotranspiration decreases yearly throughout the simulation.

iv. Assumption for recharge, i.e. what years averaged and/or drought and related stress periods, etc.

In the original historical model, recharge increases continuously through time in the Ogallala Aquifer due to the “breakthrough” of agriculturally enhanced recharge at various decades in the southern portion of the study. Recharge in the Dockum Aquifer also increases through time due to agriculturally enhanced percolation in some areas. The HPAS GAM estimates recharge for the Ogallala in GMA 1 was 324,889 acre-feet per year before pumping began. The Rita Blanca Aquifer within GMA 1 does not recharge directly from precipitation or receive inflow from rivers because it is not exposed at the surface or intersect rivers in the area to receive water. The HPAS GAM estimates recharge for the Dockum Aquifer is approximately 8,600 acre-feet per year. This only occurs in the lower portion of the Dockum Aquifer because the upper portion of the Dockum does not outcrop at land surface.

In the model update and in the predictive simulation for the area which encompasses GMA 1, constant average annual recharge values are assumed through time for both the Ogallala and lower Dockum Aquifers, whereas zero recharge are assumed for the Rita Blanca and upper Dockum Aquifers. These values are the same as the 2018 recharge rates which were applied in the calibration period.

v. Assumption for pumping in prediction

To achieve DFC targets, a certain volume, the magnitude of which is reliant on the hydrologic properties of the aquifer, must be removed from each model grid cell over each stress period. Fluid volume is calculated as:

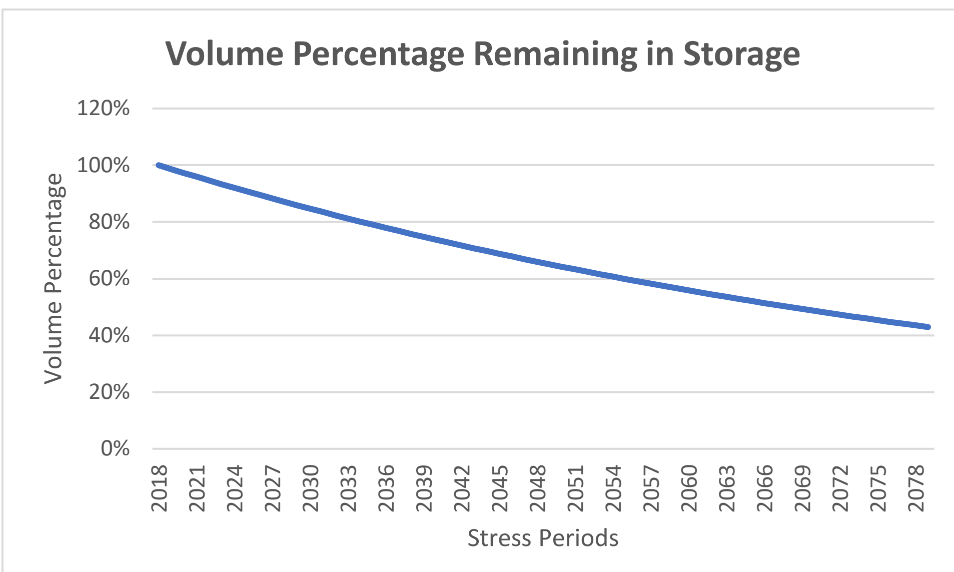
$$V = d * S_y * A$$

where d is saturated thickness, S_y is specific yield of the aquifer, and A is the area of the model grid cell. The desired change in volume in a grid cell over each stress period was calculated using different equations that reflect the DFC target. For the case where the DFC target was a volume percentage remaining in storage through a 50-year period, the volume remaining was calculated as:

$$V = V_t^{\frac{yr-2018}{50}}$$

where V is the volume remaining, V_t is the target volume percentage, and yr is the year for which the calculations are being performed. Figure 1 demonstrates the application of this equation.

Figure 1. **Example graph of 50% volume percentage remaining in storage through each 50-year period as described by the DFC target.**

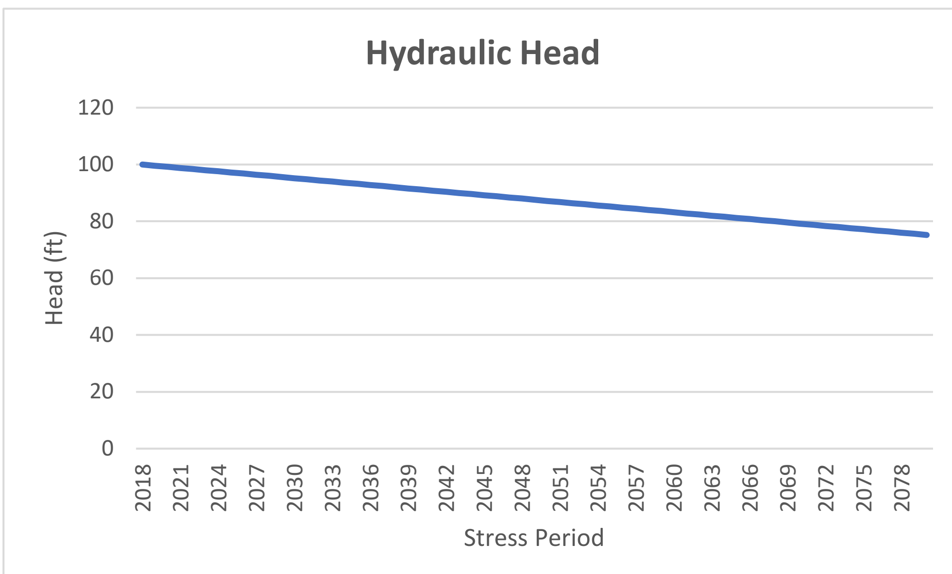


For the cases where the target was average drawdown through a 50-year period, we calculated the drawdown as:

$$Average\ Drawdown = \frac{\sum_{i=1}^{n}(h_{yr} - h_{yr+50})}{n}$$

where h_{yr} is the head in a grid cell in any year, h_{yr+50} is the head in a grid cell after 50 years of simulation time, and n is the number of grid cells. If the head in a cell is at or below the cell bottom, conventionally referred to as a "dry cell," the cell is then not considered in the drawdown calculations. Figure 2 demonstrates an idealized head value for a single grid cell through the total simulation time which reflects the DFC target.

Figure 2. **Example graph of 20 feet average drawdown through each 50-year period as described by the DFC target.**



For the case where the target was a fraction of available drawdown remaining through a 50-year period, a DFC which only affects the lower Dockum Aquifer, the fraction remaining was calculated differently based on whether a model cell was designated as “outcrop” or “confined” in the MODFLOW BAS package. This designation was made *a priori* and was not changed based on the position of the simulated head in reference to the layer top.

If IBOUND == 71 in the BAS package, which designates lower Dockum outcrop, available drawdown in a cell was calculated as follows:

$$addn_{i,yr} = h_{i,yr,4} - el_{i,b,4}$$

where $addn_{i,yr}$ is the drawdown in cell i in year yr, $h_{i,yr,4}$ is the head in cell i in layer 4 in year yr, and $el_{i,b,4}$ is the elevation of the top of layer 4 in cell i. If $h_{i,2018,4} < el_{i,b,4}$ then the cell is not considered in the average. If $h_{i,2080,4} < el_{i,b,4}$ then $addn_{i,yr} = 0$, and that zero is included in the average.

If IBOUND == 72 in the BAS package, which designates confined lower Dockum, available drawdown in a cell was calculated as follows:

$$addn_{i,yr} = h_{i,yr,4} - el_{i,t,4}$$

where $addn_{i,yr}$ is the available drawdown in cell *i* in year *yr*, $h_{i,yr,4}$ is the head in cell *i* in layer 4 in year *yr*, and $el_{i,t,4}$ is the elevation of the top of layer 4 in cell *i*. If $h_{i,2018,4} < el_{i,t,4}$ then the cell is not considered in the average. If $h_{i,2062,4} < el_{i,t,4}$ then $addn_{i,yr} = 0$, and that zero is included in the average.

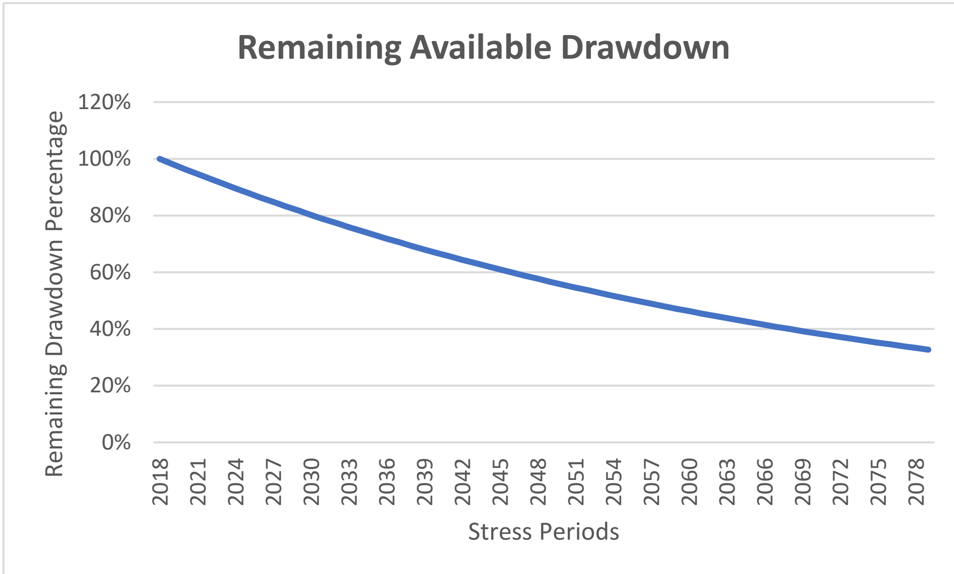
Figure 3 demonstrates and idealized case of available drawdown remaining in a single cell over the simulation time as designated by the DFC target.

The fraction available drawdown remaining for a zone is calculated as:

$$Fraction\ Remaining = \frac{\sum_{i=1}^{n} \frac{addn_{i,yr+50}}{addn_{i,yr}}}{n}$$

where n is the number of cells in the zone that were considered in the calculation. All cells (both IBOUND == 71 and IBOUND == 72) were used in the calculation of a single value for the zone. The Rita Blanca and Ogallala fraction remaining estimates were aggregated by area weighting the fractions (i.e., weighting by the number of cells considered for each of the aquifers).

Figure 3. **Example graph of 40% available drawdown through each 50-year period as described by the DFC target.**



The DFC targets were used to calculate a remaining saturated thickness in each cell at the end of each stress period. The pumping applied in the predictive model's WEL file was determined using a two-step modeling process. The predictive model was run twice: no pumping was applied during the first run and the DRN package was utilized to remove a certain volume from each aquifer layer in a grid cell equivalent to the change in ideal saturated thickness corresponding to DFC targets. The volume removed during each stress period was recorded for each cell and was used as the input pumping during the second predictive model run.

G. Version of TWDB "model grid" file that associates model grids with counties, groundwater conservation districts, river basins, groundwater management areas, and regional water planning areas within the model study area using a centroid based approach.

We used the "hpas_grid_poly010620.shp" version of the model grid. The column "DFC_ZONES" contains the political zones upon which the DFCs were based.

H. Description of method used to extract data from model; for example, method and assumptions used to average drawdown, etc. Include a description of how dry cells were treated in averaging drawdown.

Methods used to extract data were the same as those used to calculate drawdown, as referenced in Section F subsection v. Dry cells were treated differently for each DFC:

For the cases where the target was average drawdown through a 50-year period:

- Dry cells were not included in the drawdown calculations.

For the case where the target was a fraction of available drawdown remaining through a 50-year period:

- If the cell is dry in 2018, then the cell is not considered in the calculation of average available drawdown remaining.
- If the cell goes dry between 2018 and 2080, then available drawdown is set to 0 for this cell, and the cell is included in the calculation of average available drawdown remaining.

Volumetric calculations were done using model hydraulic properties as shown in the equation in Section F subsection v above.

I. Results Section to include appropriate tables of pumping versus drawdown, volume, surface water discharge, etc. by aquifer, layer, etc. as applicable to the DFC statement.

In this section, calculated pumping values which satisfy the DFC statements are reported in Tables 1 and 2. Figures 4 – 33 show calculated drawdowns in each aquifer by decade (from Appendix D).

Table 1. **Pumping values which satisfy the DFC statements in the Ogallala/Rita Blanca Aquifers. Values reported by decade.**

Ogallala/Rita Blanca Aquifer Pumping by Decade (acre-feet per year)

	2020	2030	2040	2050	2060	2070	2080
Hemphill County UWCD	**37,182**	**45,846**	**52,100**	**55,658**	**57,918**	**59,295**	**60,051**
Hemphill	37,182	45,846	52,100	55,658	57,918	59,295	60,051
High Plains UWCD No.1	**44,925**	**41,951**	**35,006**	**28,530**	**23,152**	**19,144**	**16,114**
Armstrong	5,667	4,716	3,001	1,878	1,179	969	784
Potter	2,343	2,539	2,357	2,051	1,631	1,075	801
Randall	36,915	34,697	29,648	24,601	20,343	17,100	14,529
North Plains GCD	**1,988,622**	**1,875,121**	**1,697,404**	**1,533,765**	**1,381,478**	**1,239,976**	**1,111,652**
Dallam	319,323	269,752	228,251	195,016	165,443	144,455	127,992
Hansford	296,868	295,895	281,027	264,464	247,229	229,951	211,025
Hartley	354,907	270,408	207,323	170,002	144,264	124,448	108,128
Hutchinson	77,759	80,242	77,674	74,510	70,462	67,541	63,950
Lipscomb	250,966	270,997	262,931	250,133	235,071	219,119	201,565
Moore	140,116	139,837	132,461	121,696	105,913	88,223	72,976
Ochiltree	259,136	260,144	246,760	231,654	215,169	199,455	180,919
Sherman	289,546	287,846	260,978	226,290	197,926	166,784	145,097
Panhandle GCD	**979,448**	**1,053,106**	**1,013,268**	**949,684**	**879,583**	**813,865**	**734,607**
Armstrong	56,821	51,760	45,662	40,268	35,017	30,705	27,080
Carson	162,975	166,133	159,424	149,866	140,958	134,453	121,522
Donley	72,596	78,318	76,996	72,649	66,893	60,955	53,227
Gray	177,264	181,767	173,242	160,488	146,740	133,890	121,683
Hutchinson	8,506	10,596	11,774	11,792	11,403	10,782	9,586
Potter	23,972	22,260	19,549	16,487	13,579	10,997	8,803
Roberts	357,959	409,569	394,109	369,578	343,395	317,738	285,999
Wheeler	119,354	132,702	132,512	128,557	121,599	114,345	106,707
Non-District Areas	**136,155**	**134,059**	**120,162**	**103,627**	**87,940**	**74,965**	**64,550**
Hartley	15,523	16,391	15,601	14,319	12,962	11,654	10,413
Hutchinson	33,885	32,988	28,313	24,075	20,934	18,588	17,168
Moore	8,685	9,687	9,395	8,251	7,107	6,202	5,506
Oldham	40,412	39,092	36,116	31,239	25,989	21,407	18,004
Randall	37,650	35,901	30,736	25,742	20,948	17,114	13,460
GMA 1 Total	**3,186,332**	**3,150,084**	**2,917,940**	**2,671,264**	**2,430,072**	**2,207,245**	**1,986,974**

Table 2. **Pumping values which satisfy the DFC statements in the Dockum Aquifer. Values reported by decade.**

Dockum Aquifer Pumping by Decade (acre-feet per year)

	2020	2030	2040	2050	2060	2070	2080
High Plains UWCD No.1	**11,489**	**12,235**	**12,305**	**10,971**	**10,179**	**10,085**	**10,155**
Armstrong	1,849	835	221	221	221	221	221
Potter	2,658	2,658	2,402	2,316	2,276	2,249	2,168
Randall	6,982	8,742	9,683	8,434	7,682	7,615	7,766
North Plains GCD	**33,262**	**33,170**	**31,424**	**29,745**	**28,304**	**26,928**	**25,715**
Dallam	15,953	15,549	14,687	14,045	13,502	12,920	12,406
Hartley	12,379	11,802	11,031	10,343	9,737	9,242	8,815
Moore	4,487	5,402	5,398	5,068	4,773	4,477	4,204
Sherman	444	416	309	289	293	288	290
Panhandle GCD	**35,405**	**44,836**	**45,885**	**45,599**	**44,643**	**43,623**	**42,403**
Armstrong	5,302	7,107	8,105	8,607	8,830	8,909	8,895
Carson	6	6	6	6	6	6	6
Potter	30,097	37,723	37,774	36,987	35,806	34,707	33,501
Non-District Areas	**207,317**	**236,532**	**231,191**	**218,086**	**200,544**	**179,456**	**162,332**
Hartley	44,168	52,833	52,986	50,465	46,810	43,002	39,229
Moore	241	560	593	617	641	645	624
Oldham	143,936	153,889	145,622	135,482	124,602	114,645	105,122
Randall	18,974	29,250	31,990	31,523	28,491	21,163	17,357
GMA 1 Total	**287,474**	**326,773**	**320,806**	**304,402**	**283,670**	**260,092**	**240,605**

Figure 4. Map of Initial Saturated Thickness in the Ogallala Aquifer.

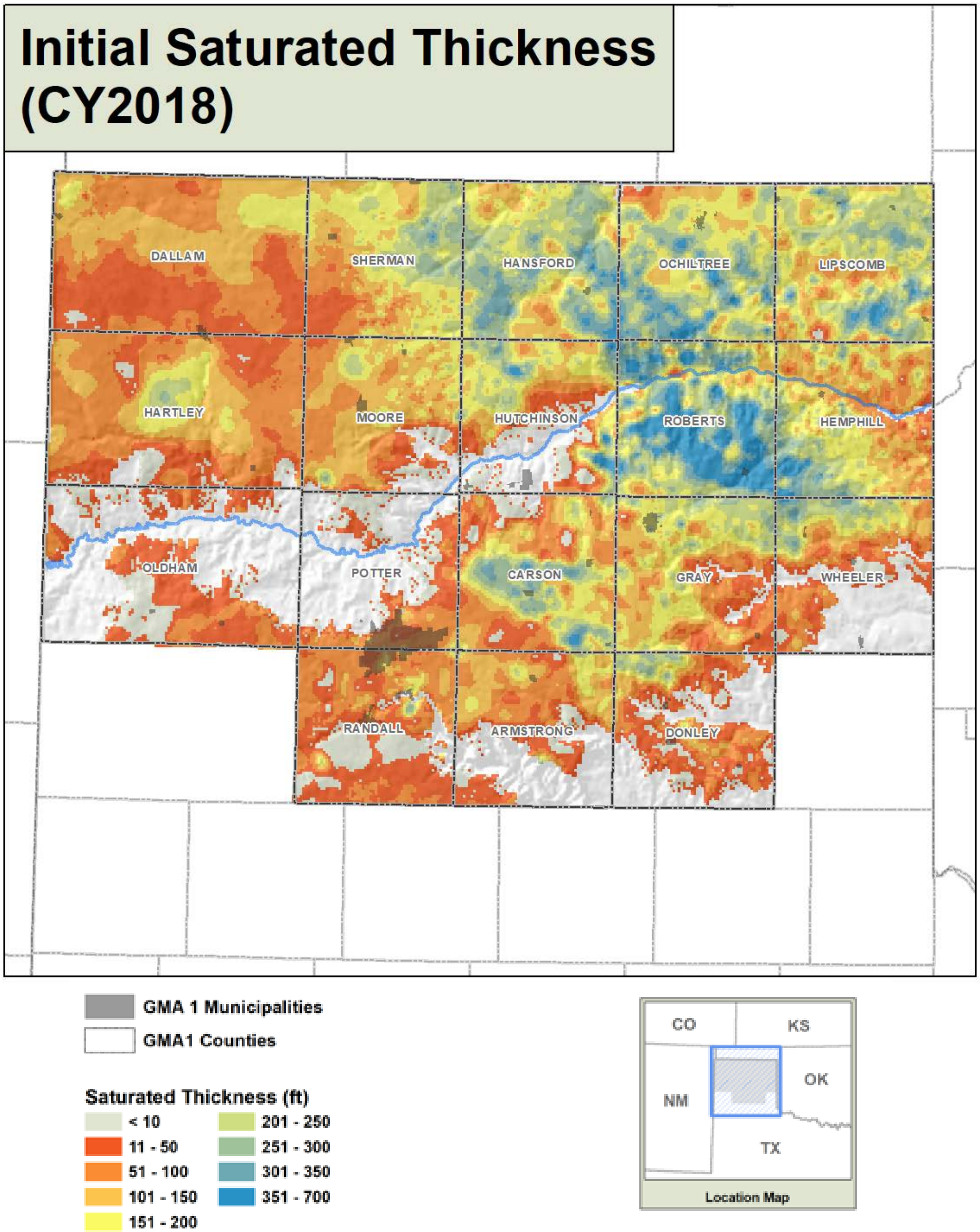


Figure 5. **Map of Saturated Thickness in the Ogallala Aquifer in the 2020 stress period.**

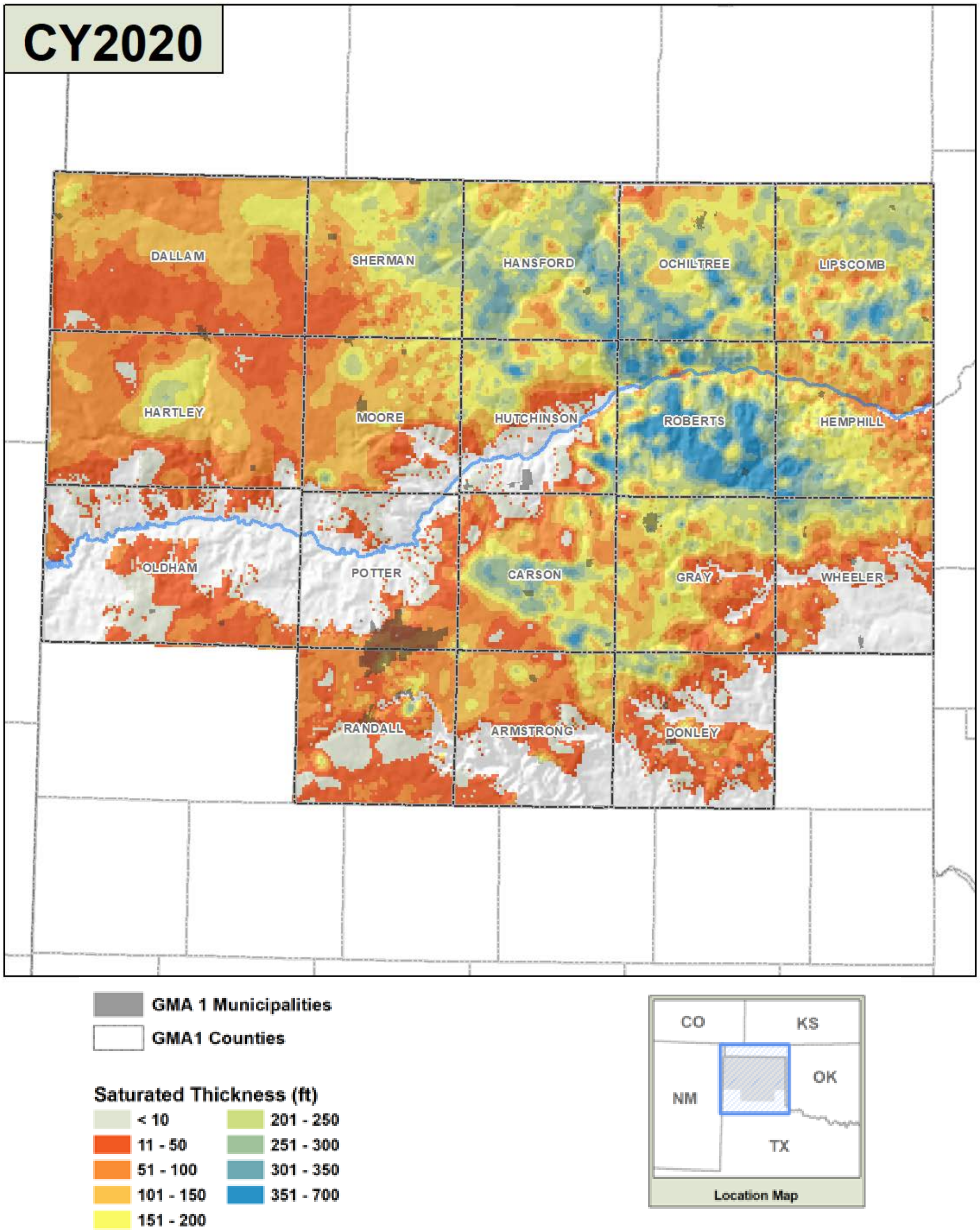


Figure 6. Map of Saturated Thickness in the Ogallala Aquifer in the 2030 stress period.

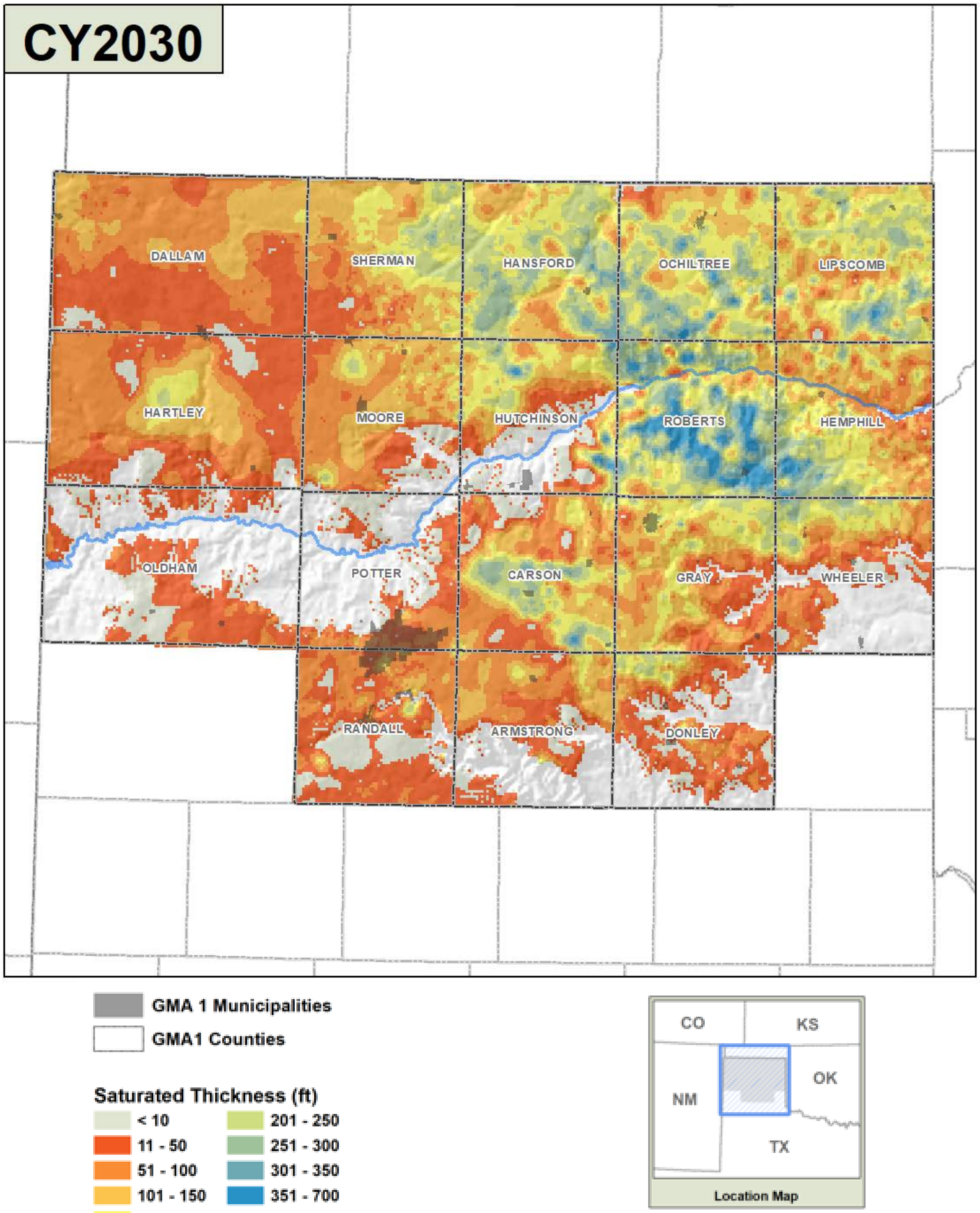


Figure 7. **Map of Saturated Thickness in the Ogallala Aquifer in the 2040 stress period.**

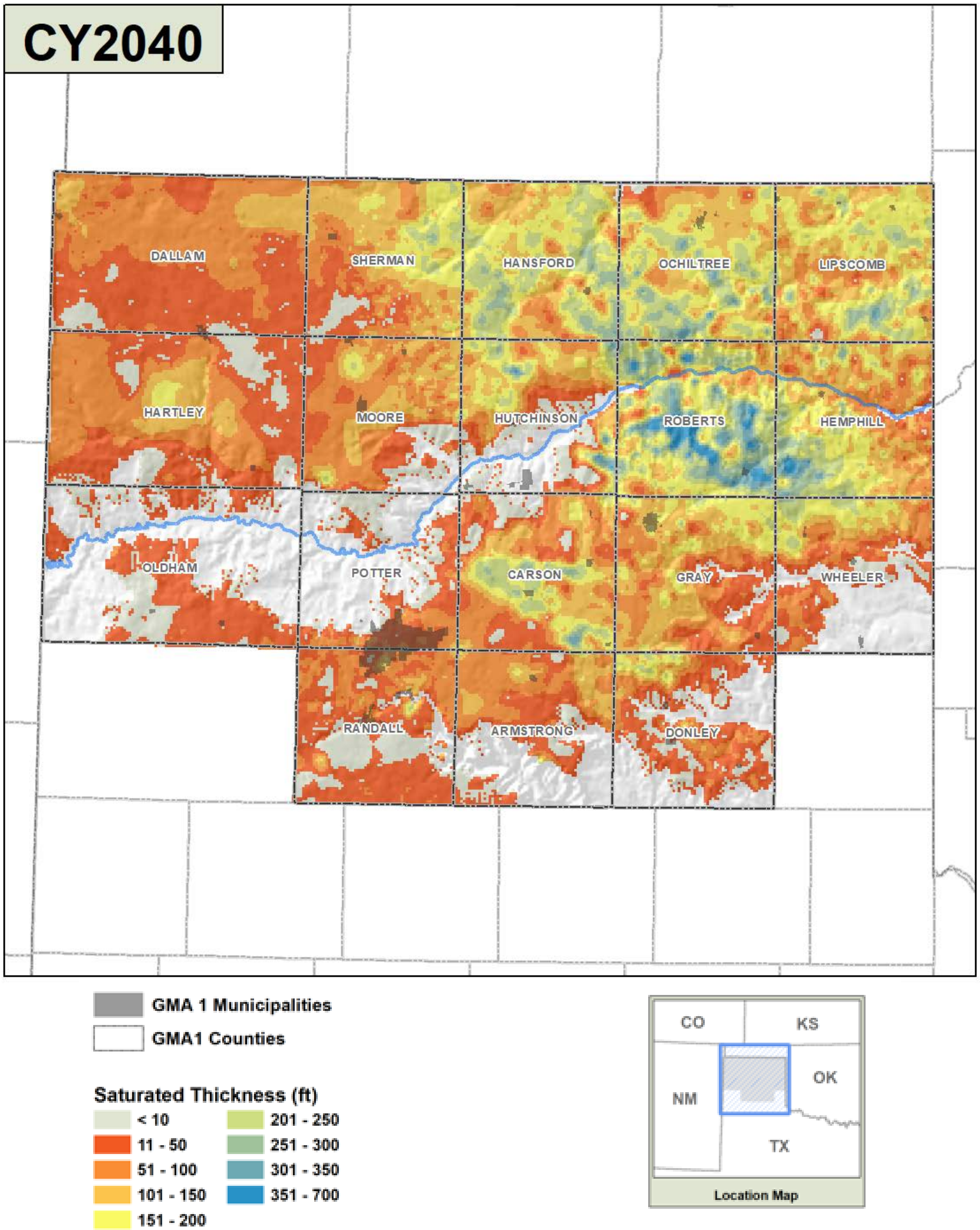


Figure 8. Map of Saturated Thickness in the Ogallala Aquifer in the 2050 stress period.

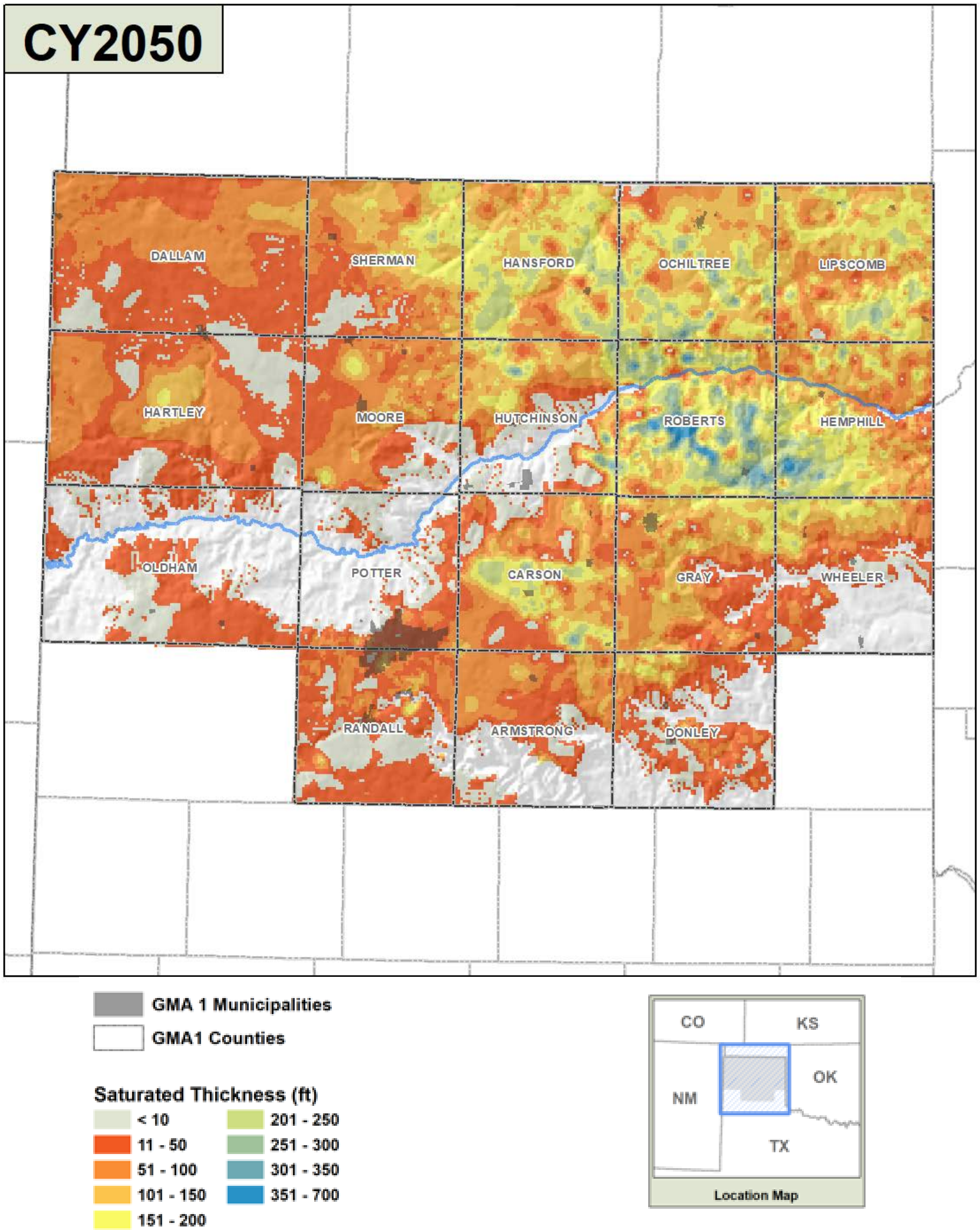


Figure 9. Map of Saturated Thickness in the Ogallala Aquifer in the 2060 stress period.

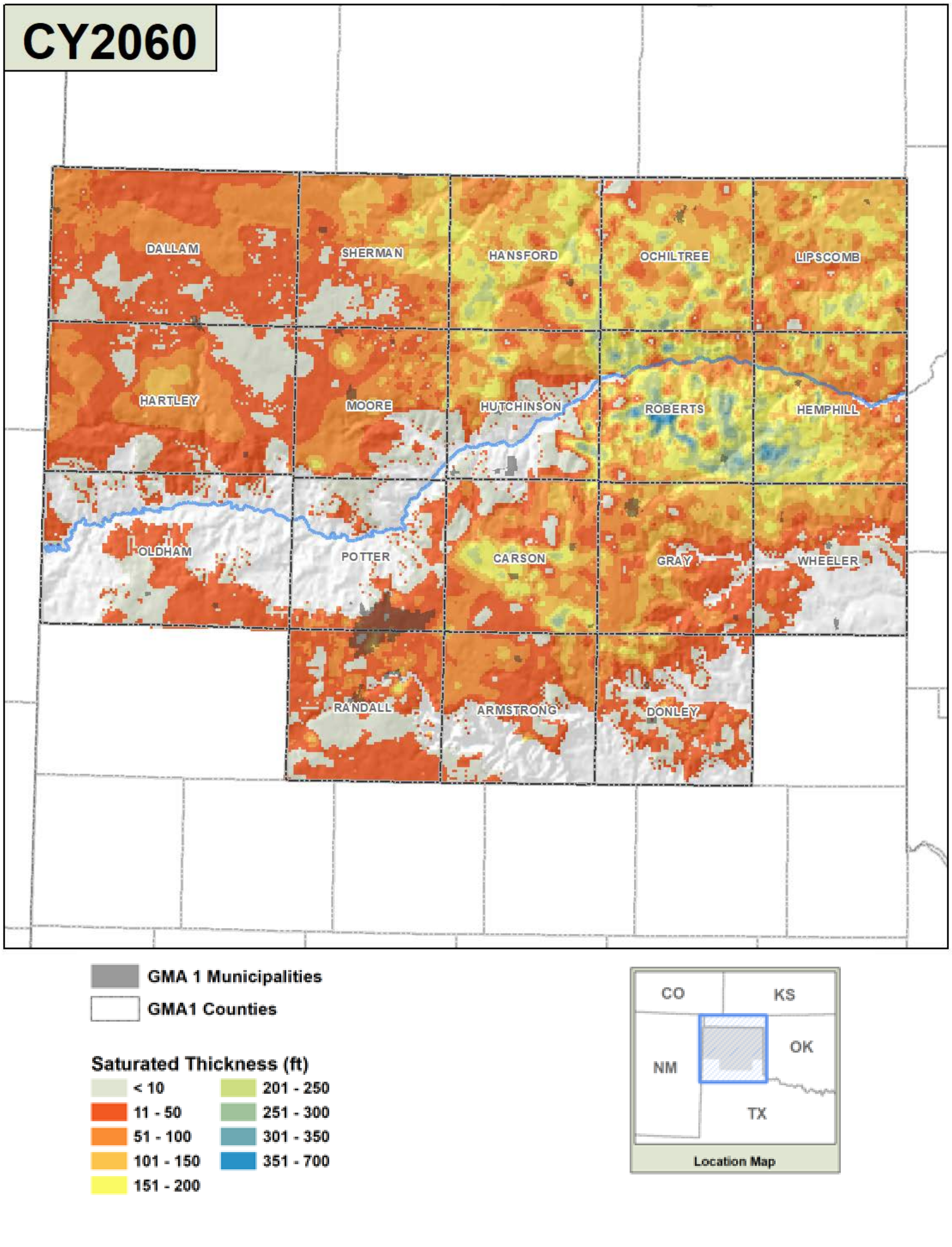


Figure 10. Map of Saturated Thickness in the Ogallala Aquifer in the 2070 stress period.

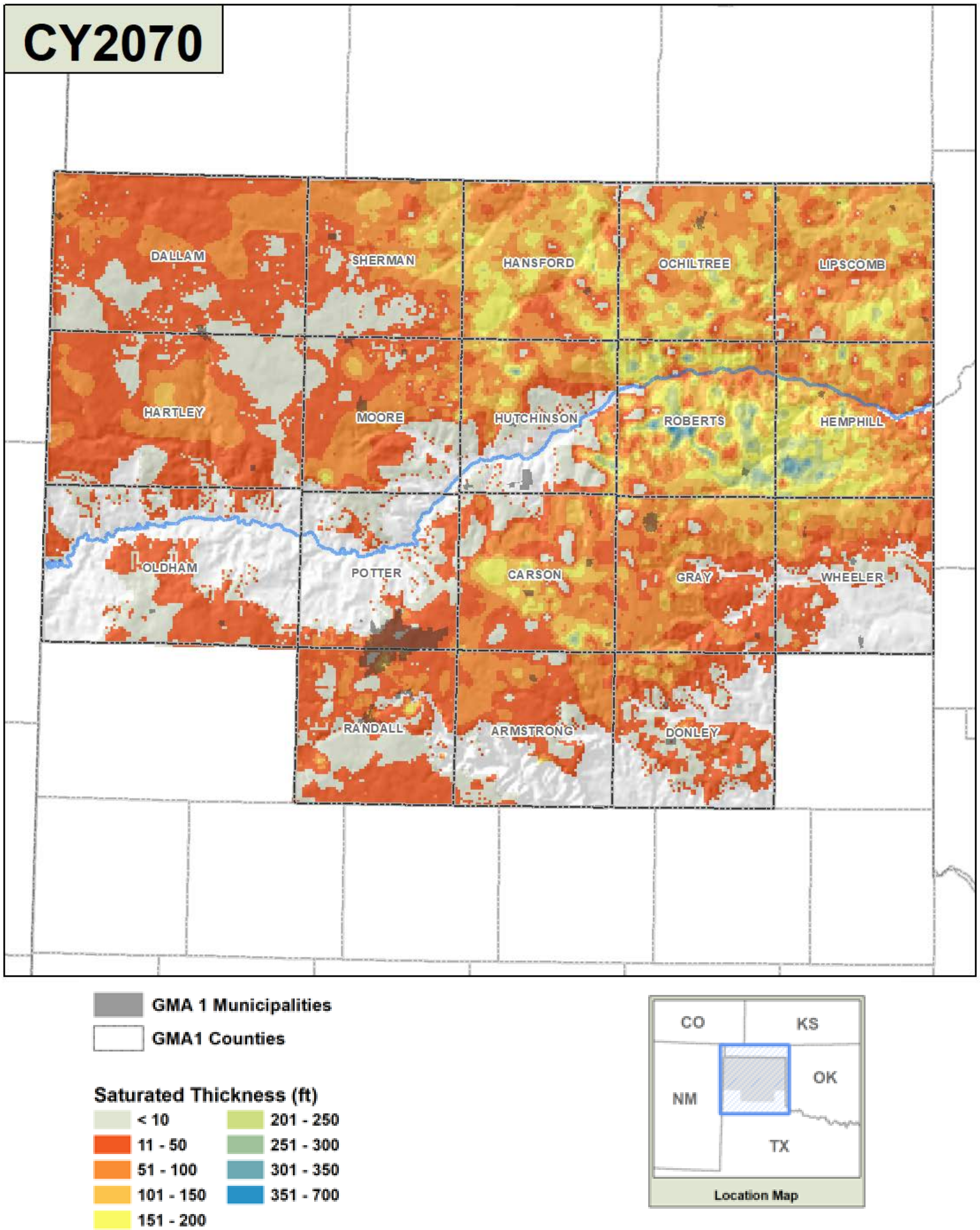


Figure 11. Map of Saturated Thickness in the Ogallala Aquifer in the 2080 stress period.

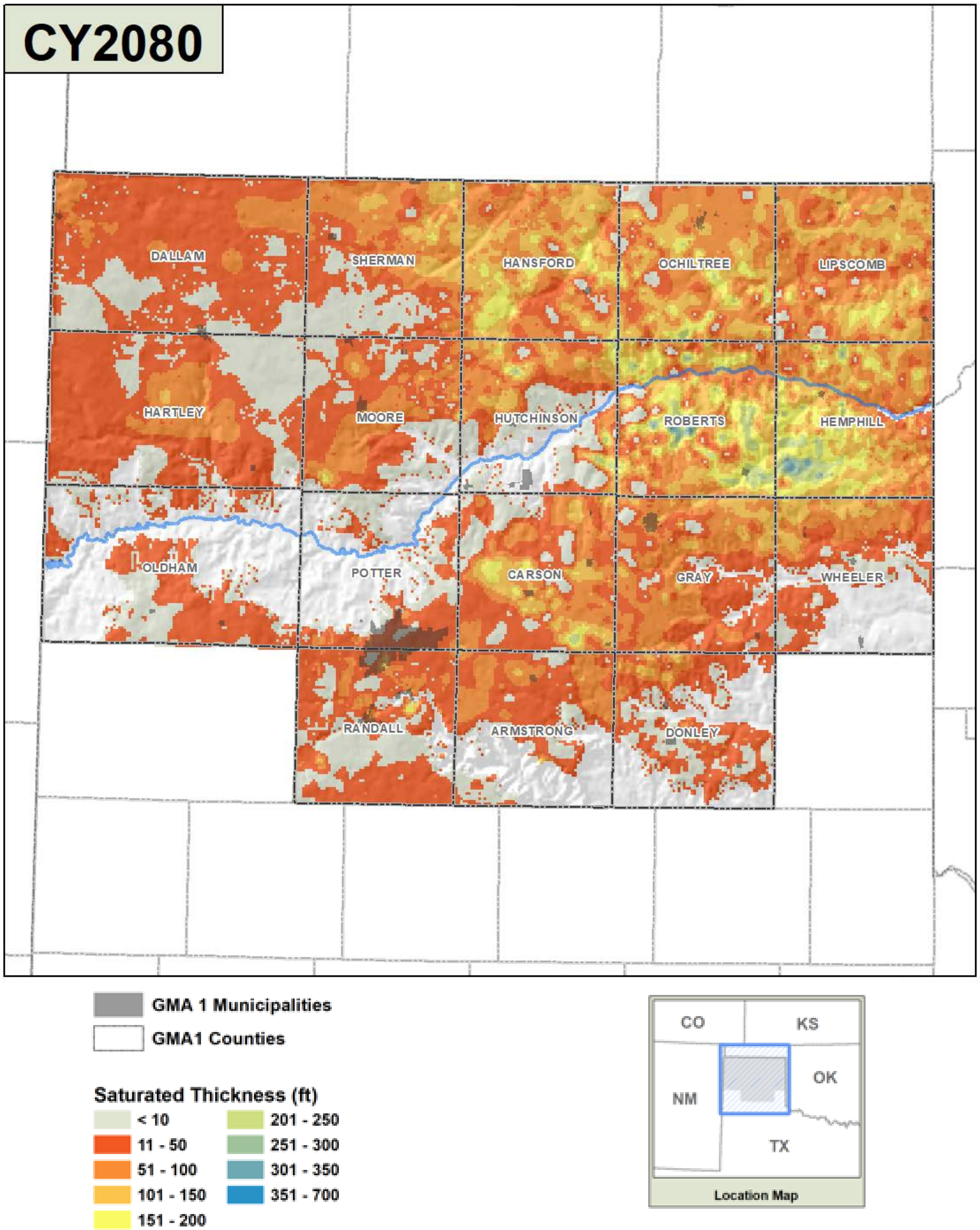


Figure 12. Map of Initial Saturated Thickness in the Rita Blanca Aquifer.

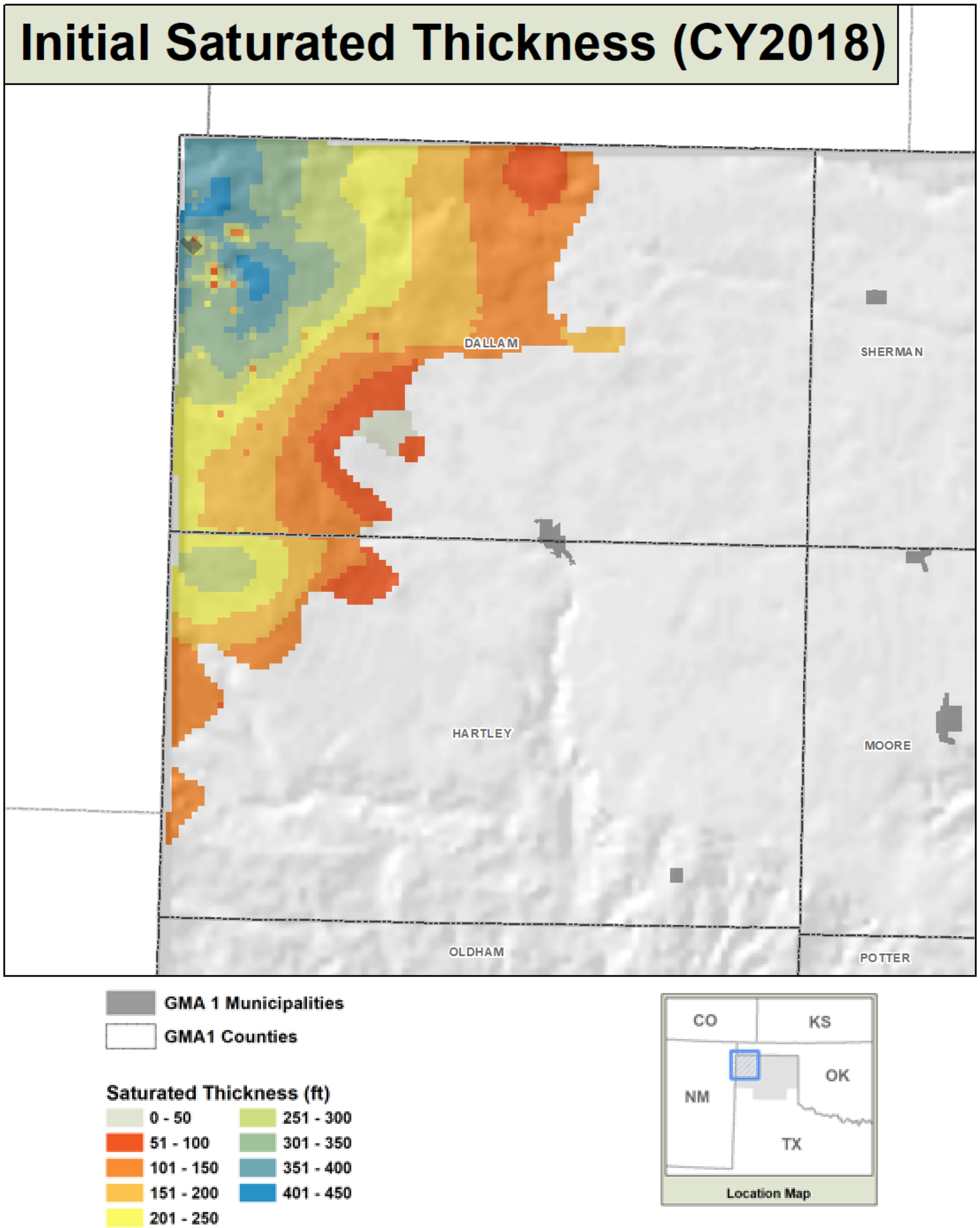


Figure 13. Map of Saturated Thickness in the Rita Blanca Aquifer in the 2020 stress period.

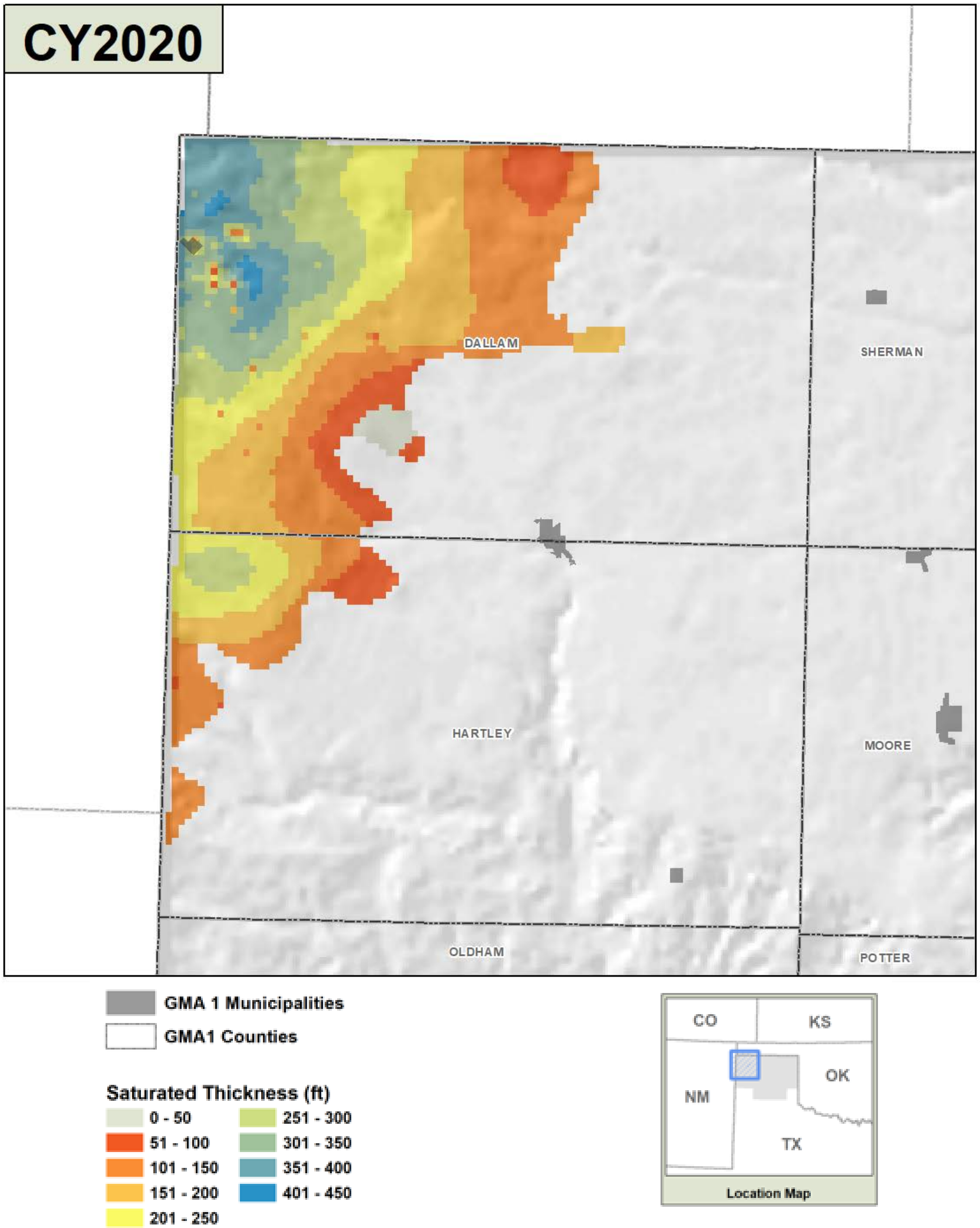


Figure 14. **Map of Saturated Thickness in the Rita Blanca Aquifer in the 2030 stress period.**

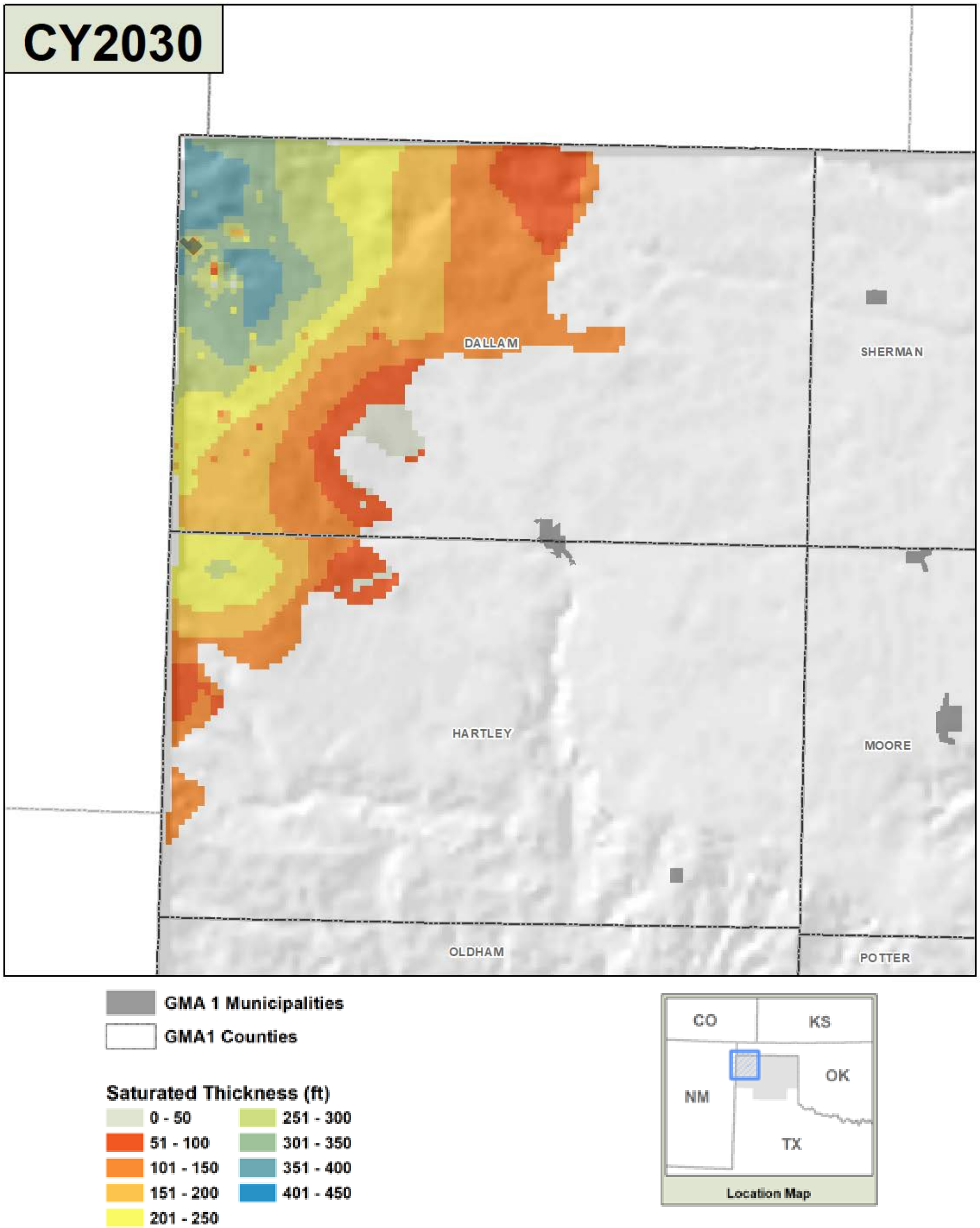


Figure 15. Map of Saturated Thickness in the Rita Blanca Aquifer in the 2040 stress period.

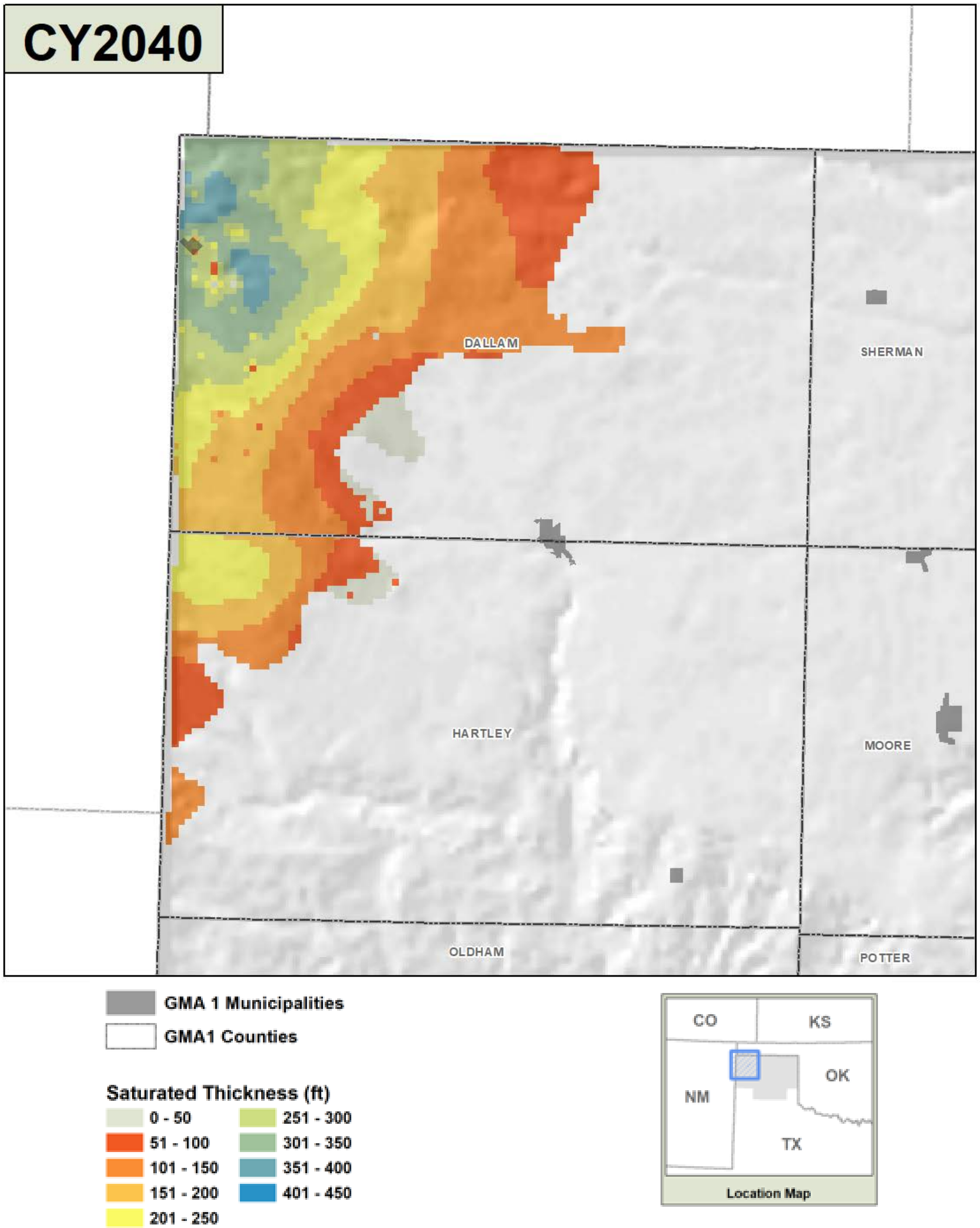


Figure 16. Map of Saturated Thickness in the Rita Blanca Aquifer in the 2050 stress period.

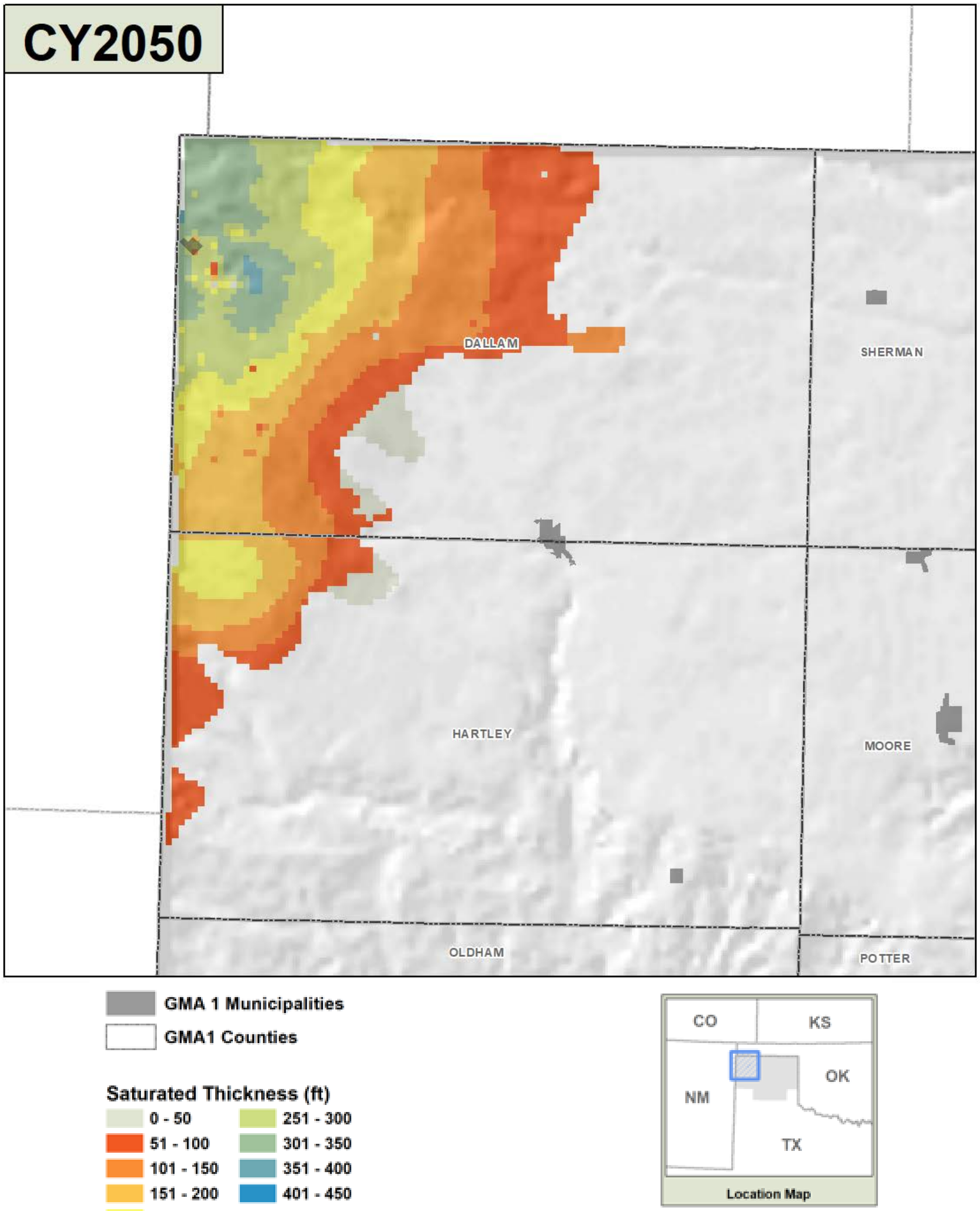


Figure 17. Map of Saturated Thickness in the Rita Blanca Aquifer in the 2060 stress period.

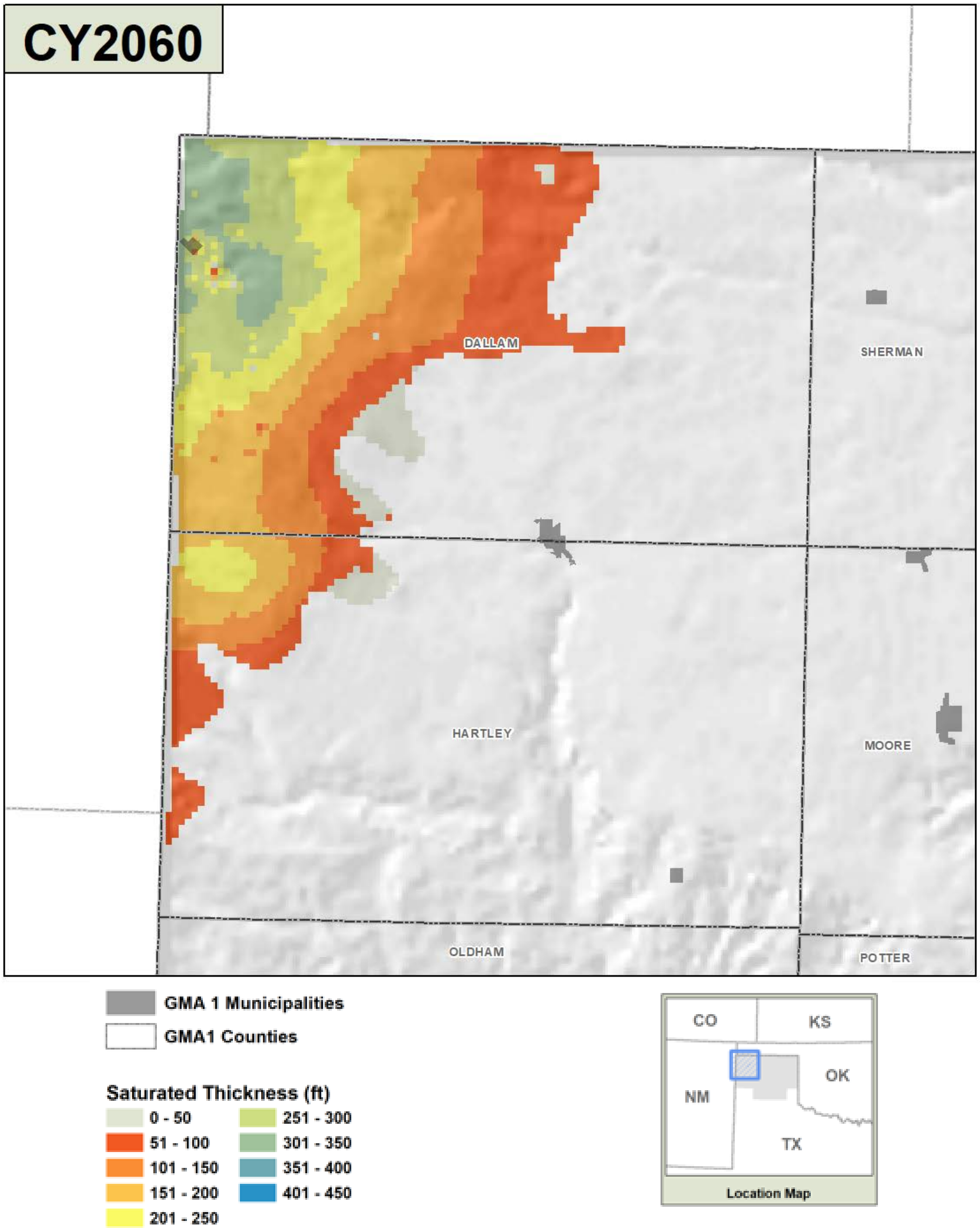


Figure 18. Map of Saturated Thickness in the Rita Blanca Aquifer in the 2070 stress period.

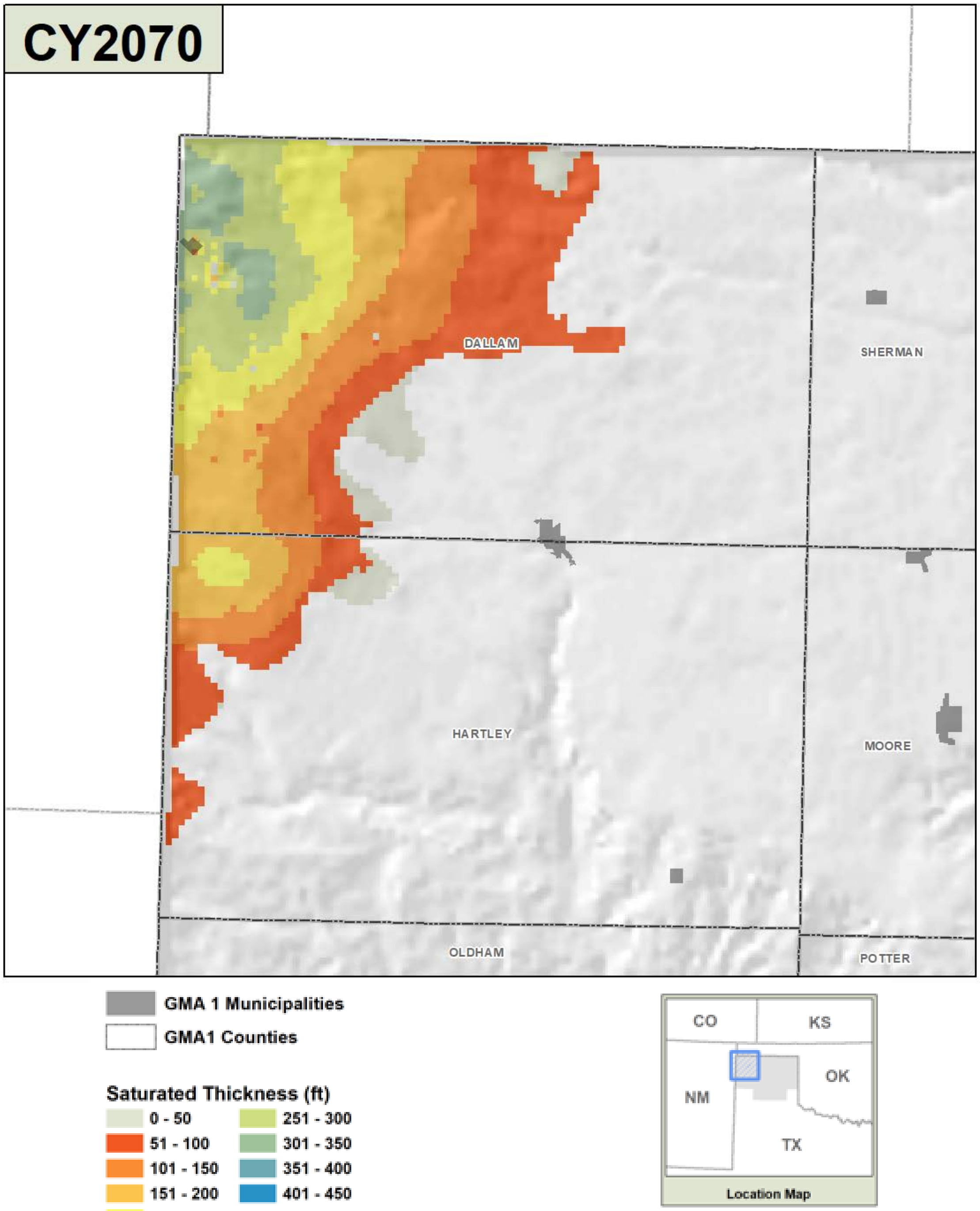


Figure 19. Map of Saturated Thickness in the Rita Blanca Aquifer in the 2080 stress period.

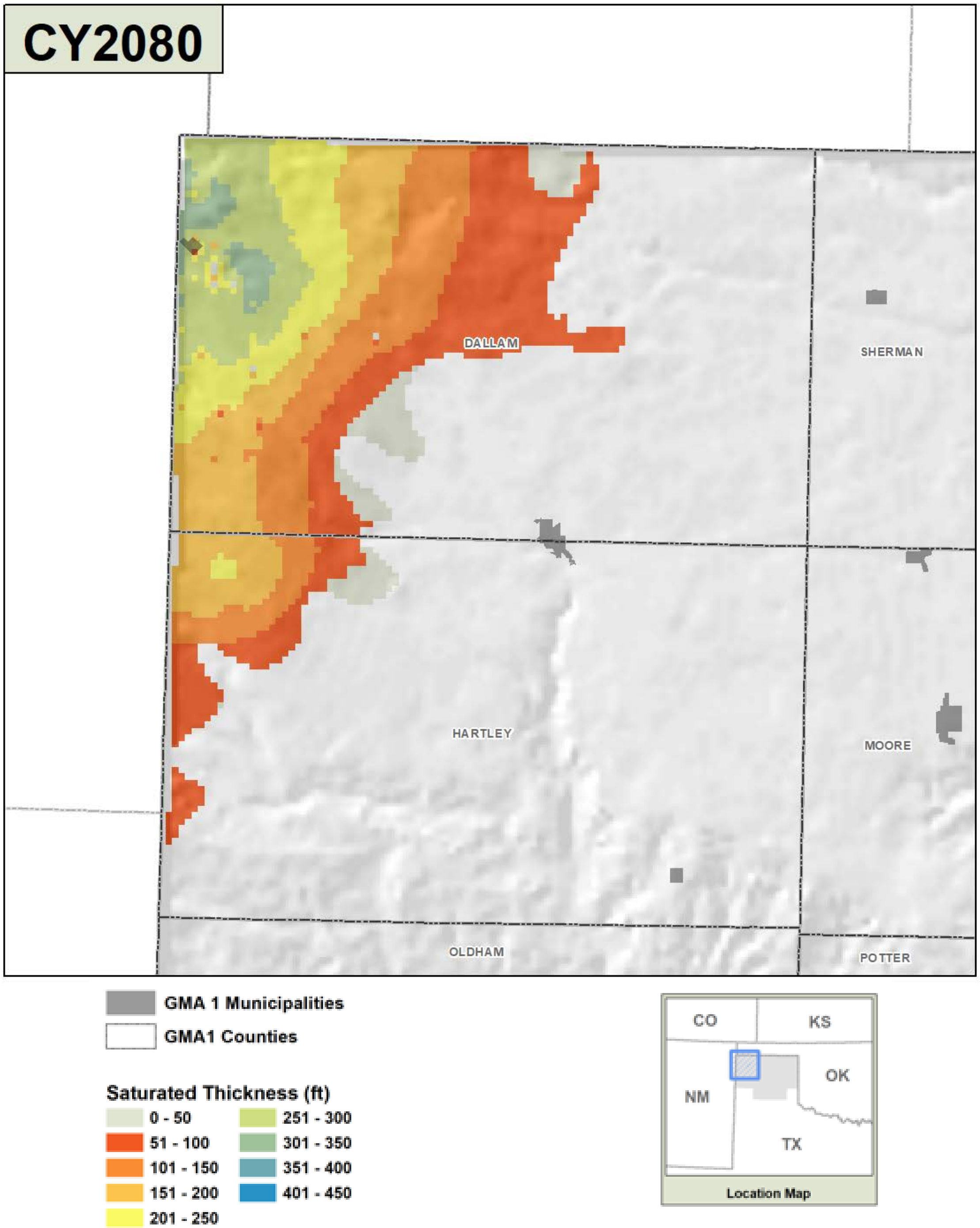


Figure 20. Map of Predicted Drawdown in the Upper Dockum Aquifer in the 2020 stress period.

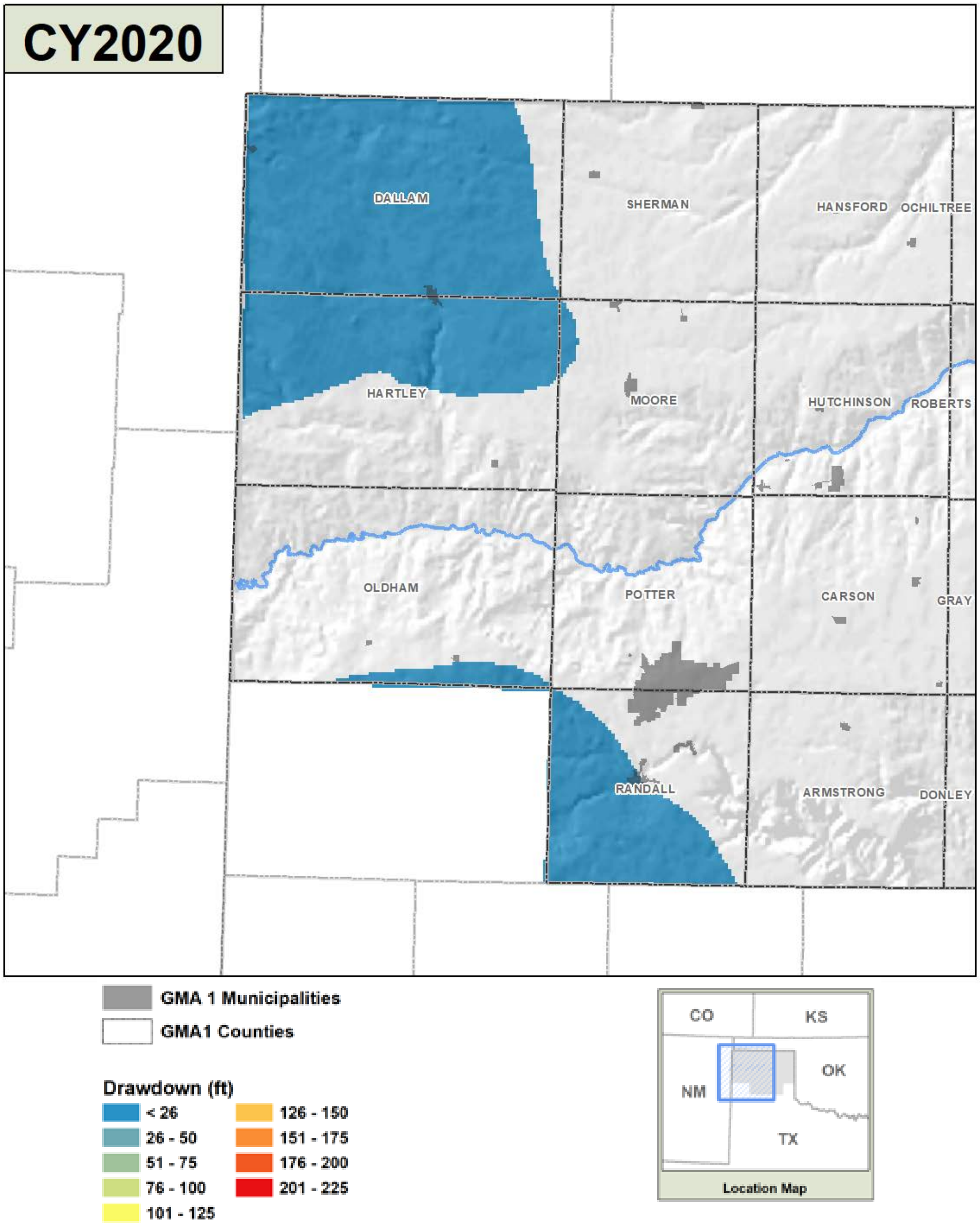


Figure 21. Map of Predicted Drawdown in the Upper Dockum Aquifer in the 2030 stress period.

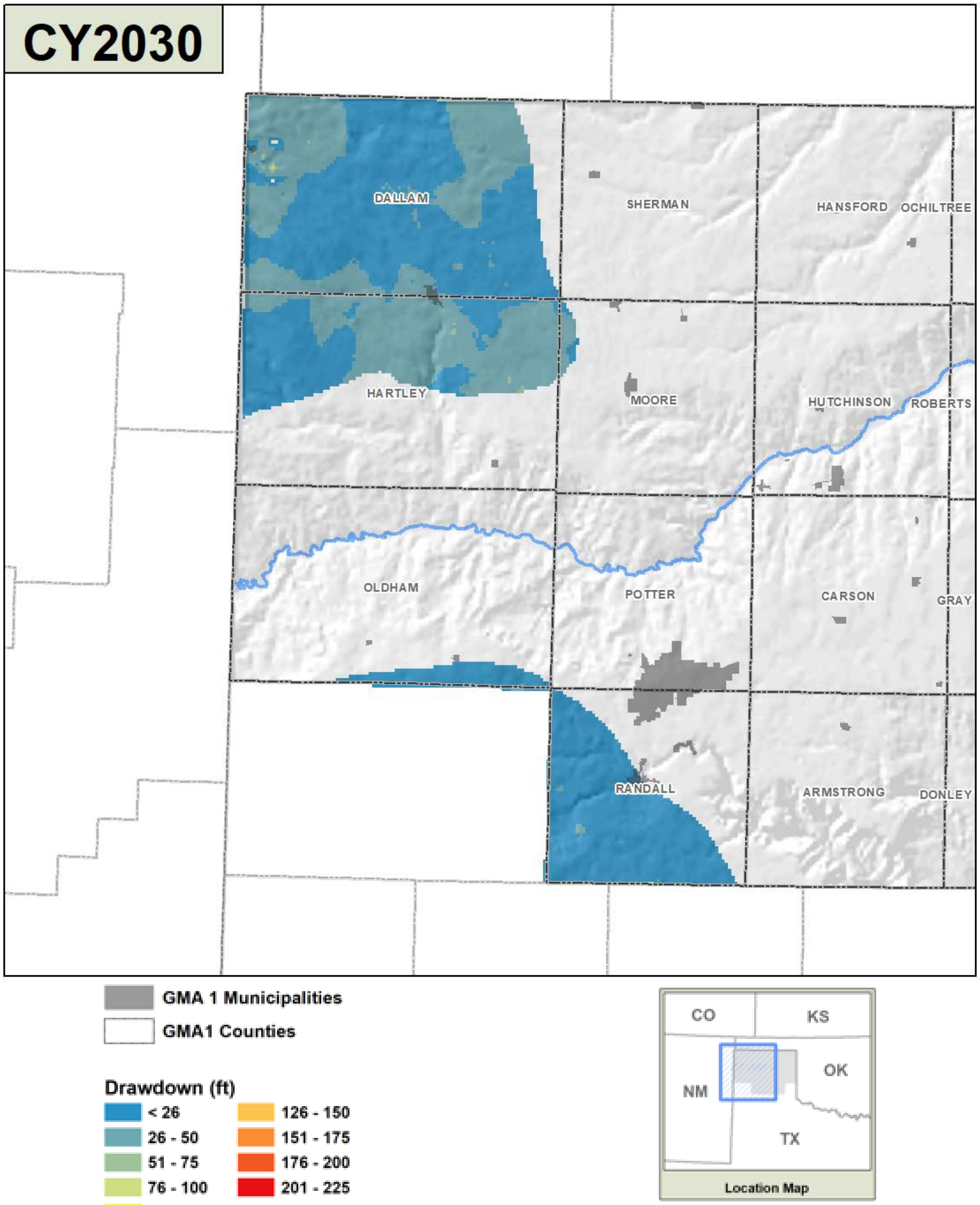


Figure 22. Map of Predicted Drawdown in the Upper Dockum Aquifer in the 2040 stress period.

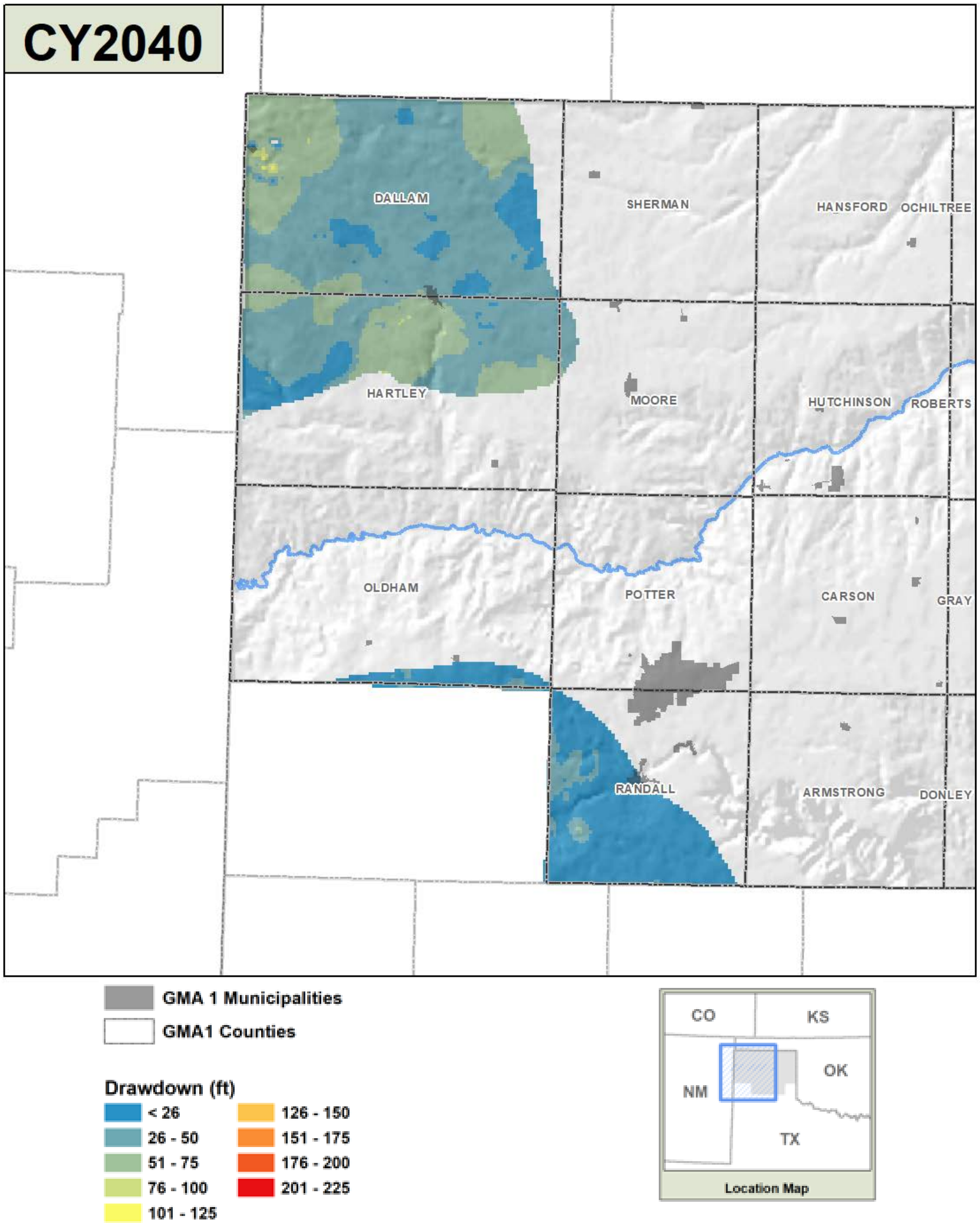


Figure 23. Map of Predicted Drawdown in the Upper Dockum Aquifer in the 2050 stress period.

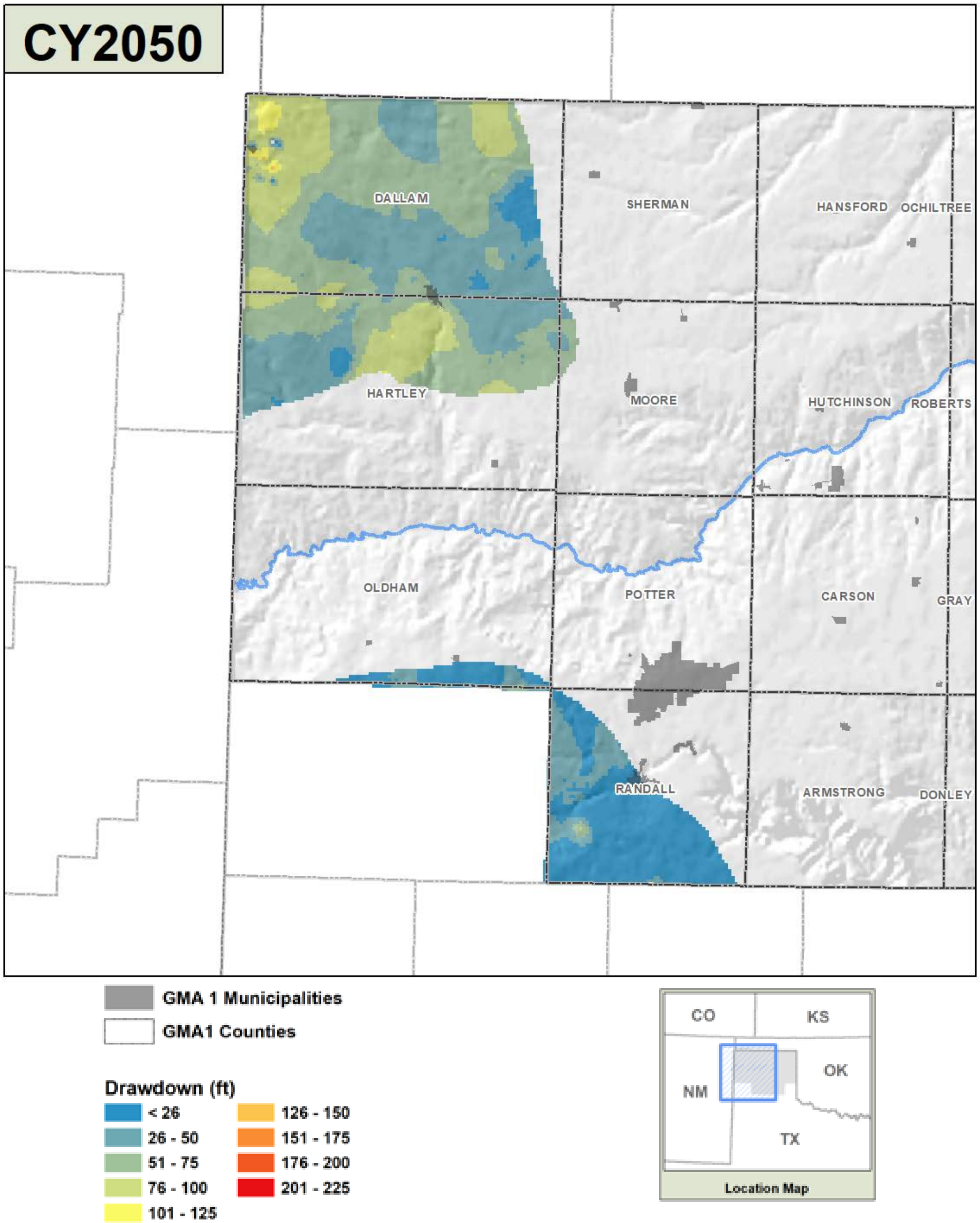


Figure 24. Map of Predicted Drawdown in the Upper Dockum Aquifer in the 2060 stress period.

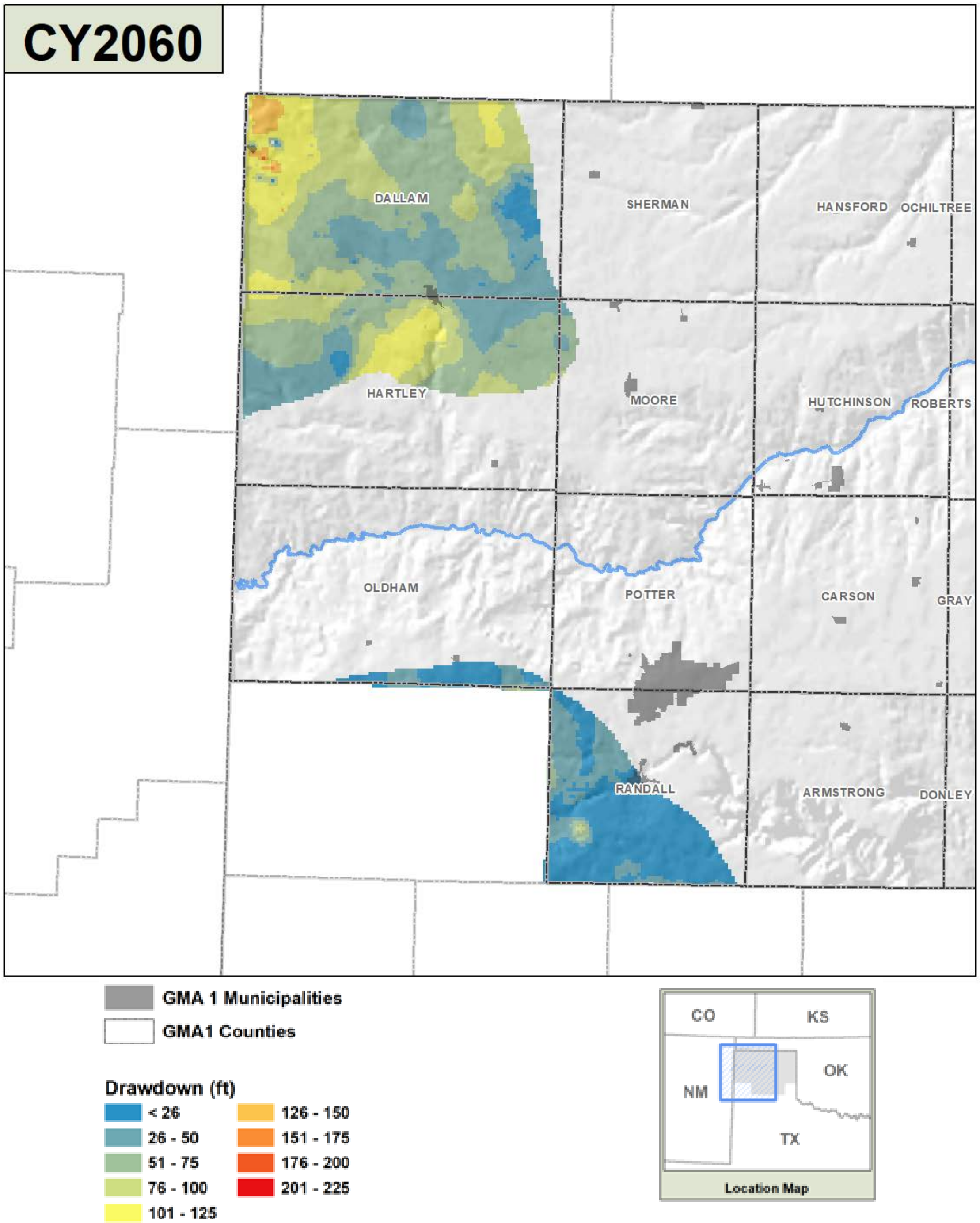


Figure 25. Map of Predicted Drawdown in the Upper Dockum Aquifer in the 2070 stress period.

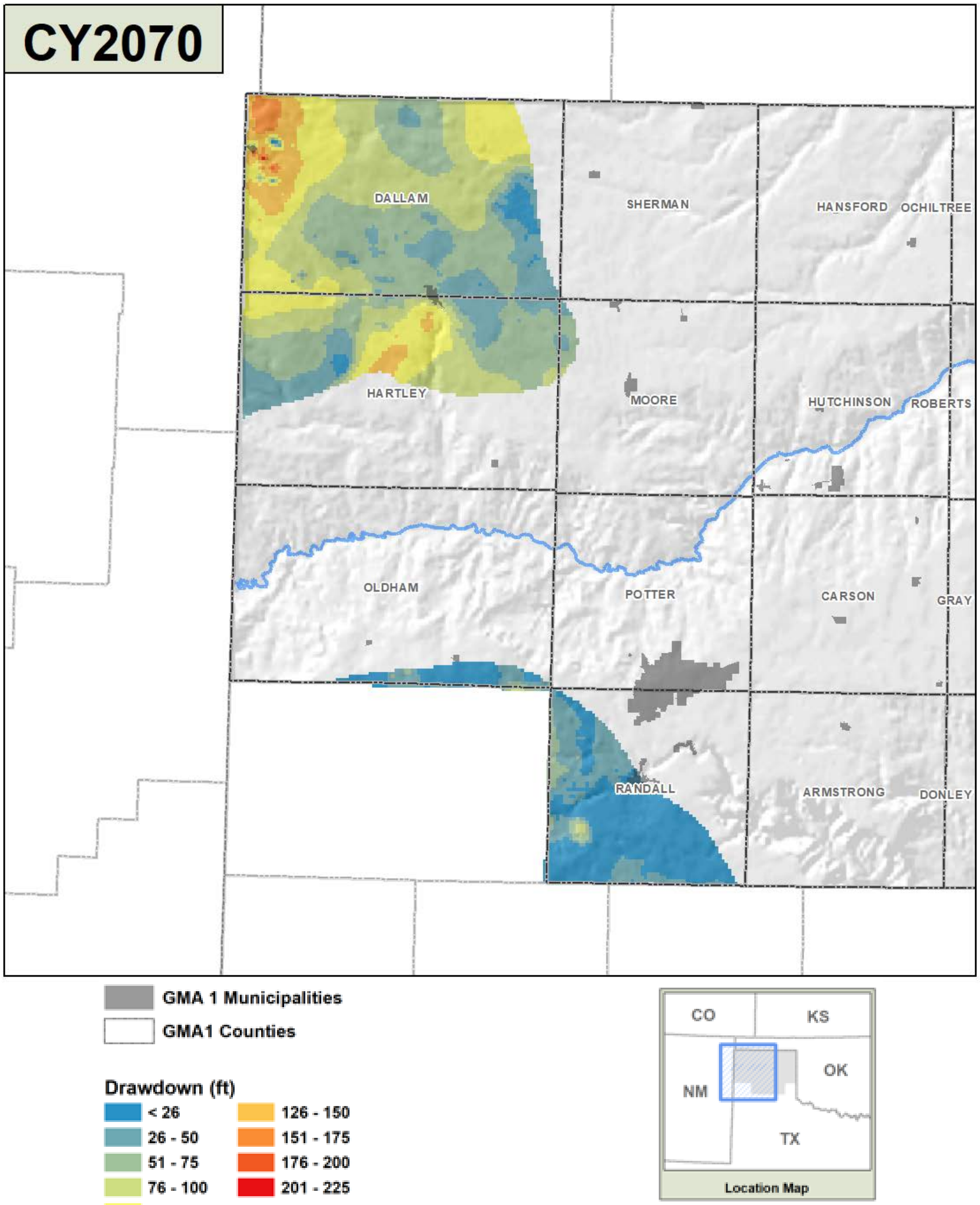


Figure 26. Map of Predicted Drawdown in the Upper Dockum Aquifer in the 2080 stress period.

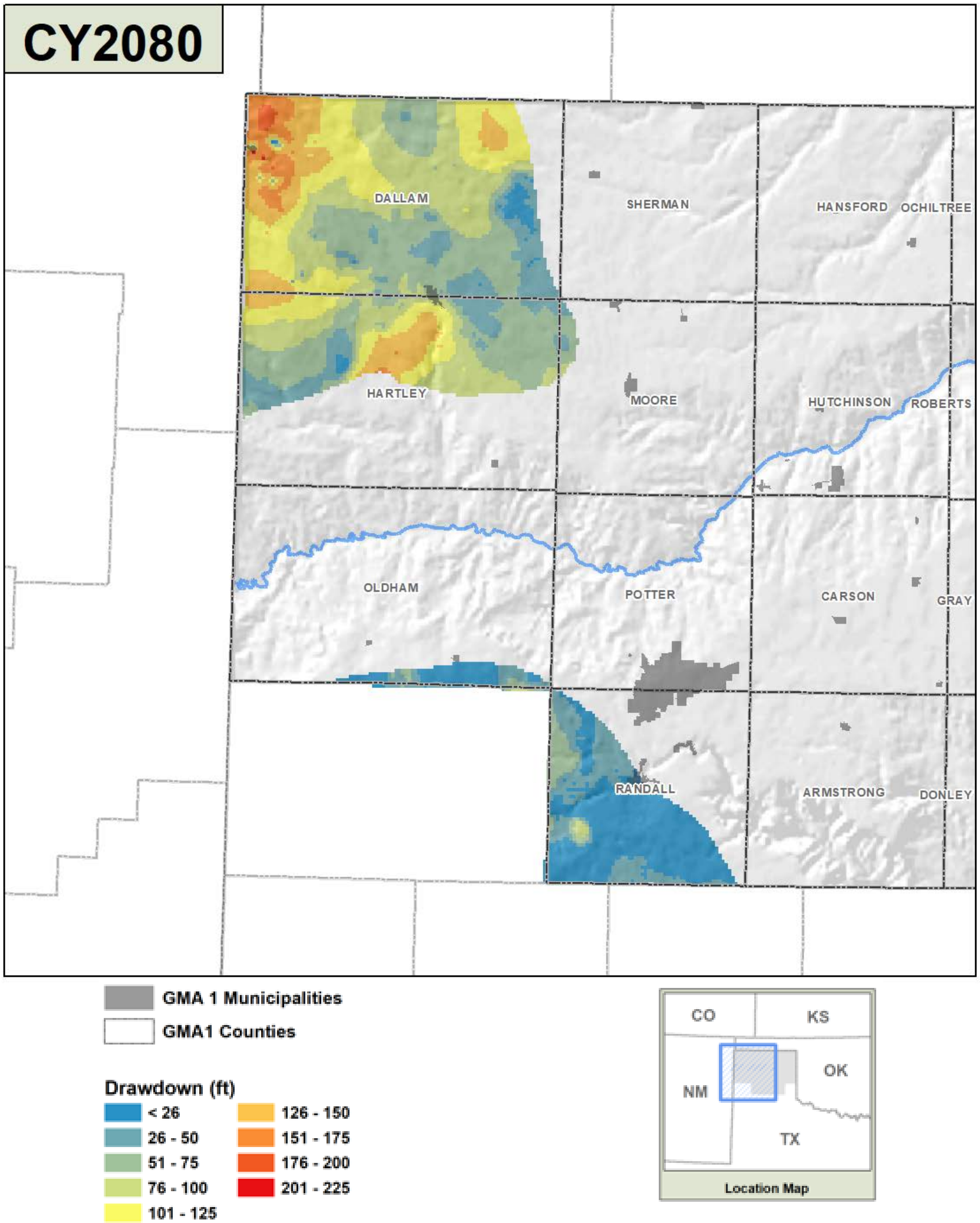


Figure 27. Map of Predicted Drawdown in the Lower Dockum Aquifer in the 2020 stress period.

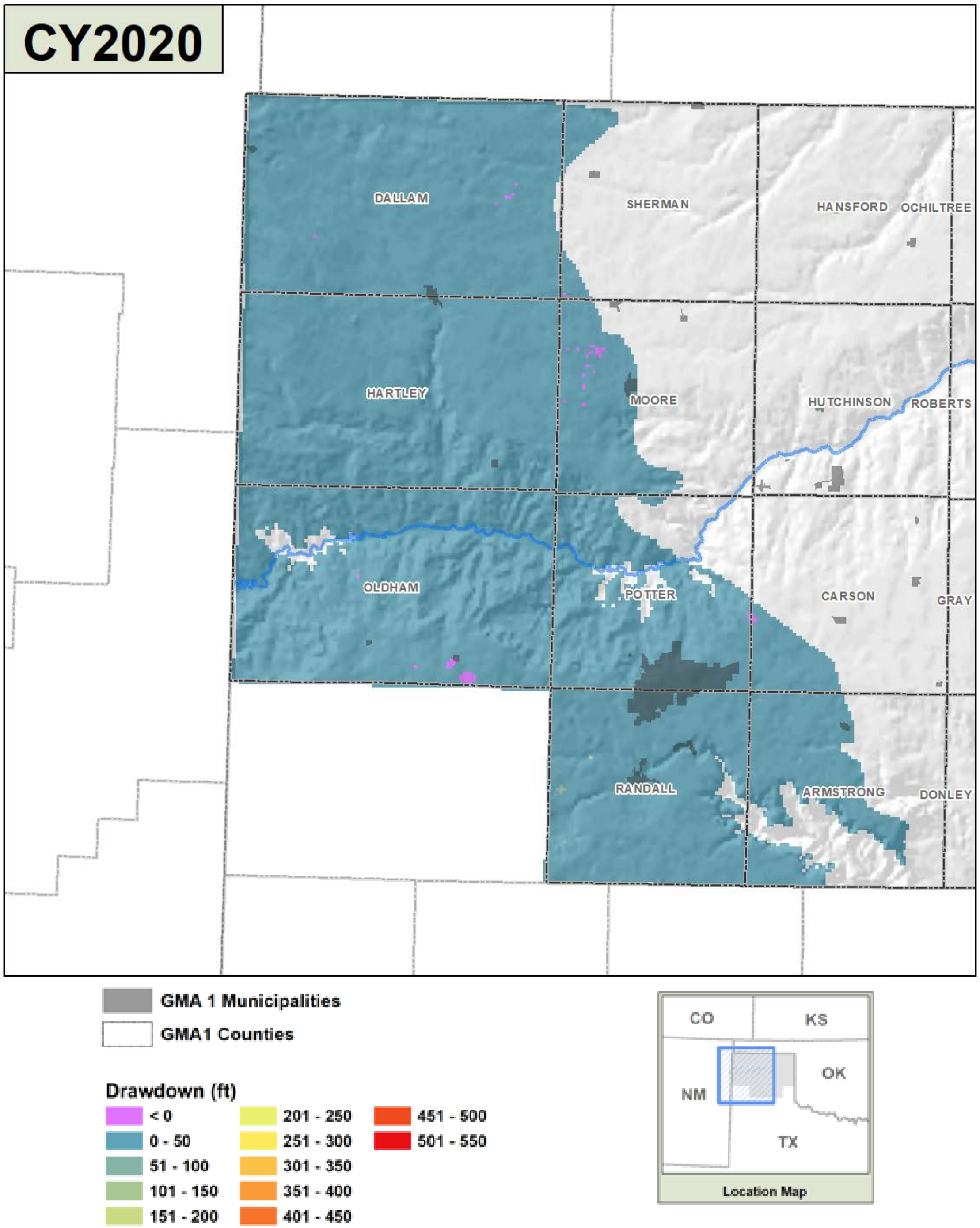


Figure 28. Map of Predicted Drawdown in the Lower Dockum Aquifer in the 2030 stress period.

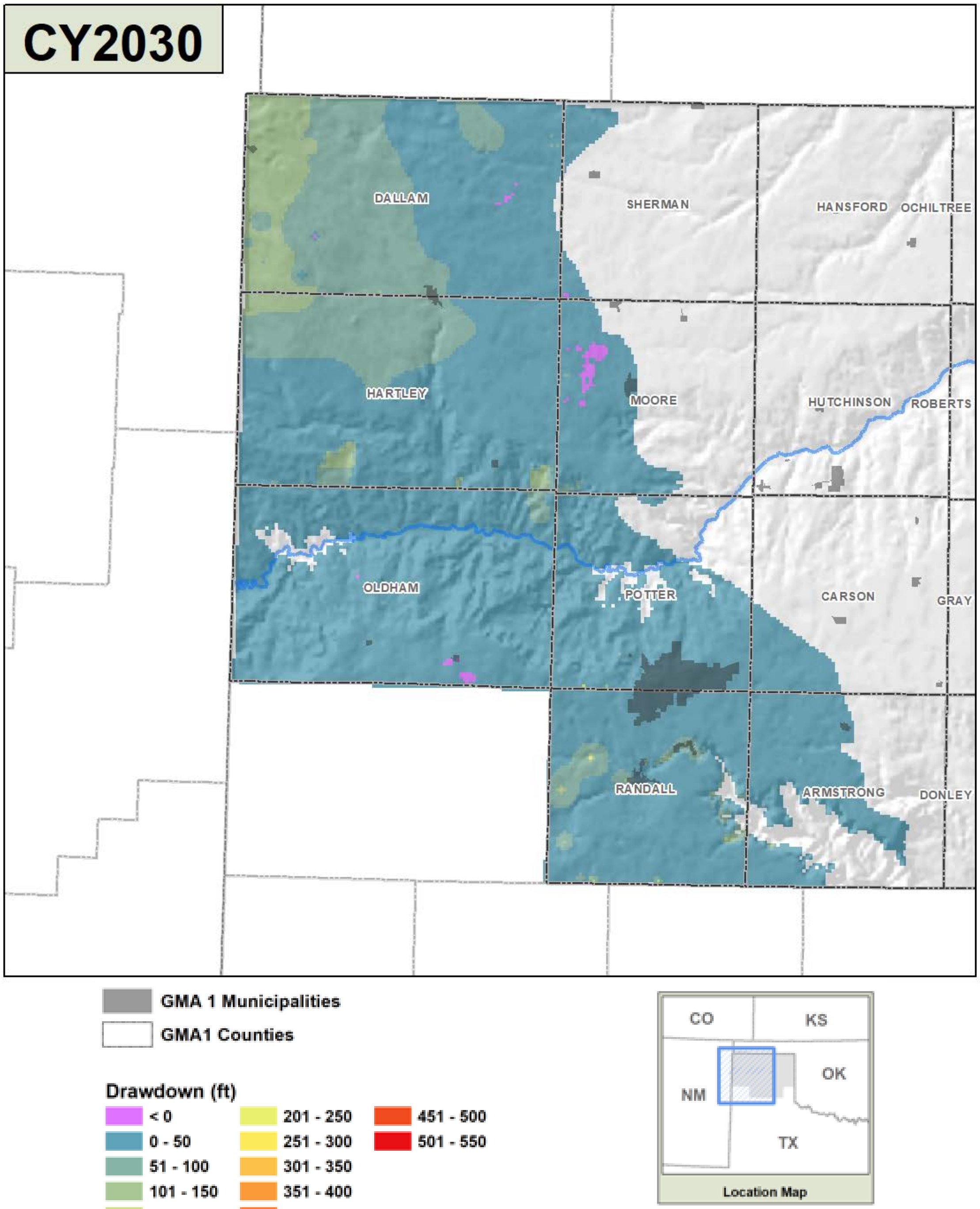


Figure 29. Map of Predicted Drawdown in the Lower Dockum Aquifer in the 2040 stress period.

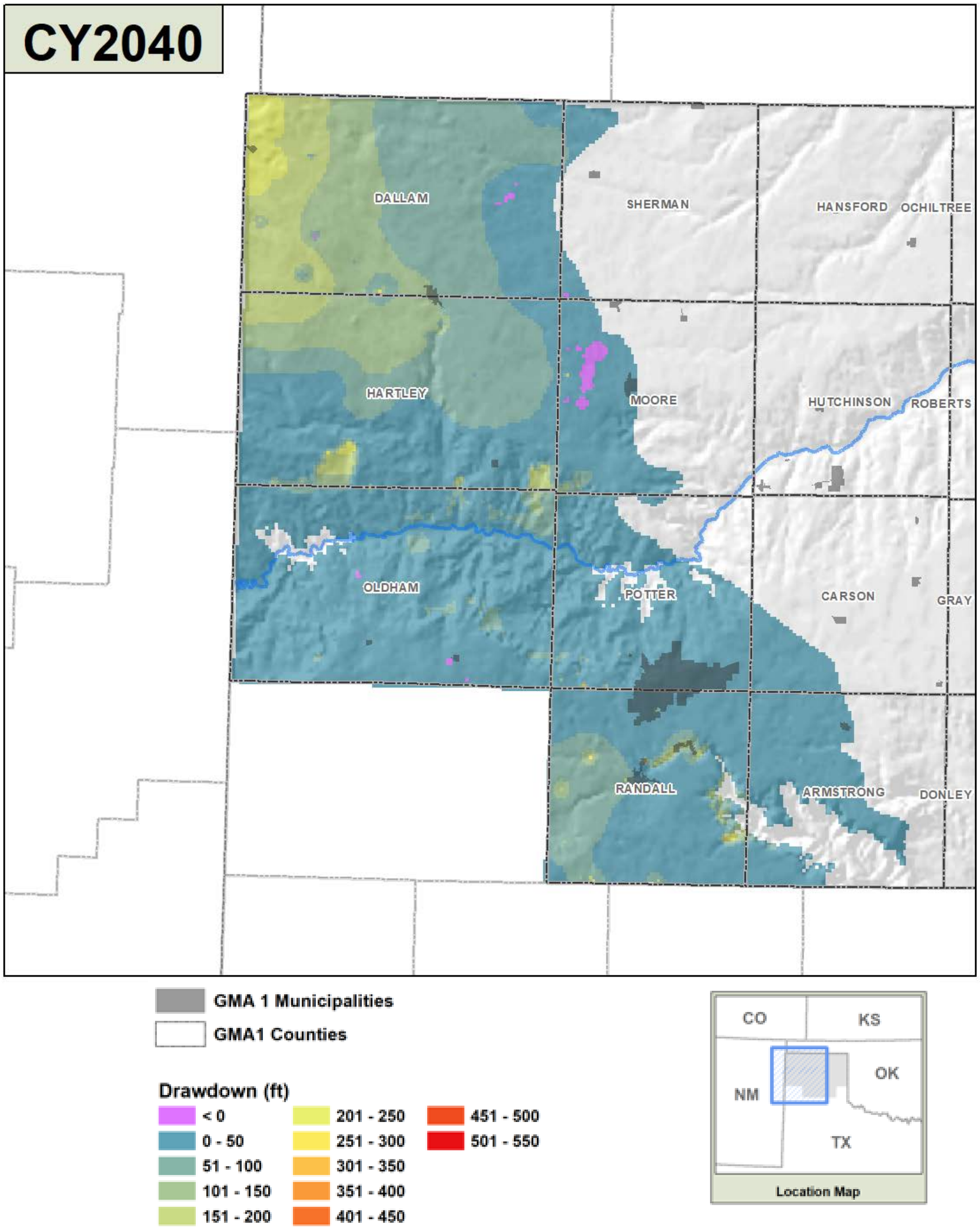


Figure 30. Map of Predicted Drawdown in the Lower Dockum Aquifer in the 2050 stress period.

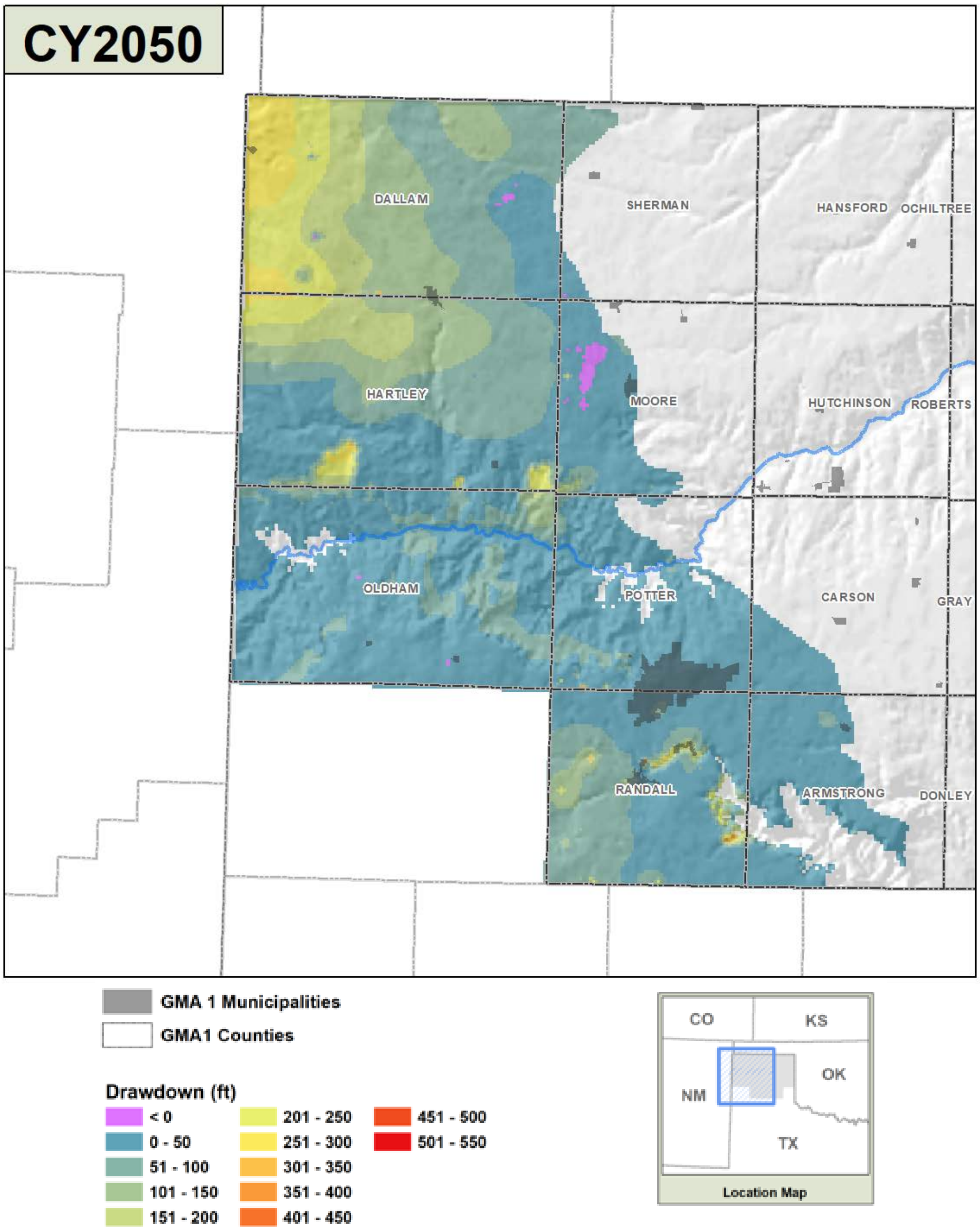


Figure 31. Map of Predicted Drawdown in the Lower Dockum Aquifer in the 2060 stress period.

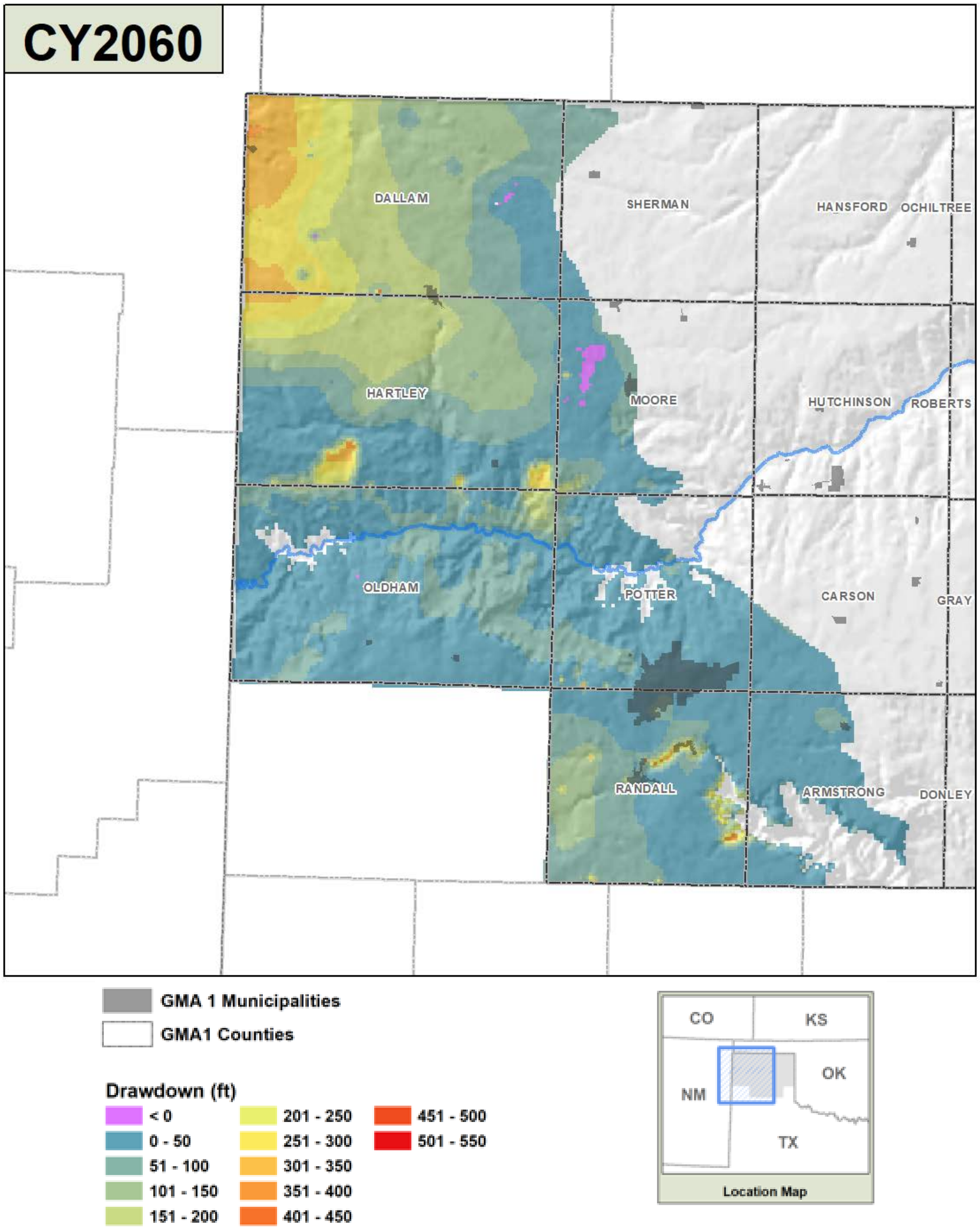


Figure 32. **Map of Predicted Drawdown in the Lower Dockum Aquifer in the 2070 stress period.**

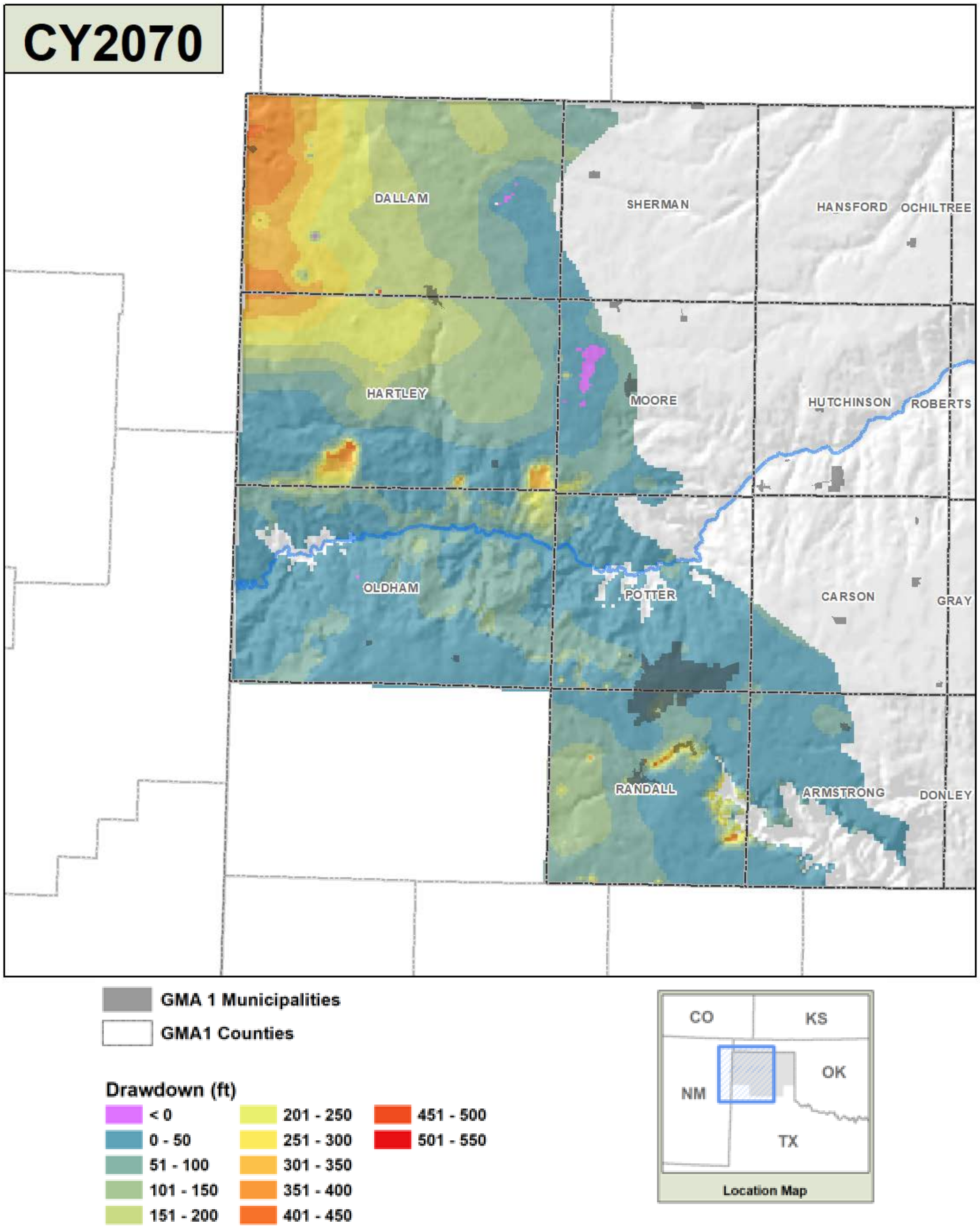
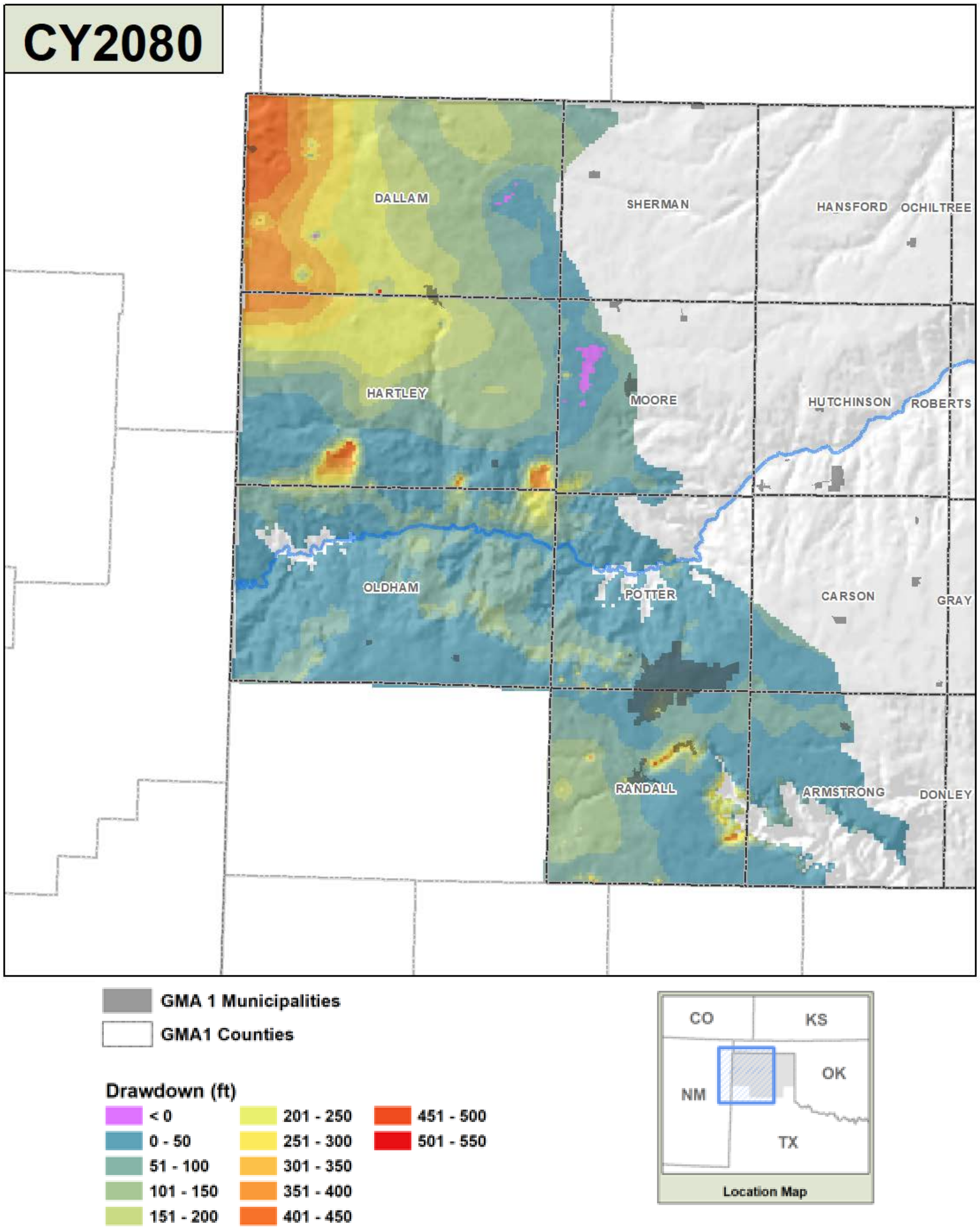


Figure 33. **Map of Predicted Drawdown in the Lower Dockum Aquifer in the 2080 stress period.**



J. References

-Deeds, Neil and M. Jigmond. (2015) Final Conceptual Model Report for the High Plains Aquifer System Groundwater Availability Model, Prepared for TWDB: INTERA Incorporated Report.

-Deeds, Neil. (2016) Draft Technical Memorandum: Summary of the Desired Future Condition Simulation for Groundwater Management Area 1: INTERA Incorporated Report.

2. Related model files (MODFLOW), PEST or other automated calibration files (if used), target files (for establishing starting conditions) with appropriate read me files.

These files are included with the electronic delivery of this Explanatory Report.

Appendix IV

Factor Analysis and Presentations

Discussion and Consideration of Aquifer Uses and Conditions

A Presentation to GMA 1
Joint Planning Group

October 28, 2019

Presented By:
Wade Oliver, P.G.
woliver@intera.com
Office: 281.560.4562
Mobile: 832.535.5763

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Objectives

- Joint Planning Overview
- Review Proposed Schedule
- Review Aquifer Uses and Conditions
- Next Steps

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Groundwater Acronyms and Definitions

GCD - Groundwater Conservation District: any district or authority created under Section 52, Article III, or Section 59, Article XVI, Texas Constitution, that has the authority to regulate the spacing of water wells, the production from water wells, or both. (TWC Ch. 36)

GMA - Groundwater Management Area: an area designated and delineated by the Texas Water Development Board under Chapter 35 as an area suitable for management of groundwater resources. (TWC Ch. 36)

DFC - Desired Future Condition: a quantitative description, adopted in accordance with Section 36.108, of the desired condition of the groundwater resources in a management area at one or more specified future times. (TWC Ch. 36)

MAG - Modeled Available Groundwater: the amount of water that the executive administrator [of TWDB] determines may be produced on an average annual basis to achieve a desired future condition established under Section 36.108. (TWC Ch. 36)

Aquifer: A rock unit that can yield economically usable quantities of water to a well.

Water Level (Head): The level to which water rises in a well. A measure of the pressure in an aquifer.

Drawdown: A water level change (usually drop) at a well or on a regional basis.

Recharge: The amount of water that infiltrates to the water table of an aquifer.

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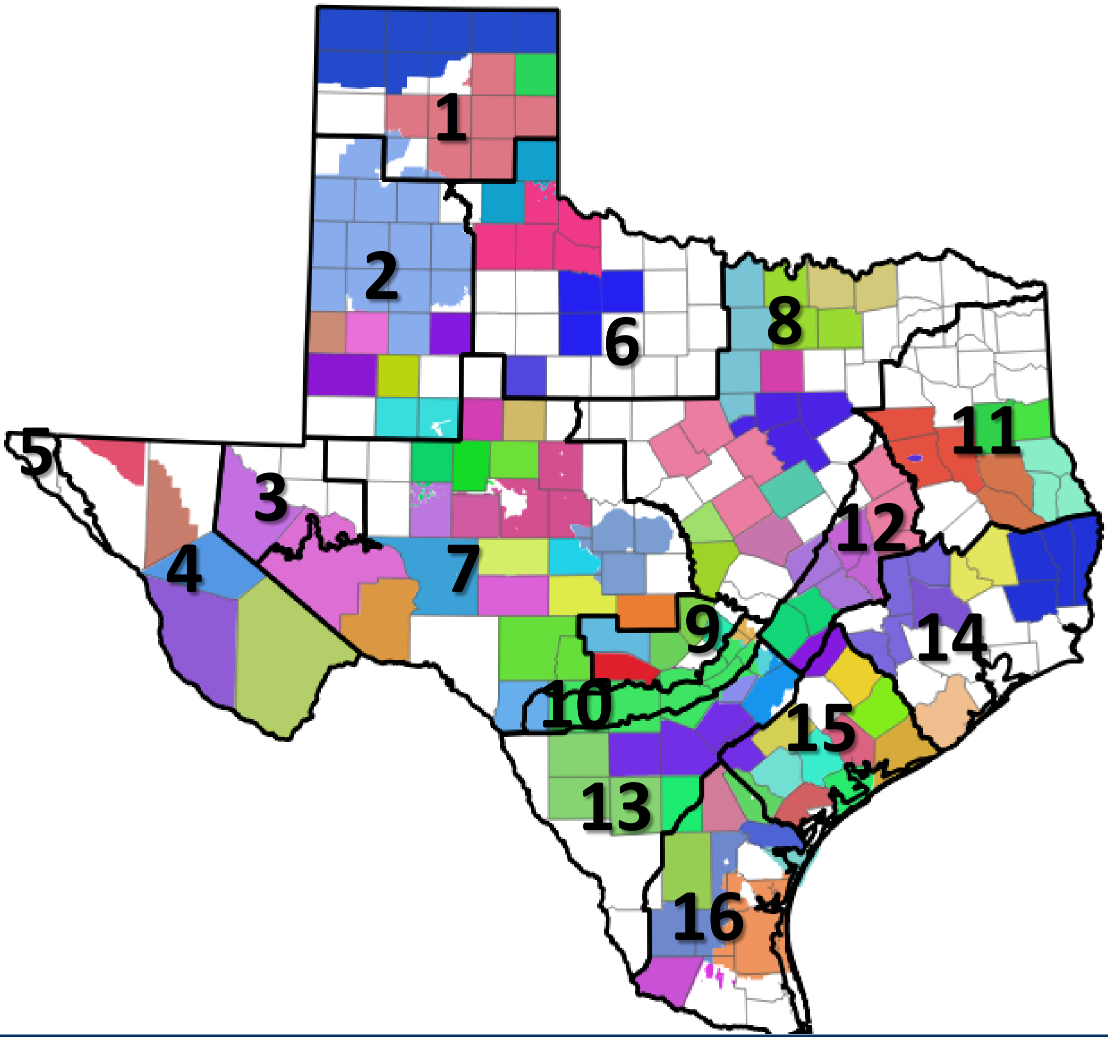
GMAs and GCDs in Texas



Balancing Test

DFCs must provide "*a balance between the highest practicable level of groundwater production and the conservation, preservation, protection, recharging, and prevention of waste of groundwater and control of subsidence in the management area*"

Consideration of Factors

- Aquifer uses or conditions
- Water supply needs and management strategies
- Hydrological conditions
- Other environmental impacts
- Impact on subsidence
- Socioeconomic impacts
- Impact on private property rights
- Feasibility of achieving the DFC
- Any other relevant information

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Balancing Test

Conservation, Preservation, Prevention of Subsidence, etc.

Aquifer uses or conditions

Environmental Impacts

Water supply needs and management strategies

Socioeconomic Impacts

Subsidence Impacts

Feasibility of achievement

Hydrological Conditions

Private Property Rights

Highest Practicable Level of Groundwater Production

Aquifer uses or conditions

Water supply needs and management strategies

Socioeconomic Impacts

Feasibility of achievement

Private Property Rights

Hydrological Conditions

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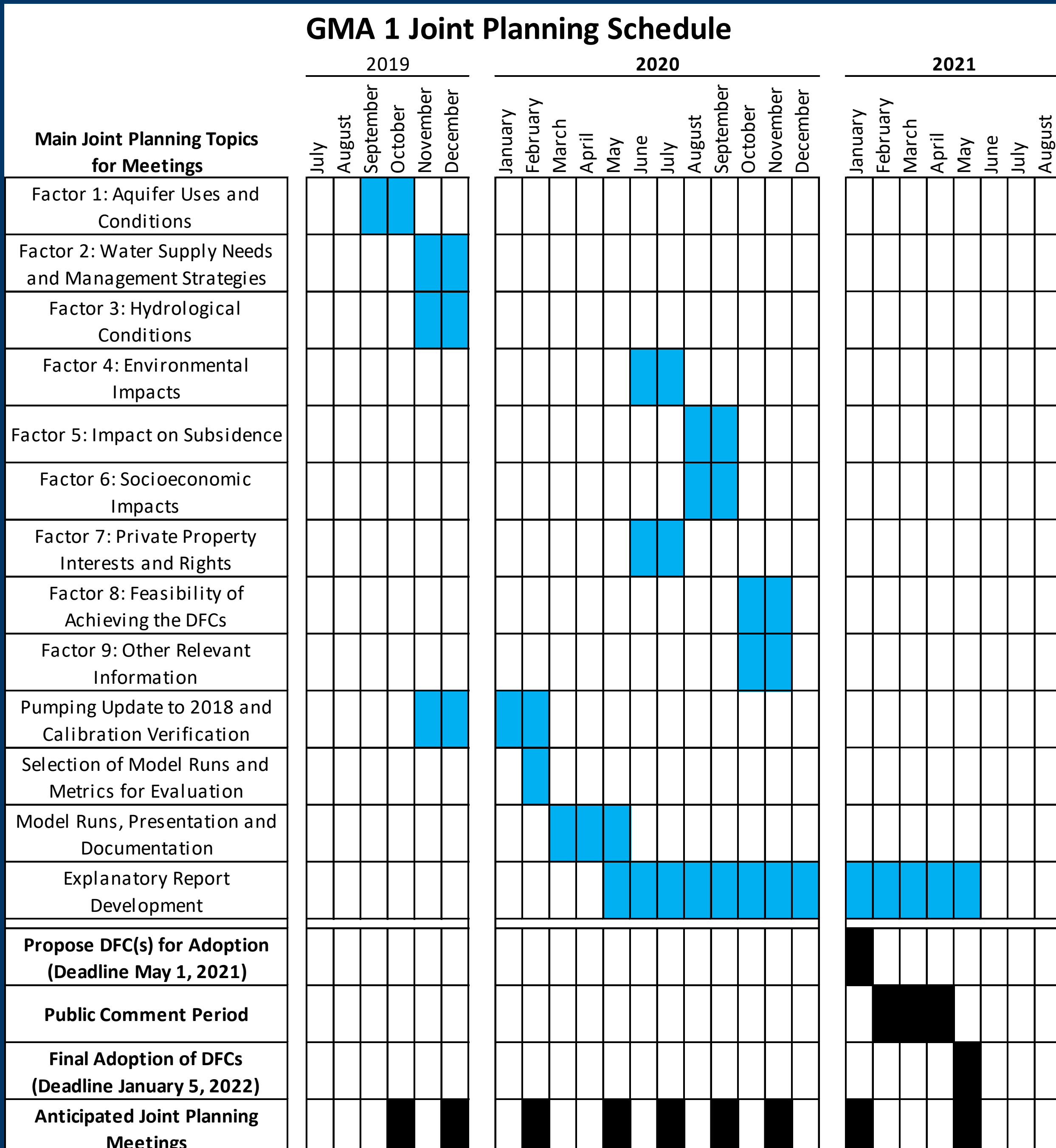
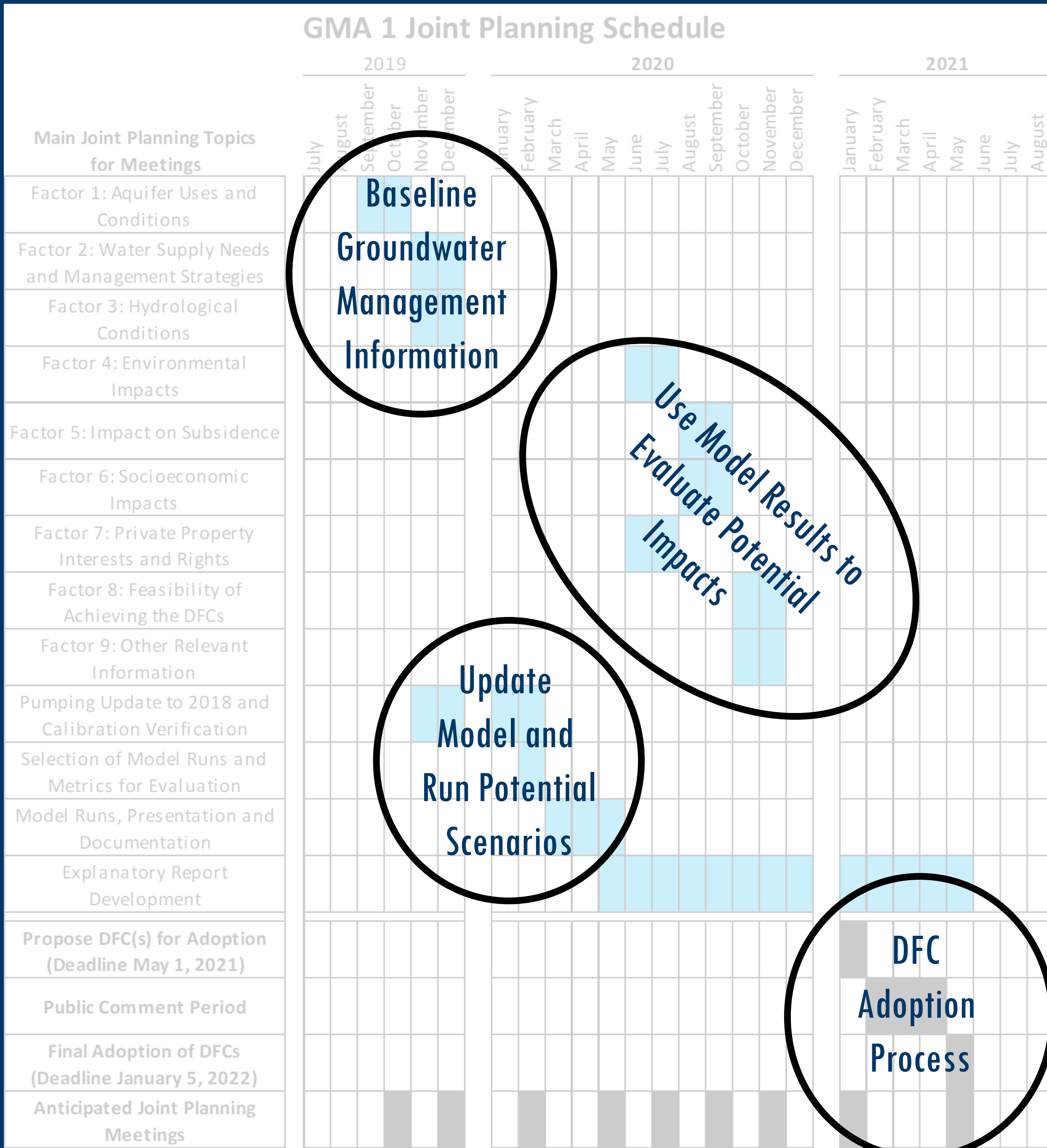
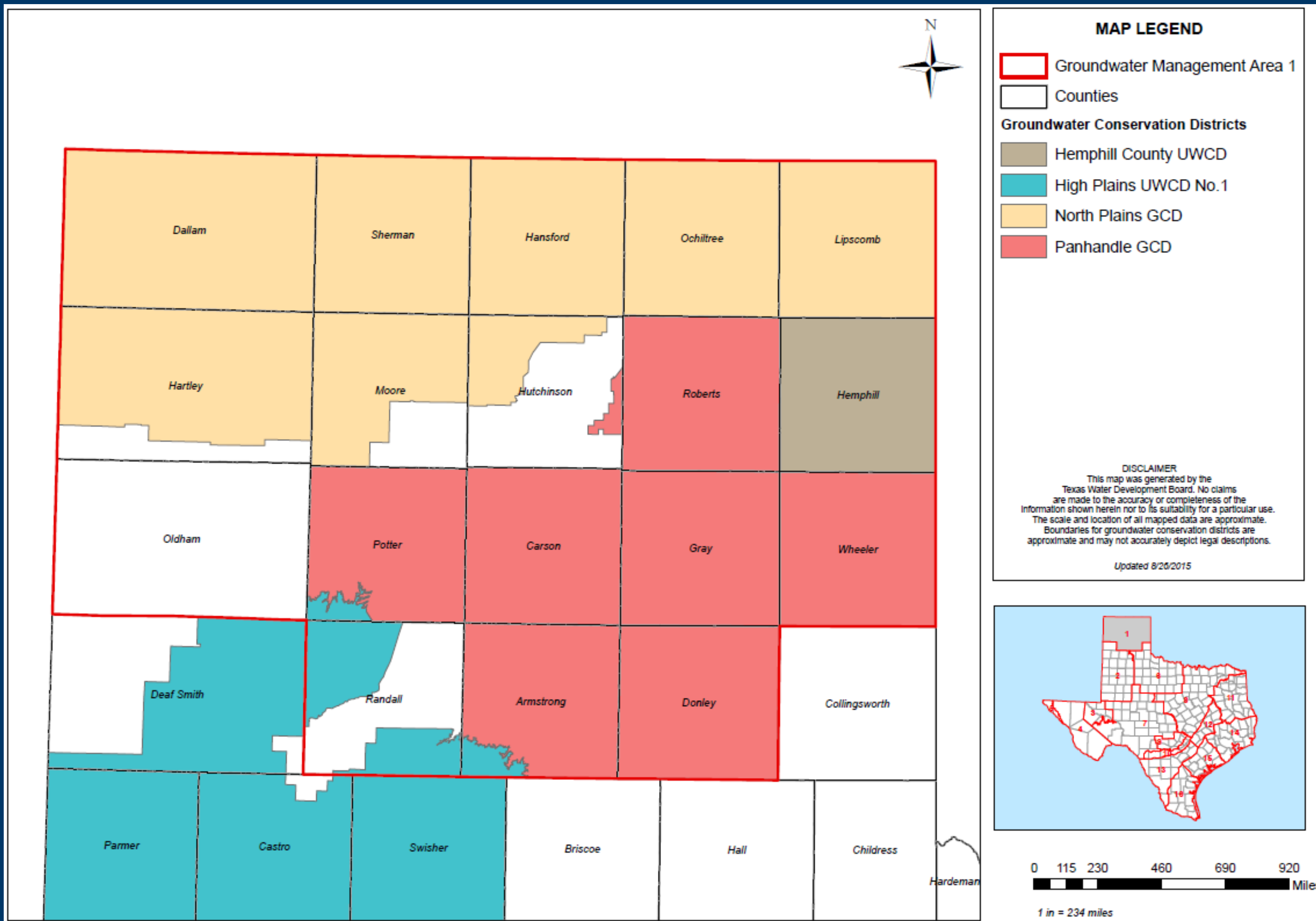
Current Schedule



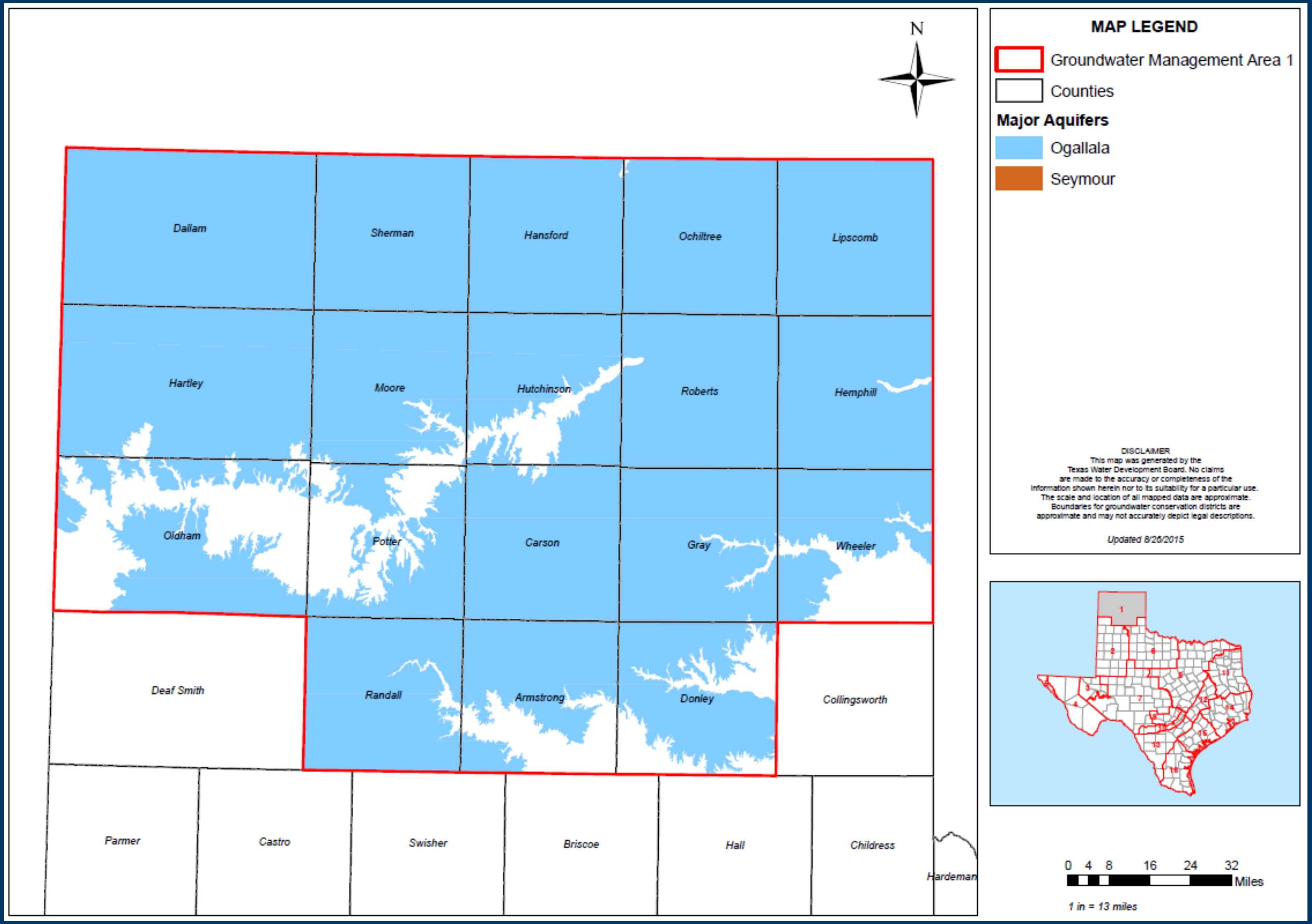
Current Schedule



GCDs in GMA 1


N
MAP LEGEND
Groundwater Management Area 1
Counties
Groundwater Conservation Districts
Hemphill County UWCD
High Plains UWCD No.1
North Plains GCD
Panhandle GCD
DISCLAIMER
This map was generated by the Texas Water Development Board. No claims are made to the accuracy or completeness of the information shown herein nor to its suitability for a particular use. The scale and location of all mapped data are approximate. Boundaries for groundwater conservation districts are approximate and may not accurately depict legal descriptions.
Updated 8/26/2015
Dallam
Sherman
Hansford
Ochiltree
Lipscomb
Hartley
Moore
Hutchinson
Roberts
Hemphill
Oldham
Potter
Carson
Gray
Wheeler
Deaf Smith
Randall
Armstrong
Donley
Collingsworth
Parmer
Castro
Swisher
Briscoe
Hall
Childress
Hardeman
0 115 230 460 690 920 Miles
1 in = 234 miles

Major Aquifers



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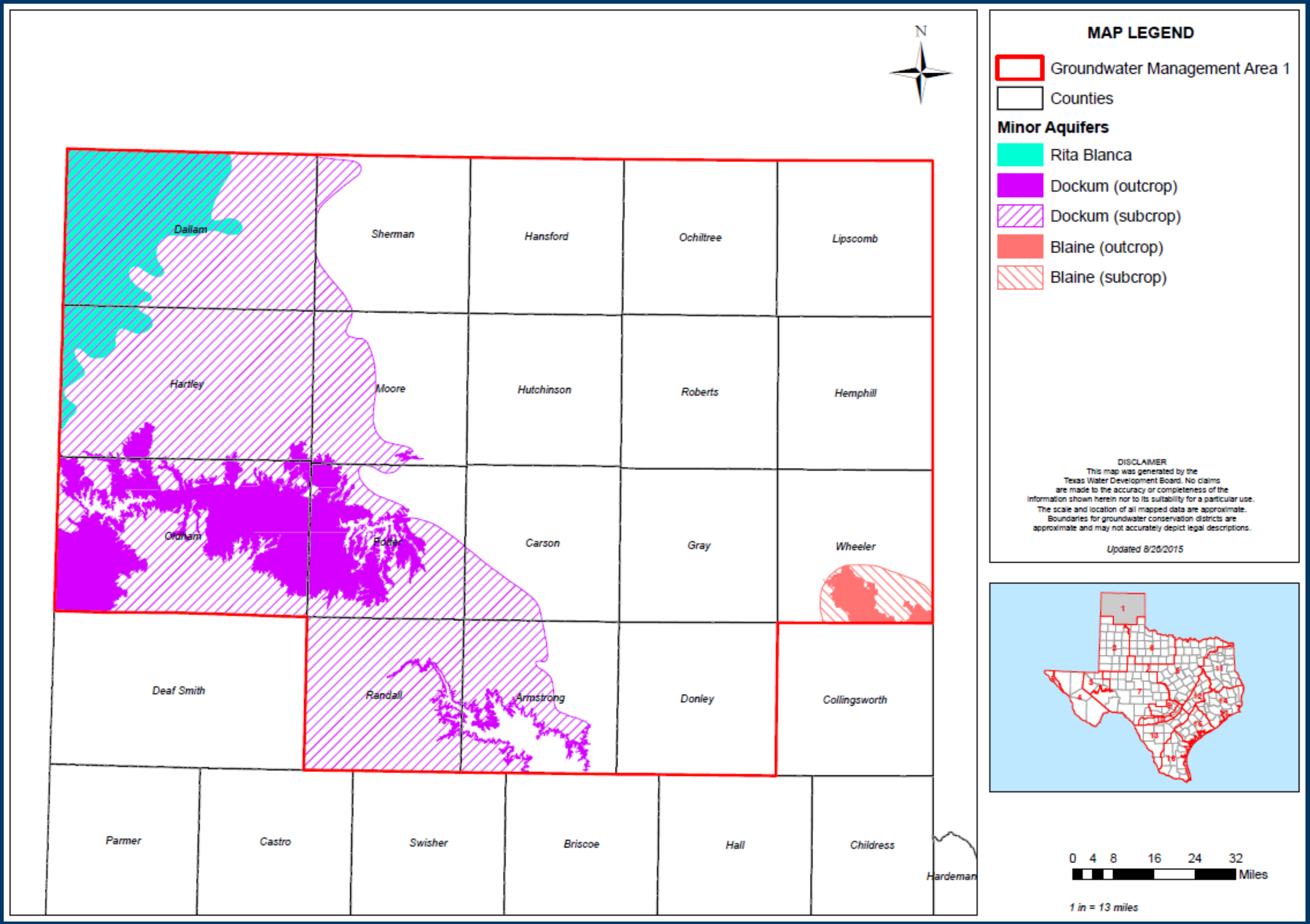
Minor Aquifers



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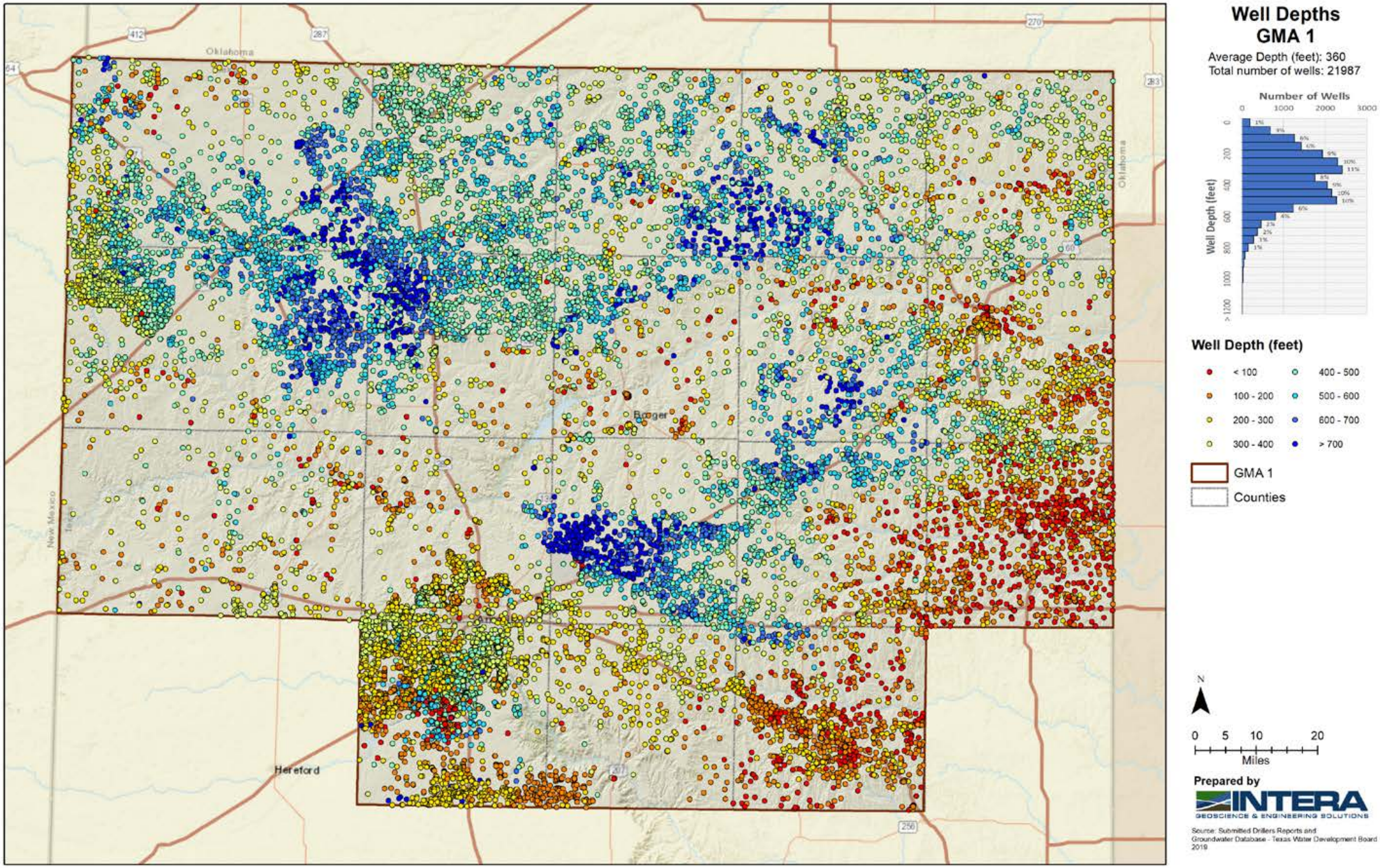
Well Depths


Well Depths
GMA 1
Average Depth (feet): 360
Total number of wells: 21987
Number of Wells
Well Depth (feet)
Well Depth (feet)
< 100
100 - 200
200 - 300
300 - 400
400 - 500
500 - 600
600 - 700
> 700
GMA 1
Counties
N
0 5 10 20
Miles
Prepared by
INTERA
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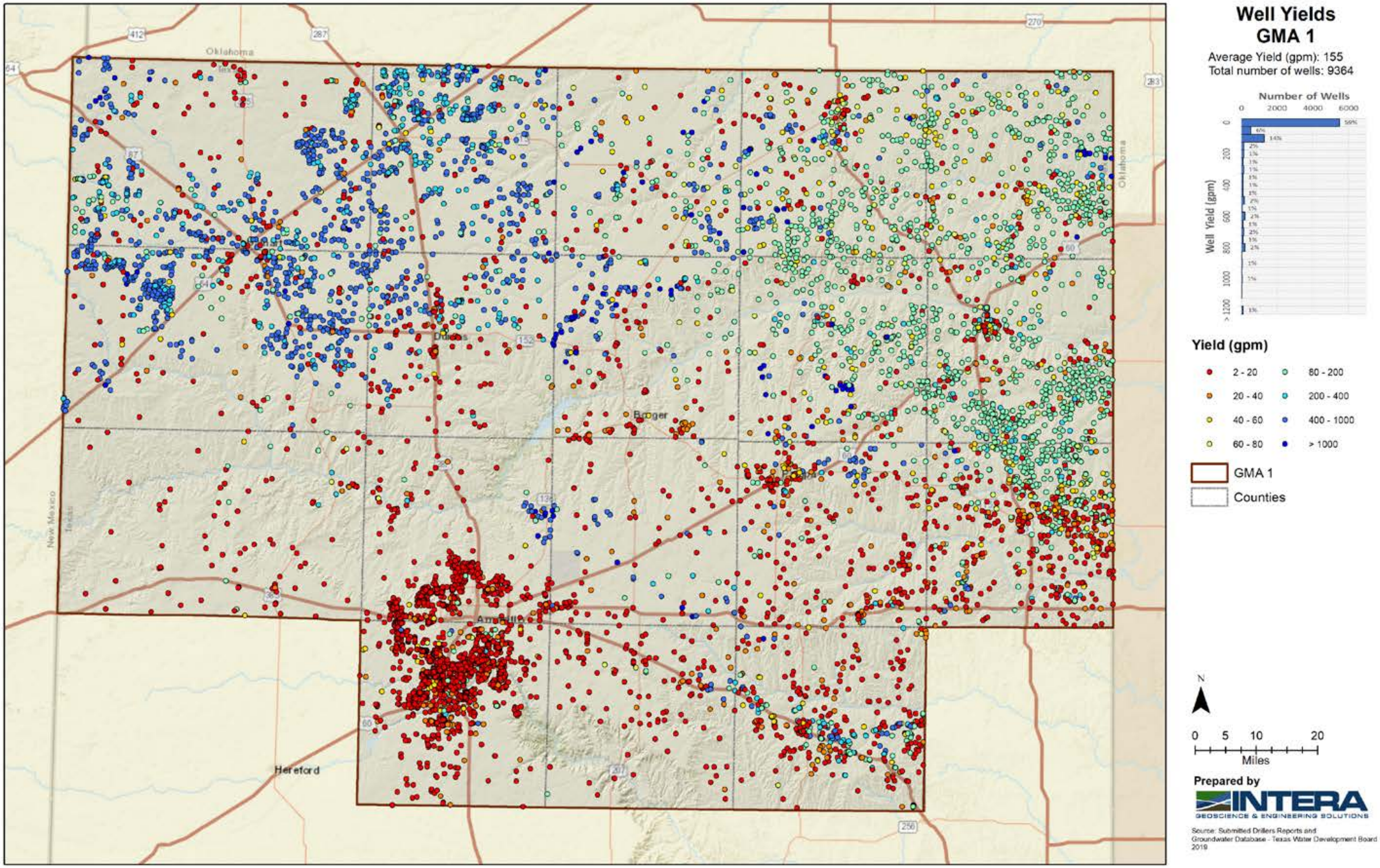
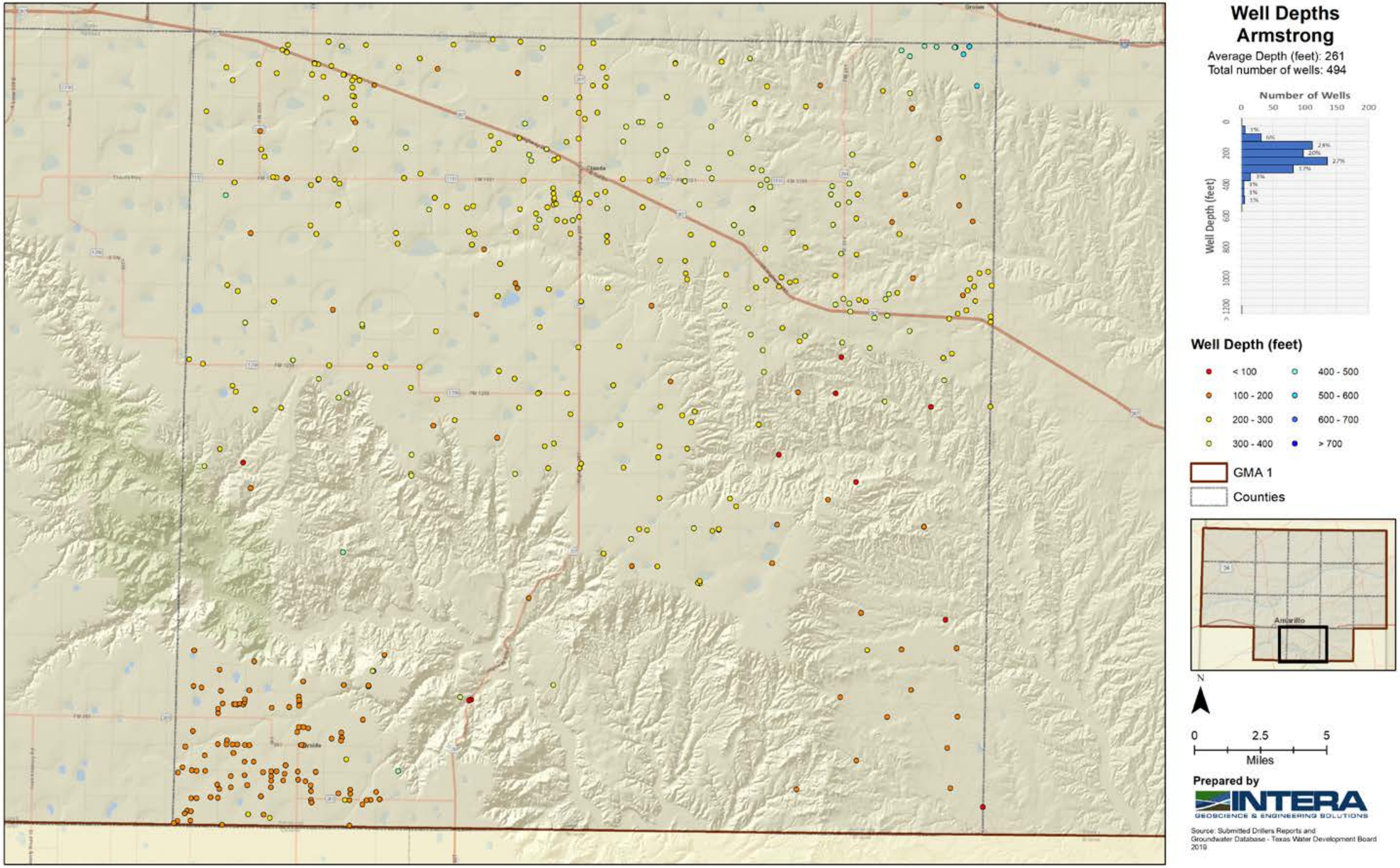
Source: Submitted Drillers Reports and Groundwater Database - Texas Water Development Board 2019
Oklahoma
New Mexico
Texas
Borger
Hereford

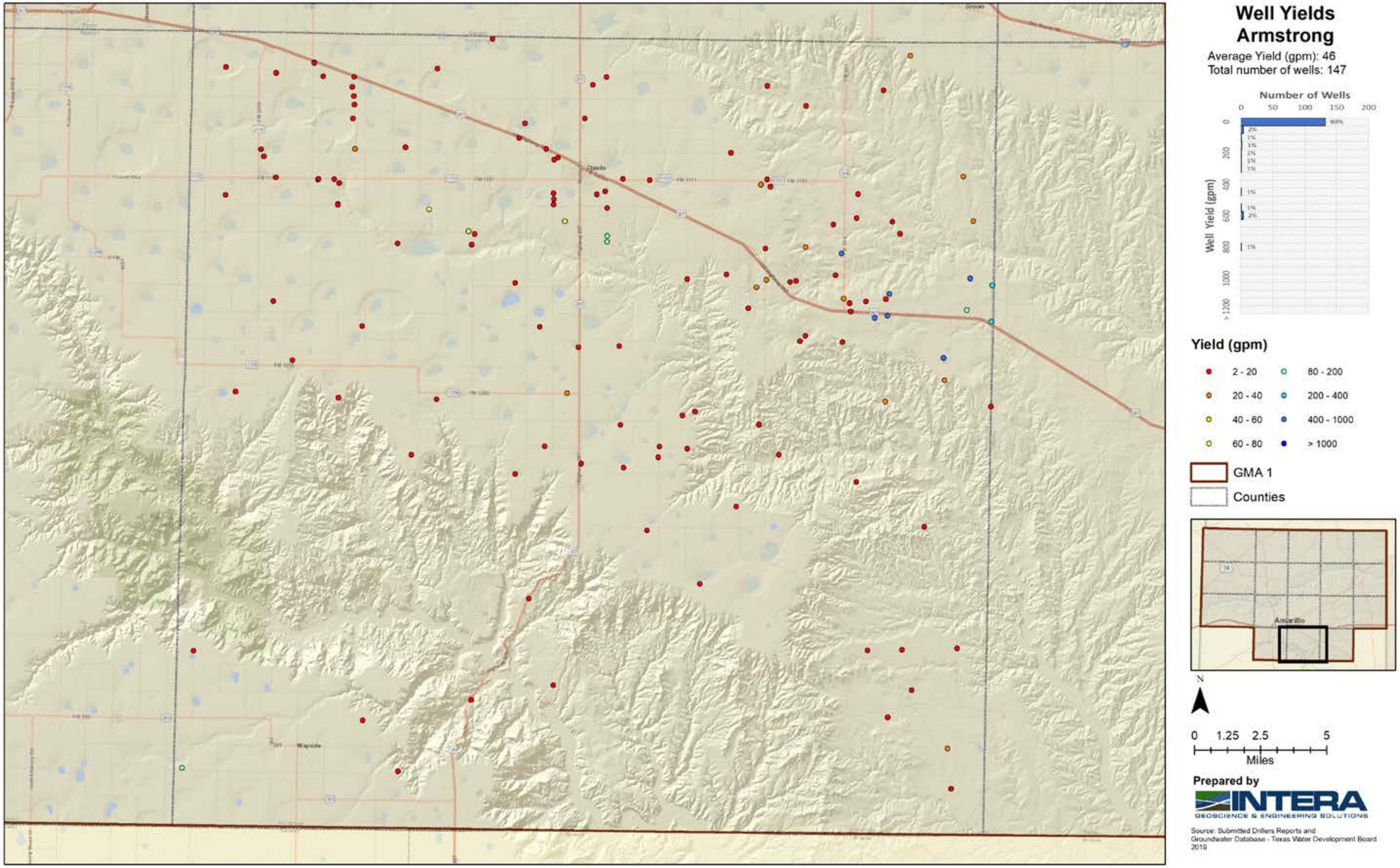
Well Yields


Well Yields
GMA 1
Average Yield (gpm): 155
Total number of wells: 9364
Number of Wells
Well Yield (gpm)
Yield (gpm)
2 - 20
20 - 40
40 - 60
60 - 80
80 - 200
200 - 400
400 - 1000
> 1000
GMA 1
Counties
0 5 10 20
Miles
Prepared by
INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS
Source: Submitted Drillers Reports and Groundwater Database - Texas Water Development Board 2019
Oklahoma
New Mexico
Texas
Borger
Hereford

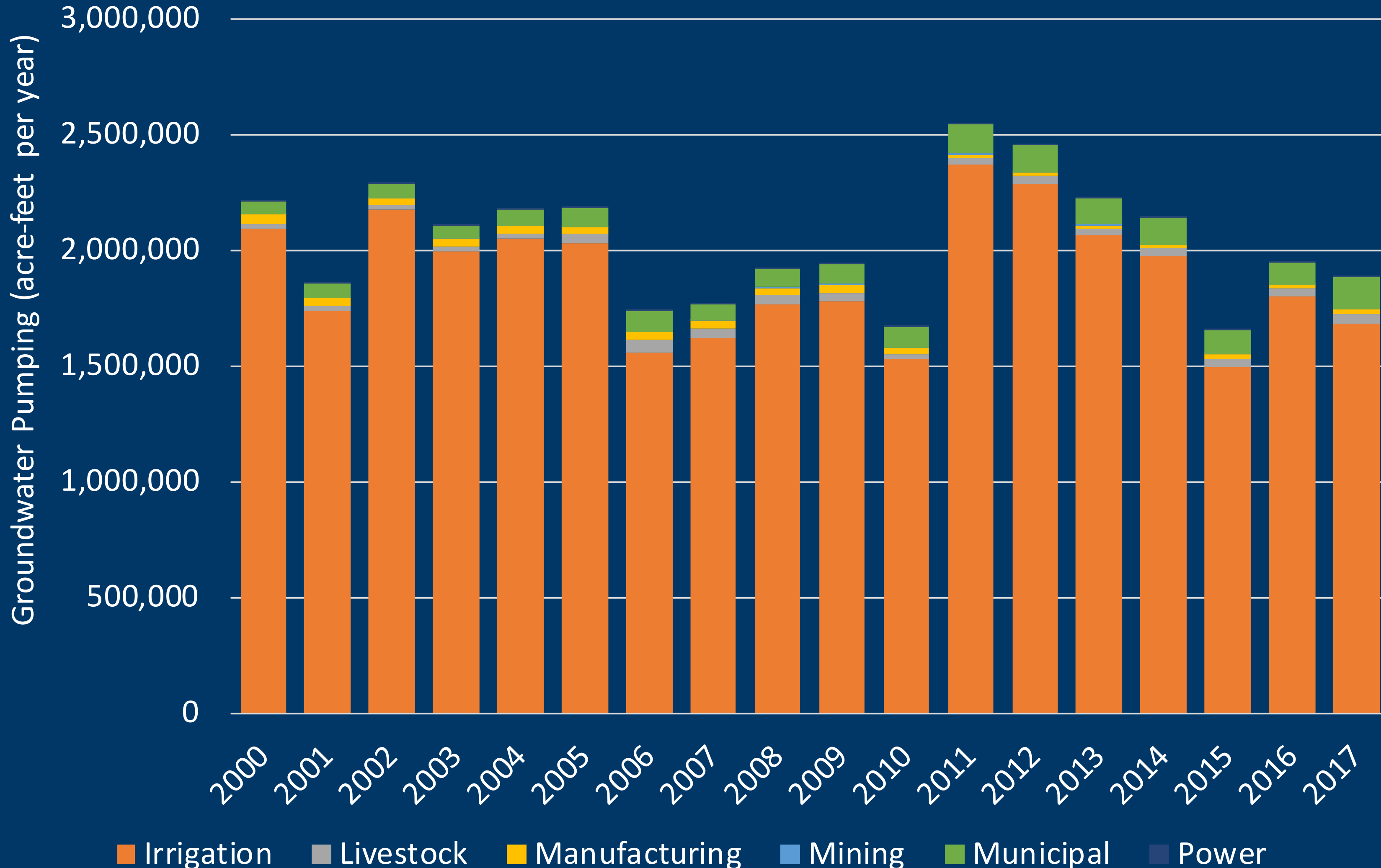
Information Available for Each County



Information Available for Each County



GMA 1 Groundwater Pumping by Use Type



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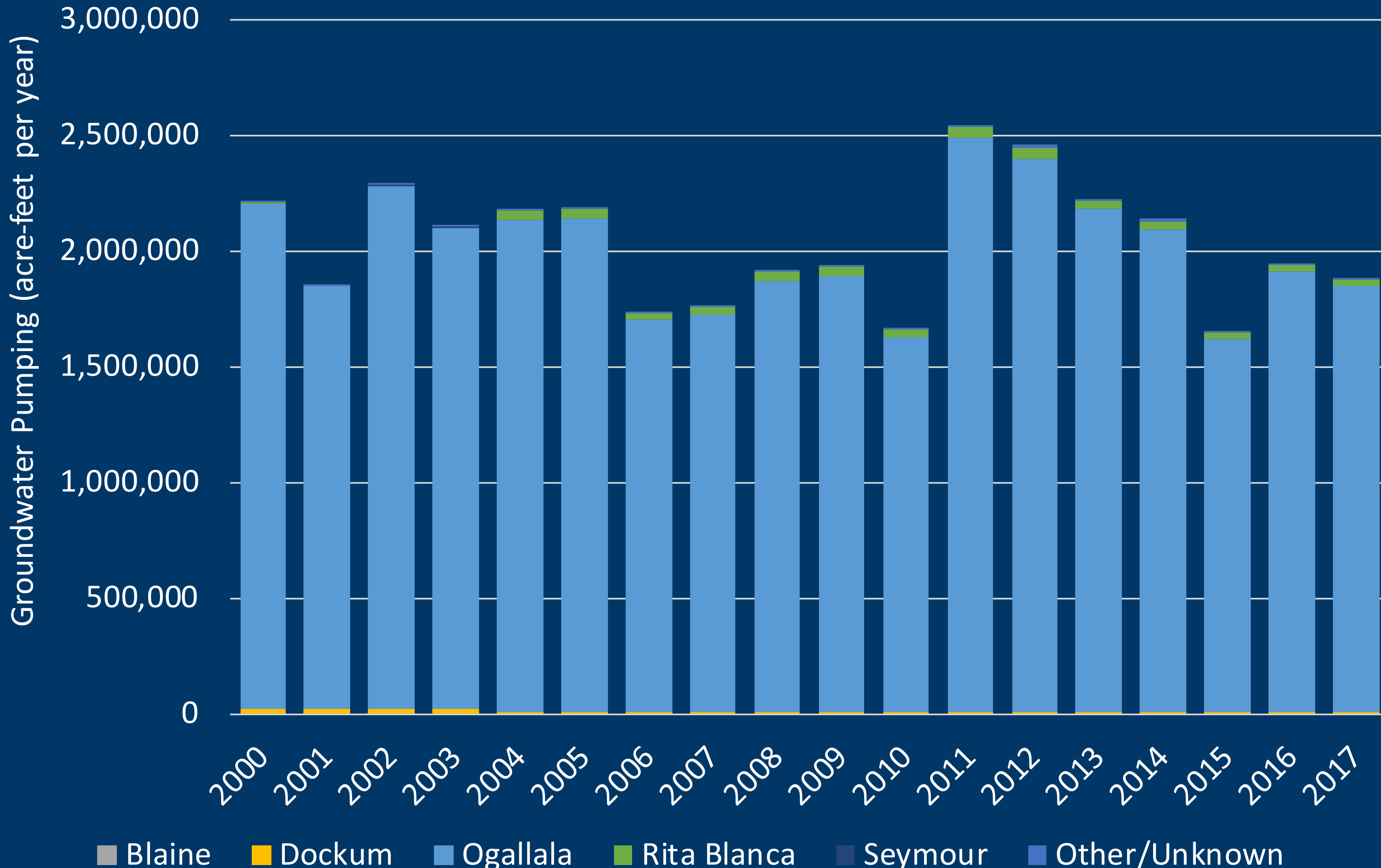
Annual Pumping by Aquifer



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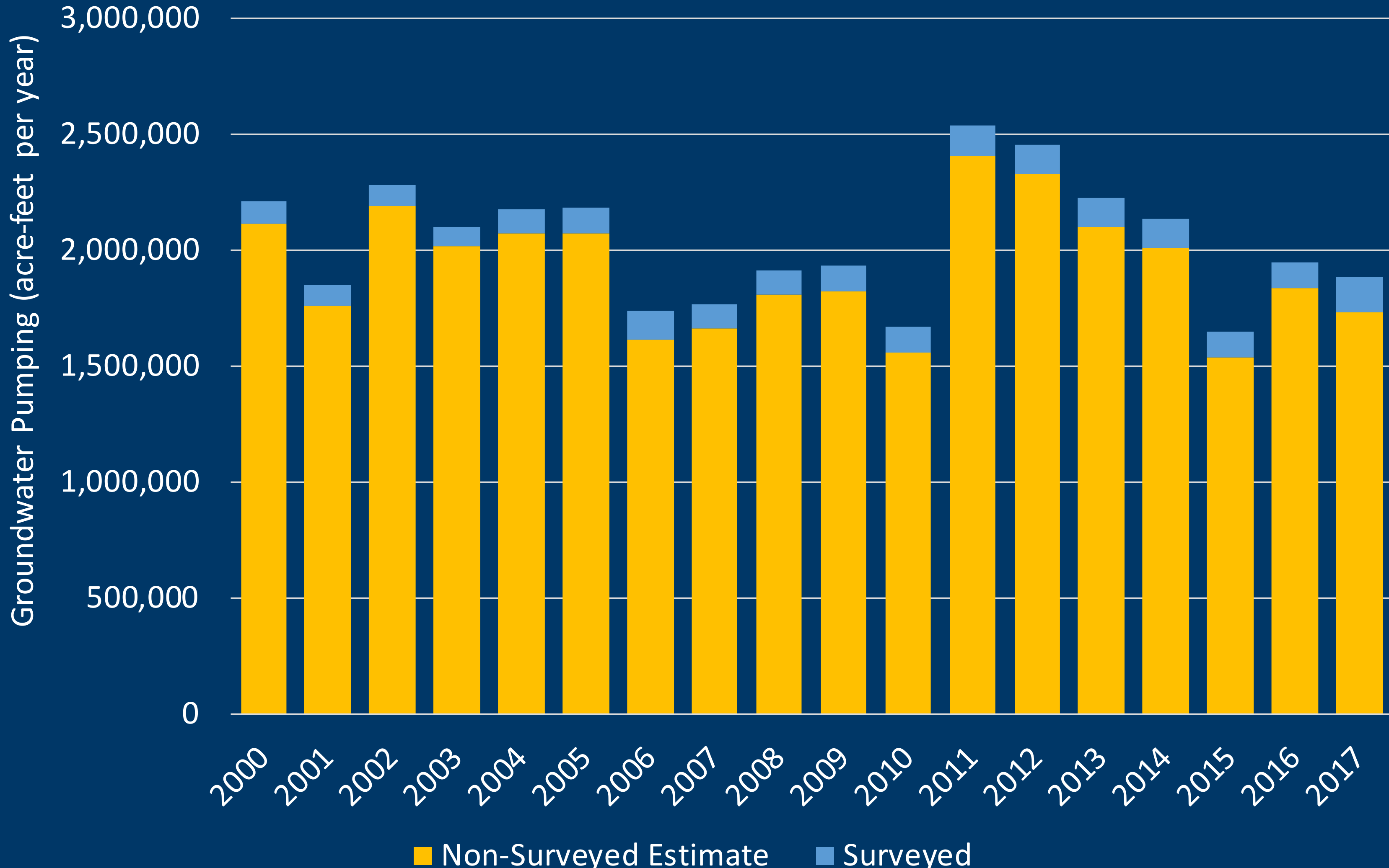
Water Use Survey Data Sources



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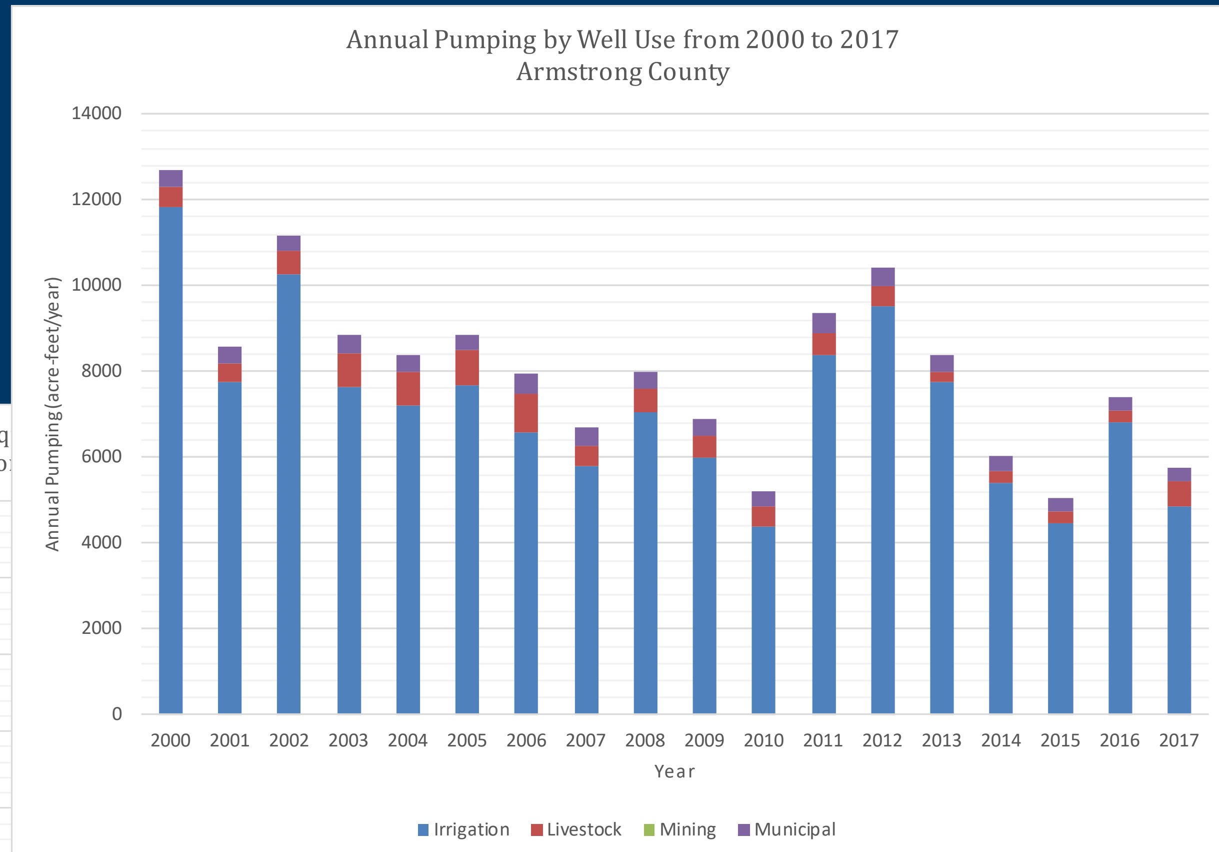
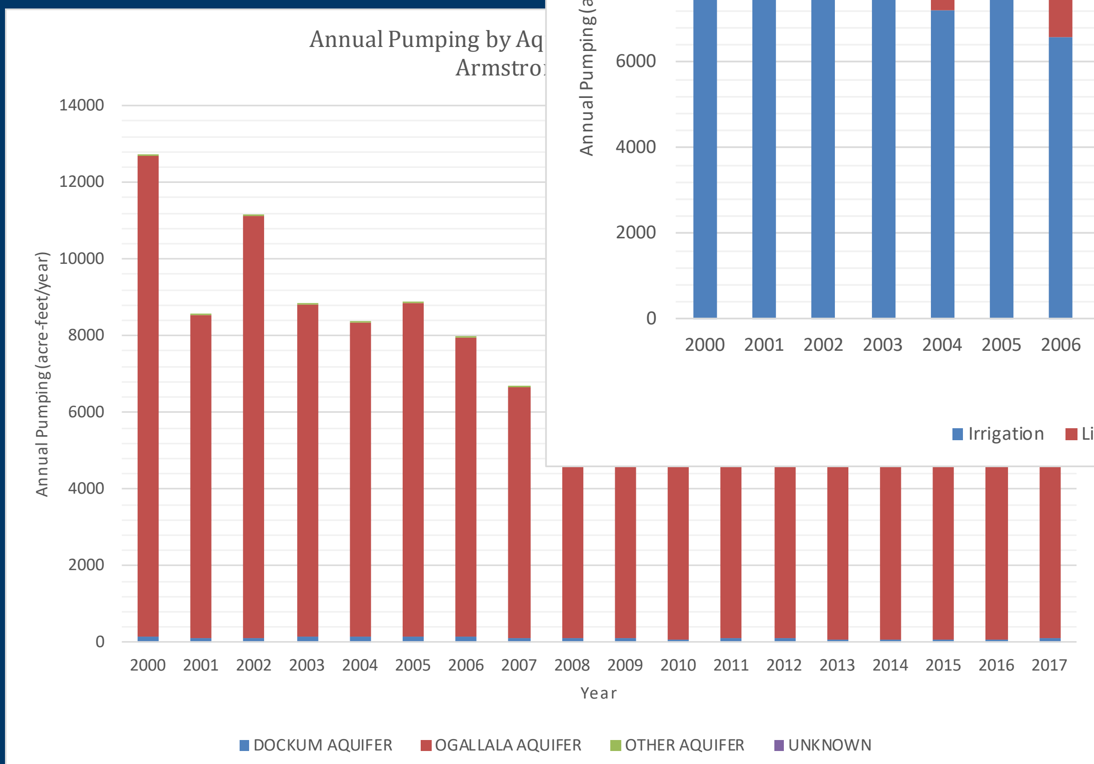
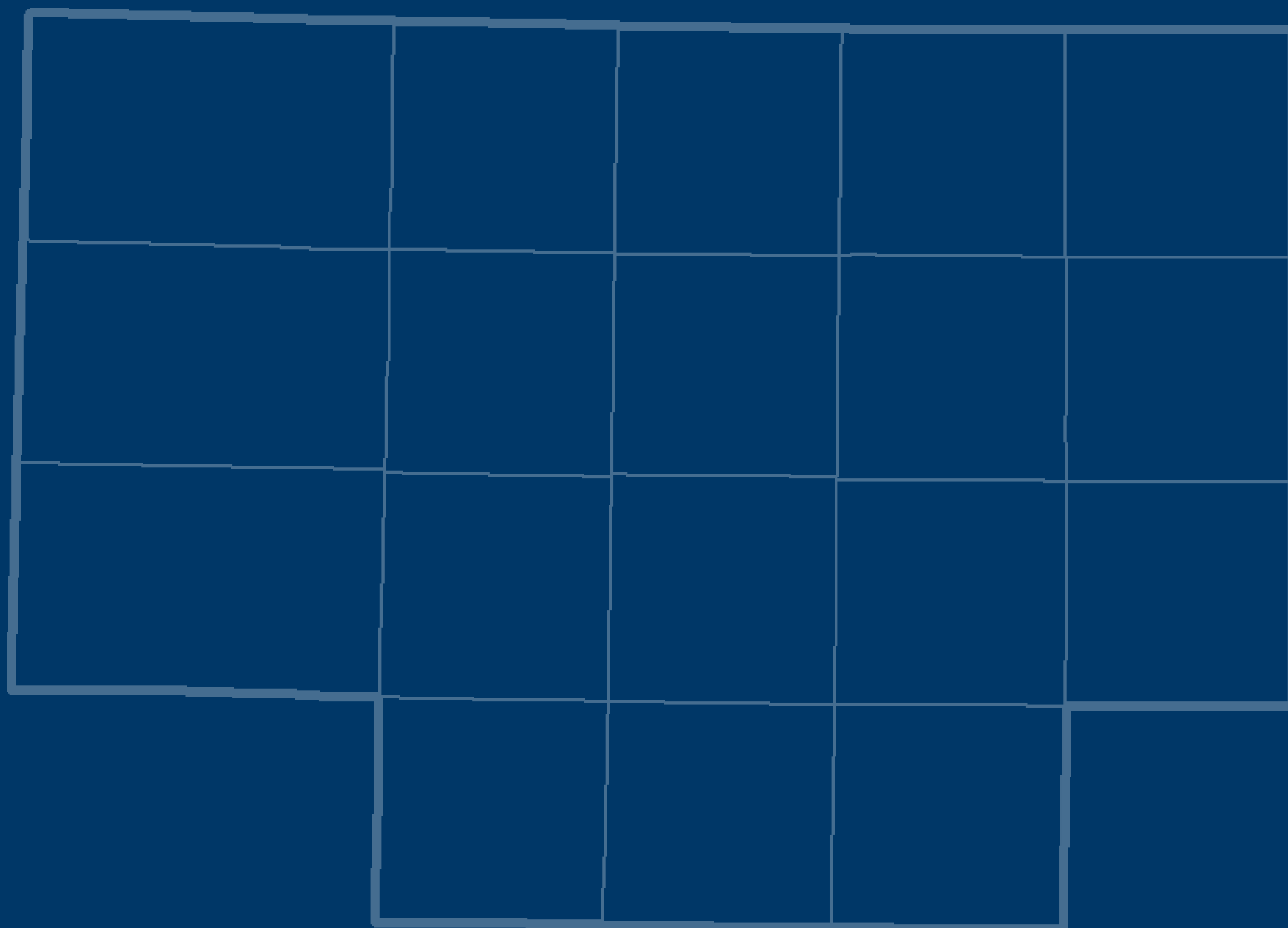
Also Available by County





Next Steps

- Post and Review County-by-County Data (Factor 1)
- Water Supply Needs and Water Management Strategies in the State Water Plan
- Hydrological Conditions
- Begin Update of Calibration Period Pumping



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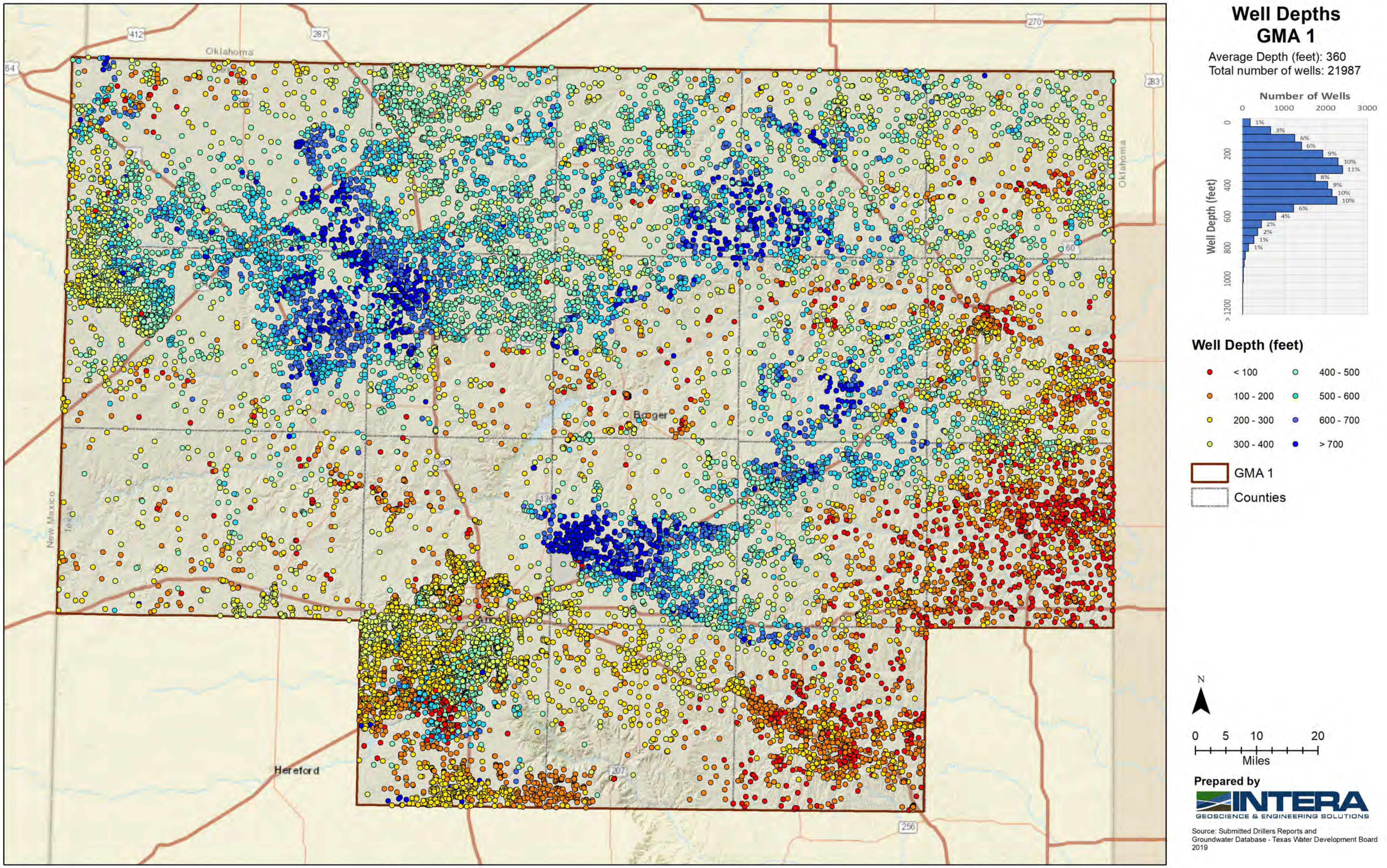
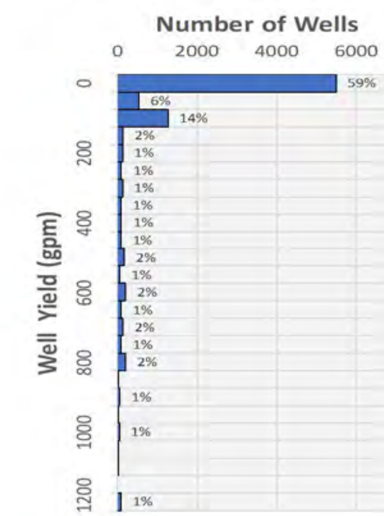
Appendix A: County Well Depths and Yields

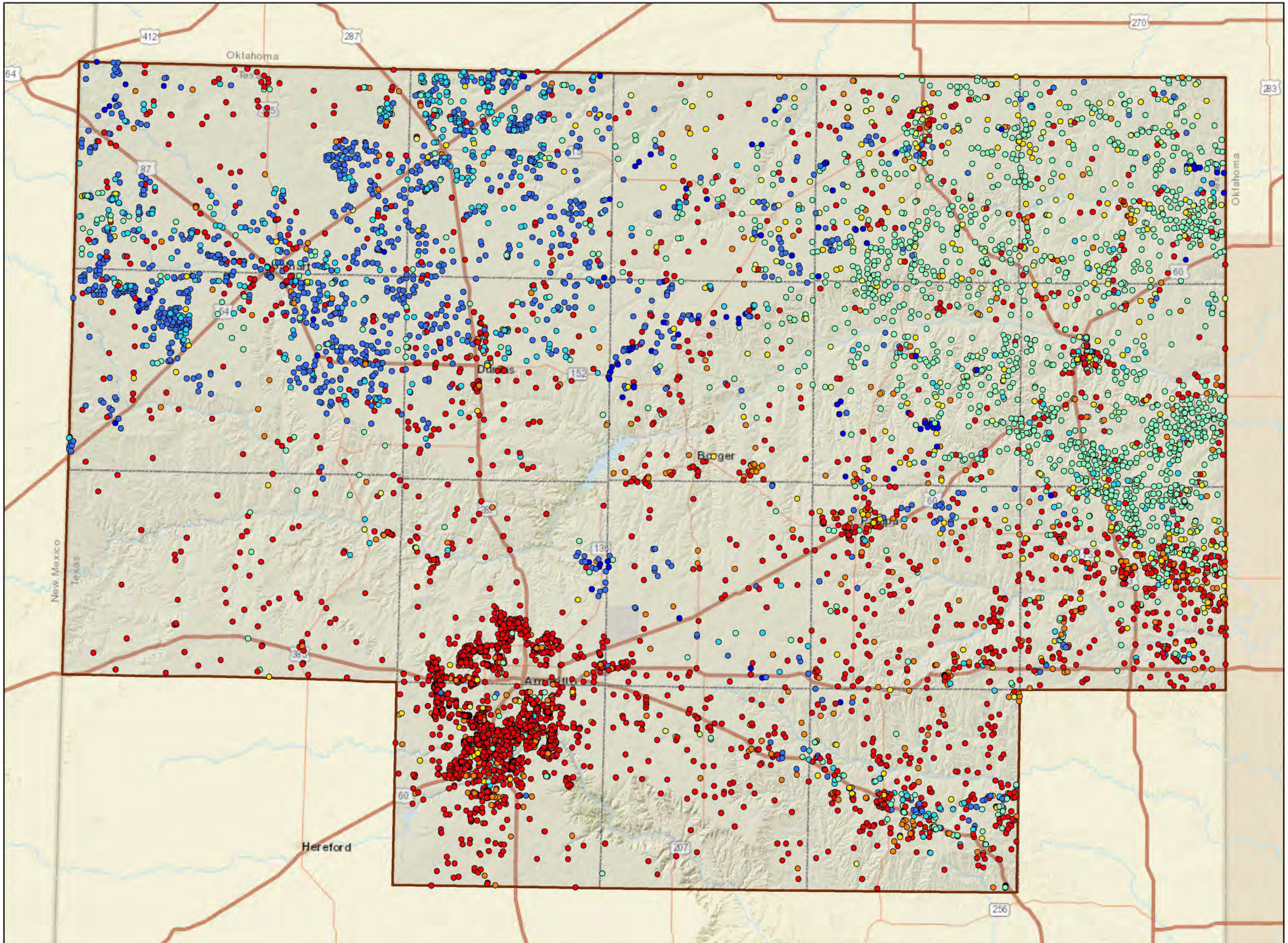
See Separate Files


Well Depths
GMA 1
Average Depth (feet): 360
Total number of wells: 21987
Number of Wells
0
1000
2000
3000
Well Depth (feet)
0
200
400
600
800
1000
> 1200
1%
3%
6%
6%
9%
10%
11%
8%
9%
10%
10%
6%
4%
2%
2%
1%
1%
Well Depth (feet)
< 100
100 - 200
200 - 300
300 - 400
400 - 500
500 - 600
600 - 700
> 700
GMA 1
Counties
N
0
5
10
20
Miles
Prepared by
INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS
Source: Submitted Drillers Reports and Groundwater Database - Texas Water Development Board 2019
Oklahoma
New Mexico
Texas
Borger
Hereford
412
287
270
283
64
60
207
256

Well Yields
GMA 1

Average Yield (gpm): 155
Total number of wells: 9364





Yield (gpm)

- 2 - 20
- 20 - 40
- 40 - 60
- 60 - 80
- 80 - 200
- 200 - 400
- 400 - 1000
- > 1000

GMA 1

Counties

N

0 5 10 20

Miles

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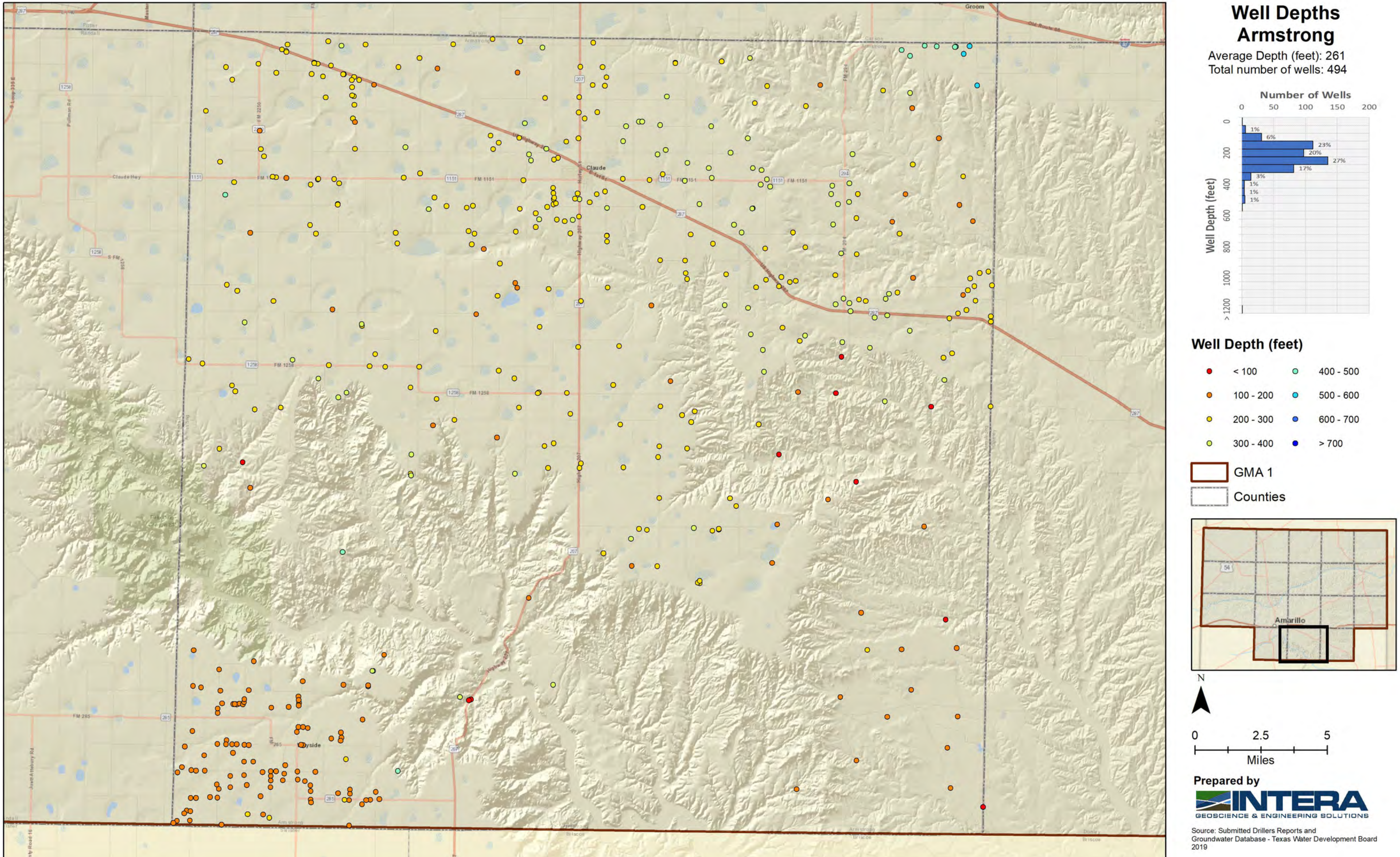
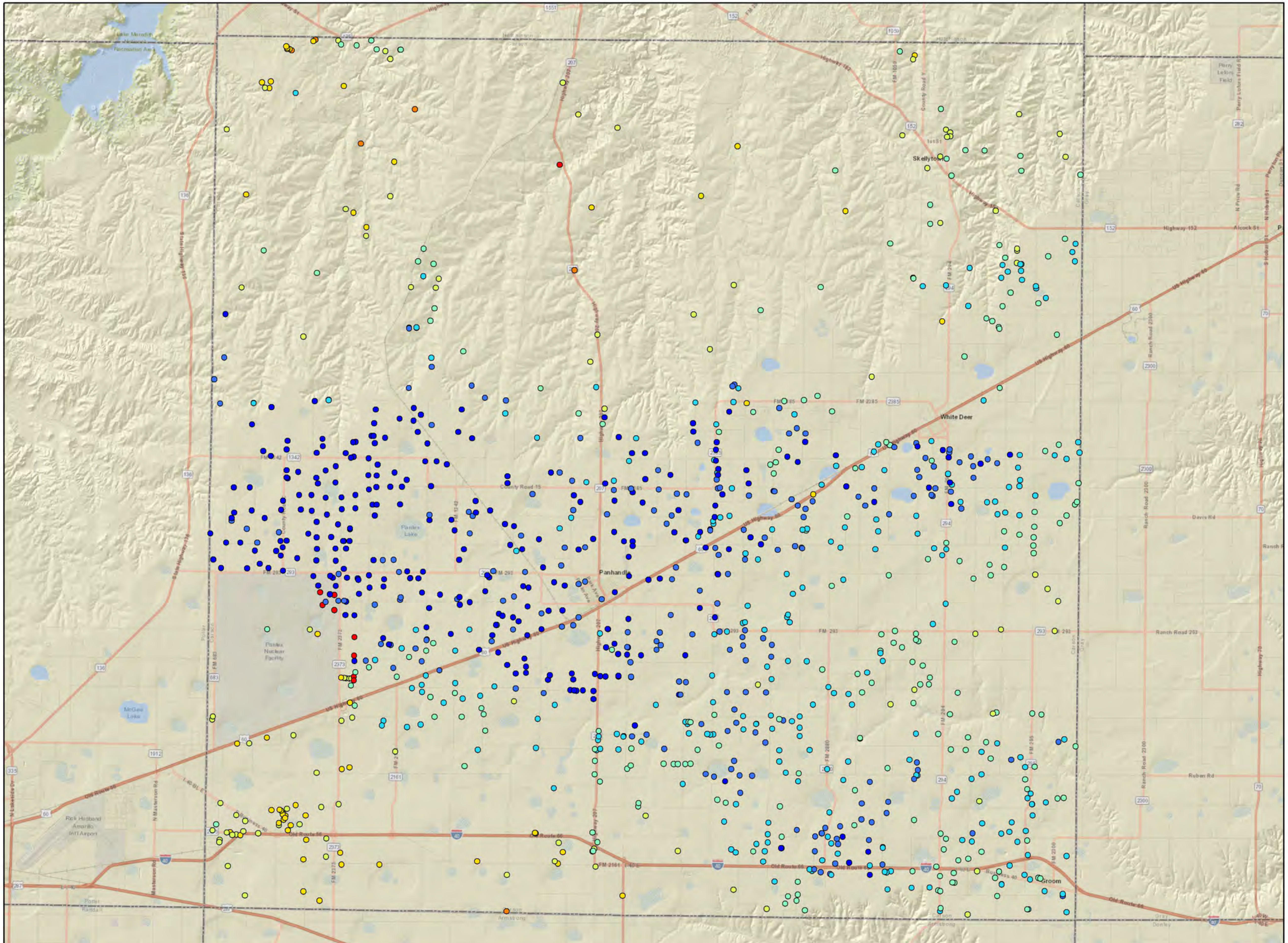
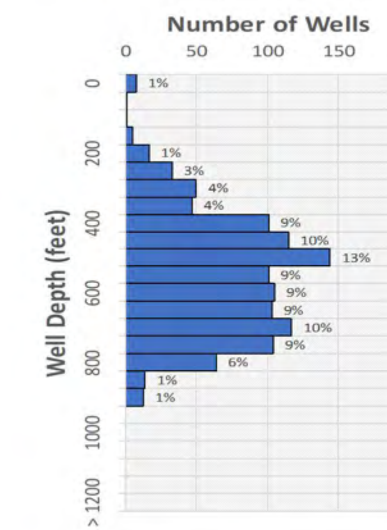
Source: Submitted Drillers Reports and Groundwater Database - Texas Water Development Board 2019


Well Depths
Armstrong
Average Depth (feet): 261
Total number of wells: 494
Number of Wells
0 50 100 150 200
Well Depth (feet)
0 200 400 600 800 1000 > 1200
1%
6%
23%
20%
27%
17%
3%
1%
1%
1%
Well Depth (feet)
< 100
100 - 200
200 - 300
300 - 400
400 - 500
500 - 600
600 - 700
> 700
GMA 1
Counties
Amarillo
N
0 2.5 5
Miles
Prepared by
INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS
Source: Submitted Drillers Reports and
Groundwater Database - Texas Water Development Board
2019
Claude
Wayside
Groom



Well Depths
Carson

Average Depth (feet): 572
Total number of wells: 1143



Well Depth (feet)

- < 100
- 100 - 200
- 200 - 300
- 300 - 400
- 400 - 500
- 500 - 600
- 600 - 700
- > 700

GMA 1

Counties

N

0 2.5 5

Miles

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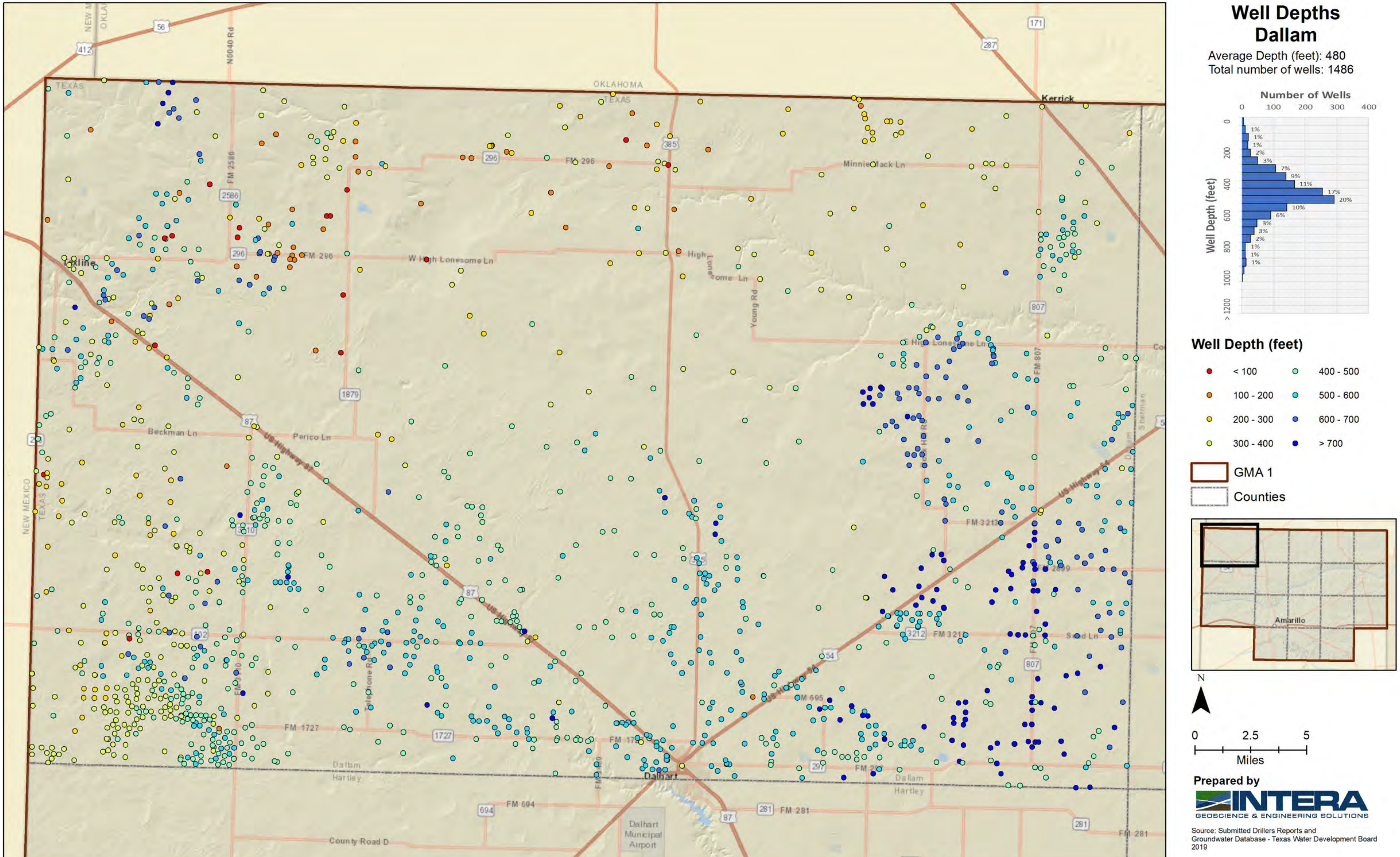
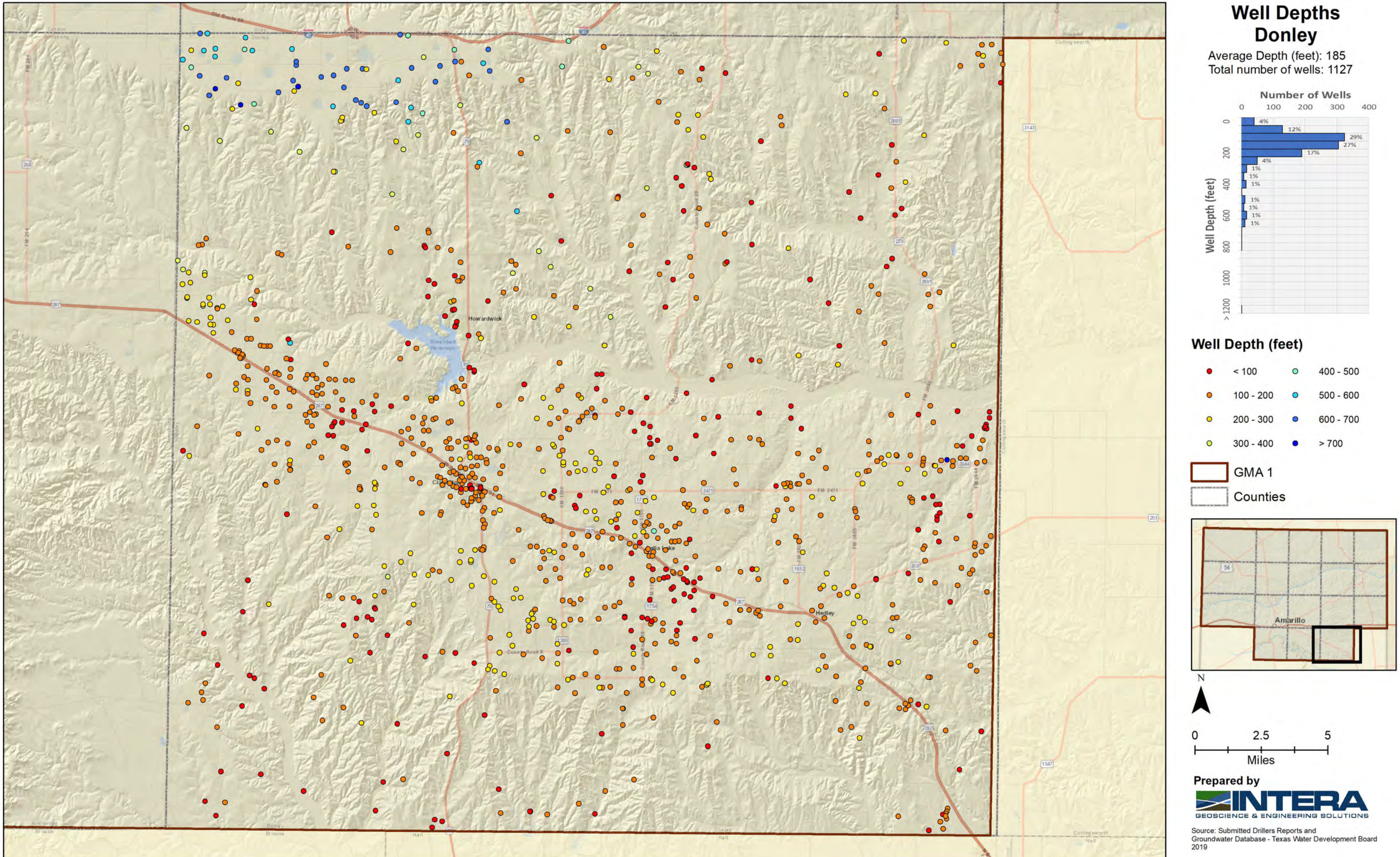
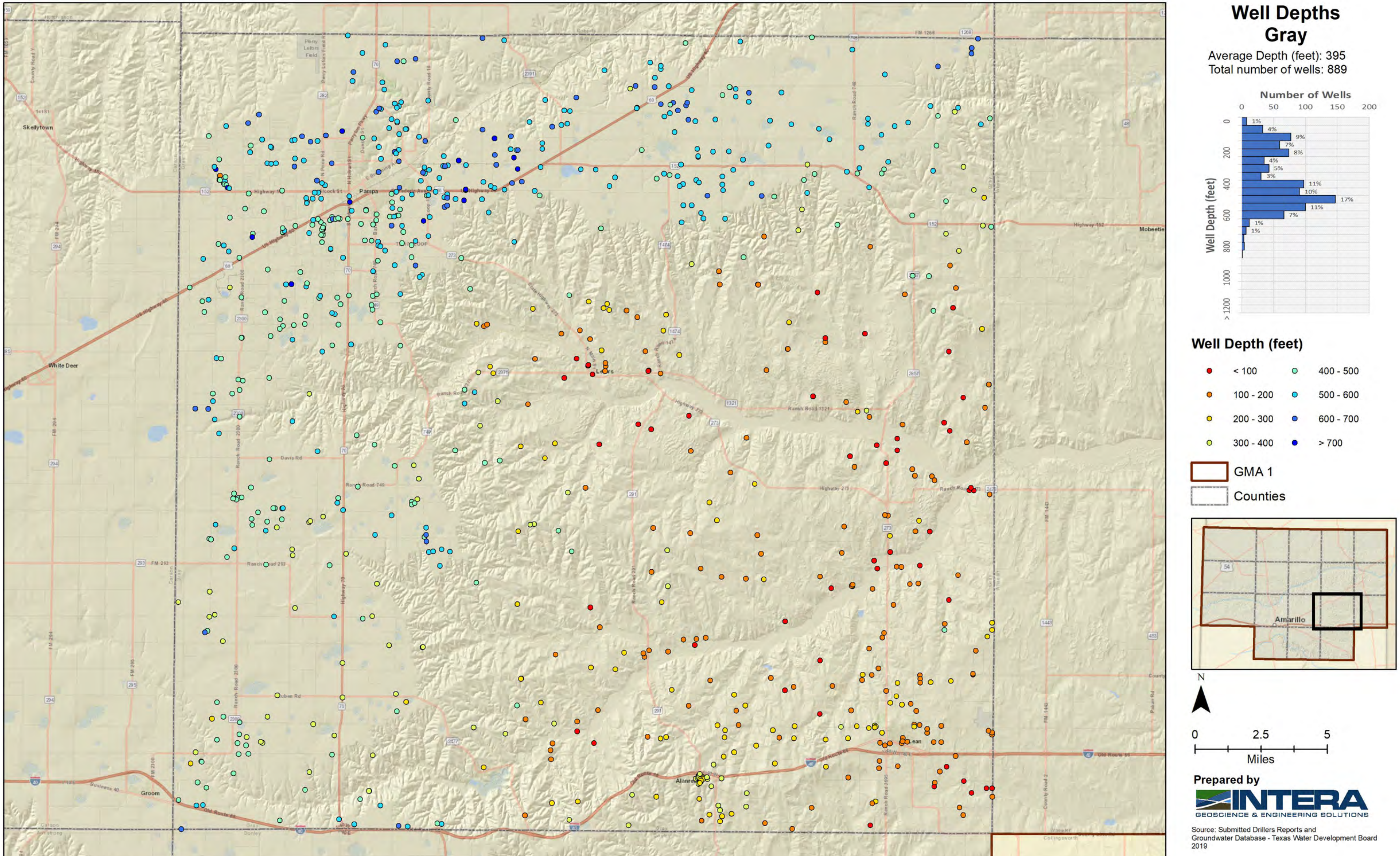
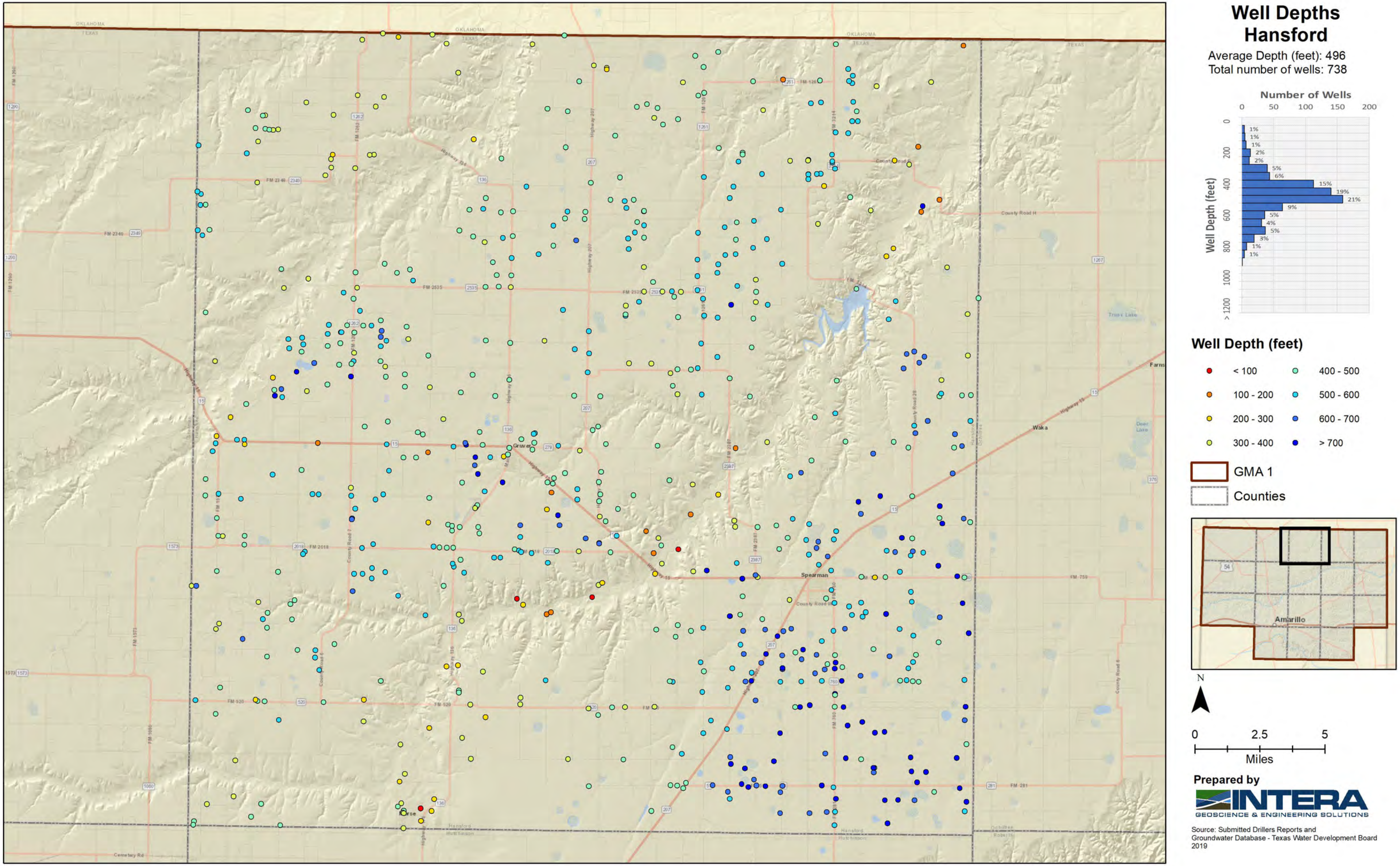
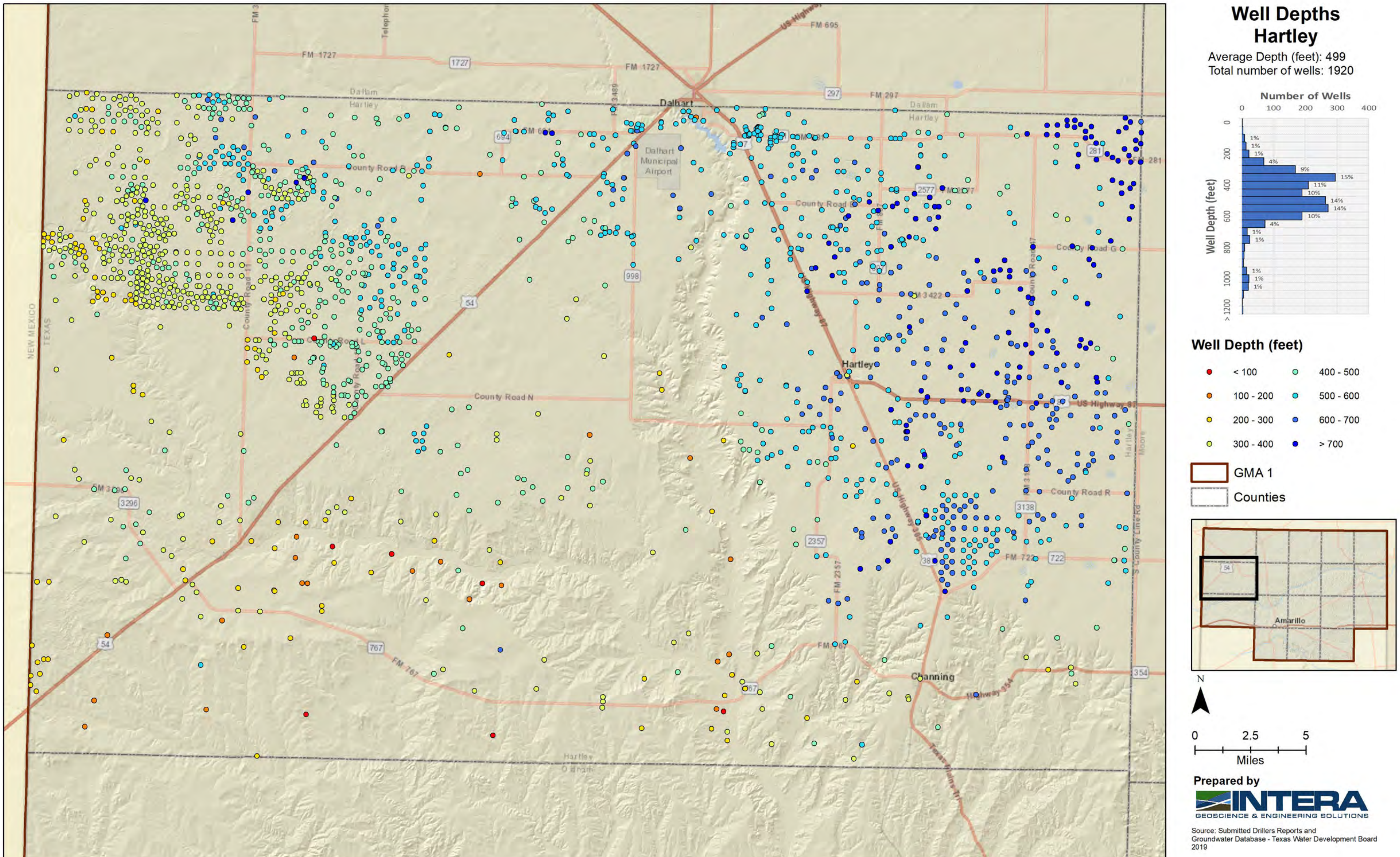


Well Depths
Dallam
Average Depth (feet): 480
Total number of wells: 1486
Number of Wells
Well Depth (feet)
Well Depth (feet)
< 100
100 - 200
200 - 300
300 - 400
400 - 500
500 - 600
600 - 700
> 700
GMA 1
Counties
Amarillo
N
0
2.5
5
Miles
Prepared by
INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS
Source: Submitted Drillers Reports and Groundwater Database - Texas Water Development Board 2019
Texline
Dalhart
Kerrick
OKLAHOMA
TEXAS
NEW MEXICO
US Highway 87
US Highway 54
Dalhart Municipal Airport


Well Depths
Donley
Average Depth (feet): 185
Total number of wells: 1127
Number of Wells
0 100 200 300 400
Well Depth (feet)
0
200
400
600
800
1000
> 1200
4%
12%
29%
27%
17%
4%
1%
1%
1%
1%
1%
1%
1%
Well Depth (feet)
< 100
100 - 200
200 - 300
300 - 400
400 - 500
500 - 600
600 - 700
> 700
GMA 1
Counties
Amarillo
N
0 2.5 5
Miles
Prepared by
INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS
Source: Submitted Drillers Reports and Groundwater Database - Texas Water Development Board 2019
Howardwick
Hedley

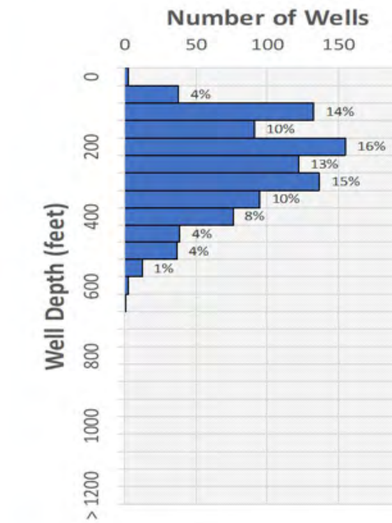

Well Depths
Gray
Average Depth (feet): 395
Total number of wells: 889
Number of Wells
0 50 100 150 200
Well Depth (feet)
1%
4%
9%
7%
8%
4%
5%
3%
11%
10%
17%
11%
7%
1%
1%
Well Depth (feet)
< 100
100 - 200
200 - 300
300 - 400
400 - 500
500 - 600
600 - 700
> 700
GMA 1
Counties
Amarillo
N
0 2.5 5
Miles
Prepared by
INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS
Source: Submitted Drillers Reports and Groundwater Database - Texas Water Development Board 2019
Skellytown
Pampa
White Deer
Lefors
Mobeetie
Groom
Alanreed
McLean

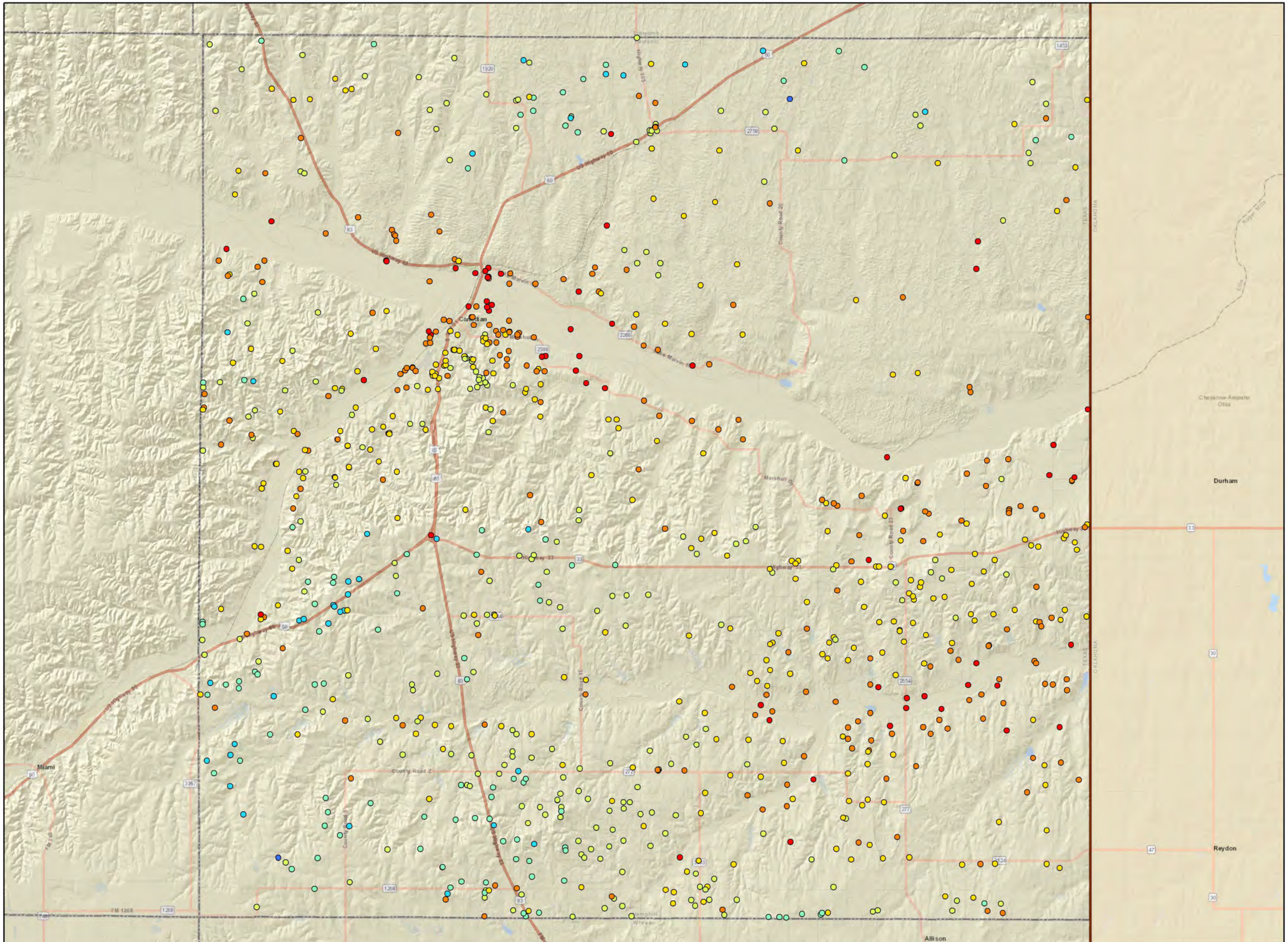

Well Depths
Hansford
Average Depth (feet): 496
Total number of wells: 738
Number of Wells
0 50 100 150 200
Well Depth (feet)
0 200 400 600 800 1000 > 1200
1% 1% 1% 2% 2% 5% 6% 15% 19% 21% 9% 5% 4% 5% 3% 1% 1%
Well Depth (feet)
< 100
100 - 200
200 - 300
300 - 400
400 - 500
500 - 600
600 - 700
> 700
GMA 1
Counties
Amarillo
N
0 2.5 5
Miles
Prepared by
INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS
Source: Submitted Drillers Reports and Groundwater Database - Texas Water Development Board 2019
Gruver
Spearman
Waka
OKLAHOMA
TEXAS


Well Depths
Hartley
Average Depth (feet): 499
Total number of wells: 1920
Number of Wells
0 100 200 300 400
Well Depth (feet)
0 200 400 600 800 1000 > 1200
1% 1% 1% 4% 9% 15% 11% 10% 14% 14% 10% 4% 1% 1% 1% 1% 1%
Well Depth (feet)
< 100
100 - 200
200 - 300
300 - 400
400 - 500
500 - 600
600 - 700
> 700
GMA 1
Counties
Amarillo
N
0 2.5 5
Miles
Prepared by
INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS
Source: Submitted Drillers Reports and Groundwater Database - Texas Water Development Board 2019
Dalhart
Dalhart Municipal Airport
Hartley
Channing
Dallam
Hartley
Oldham
Moore
NEW MEXICO
TEXAS
FM 1727
FM 695
FM 297
County Road G
County Road L
County Road N
County Road R
US Highway 87
US Highway 385
FM 767
FM 722
FM 2357
Highway 354
Texas Mains Rd
S County Line Rd

Well Depths Hemphill

Average Depth (feet): 276
Total number of wells: 942



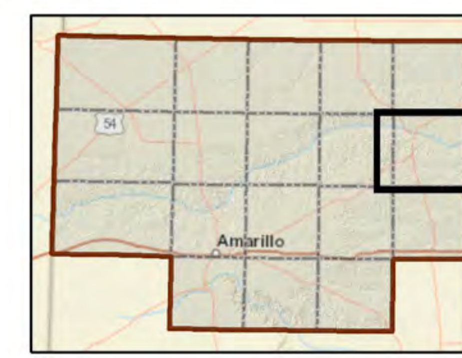


Well Depth (feet)

- < 100
- 100 - 200
- 200 - 300
- 300 - 400
- 400 - 500
- 500 - 600
- 600 - 700
- > 700

GMA 1

Counties



N

0 2.5 5
Miles

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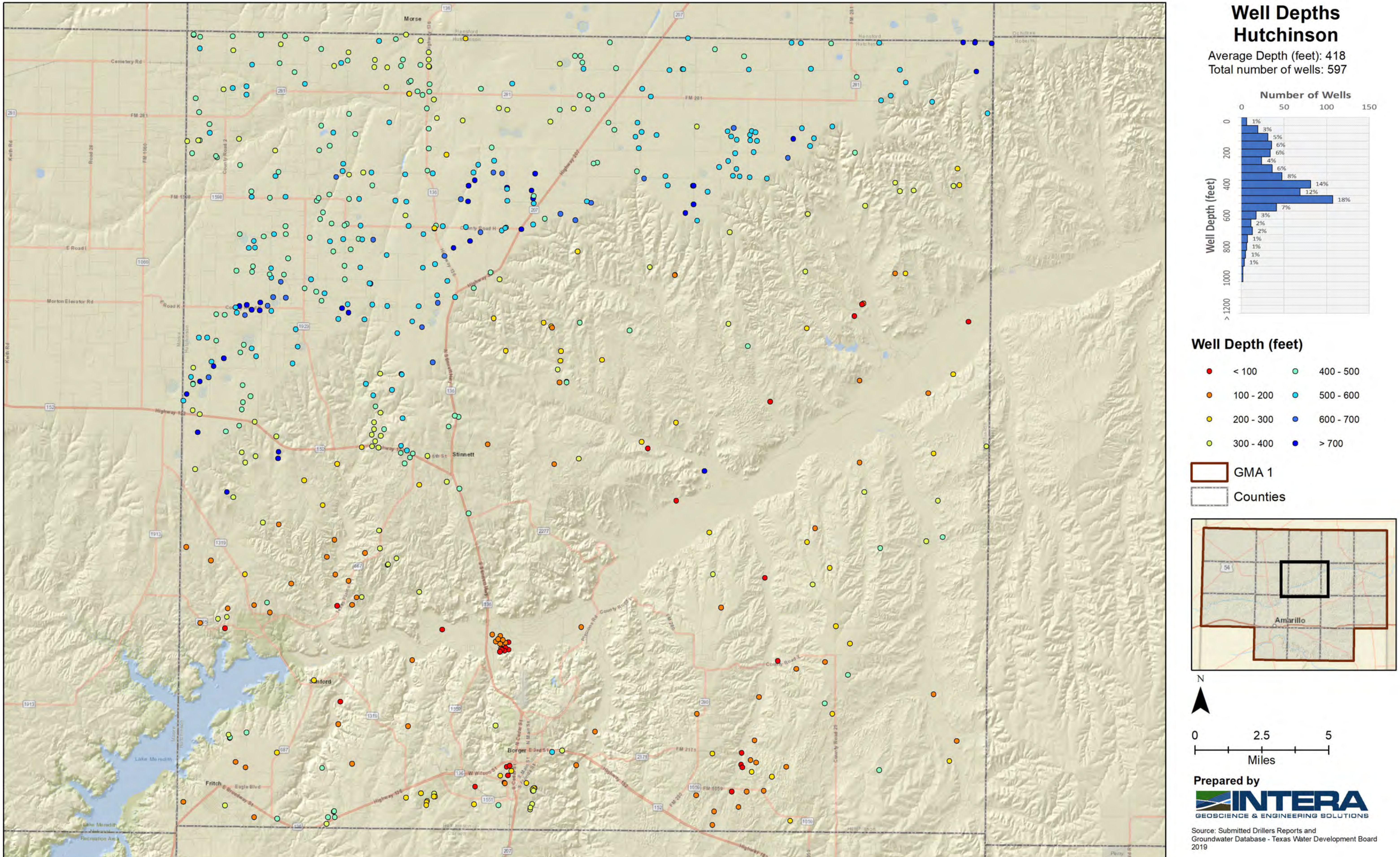
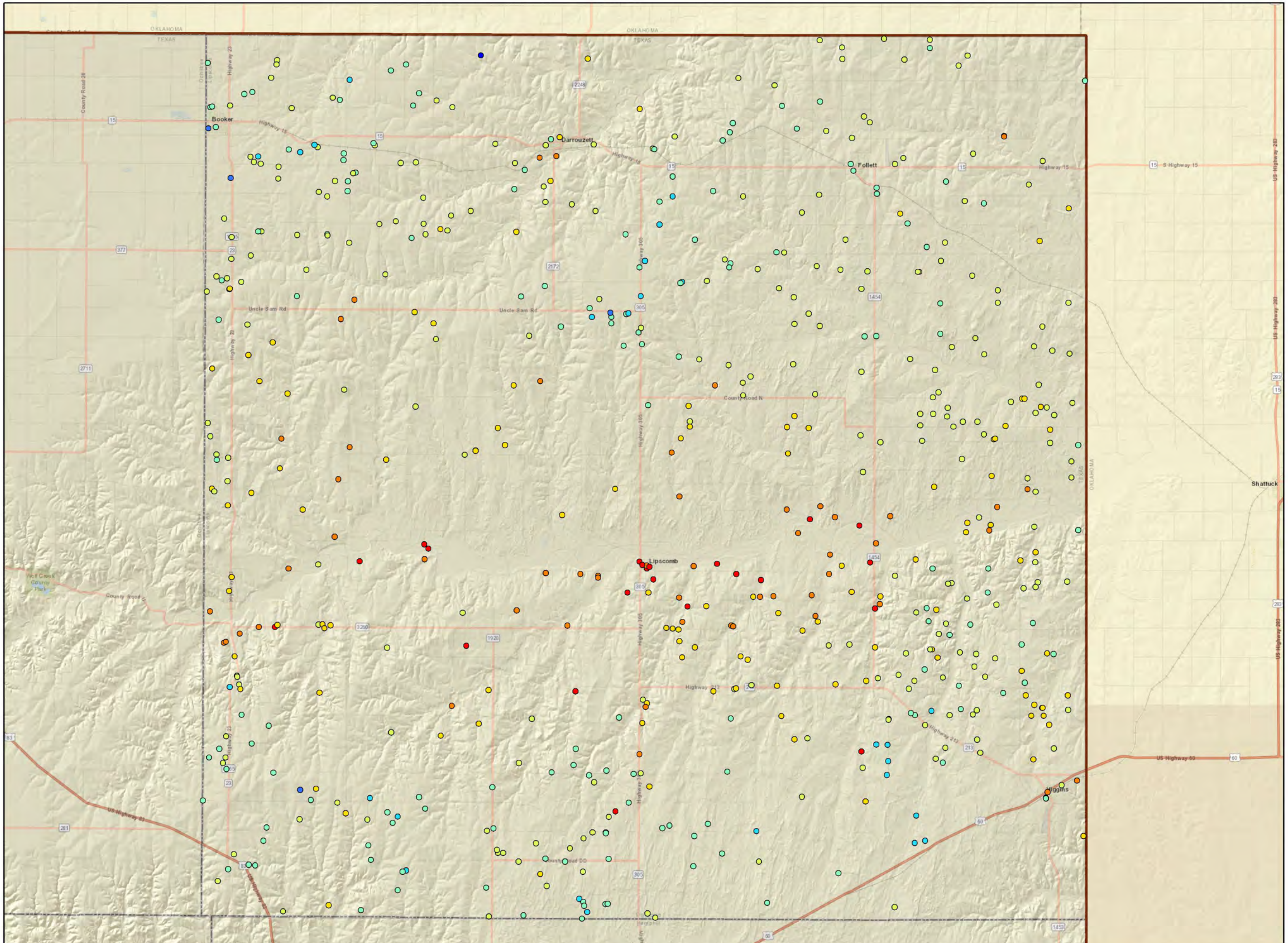
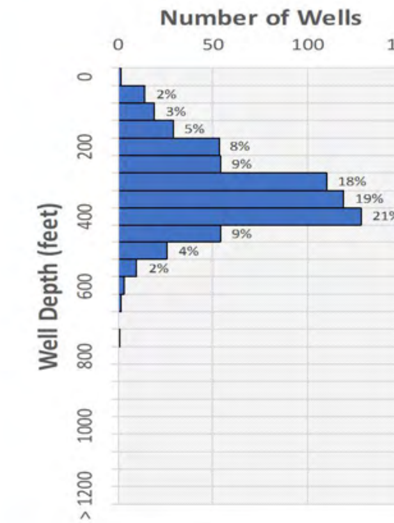

Well Depths
Hutchinson
Average Depth (feet): 418
Total number of wells: 597
Number of Wells
0
50
100
150
Well Depth (feet)
0
200
400
600
800
1000
> 1200
1%
3%
5%
6%
6%
4%
6%
8%
14%
12%
18%
7%
3%
2%
2%
1%
1%
1%
1%
Well Depth (feet)
< 100
100 - 200
200 - 300
300 - 400
400 - 500
500 - 600
600 - 700
> 700
GMA 1
Counties
Amarillo
N
0
2.5
5
Miles
Prepared by
INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS
Source: Submitted Drillers Reports and Groundwater Database - Texas Water Development Board 2019
Morse
Stinnett
Sanford
Borger
Fritch
Lake Meredith
Cemetery Rd
FM 281
E Road I
Morton Elevator Rd
Highway 152
Highway 207
Highway 136
FM 2171
Eagle Blvd



Well Depths Lipscomb

Average Depth (feet): 347
Total number of wells: 624

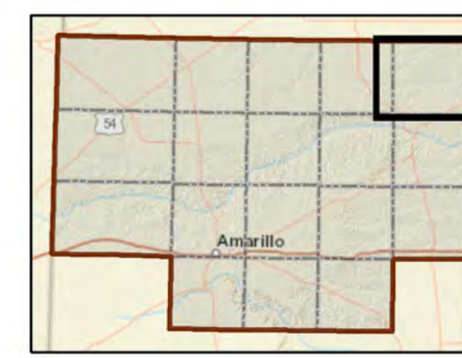


Well Depth (feet)

- < 100
- 100 - 200
- 200 - 300
- 300 - 400
- 400 - 500
- 500 - 600
- 600 - 700
- > 700

GMA 1

Counties



N

0 2.5 5
Miles

Prepared by

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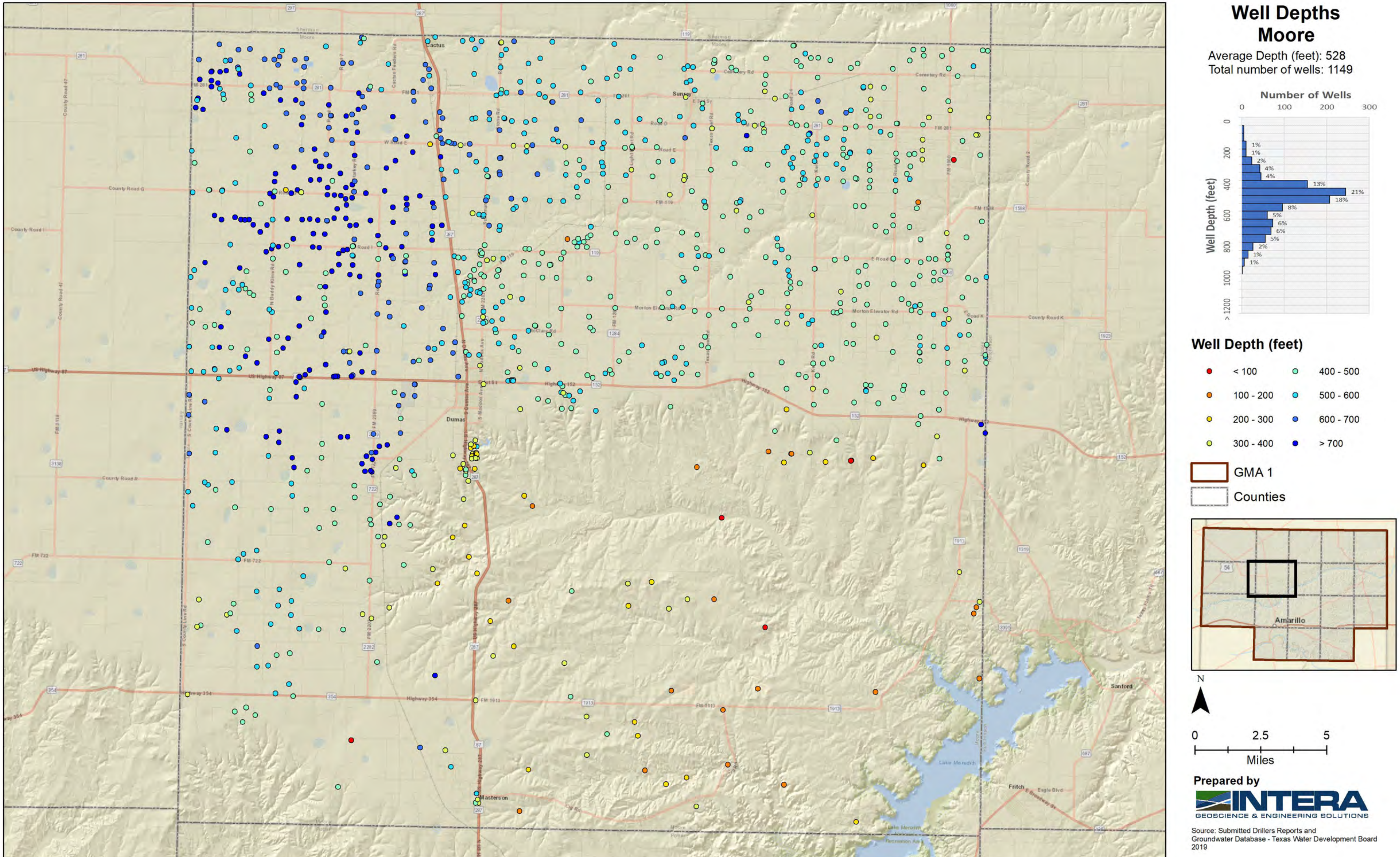
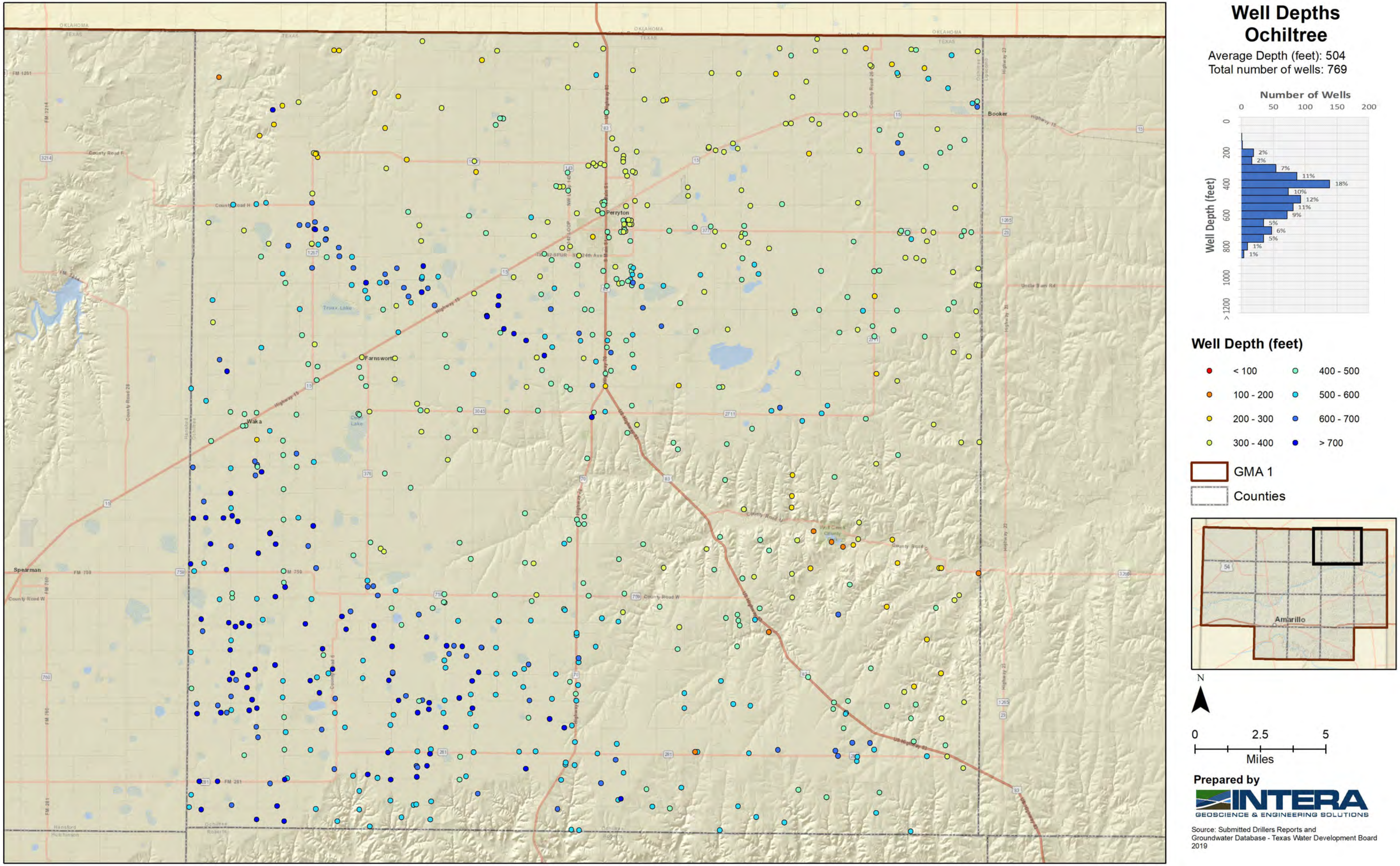
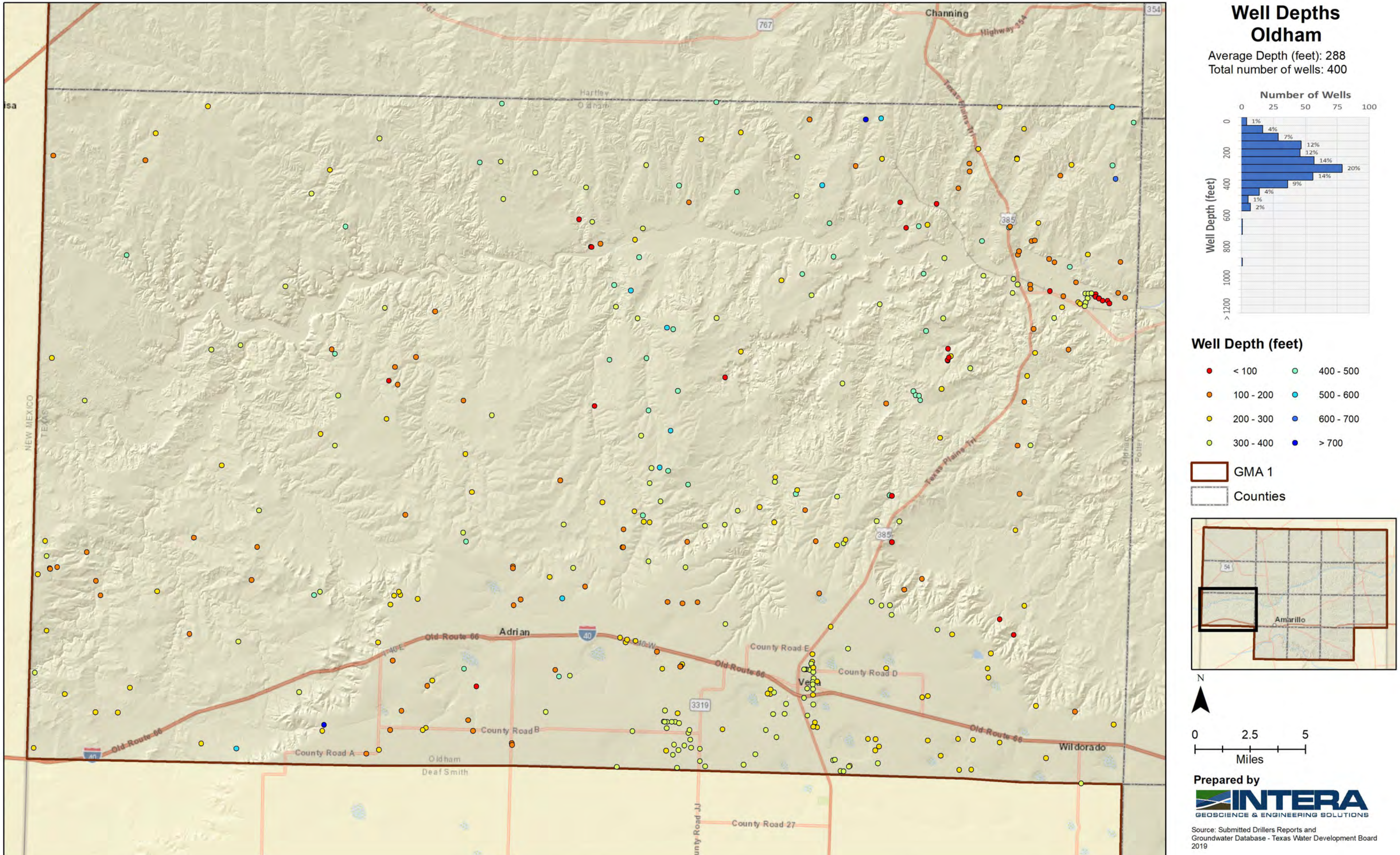
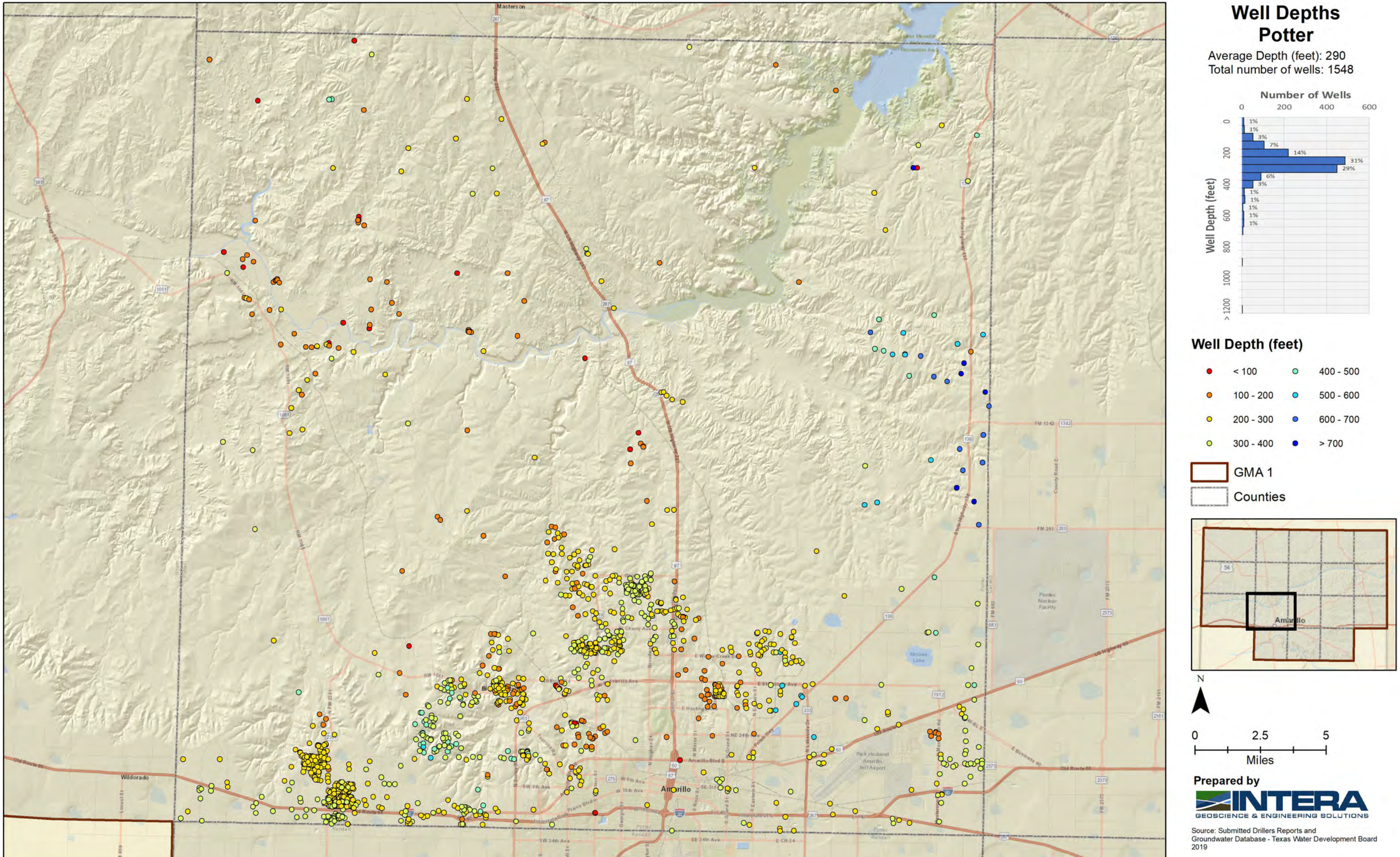
Source: Submitted Drillers Reports and Groundwater Database - Texas Water Development Board 2019


Well Depths
Moore
Average Depth (feet): 528
Total number of wells: 1149
Number of Wells
0
100
200
300
Well Depth (feet)
0
200
400
600
800
1000
> 1200
1%
1%
2%
4%
4%
13%
21%
18%
8%
5%
6%
6%
5%
2%
1%
1%
Well Depth (feet)
< 100
100 - 200
200 - 300
300 - 400
400 - 500
500 - 600
600 - 700
> 700
GMA 1
Counties
Amarillo
N
0
2.5
5
Miles
Prepared by
INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS
Source: Submitted Drillers Reports and Groundwater Database - Texas Water Development Board 2019
Cactus
Sunray
Dumas
Masterson
Sanford
Fritch
Lake Meredith
US Highway 87
Highway 152
Highway 354
FM 281
FM 722
County Road G
County Road K
Morton Elevator Rd

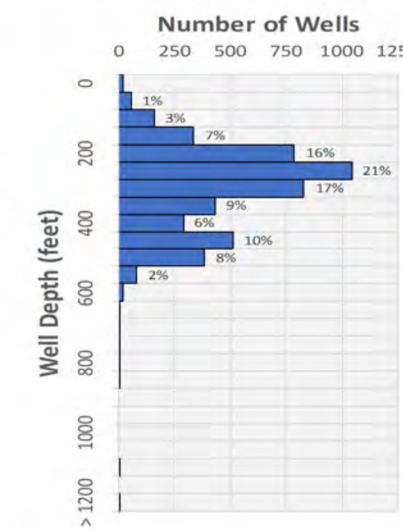

Well Depths
Ochiltree
Average Depth (feet): 504
Total number of wells: 769
Number of Wells
Well Depth (feet)
2%
2%
7%
11%
18%
10%
12%
11%
9%
5%
6%
5%
1%
1%
Well Depth (feet)
< 100
100 - 200
200 - 300
300 - 400
400 - 500
500 - 600
600 - 700
> 700
GMA 1
Counties
Amarillo
N
0
2.5
5
Miles
Prepared by
INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS
Source: Submitted Drillers Reports and Groundwater Database - Texas Water Development Board 2019
Perryton
Booker
Farnsworth
Waka
Spearman

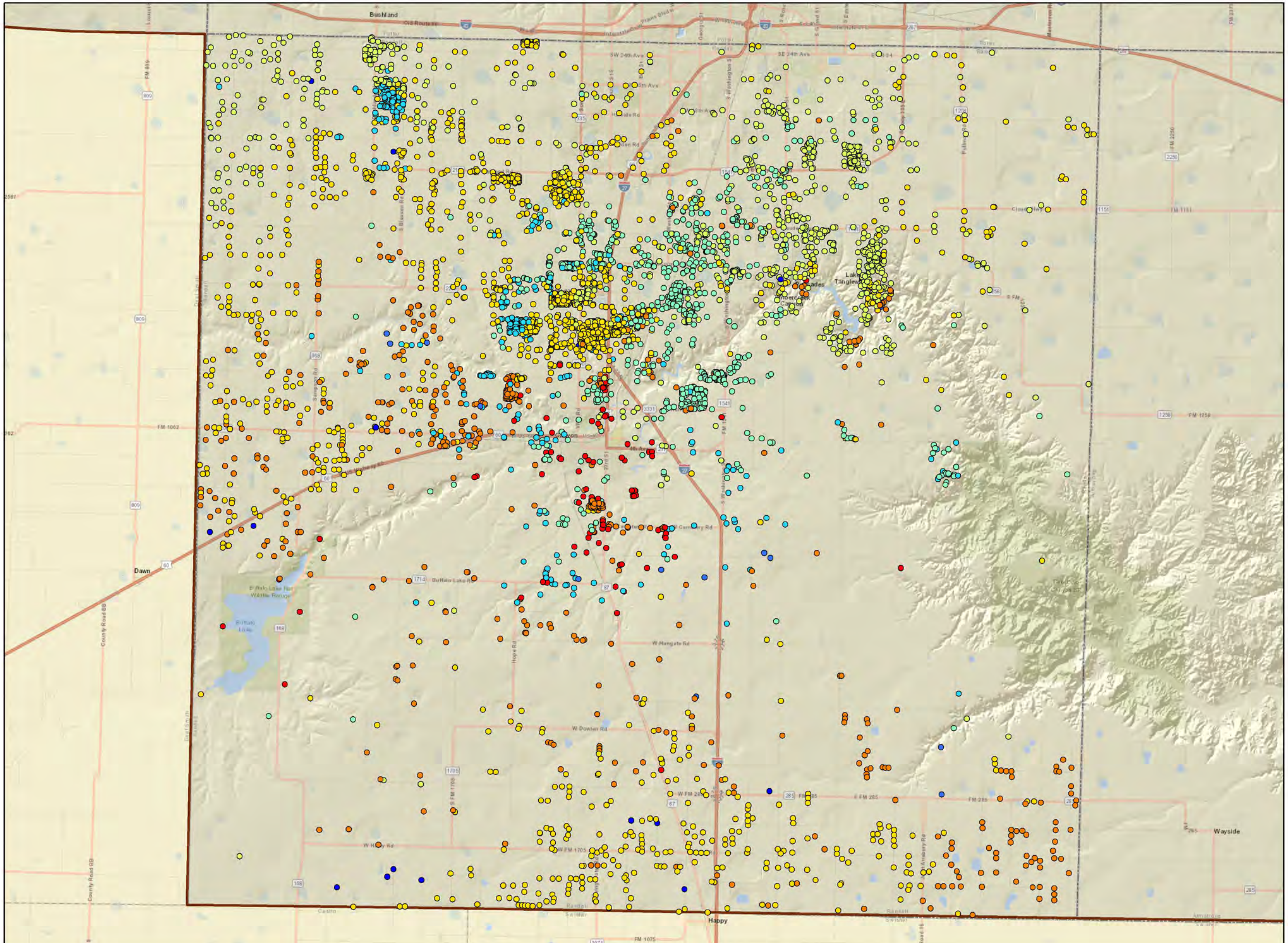

Well Depths
Oldham
Average Depth (feet): 288
Total number of wells: 400
Number of Wells
0 25 50 75 100
Well Depth (feet)
0
200
400
600
800
1000
> 1200
1%
4%
7%
12%
12%
14%
20%
14%
9%
4%
1%
2%
Well Depth (feet)
< 100
100 - 200
200 - 300
300 - 400
400 - 500
500 - 600
600 - 700
> 700
GMA 1
Counties
Amarillo
N
0 2.5 5
Miles
Prepared by
INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS
Source: Submitted Drillers Reports and Groundwater Database - Texas Water Development Board 2019
Channing
Highway 354
Hartley
Oldham
Texas Plains Trl
Adrian
Old Route 66
County Road E
County Road D
Vega
County Road B
County Road A
Oldham
Deaf Smith
Wildorado
County Road 27
County Road JJ
NEW MEXICO
TEXAS
Potter
767
354
385
3319
40


Well Depths
Potter
Average Depth (feet): 290
Total number of wells: 1548
Number of Wells
0
200
400
600
Well Depth (feet)
0
200
400
600
800
1000
> 1200
1%
1%
3%
7%
14%
31%
29%
6%
3%
1%
1%
1%
1%
1%
Well Depth (feet)
< 100
100 - 200
200 - 300
300 - 400
400 - 500
500 - 600
600 - 700
> 700
GMA 1
Counties
Amarillo
N
0
2.5
5
Miles
Prepared by
INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS
Source: Submitted Drillers Reports and Groundwater Database - Texas Water Development Board 2019
Masterson
Wildorado
Amarillo

Well Depths Randall

Average Depth (feet): 325
Total number of wells: 4973





Well Depth (feet)

< 100	400 - 500
100 - 200	500 - 600
200 - 300	600 - 700
300 - 400	> 700

GMA 1

Counties

N

0 2.5 5
Miles

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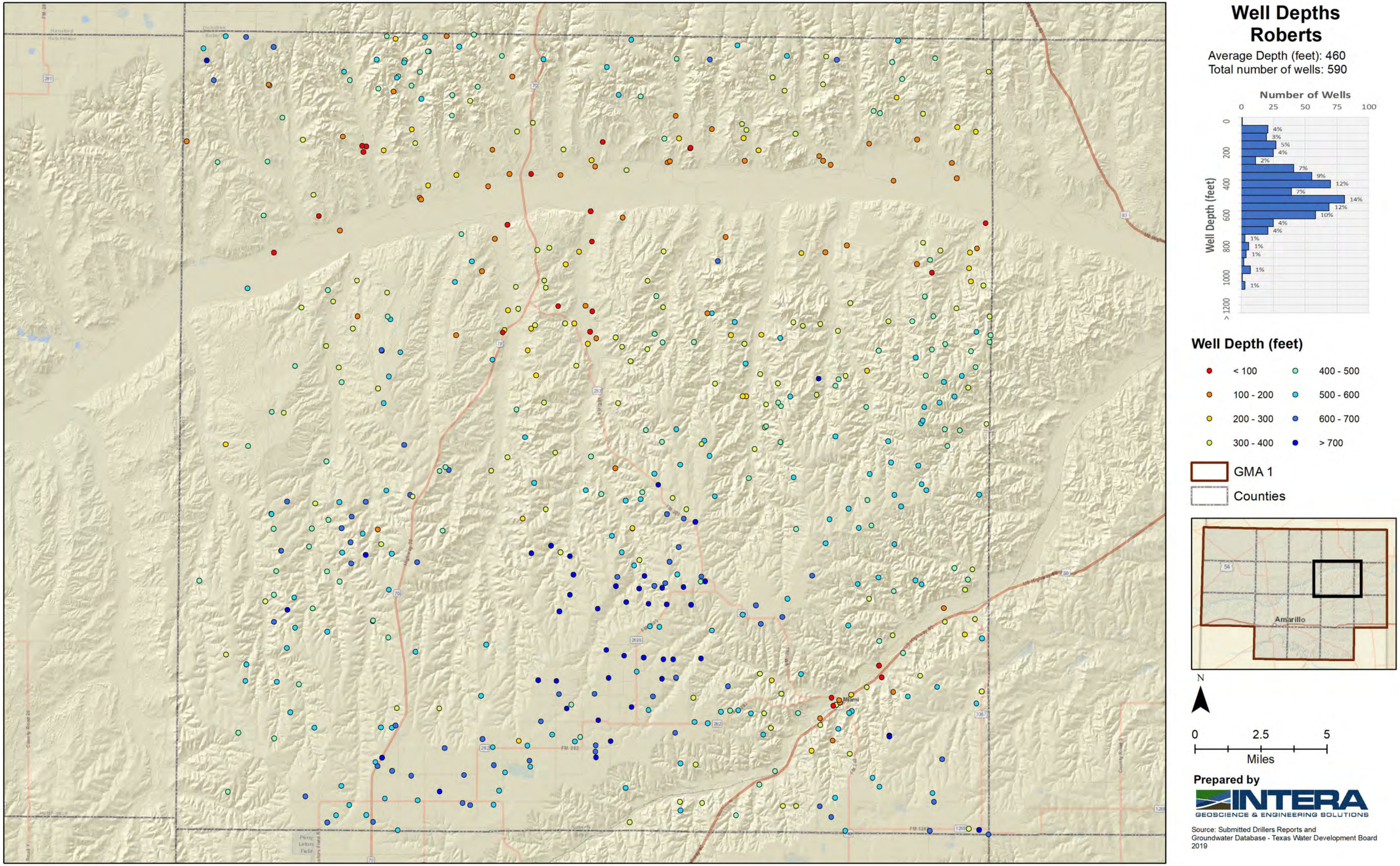
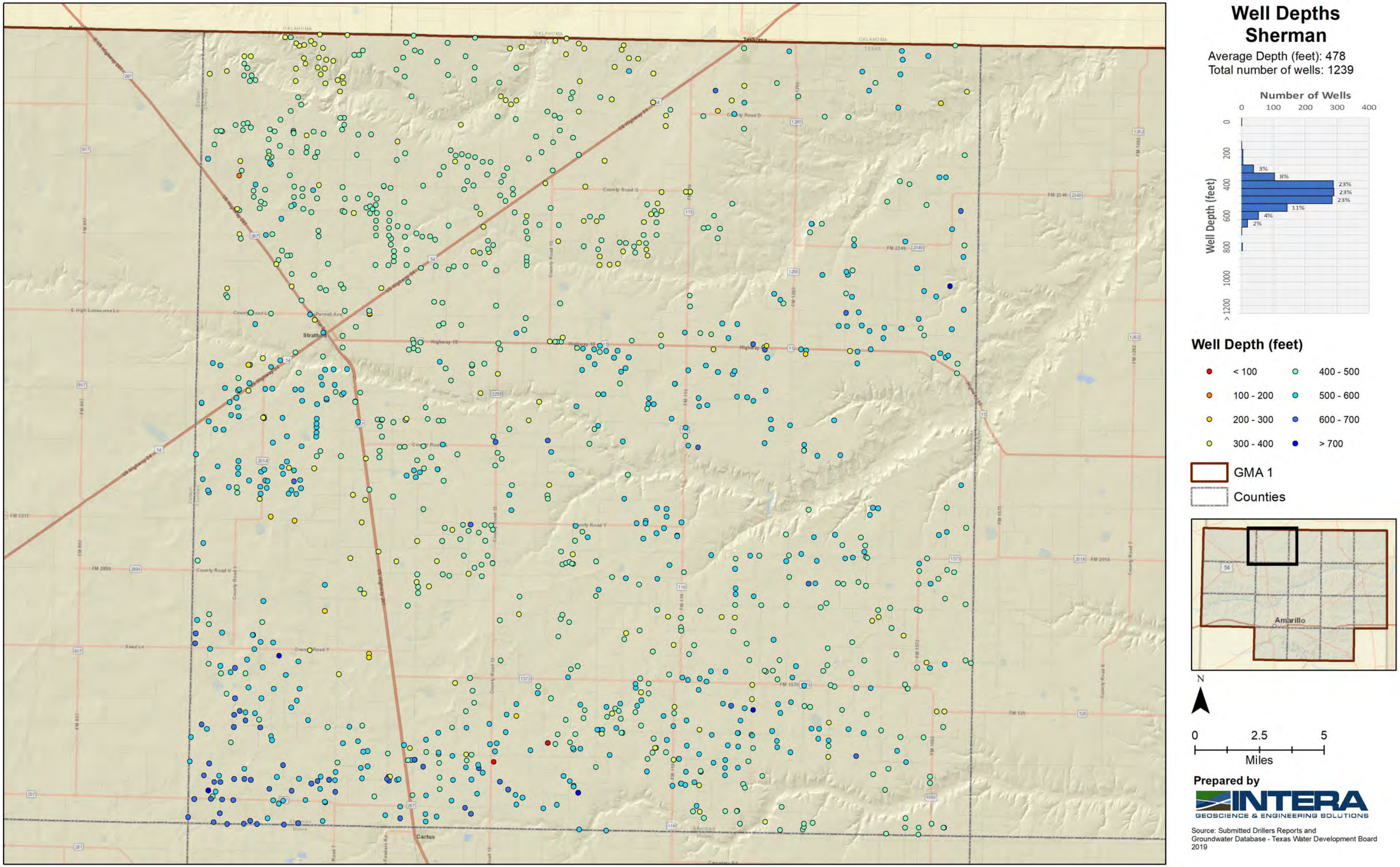
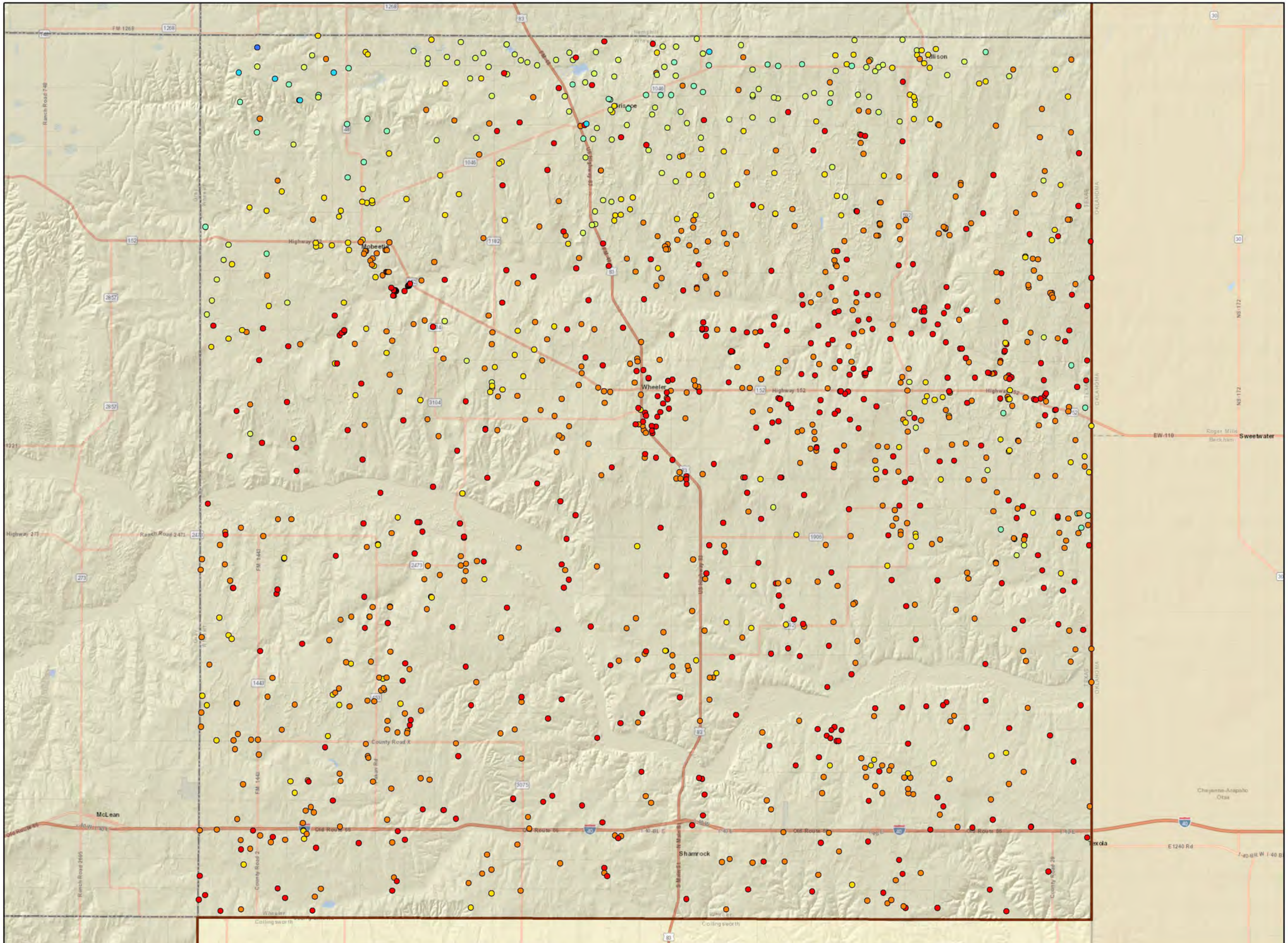
Source: Submitted Drillers Reports and Groundwater Database - Texas Water Development Board 2019



Prepared by INTERA GEOSCIENCE & ENGINEERING SOLUTIONS

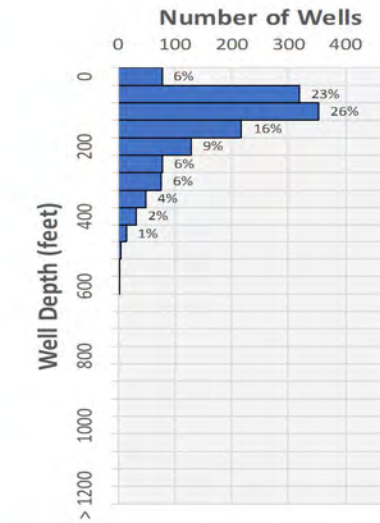
Source: Submitted Drillers Reports and Groundwater Database - Texas Water Development Board 2019


Well Depths
Sherman
Average Depth (feet): 478
Total number of wells: 1239
Number of Wells
0
100
200
300
400
Well Depth (feet)
0
200
400
600
800
1000
> 1200
3%
8%
23%
23%
23%
11%
4%
2%
Well Depth (feet)
< 100
100 - 200
200 - 300
300 - 400
400 - 500
500 - 600
600 - 700
> 700
GMA 1
Counties
Amarillo
N
0
2.5
5
Miles
Prepared by
INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS
Source: Submitted Drillers Reports and Groundwater Database - Texas Water Development Board 2019
Stratford
Texhoma
Cactus
OKLAHOMA
TEXAS



Well Depths Wheeler

Average Depth (feet): 165
Total number of wells: 1359

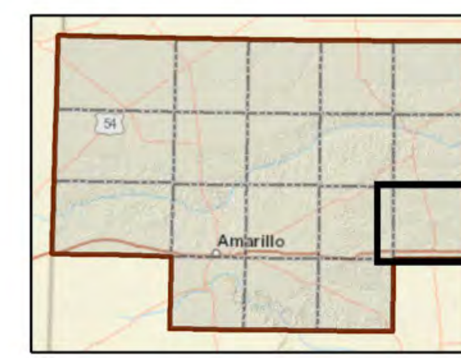


Well Depth (feet)

- < 100
- 100 - 200
- 200 - 300
- 300 - 400
- 400 - 500
- 500 - 600
- 600 - 700
- > 700

GMA 1

Counties



N

0 2.5 5

Miles

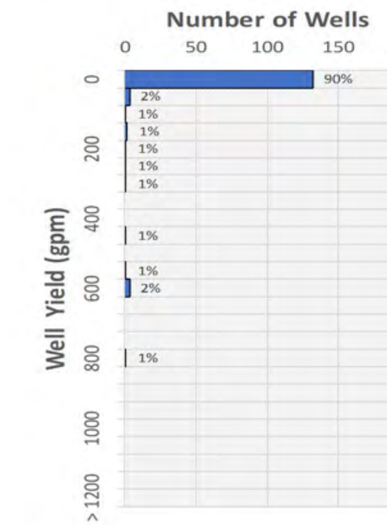
Prepared by

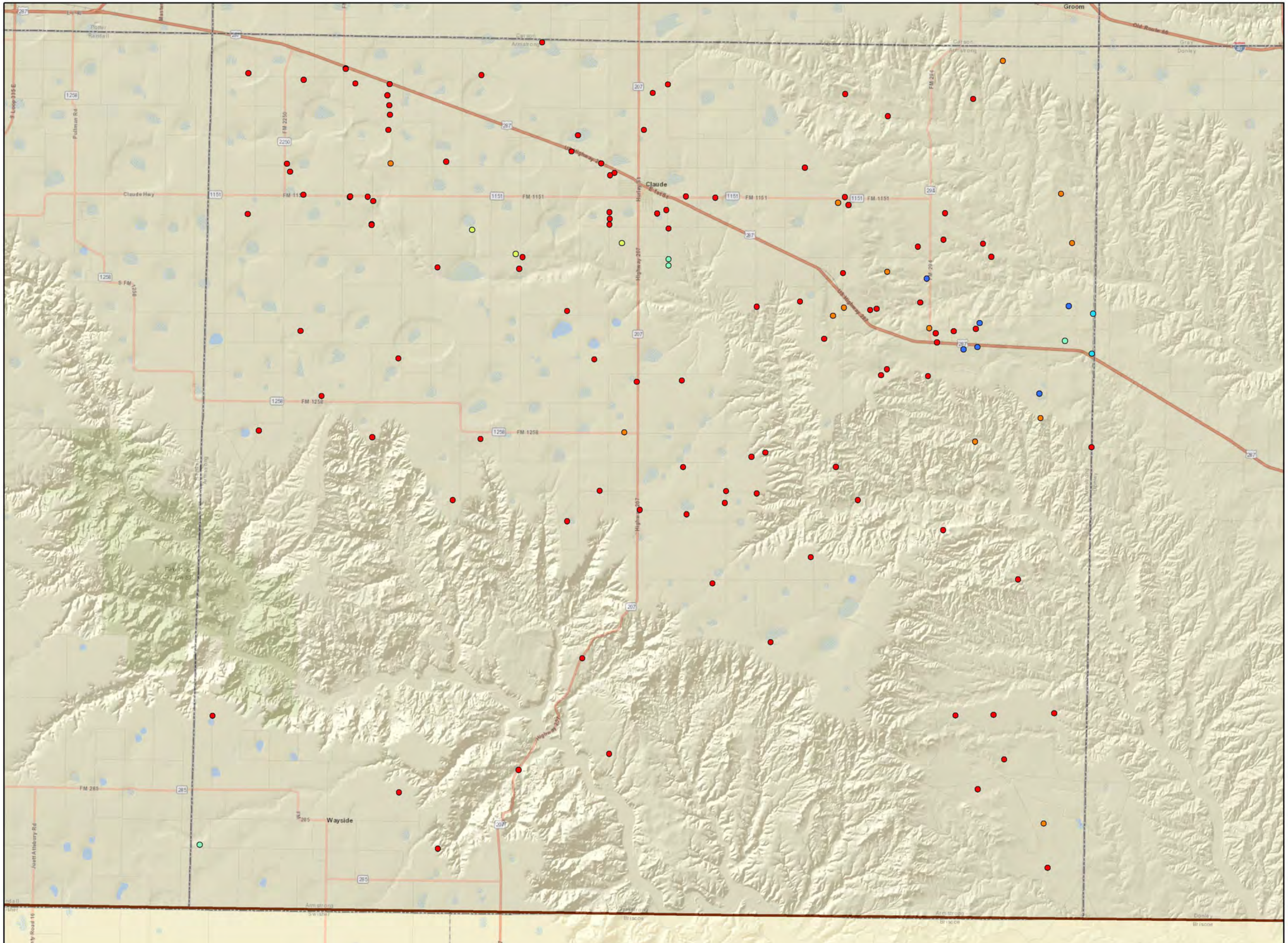
INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS

Source: Submitted Drillers Reports and Groundwater Database - Texas Water Development Board 2019

Well Yields
Armstrong

Average Yield (gpm): 46
Total number of wells: 147





Yield (gpm)

- 2 - 20
- 20 - 40
- 40 - 60
- 60 - 80
- 80 - 200
- 200 - 400
- 400 - 1000
- > 1000

GMA 1

Counties

N

0 1.25 2.5 5

Miles

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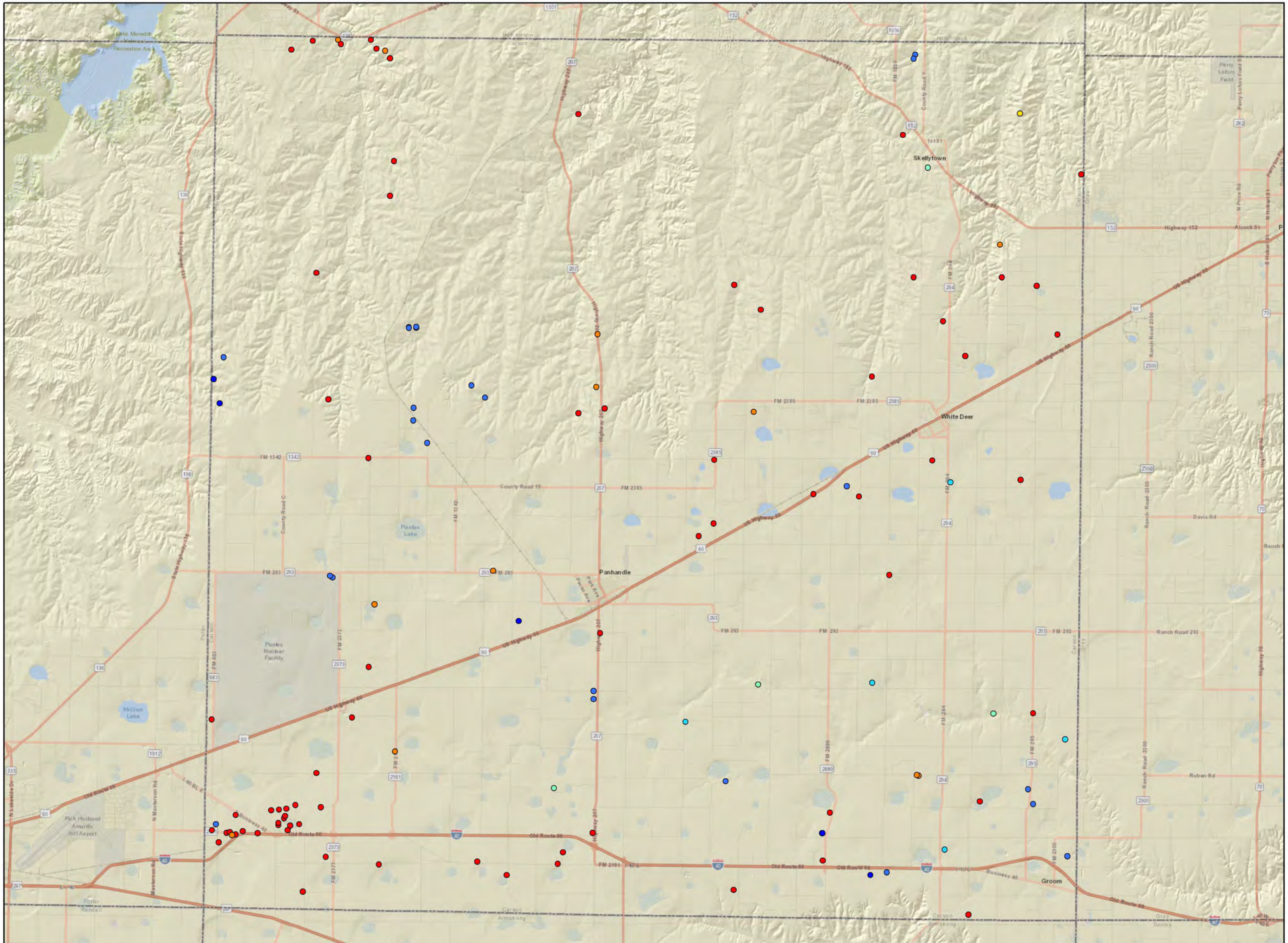
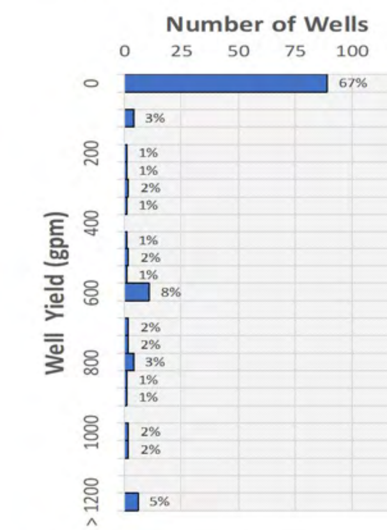


Well Yields
Carson

Average Yield (gpm): 235
Total number of wells: 133



Yield (gpm)

- 2 - 20
- 20 - 40
- 40 - 60
- 60 - 80
- 80 - 200
- 200 - 400
- 400 - 1000
- > 1000

GMA 1

Counties

N

0 1.25 2.5 5 7.5
Miles

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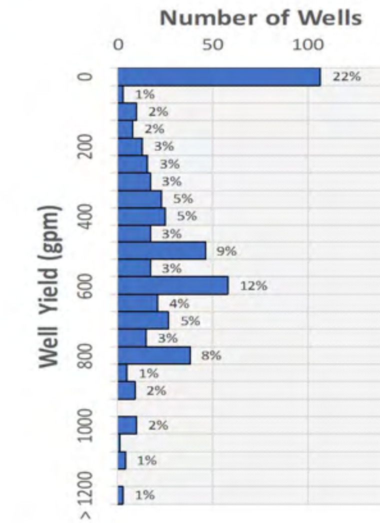
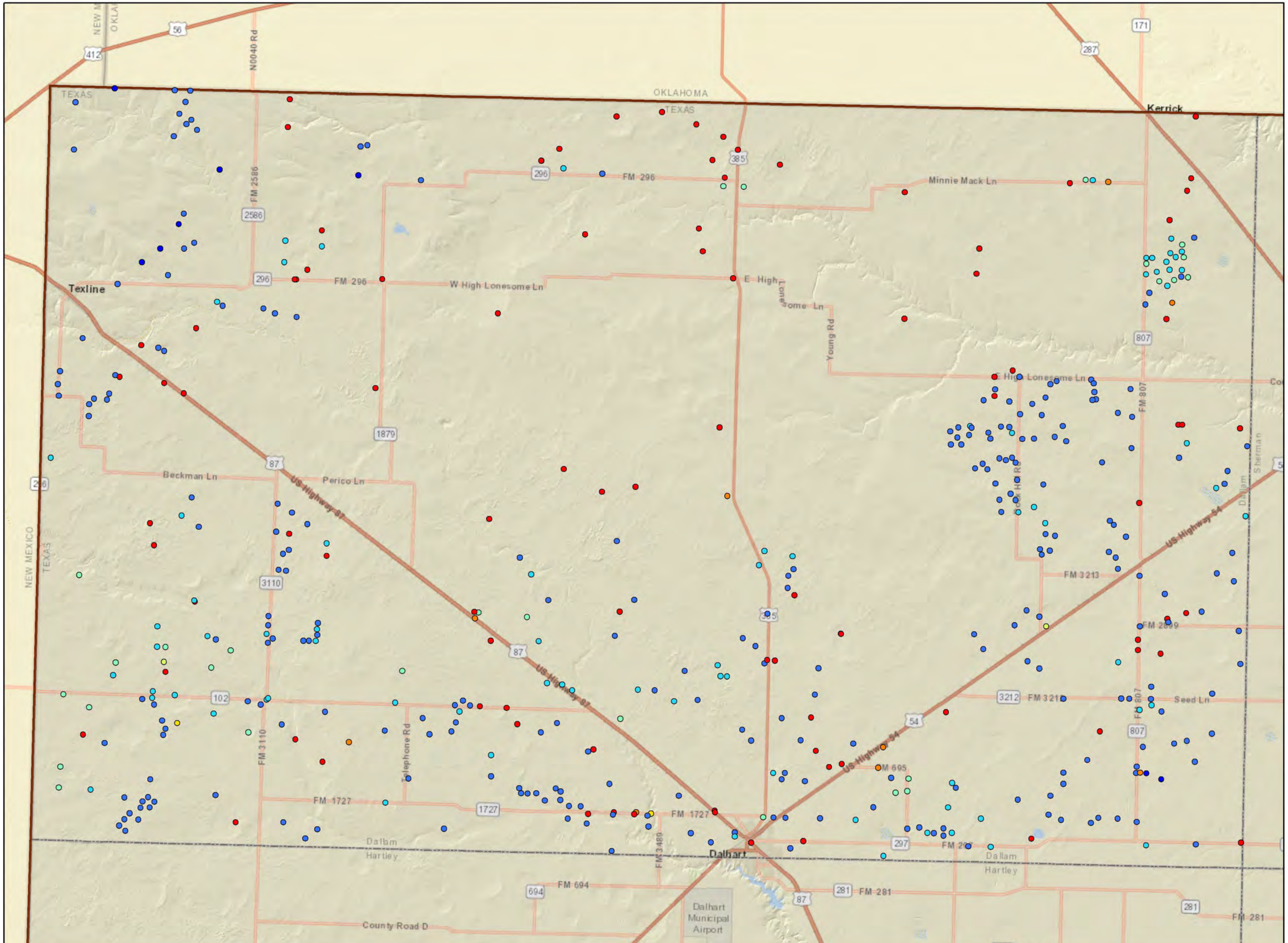
Well Yields
Dallam

Average Yield (gpm): 440
Total number of wells: 493





Yield (gpm)

- 2 - 20
- 20 - 40
- 40 - 60
- 60 - 80
- 80 - 200
- 200 - 400
- 400 - 1000
- > 1000

GMA 1
Counties

N

0 1.25 2.5 5 7.5
Miles

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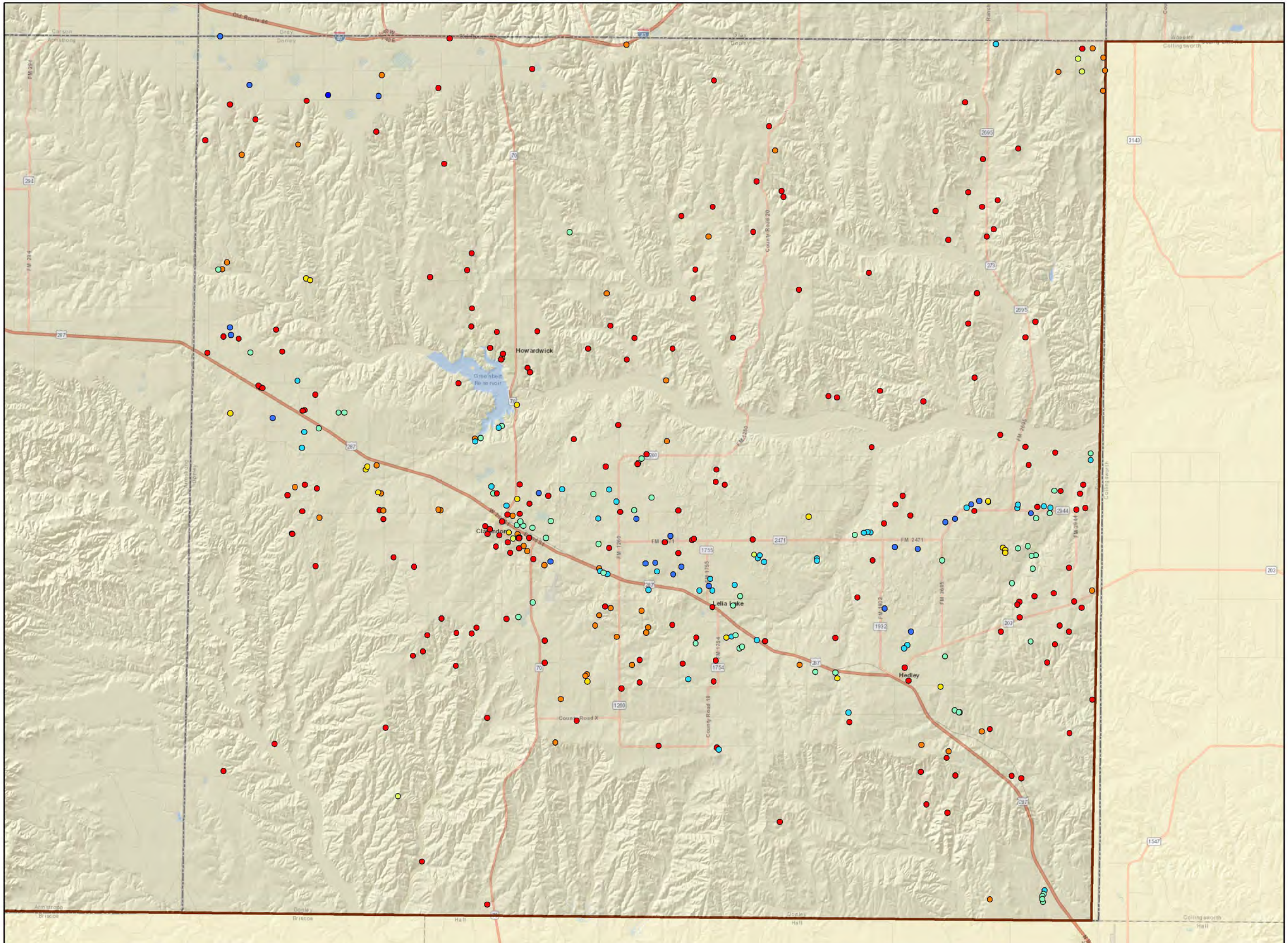
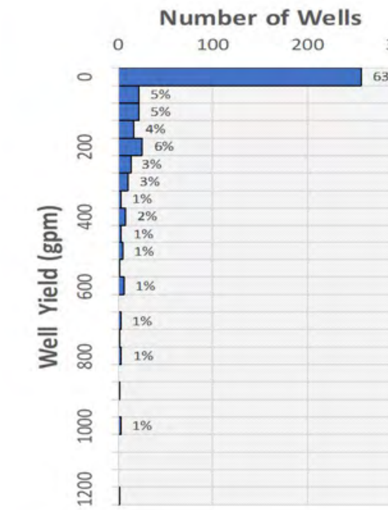


Well Yields
Donley

Average Yield (gpm): 116
Total number of wells: 410

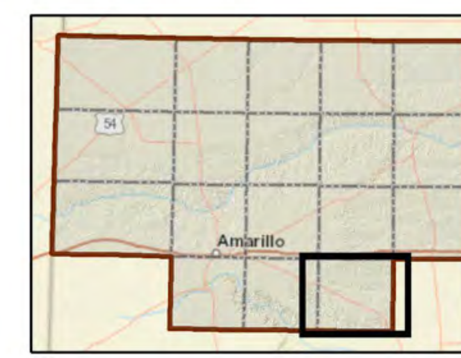


Yield (gpm)

- 2 - 20
- 20 - 40
- 40 - 60
- 60 - 80
- 80 - 200
- 200 - 400
- 400 - 1000
- > 1000

GMA 1

Counties



N

0 1.25 2.5 5
Miles

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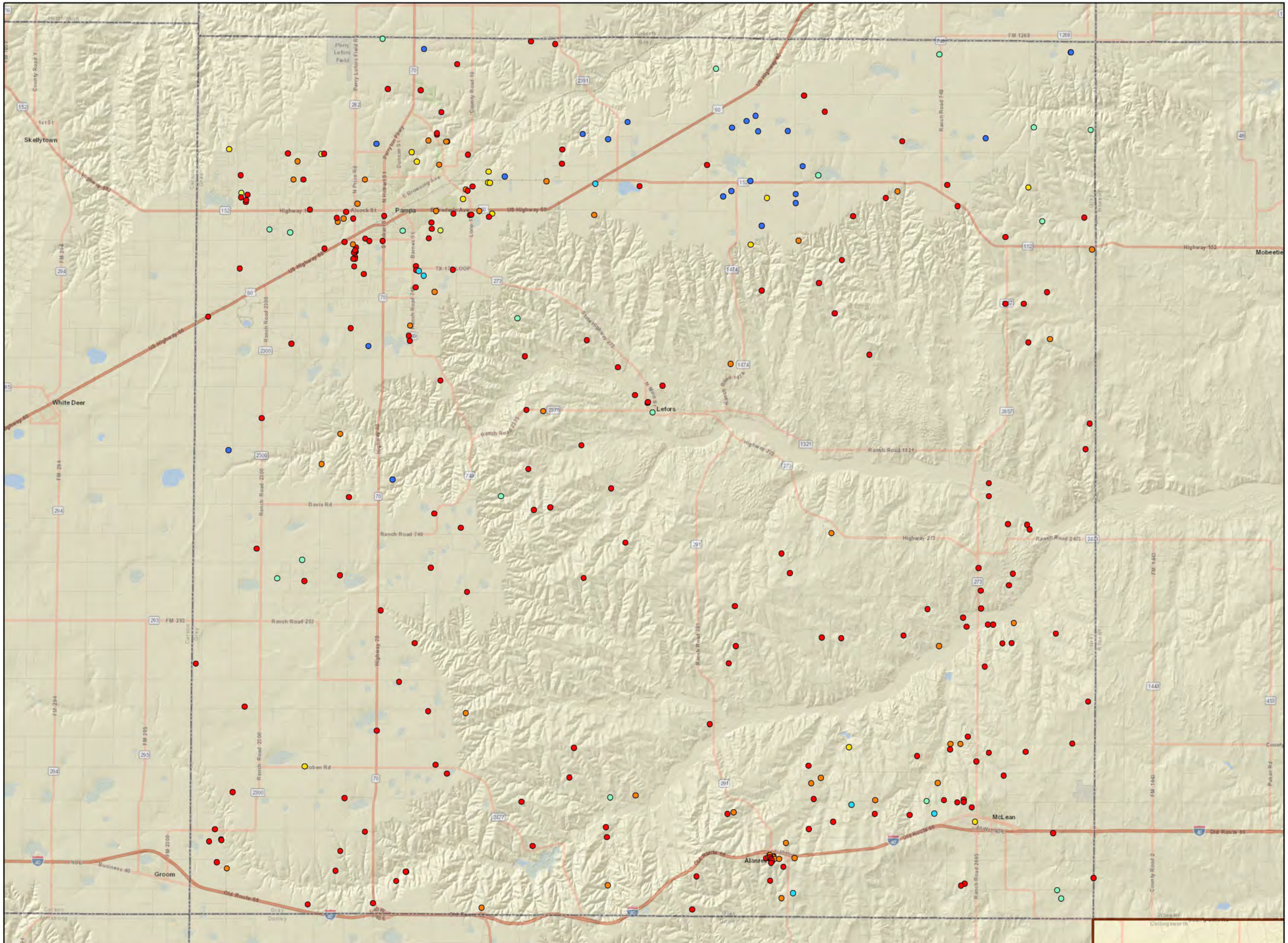
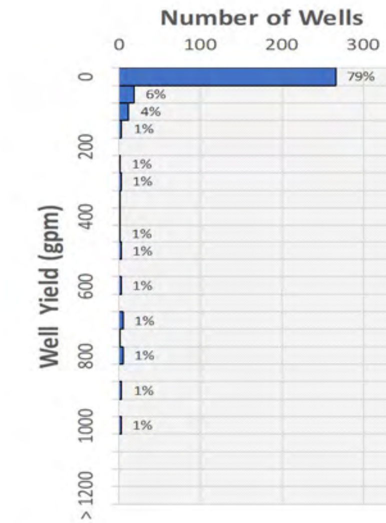


Well Yields
Gray

Average Yield (gpm): 86
Total number of wells: 335



Yield (gpm)

- 2 - 20
- 20 - 40
- 40 - 60
- 60 - 80
- 80 - 200
- 200 - 400
- 400 - 1000
- > 1000

GMA 1

Counties

N

0 1.25 2.5 5
Miles

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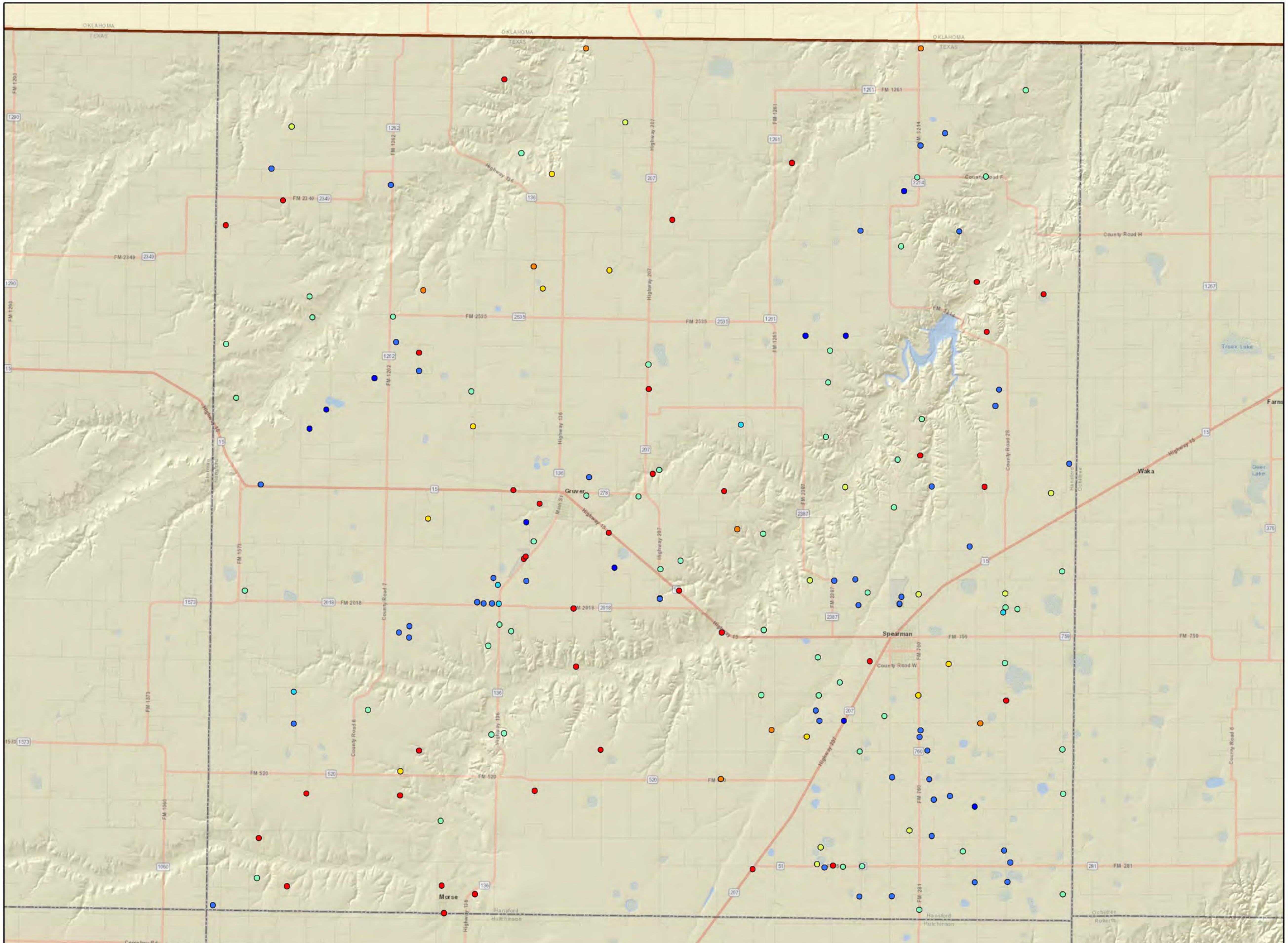
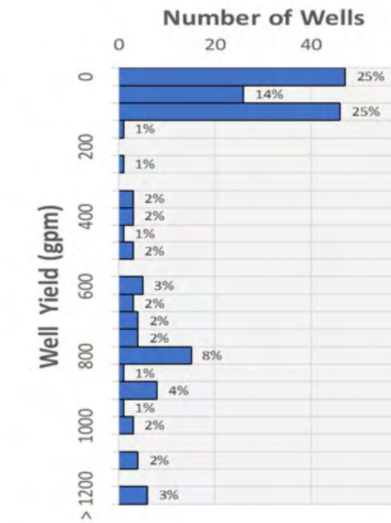


Well Yields Hansford

Average Yield (gpm): 319
Total number of wells: 185

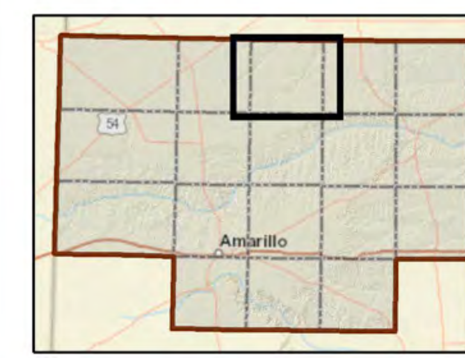


Yield (gpm)

- 2 - 20
- 20 - 40
- 40 - 60
- 60 - 80
- 80 - 200
- 200 - 400
- 400 - 1000
- > 1000

GMA 1

Counties



N

0 1.25 2.5 5 7.5

Miles

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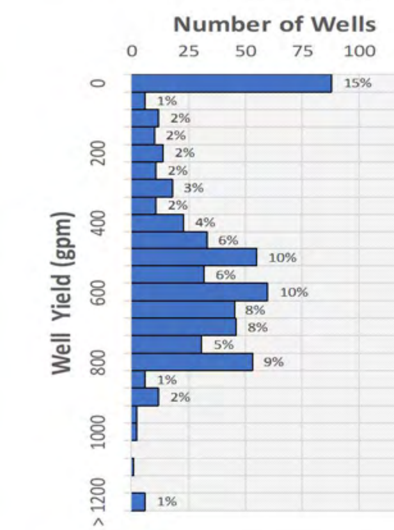
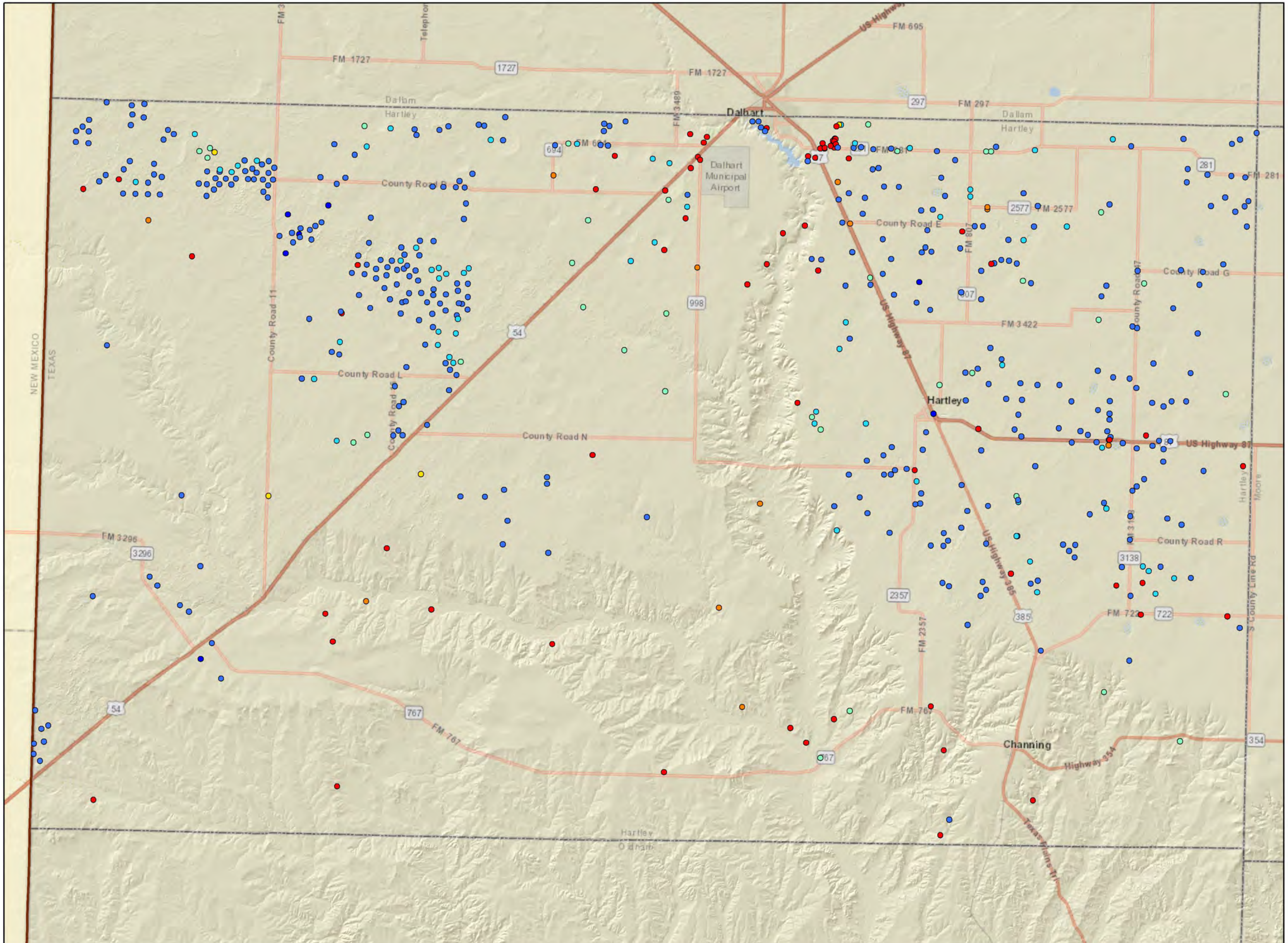
Well Yields
Hartley

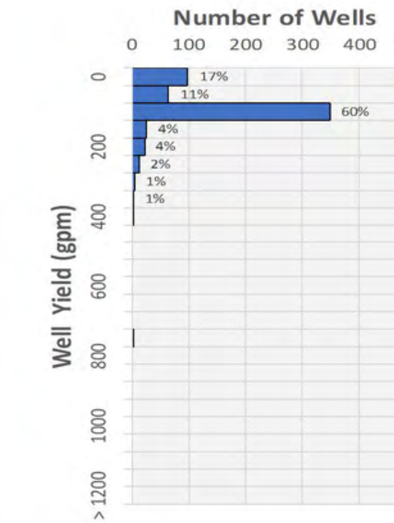
Average Yield (gpm): 489
Total number of wells: 577

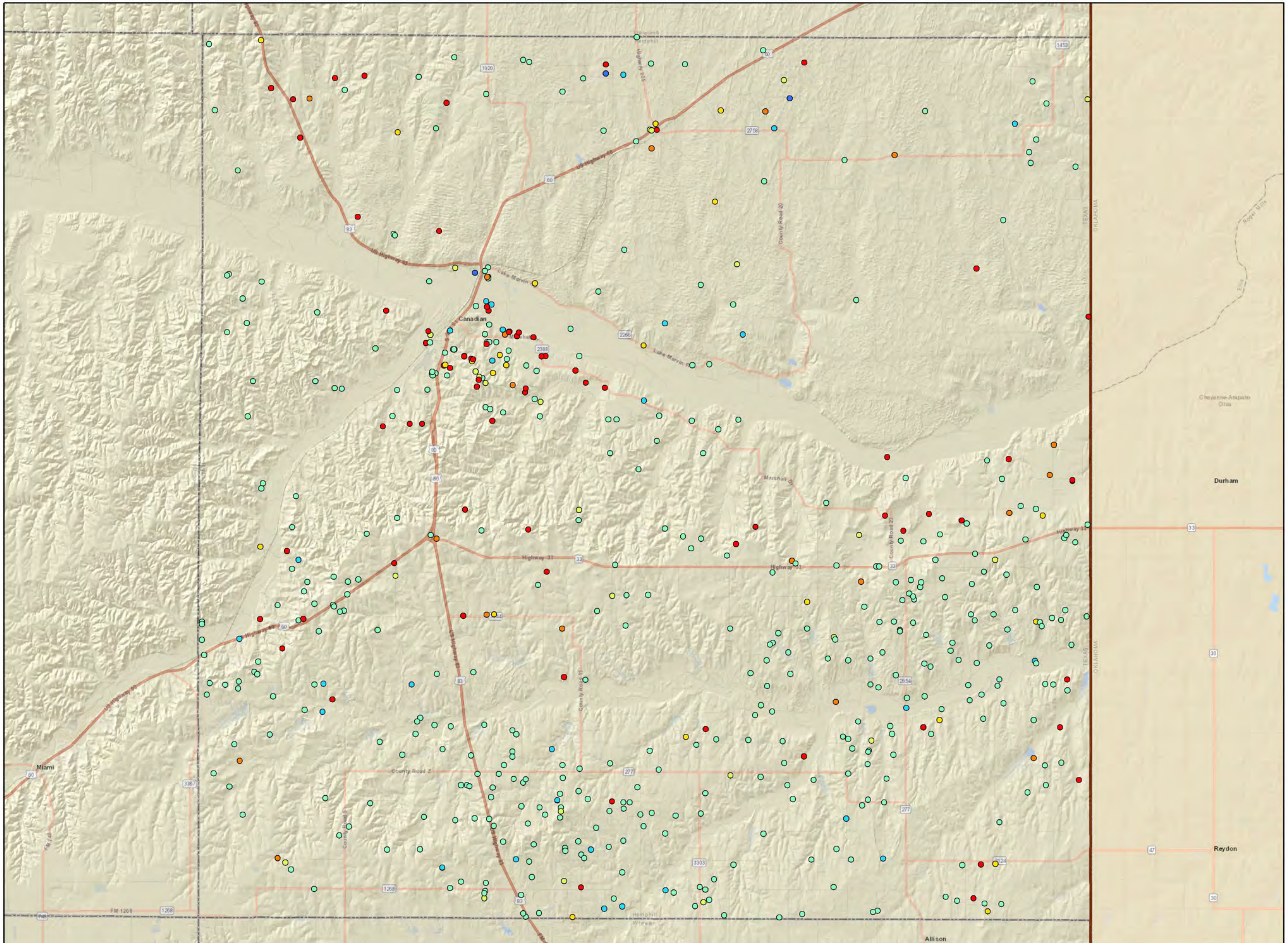




Well Yields Hemphill

Average Yield (gpm): 100
Total number of wells: 583





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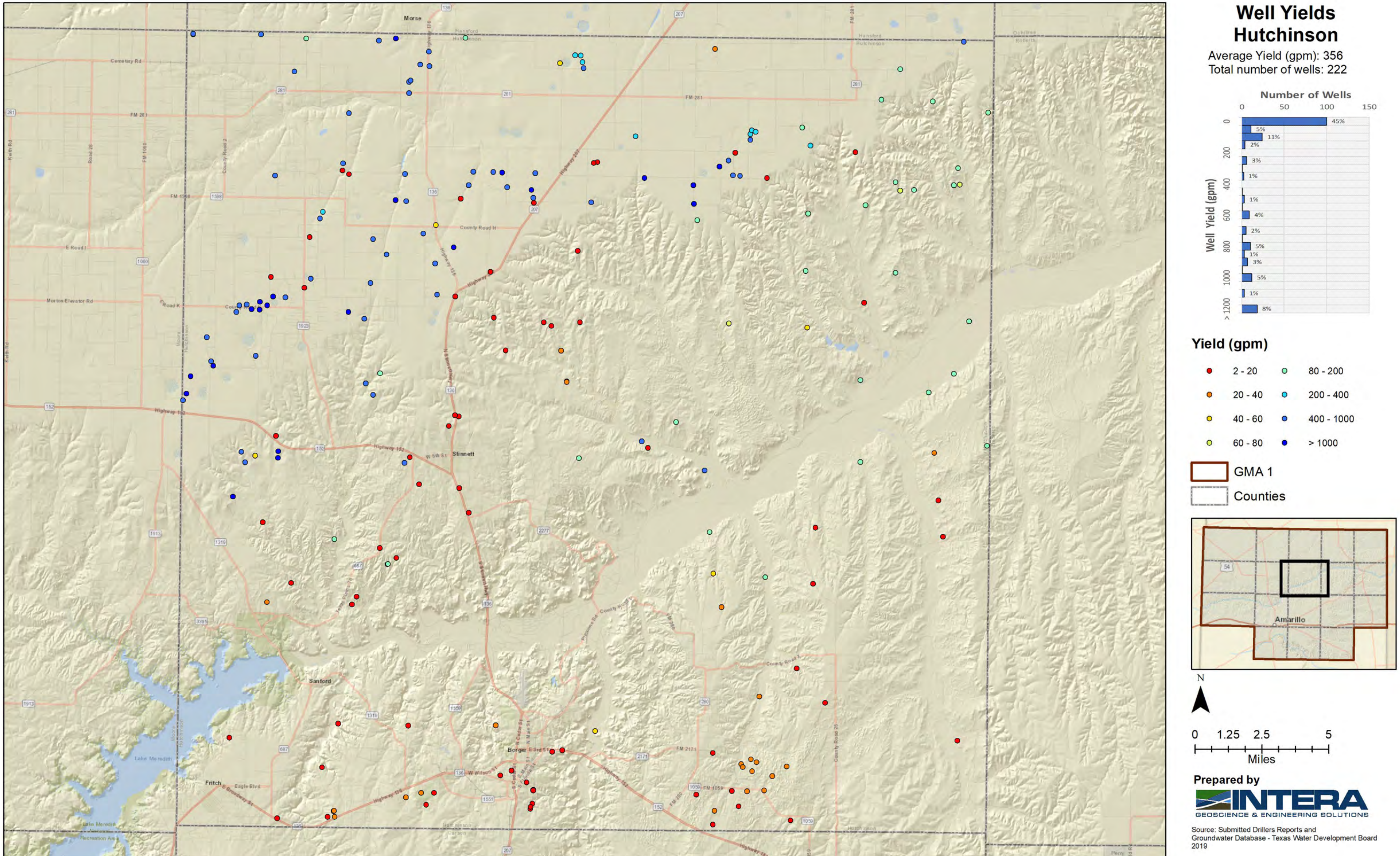
Source: Submitted Drillers Reports and Groundwater Database - Texas Water Development Board 2019


Well Yields
Hutchinson
Average Yield (gpm): 356
Total number of wells: 222
Number of Wells
0 50 100 150
Well Yield (gpm)
0
200
400
600
800
1000
> 1200
45%
5%
11%
2%
3%
1%
1%
4%
2%
5%
1%
3%
5%
1%
8%
Yield (gpm)
2 - 20
20 - 40
40 - 60
60 - 80
80 - 200
200 - 400
400 - 1000
> 1000
GMA 1
Counties
Amarillo
N
0 1.25 2.5 5
Miles
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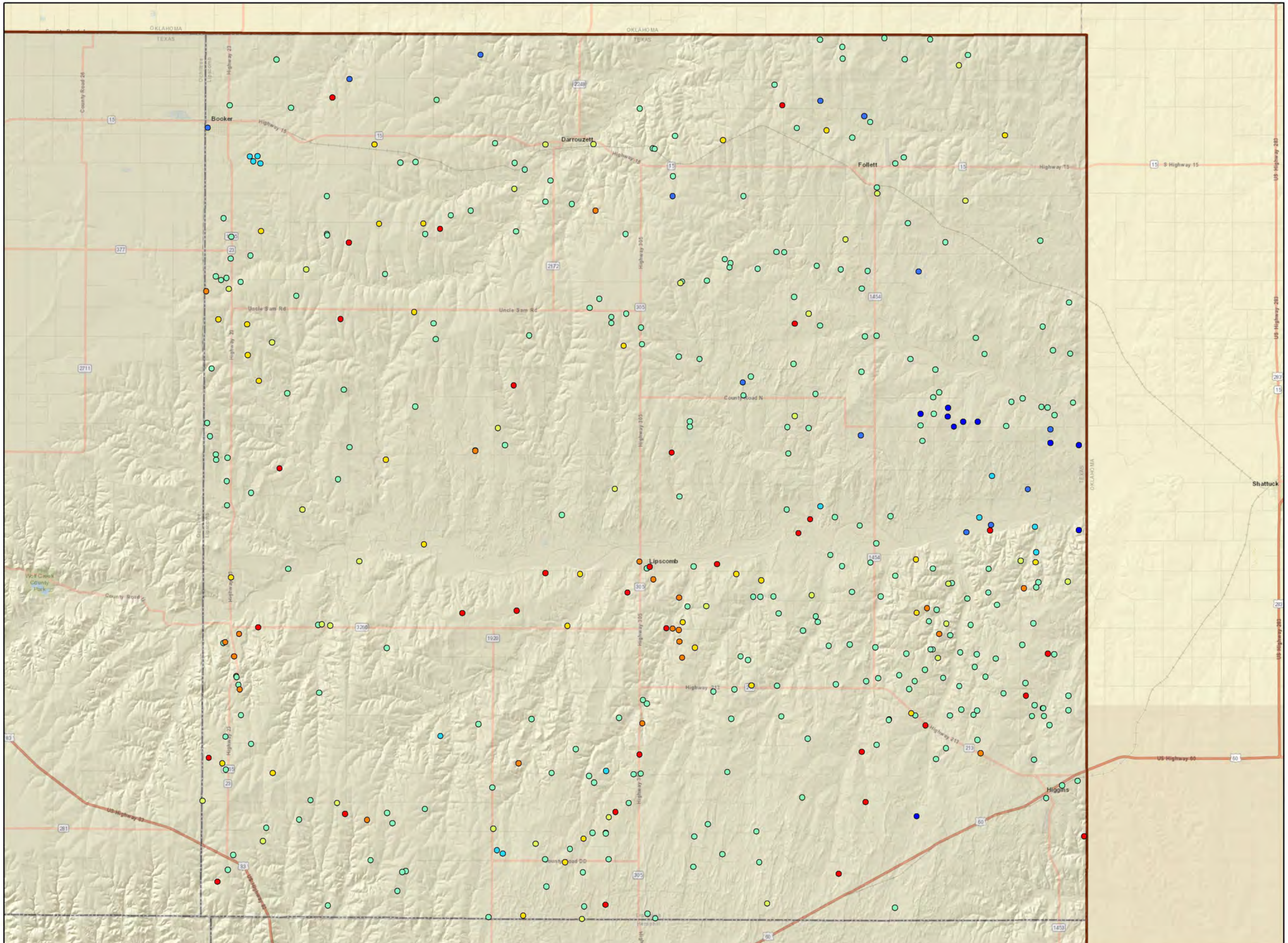
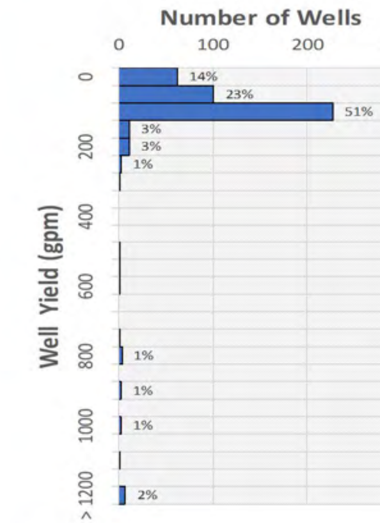
Source: Submitted Drillers Reports and Groundwater Database - Texas Water Development Board 2019
Morse
Stinnett
Sanford
Borger
Fritch
Lake Meredith
FM 281
FM 1598
Highway 152
Highway 207
Highway 136
County Road H
Morton Elevator Rd
Cemetery Rd
E Road I
FM 2171
FM 1059
Eagle Blvd



Well Yields Lipscomb

Average Yield (gpm): 143
Total number of wells: 443

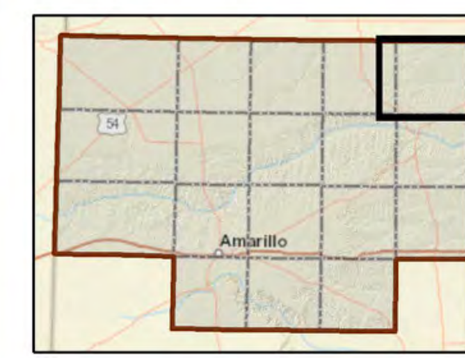


Yield (gpm)

- 2 - 20
- 20 - 40
- 40 - 60
- 60 - 80
- 80 - 200
- 200 - 400
- 400 - 1000
- > 1000

GMA 1

Counties



N

0 1.25 2.5 5
Miles

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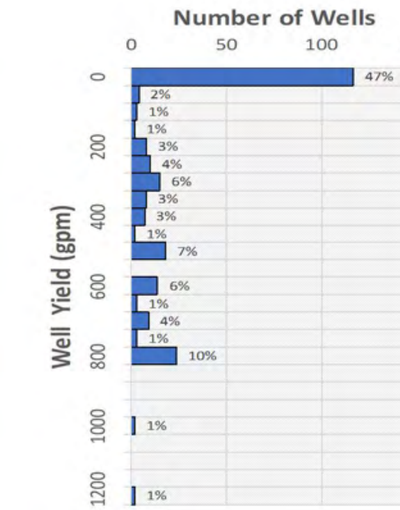
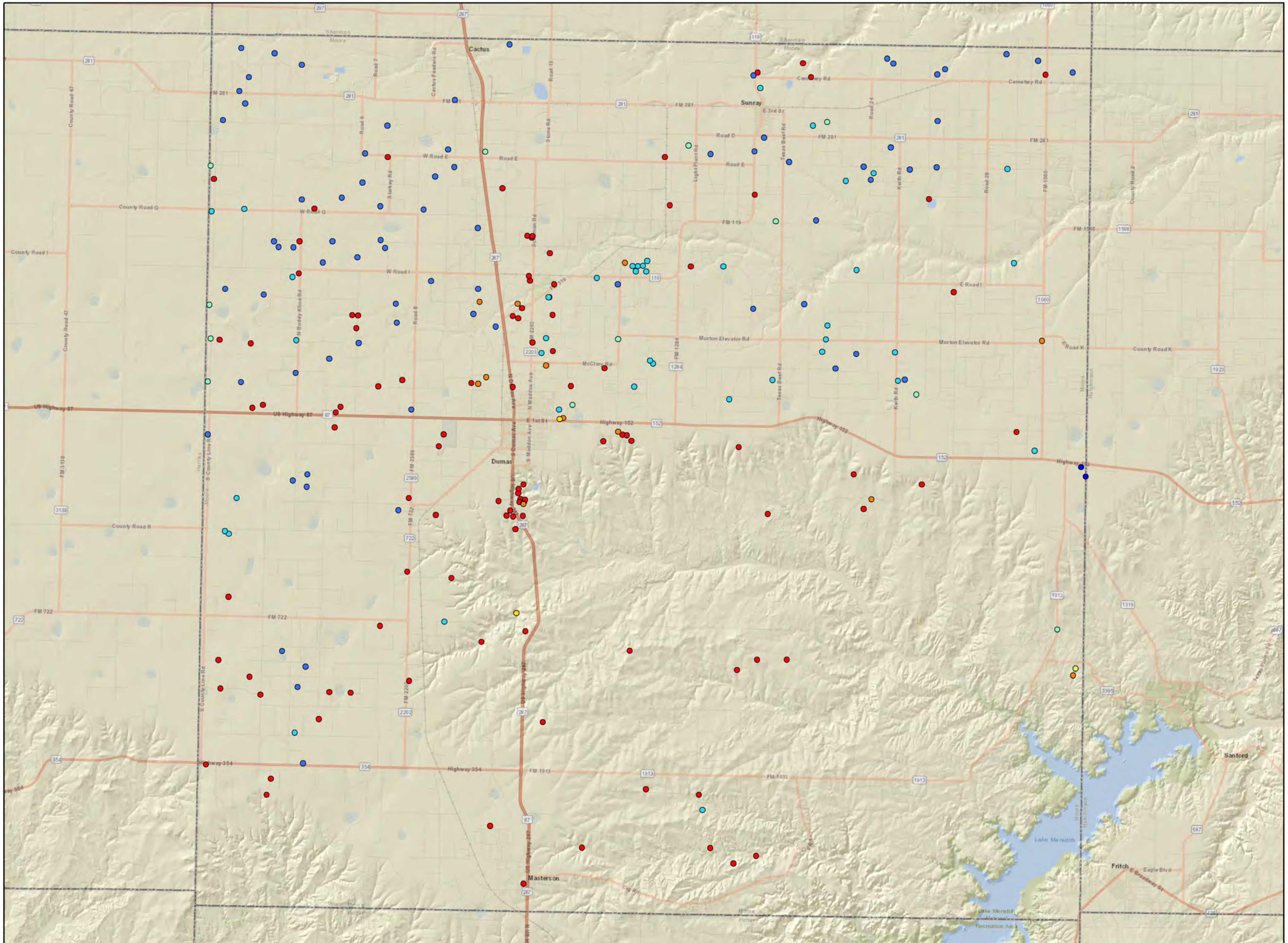
Well Yields
Moore

Average Yield (gpm): 282
Total number of wells: 251



Yield (gpm)

- 2 - 20
- 20 - 40
- 40 - 60
- 60 - 80
- 80 - 200
- 200 - 400
- 400 - 1000
- > 1000
- GMA 1
- Counties



N

0 1.25 2.5 5
Miles

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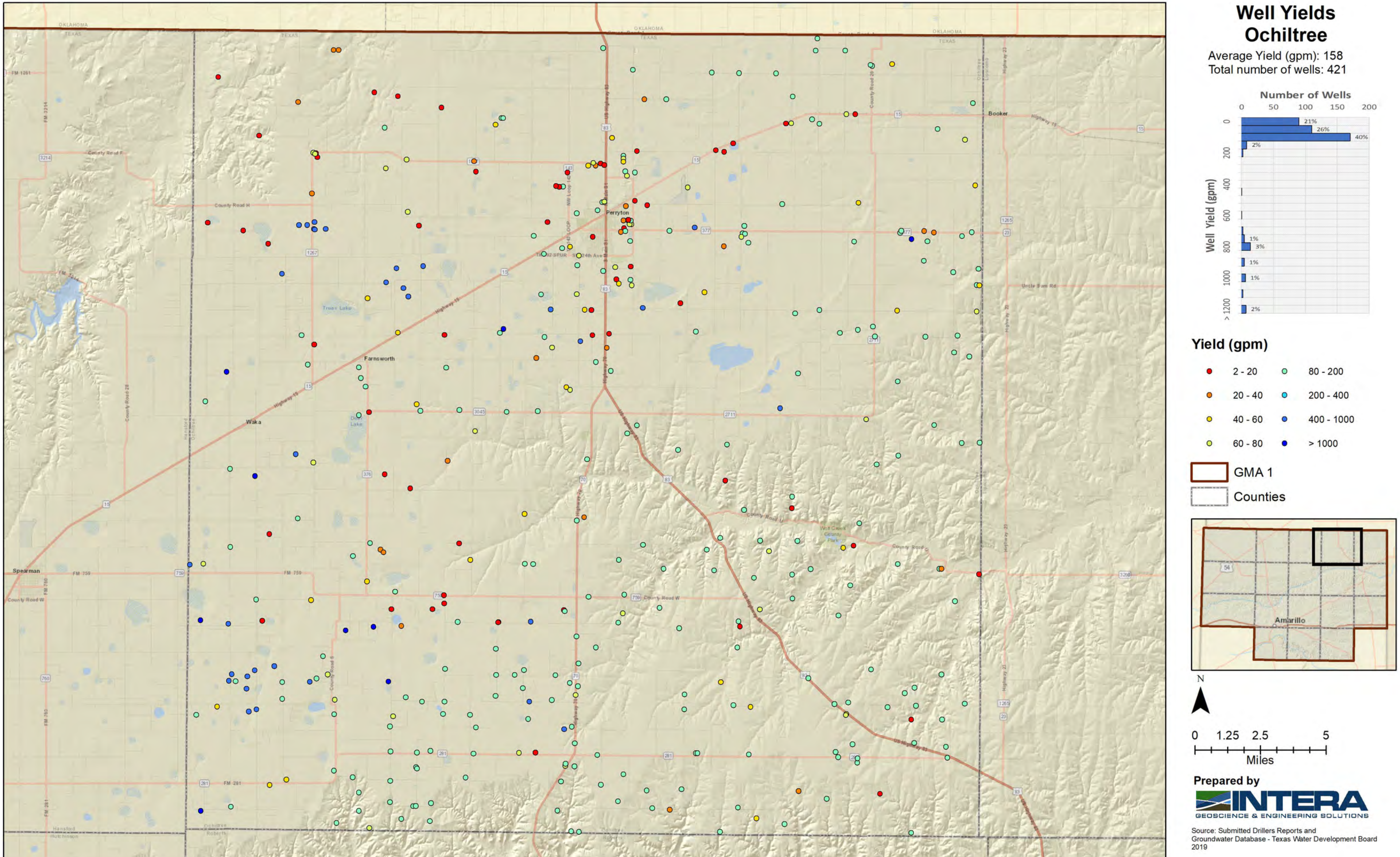

Well Yields
Ochiltree
Average Yield (gpm): 158
Total number of wells: 421
Number of Wells
Well Yield (gpm)
Yield (gpm)
2 - 20
20 - 40
40 - 60
60 - 80
80 - 200
200 - 400
400 - 1000
> 1000
GMA 1
Counties
Amarillo
Miles
Perryton
Farnsworth
Waka
Spearman
Booker
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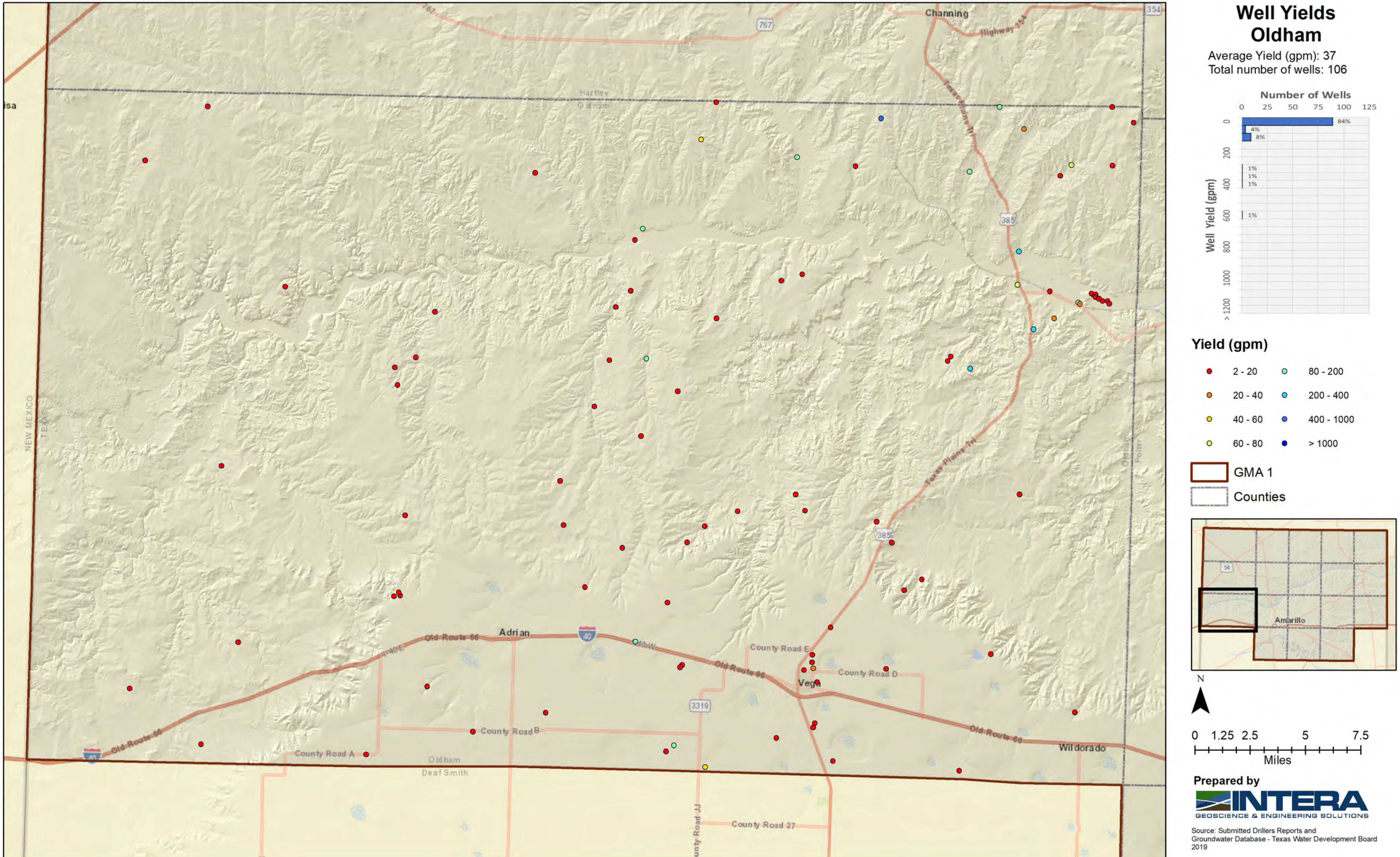

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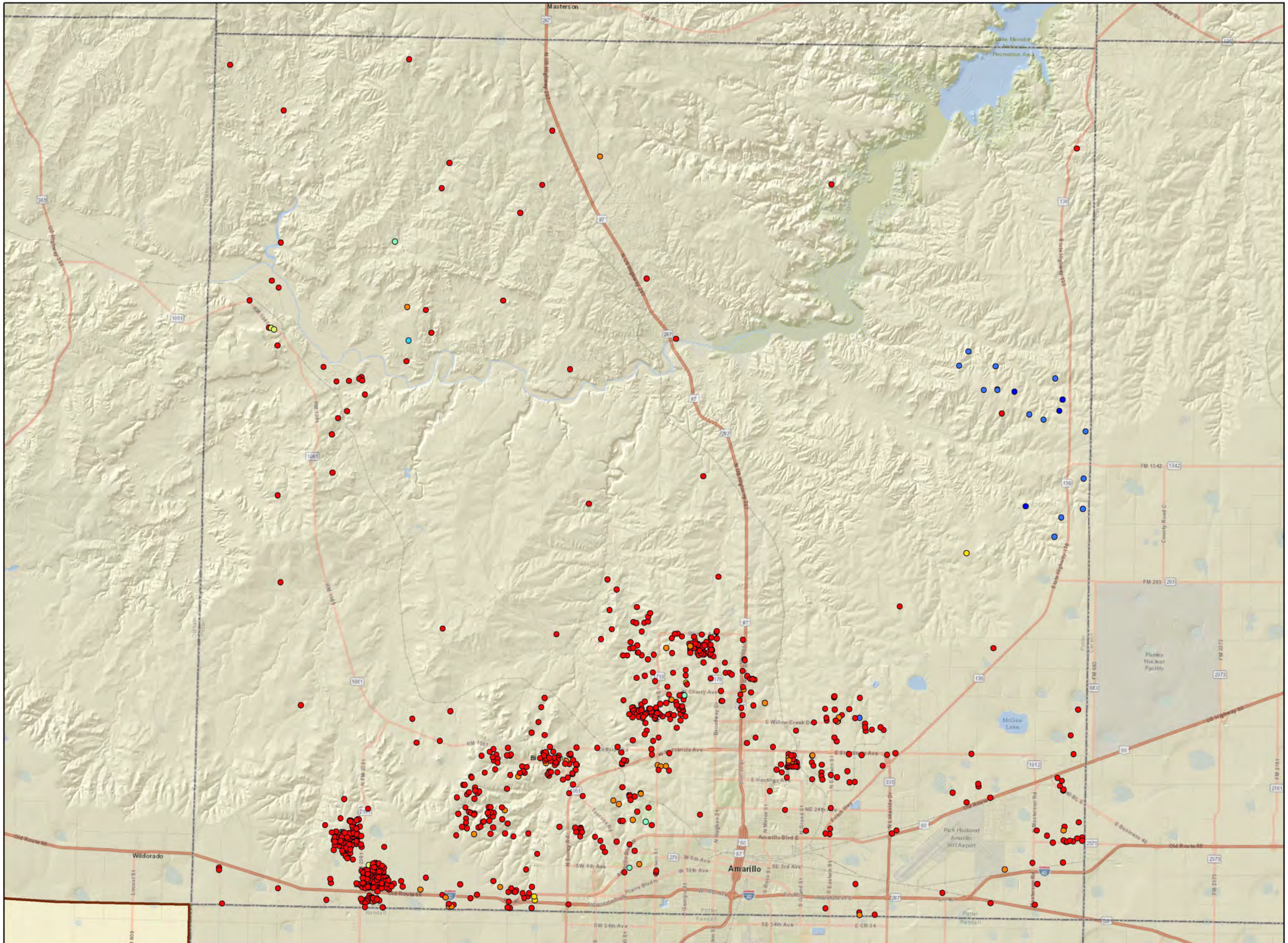
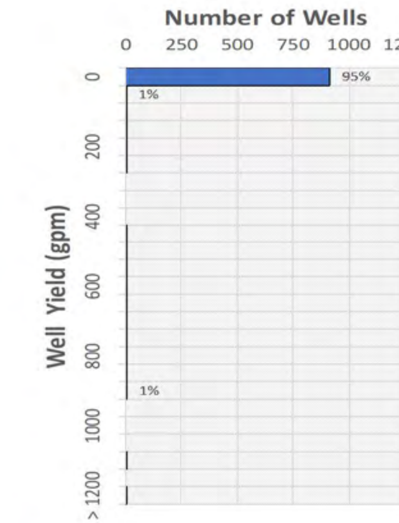
Source: Submitted Drillers Reports and Groundwater Database - Texas Water Development Board 2019



Well Yields
Potter

Average Yield (gpm): 48
Total number of wells: 969

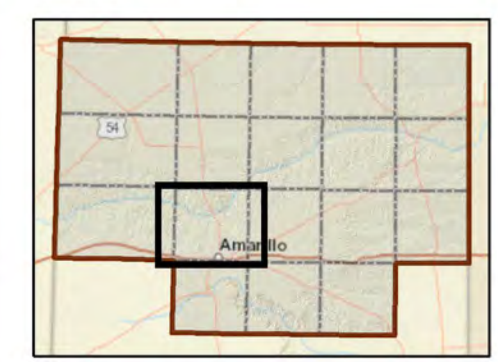


Yield (gpm)

- 2 - 20
- 20 - 40
- 40 - 60
- 60 - 80
- 80 - 200
- 200 - 400
- 400 - 1000
- > 1000

GMA 1

Counties



N

0 1.25 2.5 5
Miles

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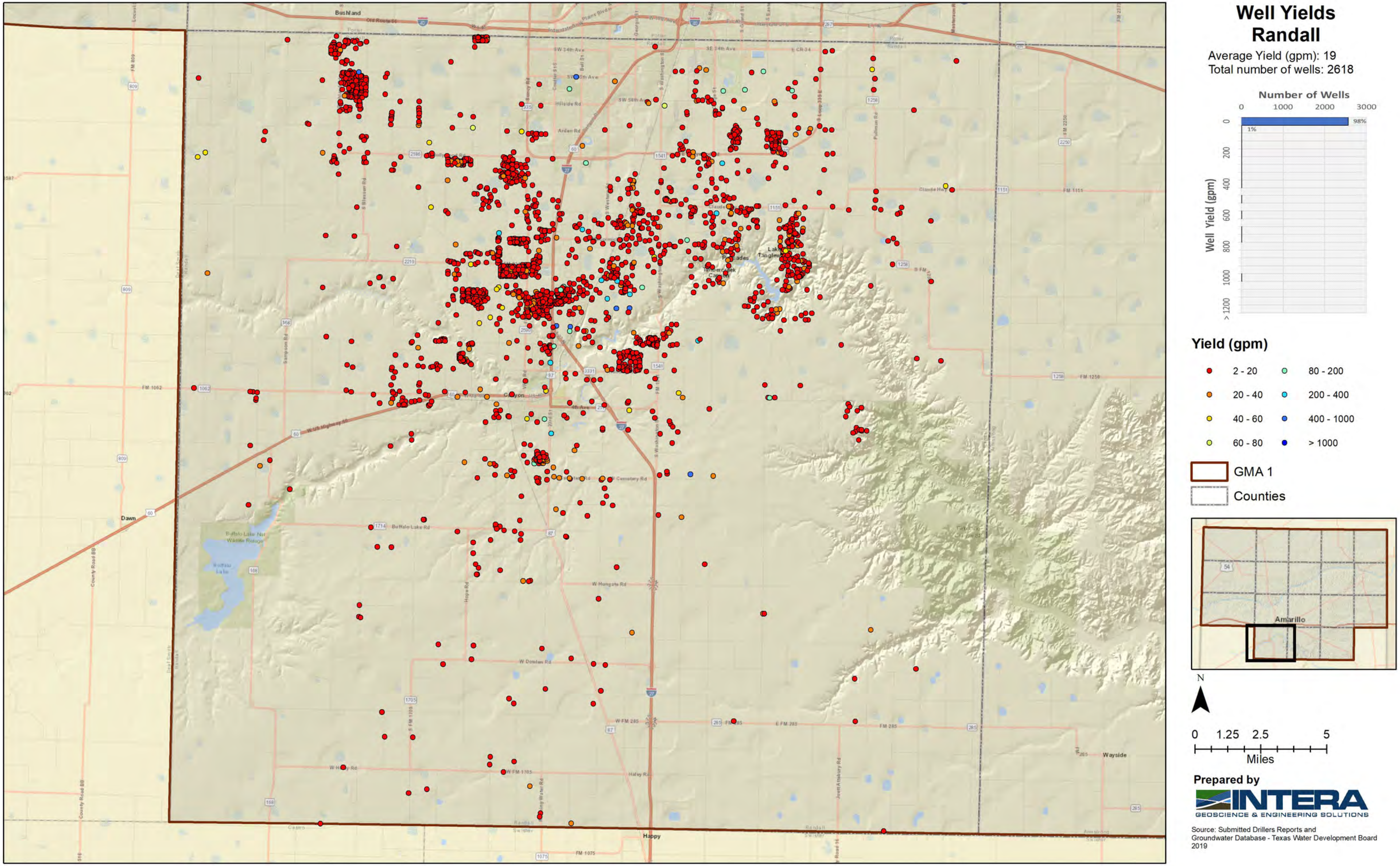
Well Yields
Randall
Average Yield (gpm): 19
Total number of wells: 2618
Number of Wells
0 1000 2000 3000
Well Yield (gpm)
0 200 400 600 800 1000 > 1200
98%
1%
Yield (gpm)
2 - 20
20 - 40
40 - 60
60 - 80
80 - 200
200 - 400
400 - 1000
> 1000
GMA 1
Counties
Amarillo
N
0 1.25 2.5 5
Miles
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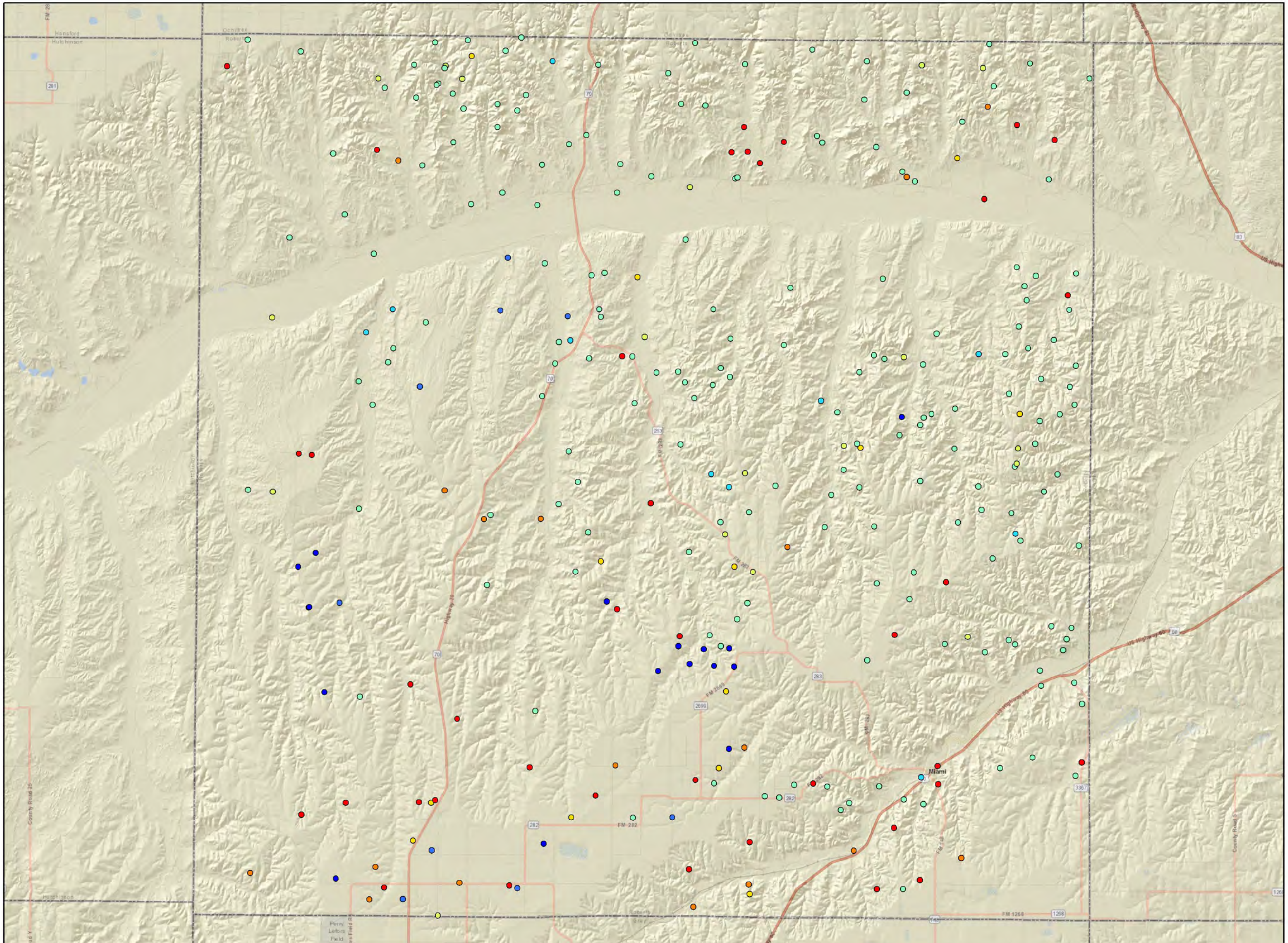
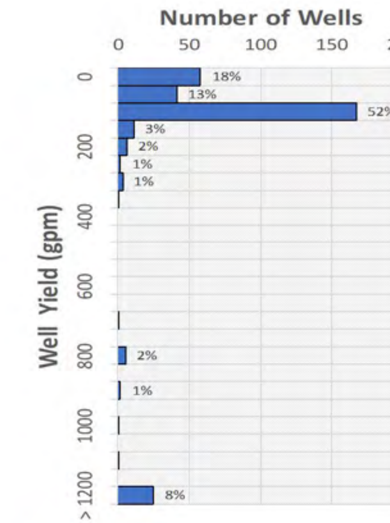
Source: Submitted Drillers Reports and Groundwater Database - Texas Water Development Board 2019
Bushland
Canyon
Dawn
Happy
Wayside
Buffalo Lake
Lake Tanglewood
Palisades
Timbercreek Canyon



Well Yields
Roberts

Average Yield (gpm): 269
Total number of wells: 324

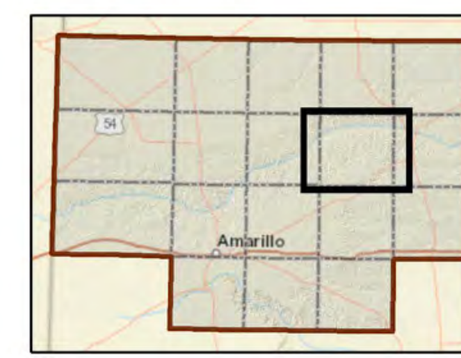


Yield (gpm)

- 2 - 20
- 20 - 40
- 40 - 60
- 60 - 80
- 80 - 200
- 200 - 400
- 400 - 1000
- > 1000

GMA 1

Counties



N

0 1.25 2.5 5

Miles

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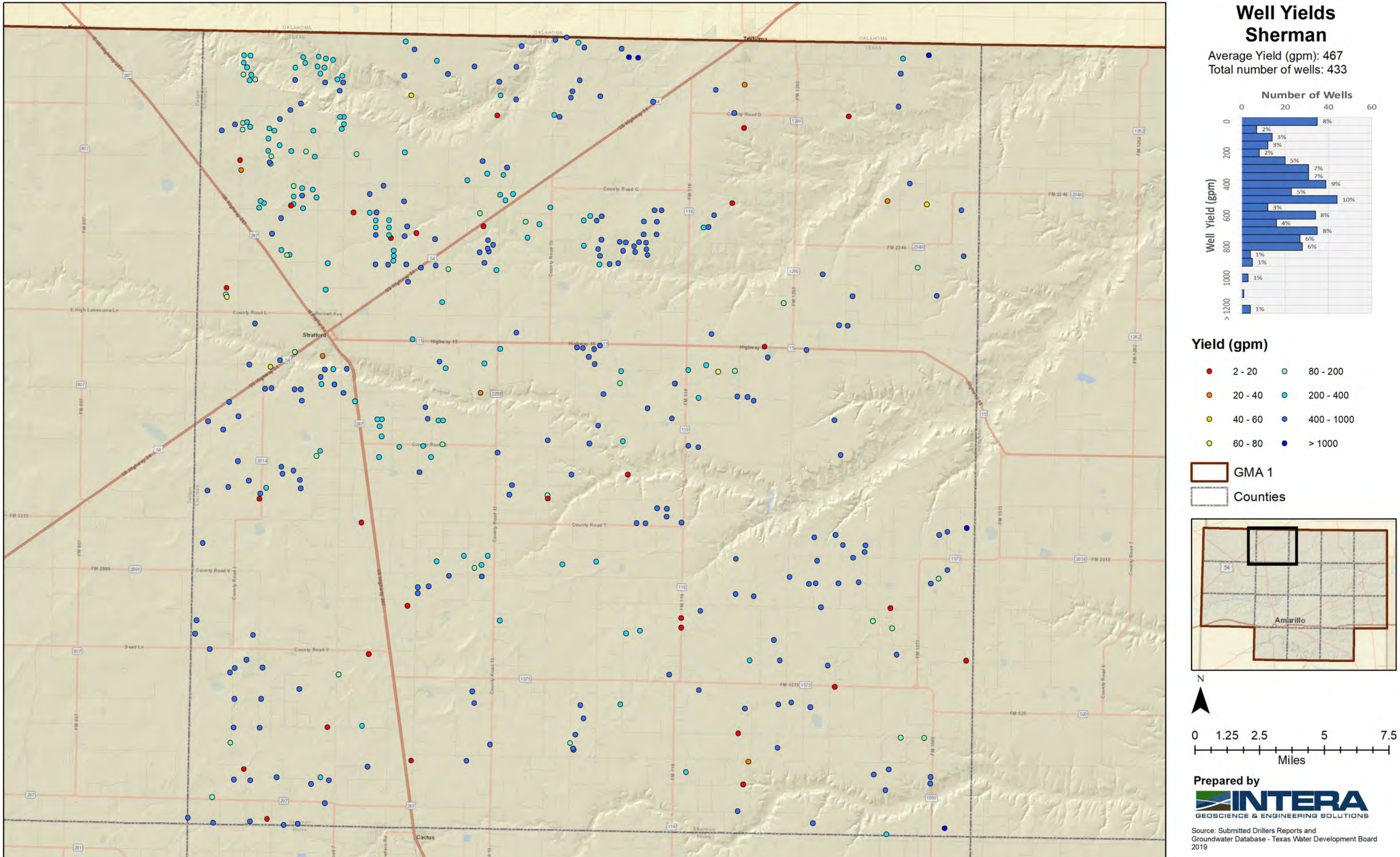
Well Yields
Sherman
Average Yield (gpm): 467
Total number of wells: 433
Number of Wells
0 20 40 60
Well Yield (gpm)
0 200 400 600 800 1000 > 1200
8%
2%
3%
3%
2%
5%
7%
7%
9%
5%
10%
3%
8%
4%
8%
6%
6%
1%
1%
1%
1%
Yield (gpm)
2 - 20
20 - 40
40 - 60
60 - 80
80 - 200
200 - 400
400 - 1000
> 1000
GMA 1
Counties
Amarillo
N
0 1.25 2.5 5 7.5
Miles
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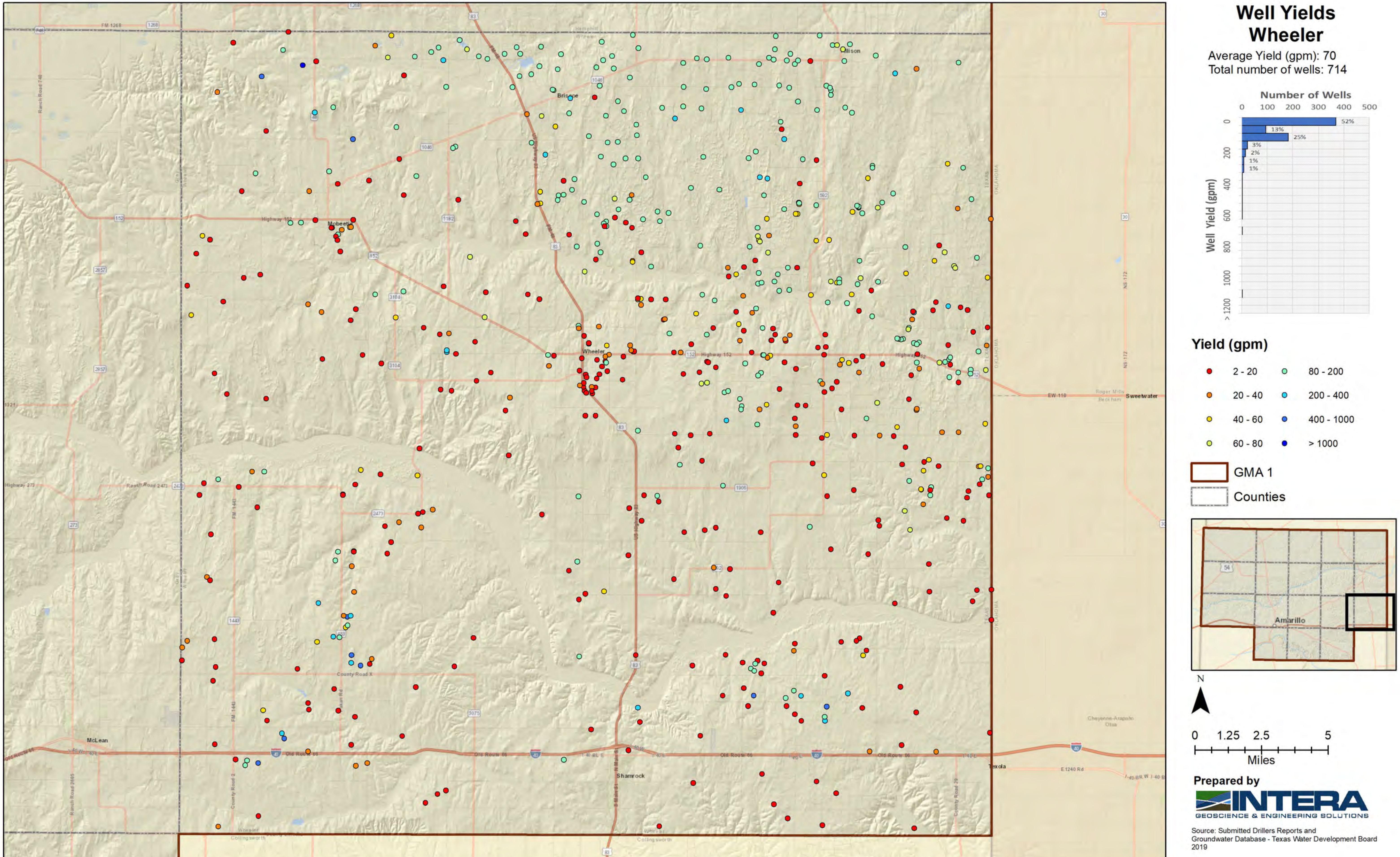
Stratford
Texhoma
Cactus



Well Yields
Wheeler
Average Yield (gpm): 70
Total number of wells: 714
Number of Wells
0 100 200 300 400 500
Well Yield (gpm)
0 200 400 600 800 1000 > 1200
52%
13%
25%
3%
2%
1%
1%
Yield (gpm)
2 - 20
20 - 40
40 - 60
60 - 80
80 - 200
200 - 400
400 - 1000
> 1000
GMA 1
Counties
Amarillo
N
0 1.25 2.5 5
Miles
Prepared by
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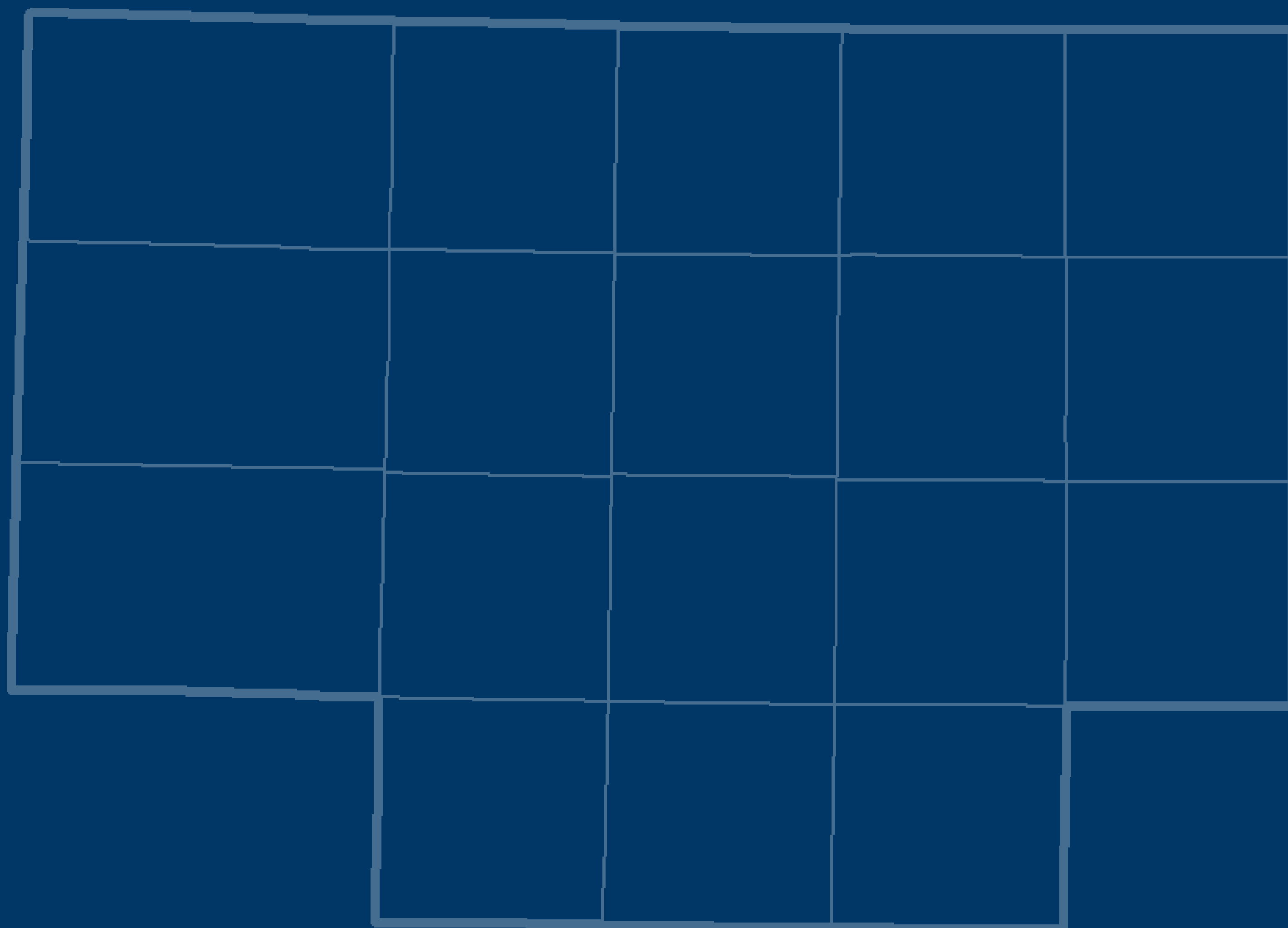
Source: Submitted Drillers Reports and Groundwater Database - Texas Water Development Board 2019
Allison
Briscoe
Mobeetie
Wheeler
Sweetwater
McLean
Shamrock
Texola
Highway 152
Old Route 66

Appendix B: County Pumping by Aquifer and Use



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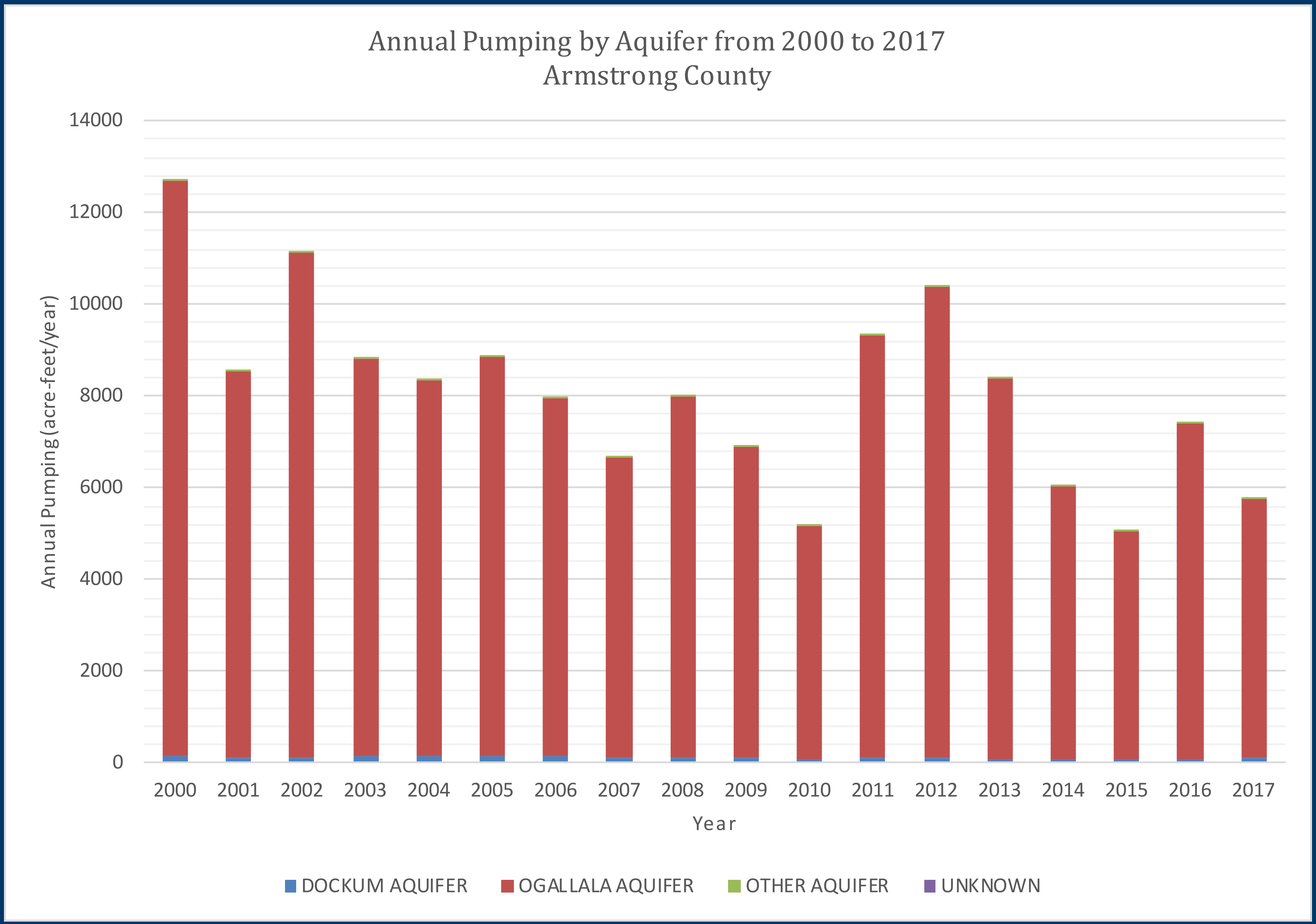

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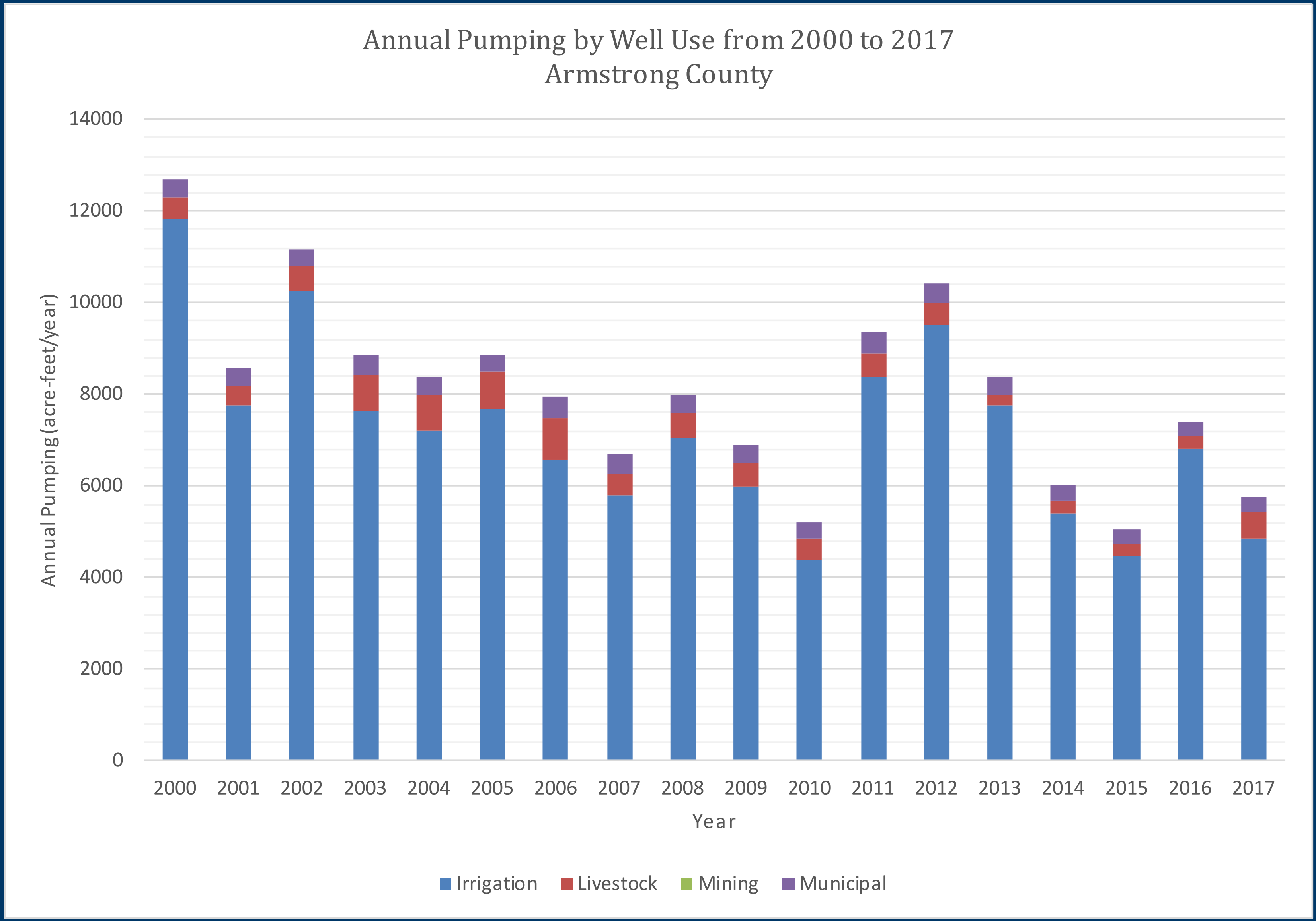

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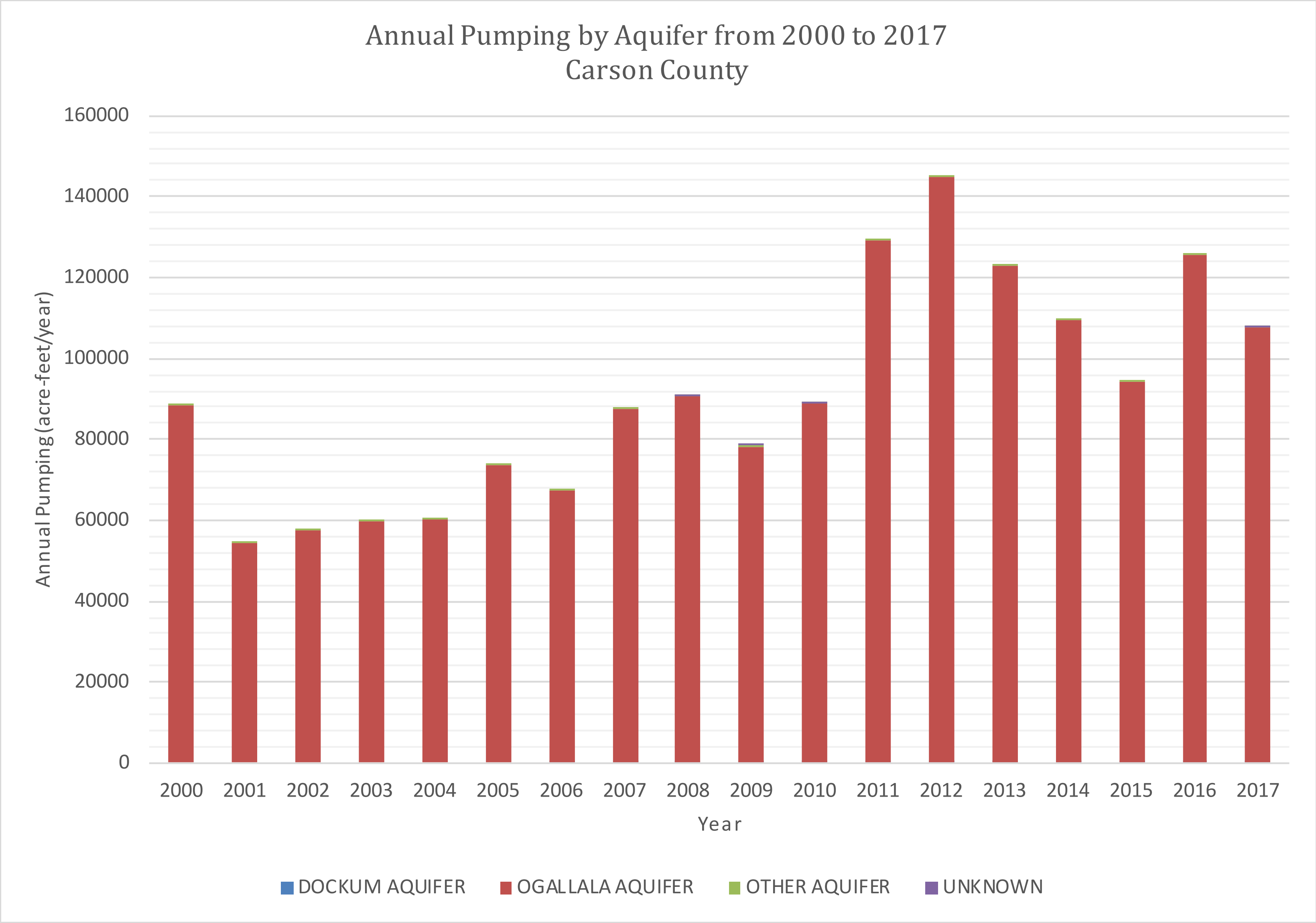

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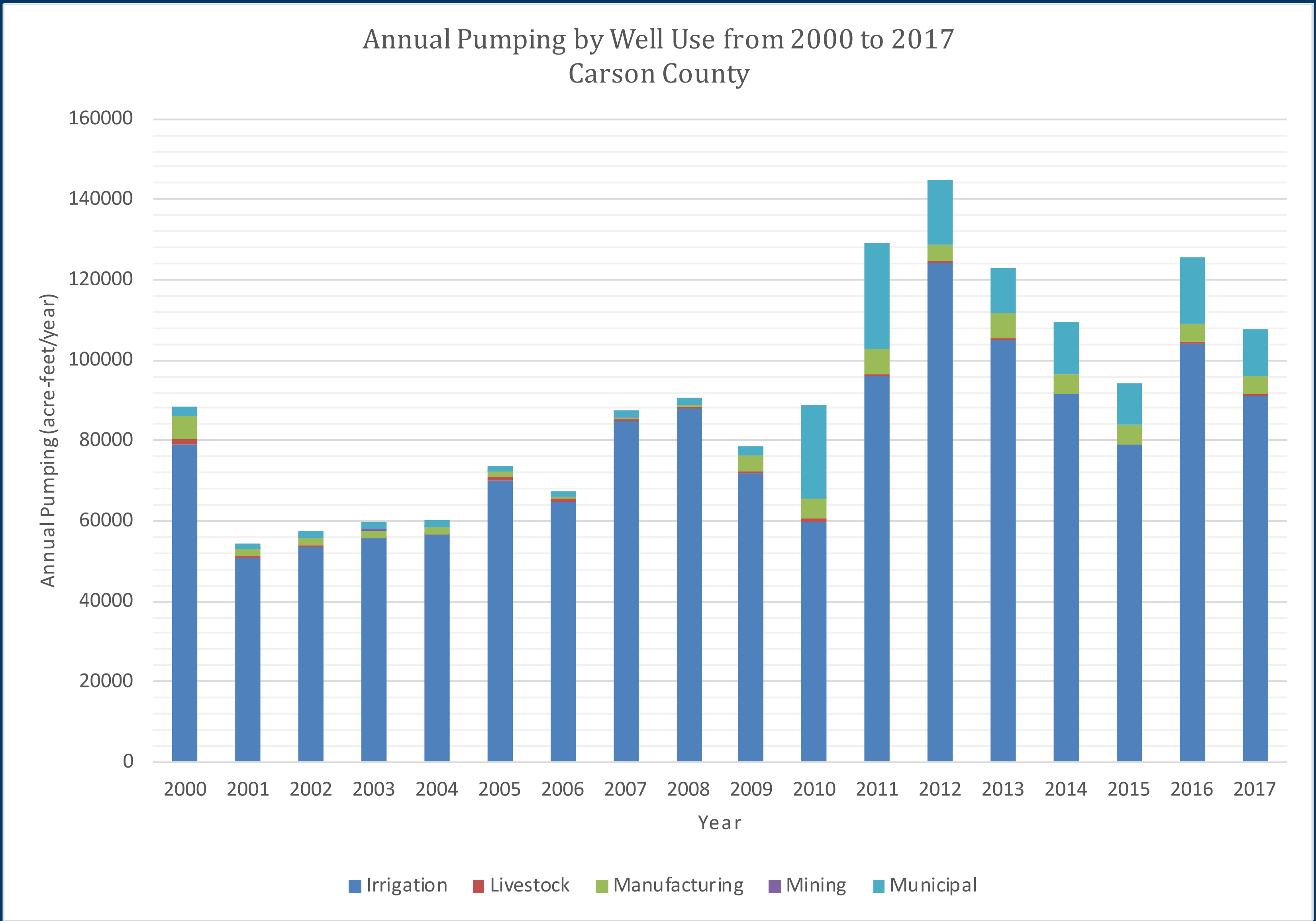

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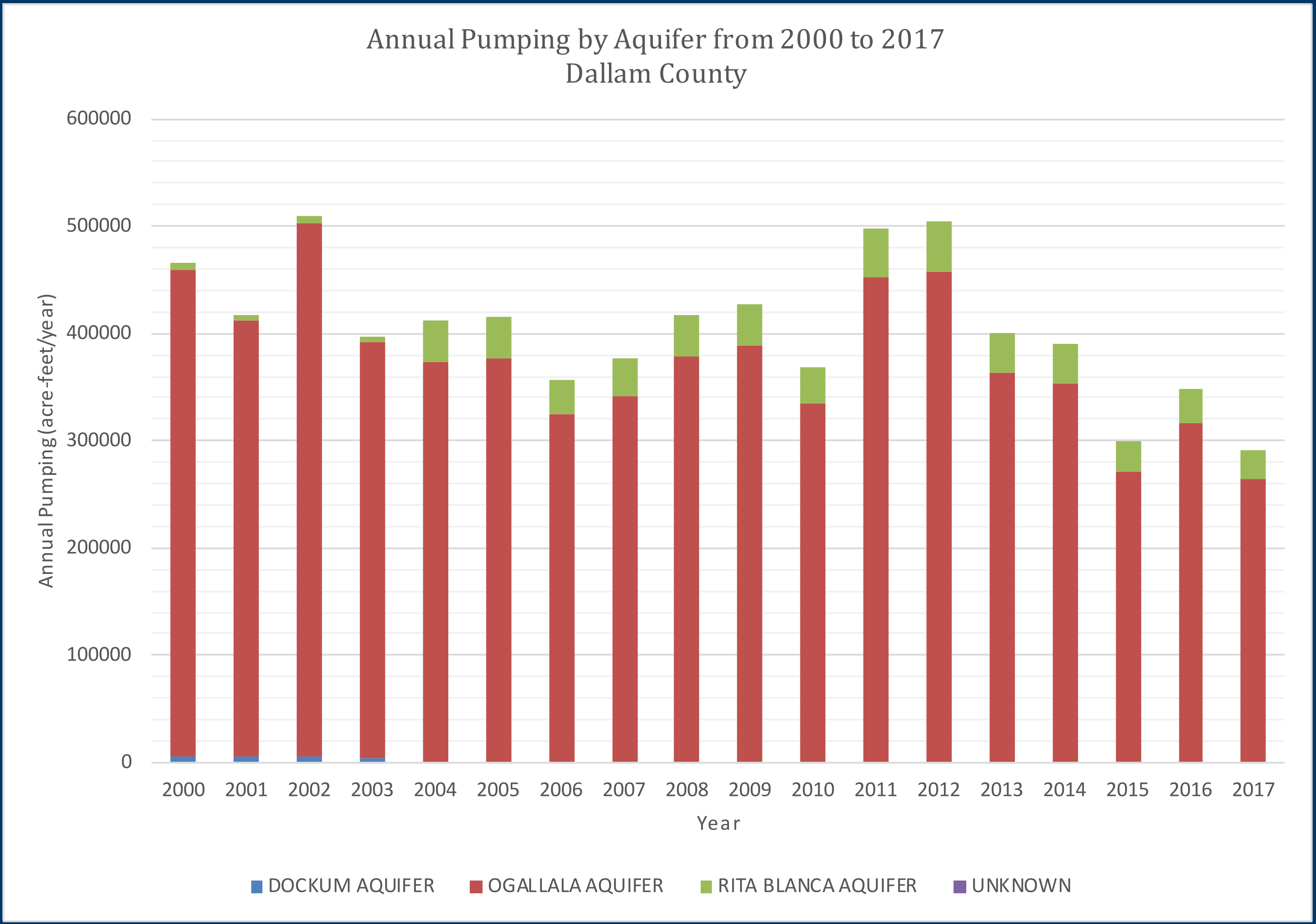
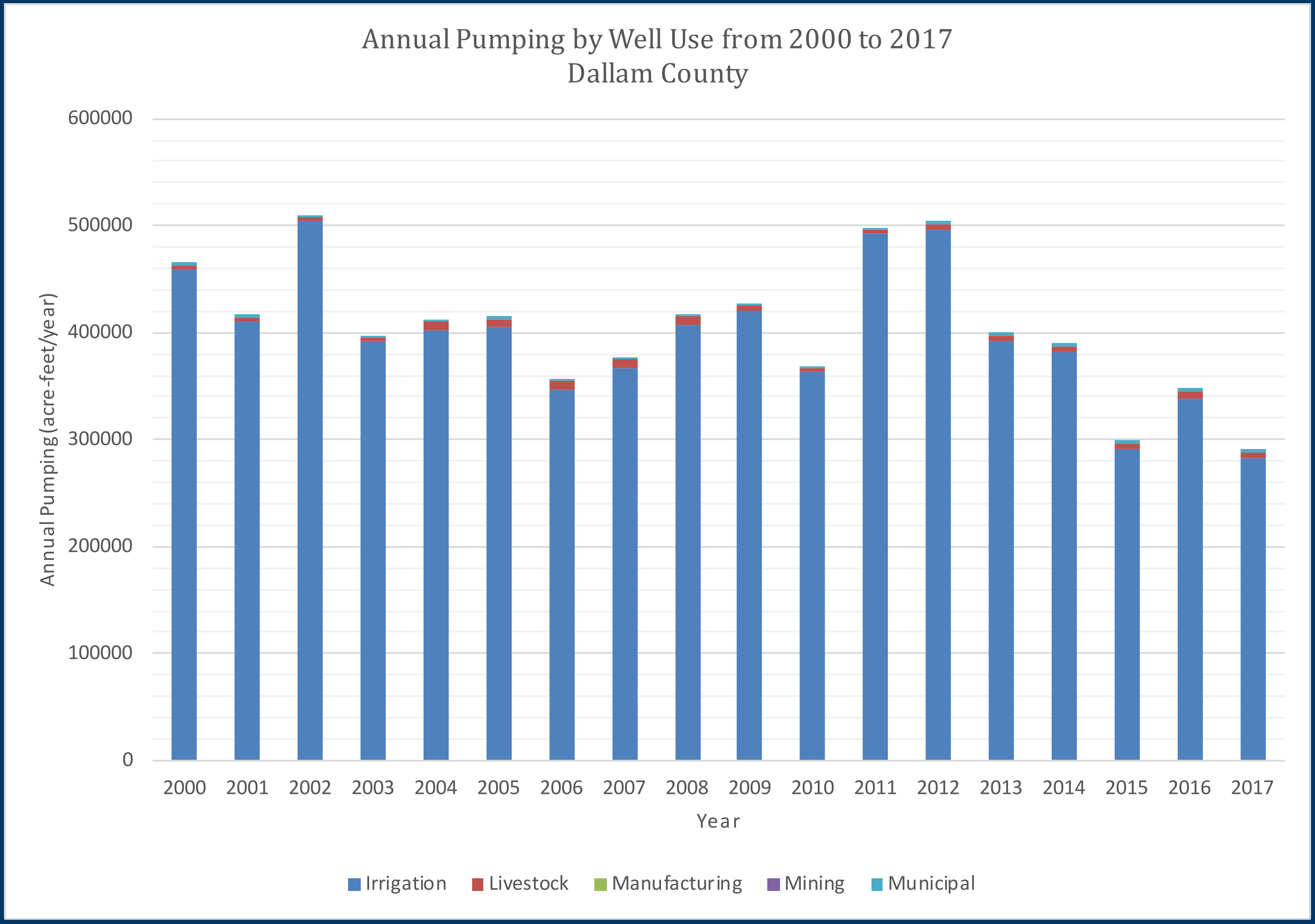
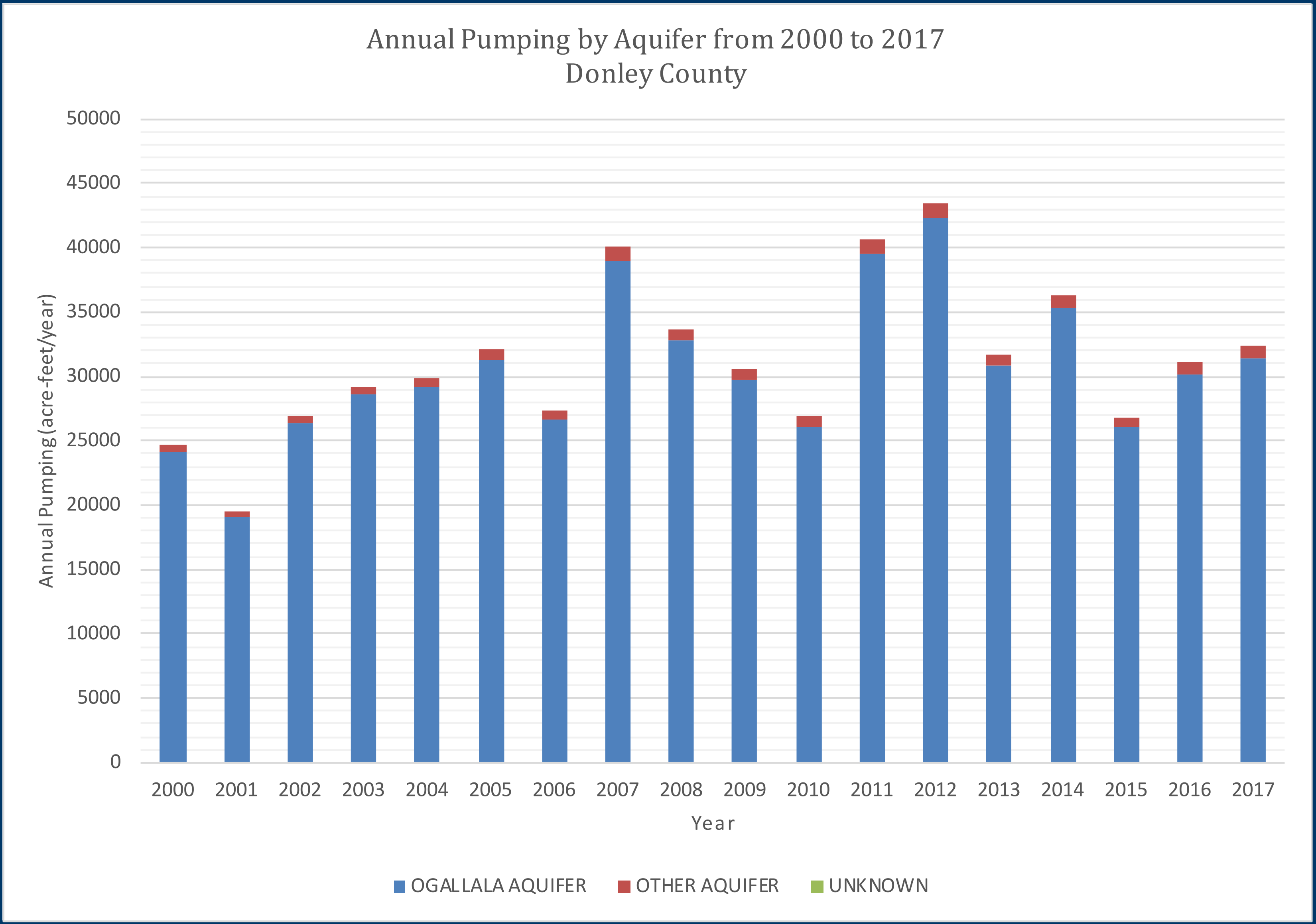

Annual Pumping by Aquifer from 2000 to 2017
Dallam County
600000
500000
400000
300000
200000
100000
0
Annual Pumping (acre-feet/year)
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Year
DOCKUM AQUIFER
OGALLALA AQUIFER
RITA BLANCA AQUIFER
UNKNOWN



Annual Pumping by Well Use from 2000 to 2017
Dallam County
Annual Pumping (acre-feet/year)
600000
500000
400000
300000
200000
100000
0
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Year
Irrigation
Livestock
Manufacturing
Mining
Municipal



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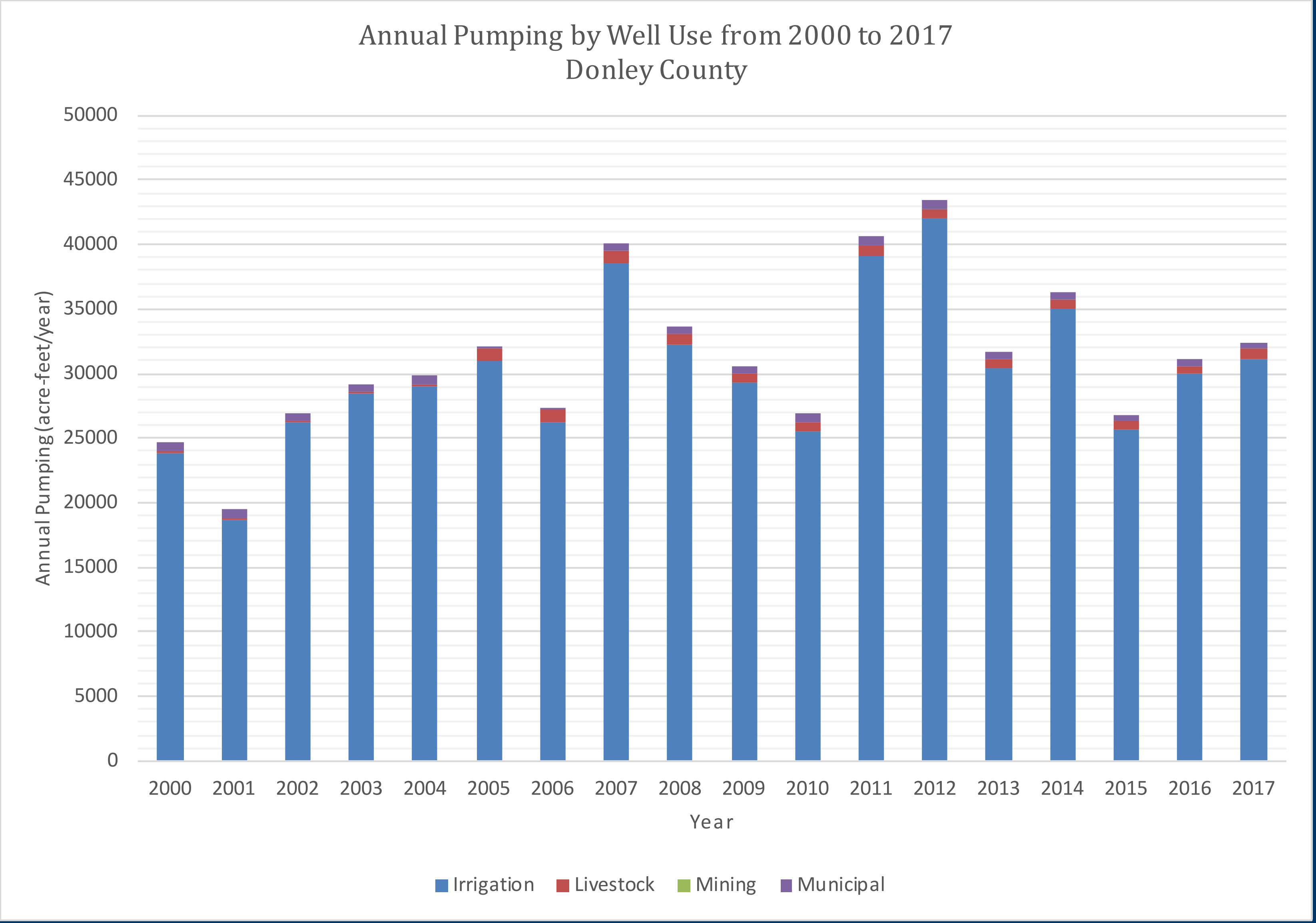

Annual Pumping by Well Use from 2000 to 2017
Donley County
Annual Pumping (acre-feet/year)
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Year
Irrigation
Livestock
Mining
Municipal

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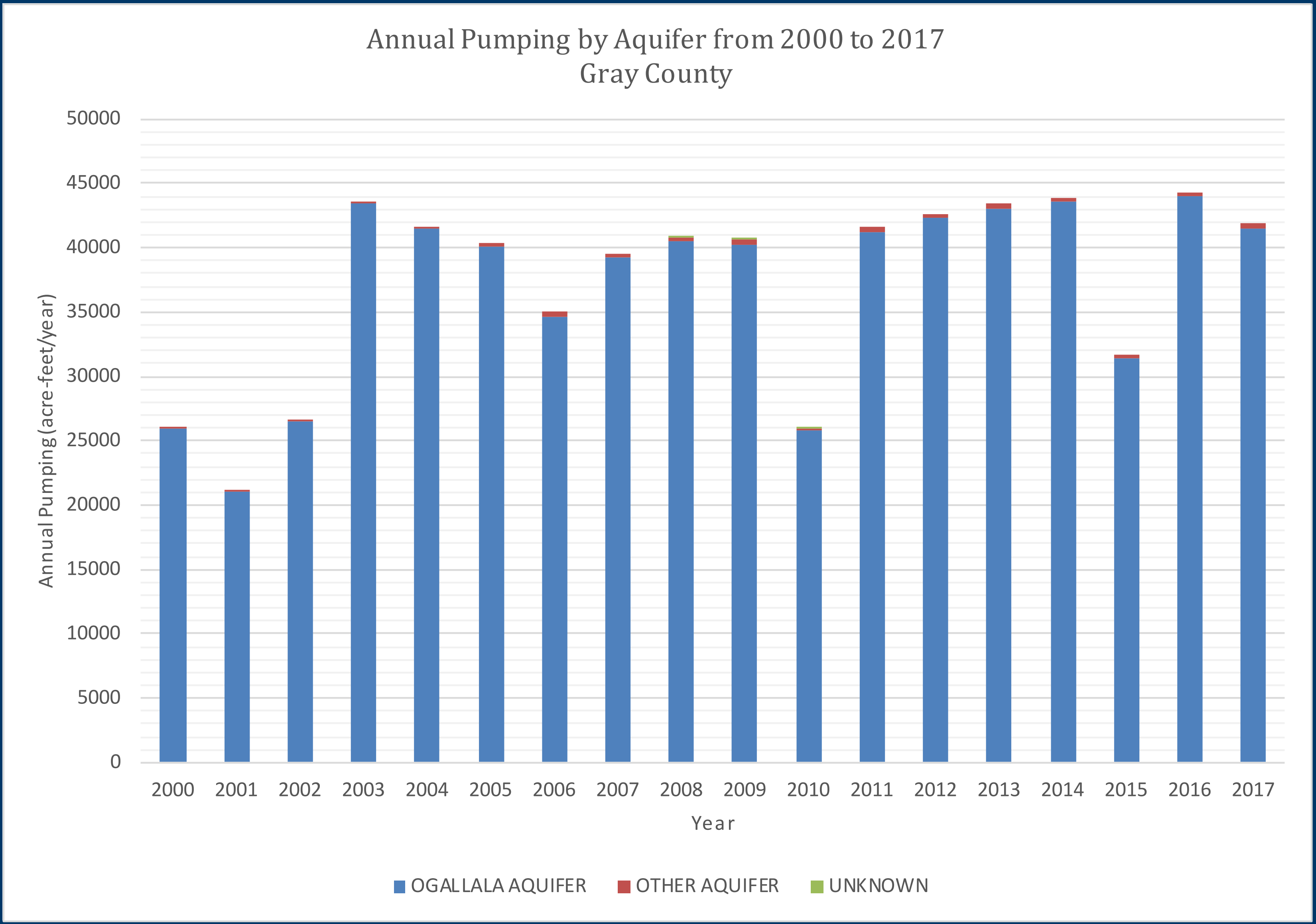

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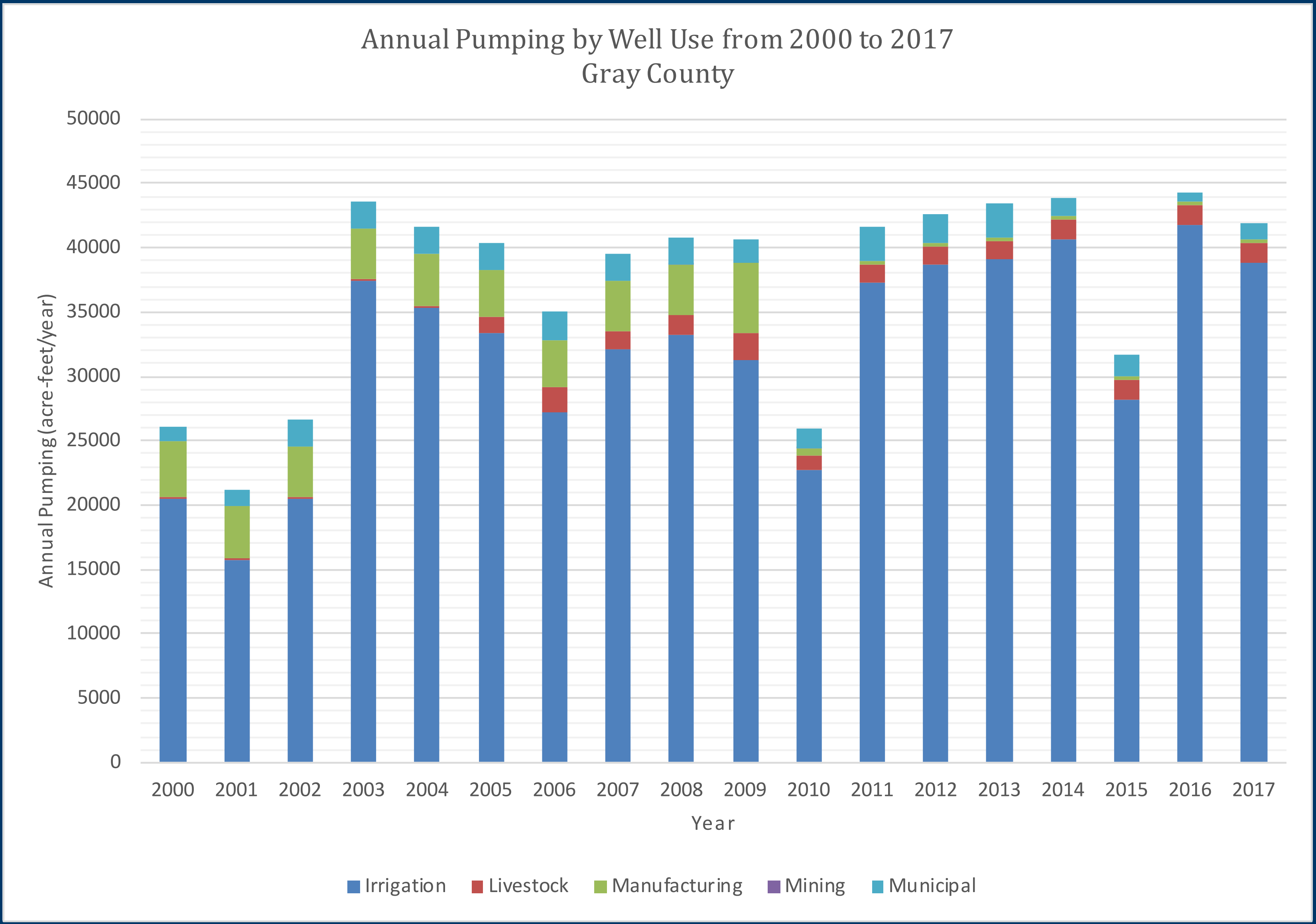
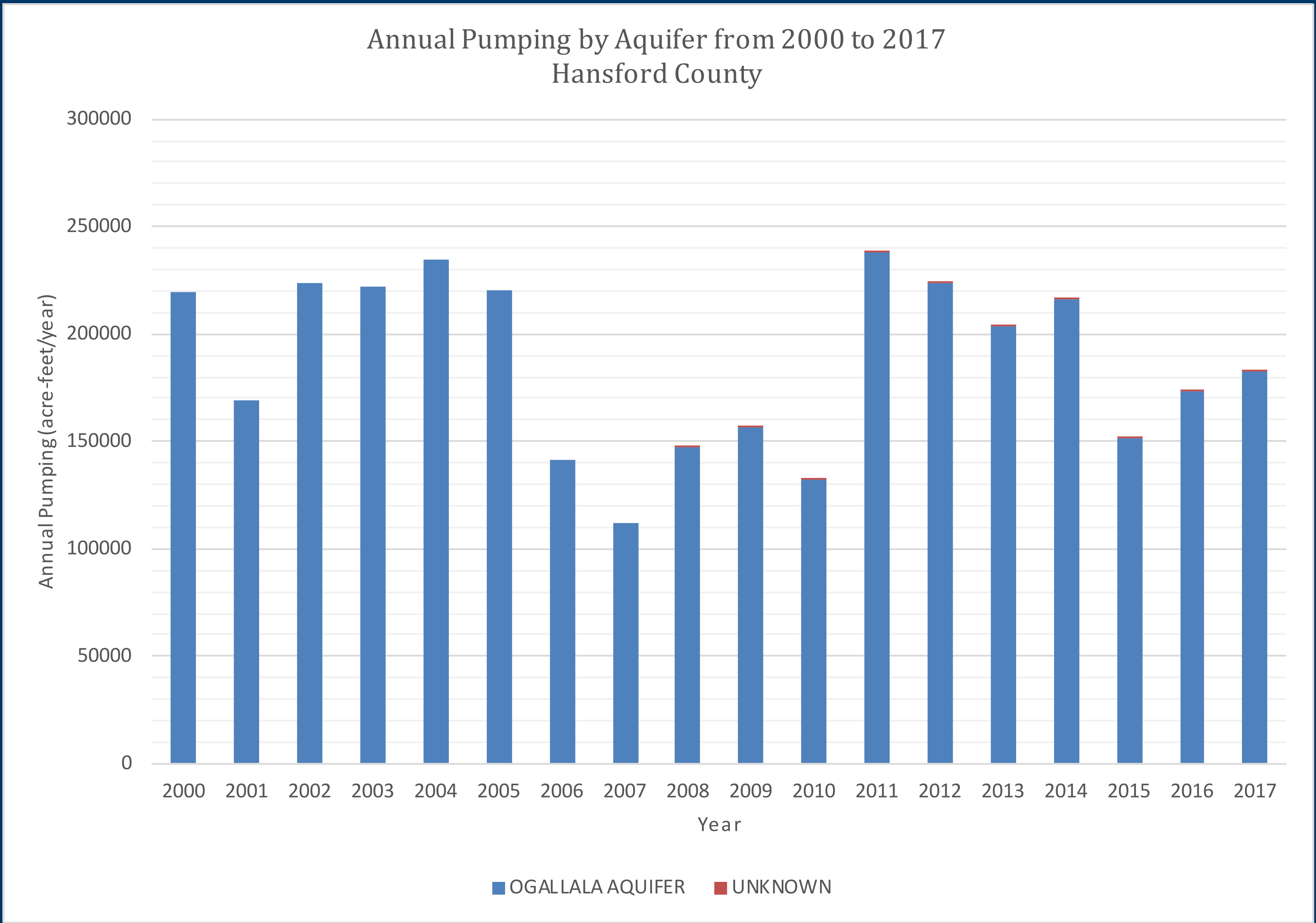
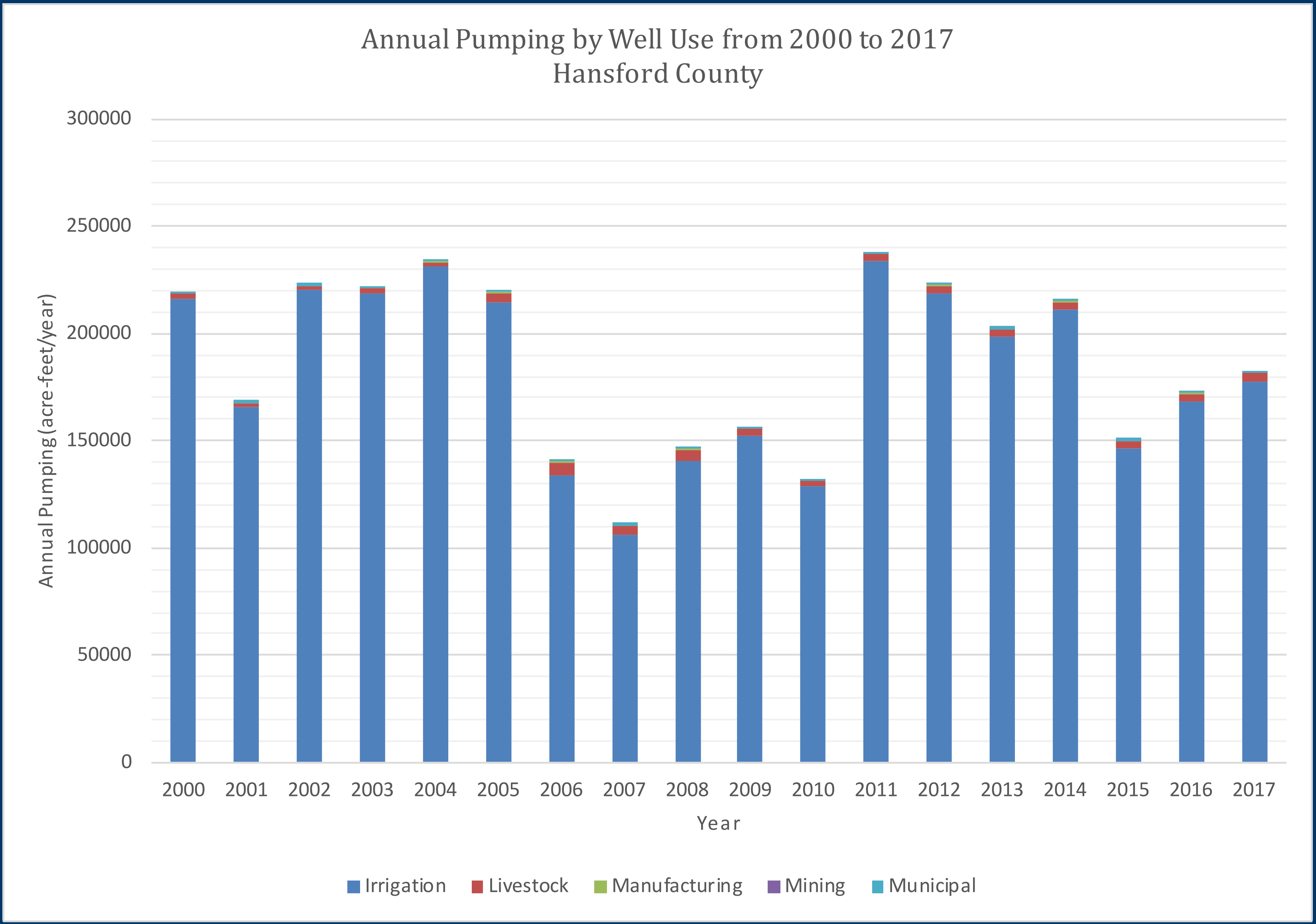


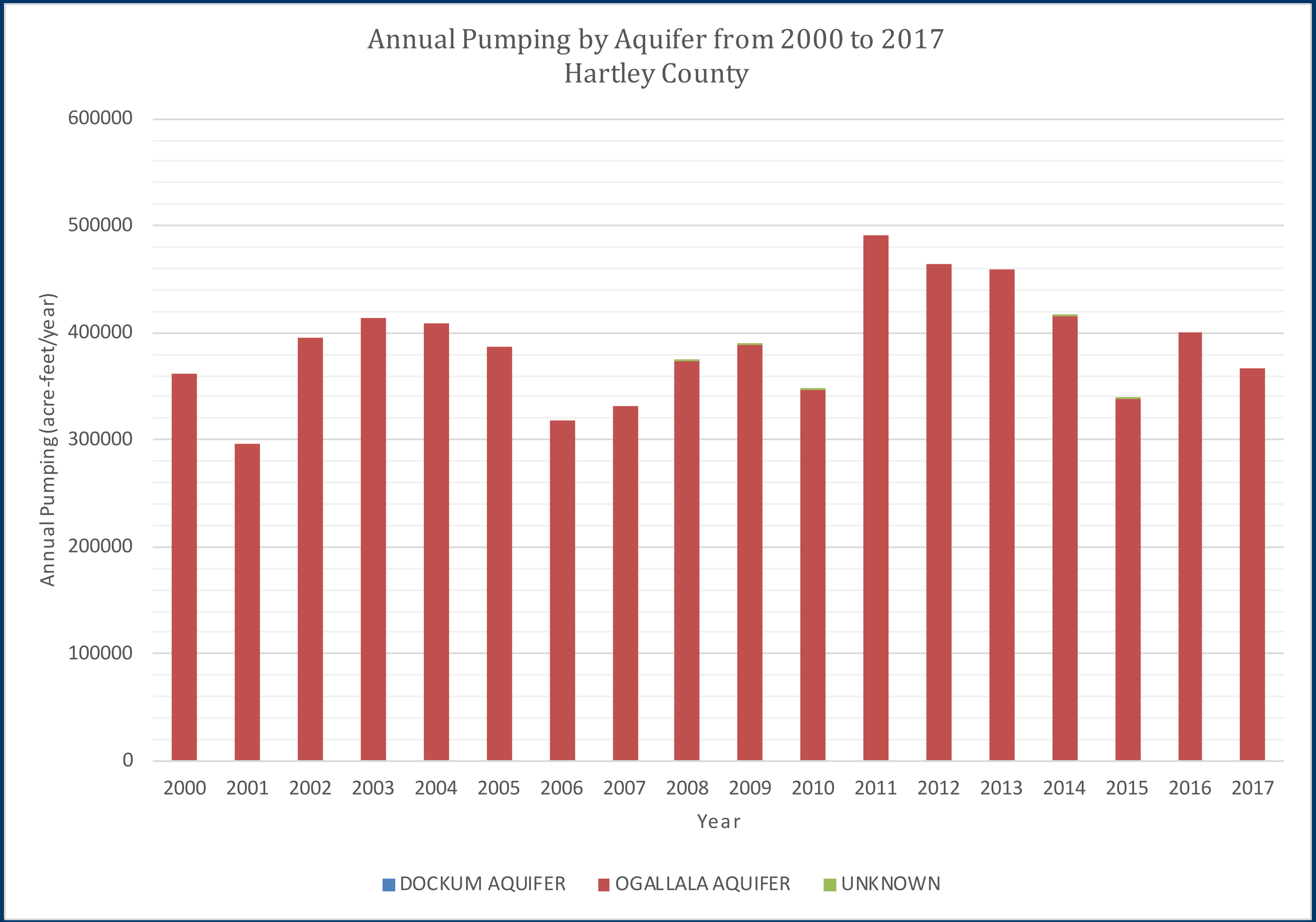
Annual Pumping by Well Use from 2000 to 2017
Gray County
Annual Pumping (acre-feet/year)
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Year
Irrigation
Livestock
Manufacturing
Mining
Municipal



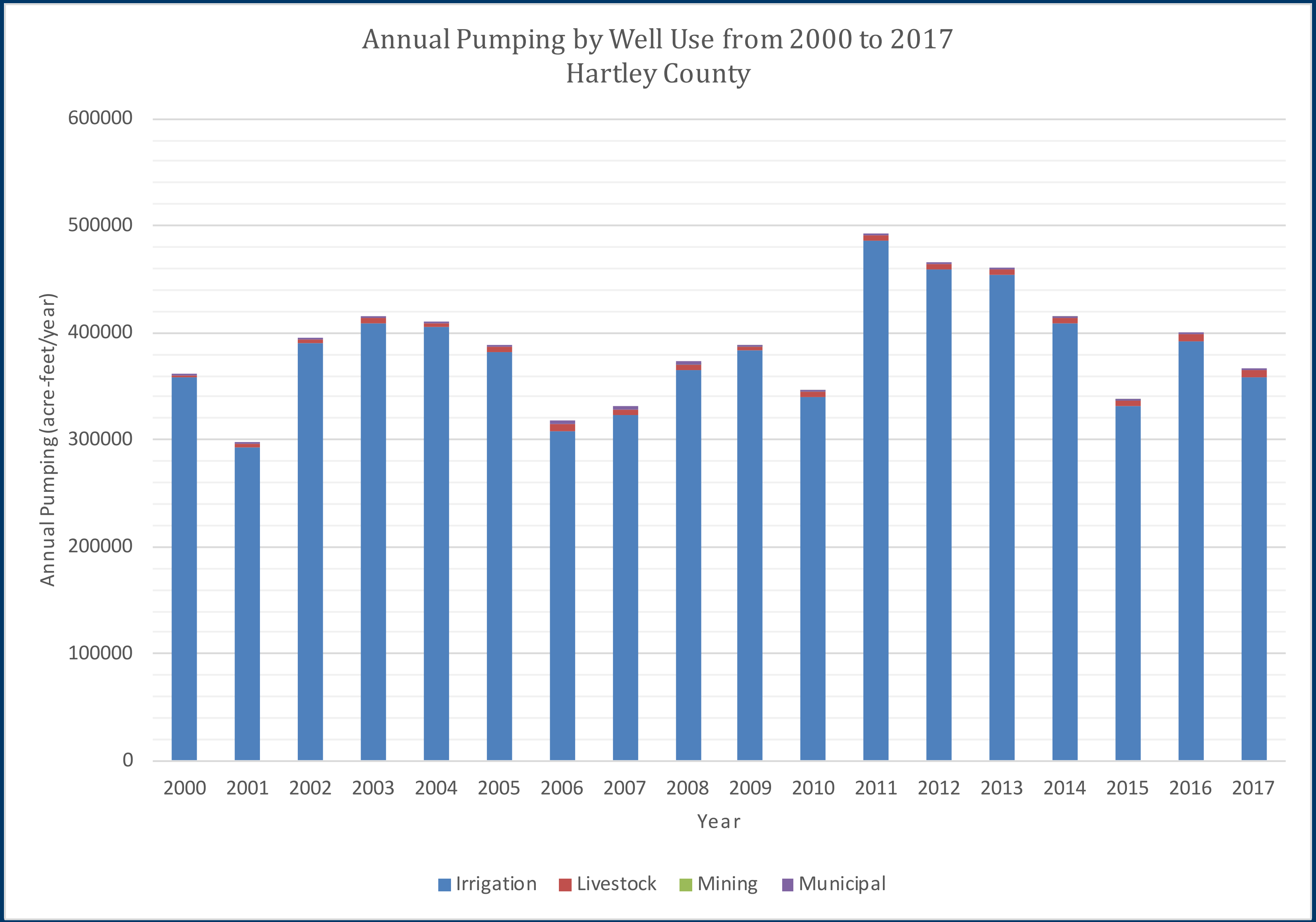
INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS



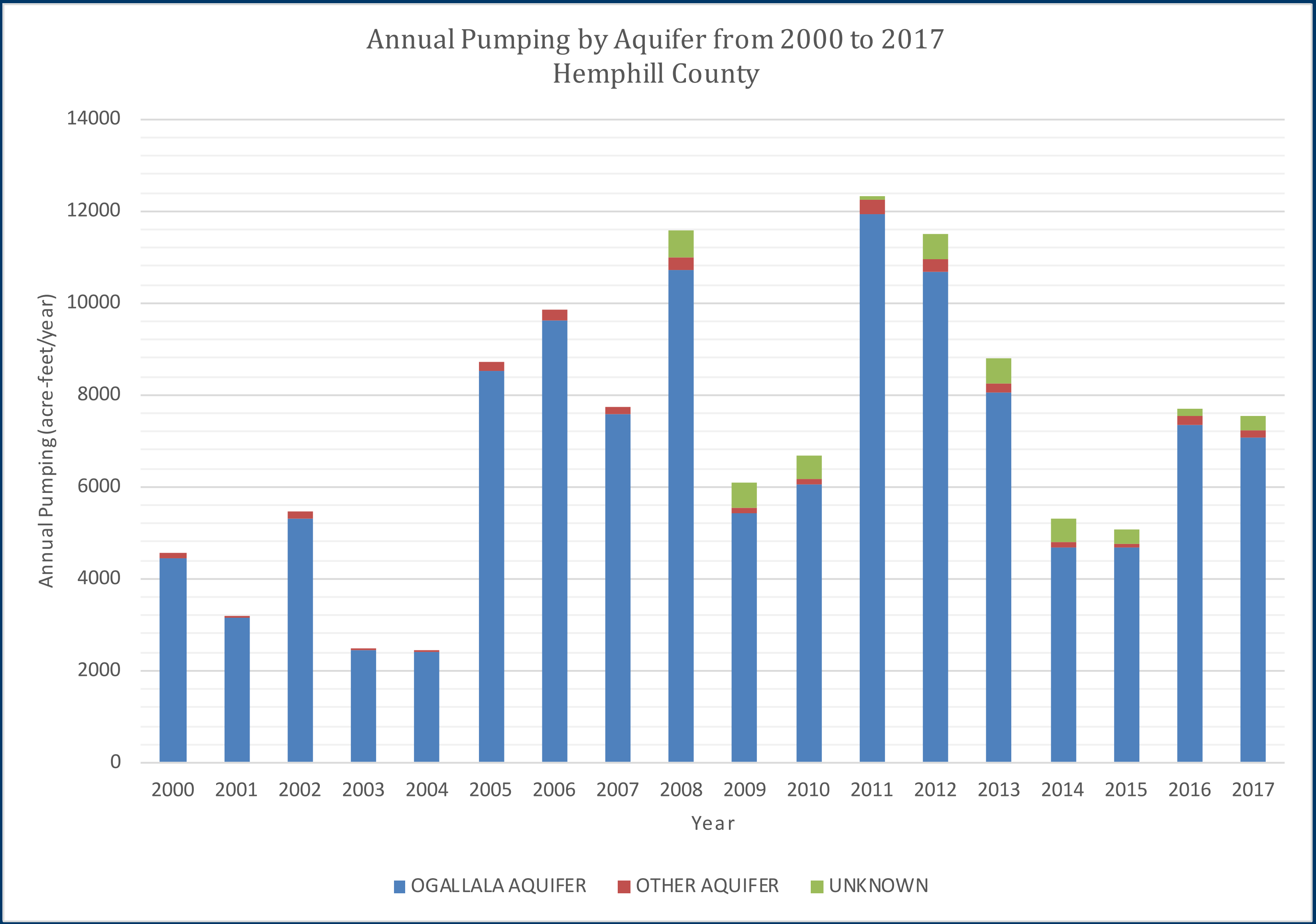
Annual Pumping by Well Use from 2000 to 2017
Hansford County
Annual Pumping (acre-feet/year)
300000
250000
200000
150000
100000
50000
0
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Year
Irrigation
Livestock
Manufacturing
Mining
Municipal



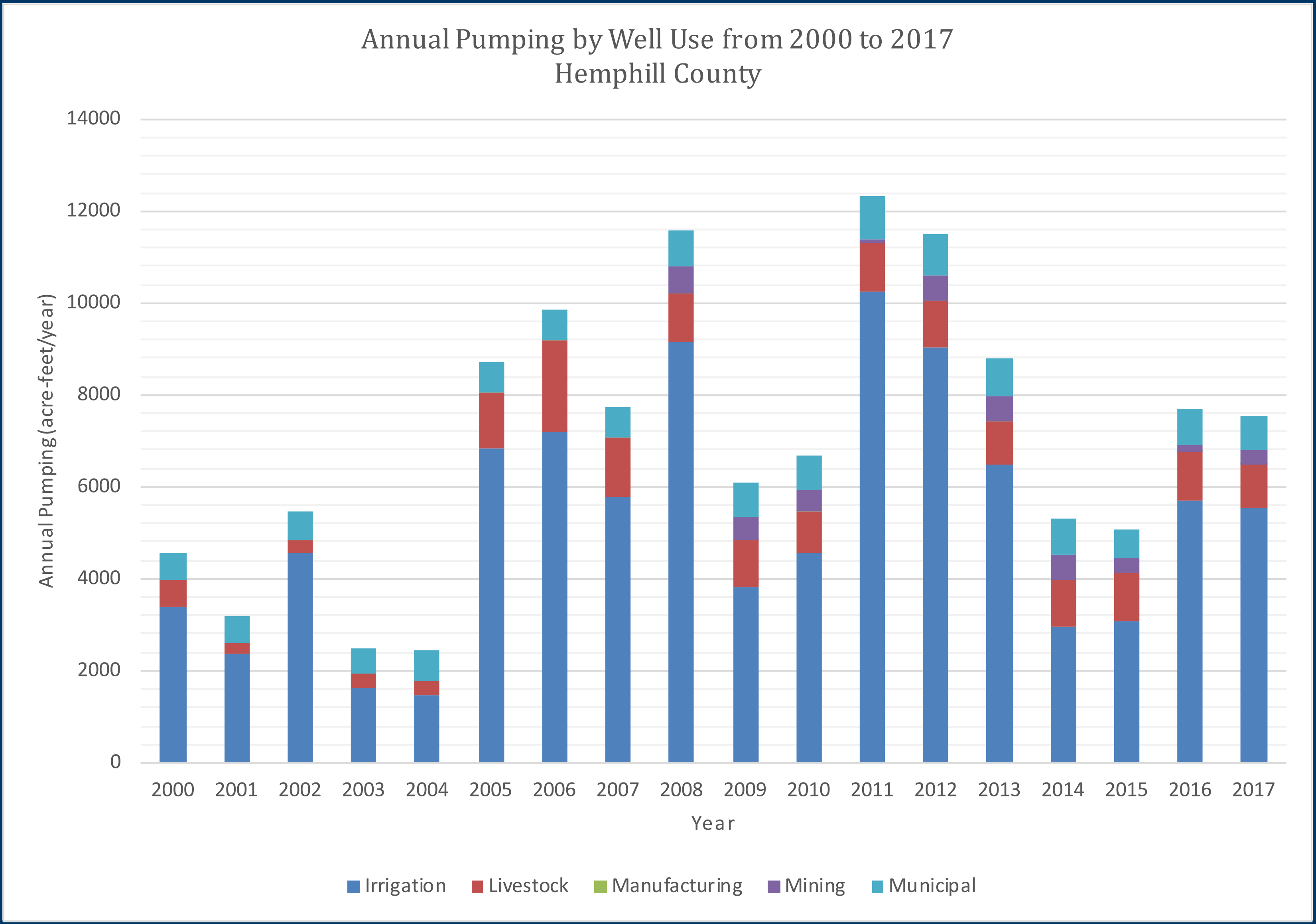
INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS



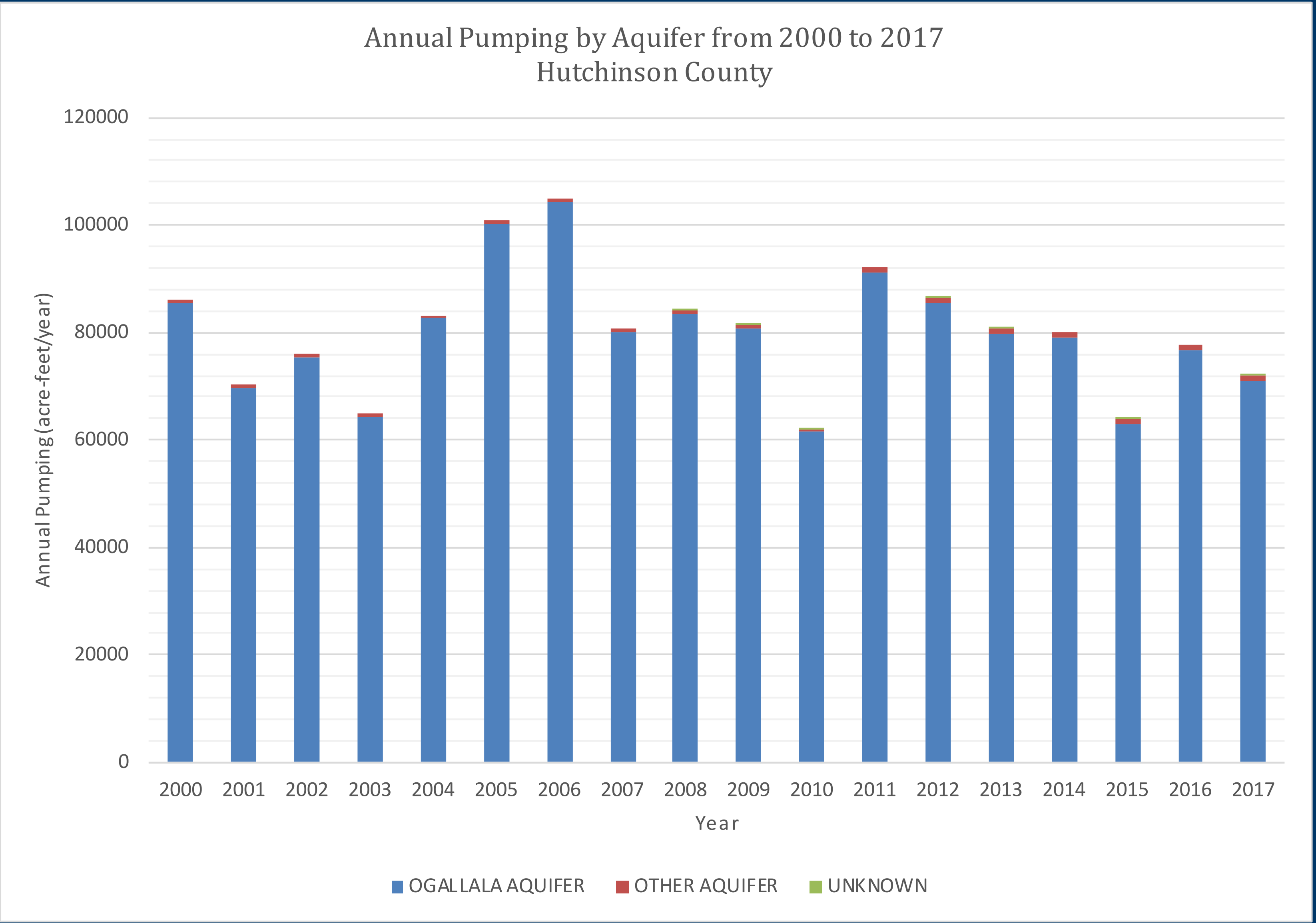
Annual Pumping by Well Use from 2000 to 2017
Hartley County
Annual Pumping (acre-feet/year)
600000
500000
400000
300000
200000
100000
0
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Year
Irrigation
Livestock
Mining
Municipal



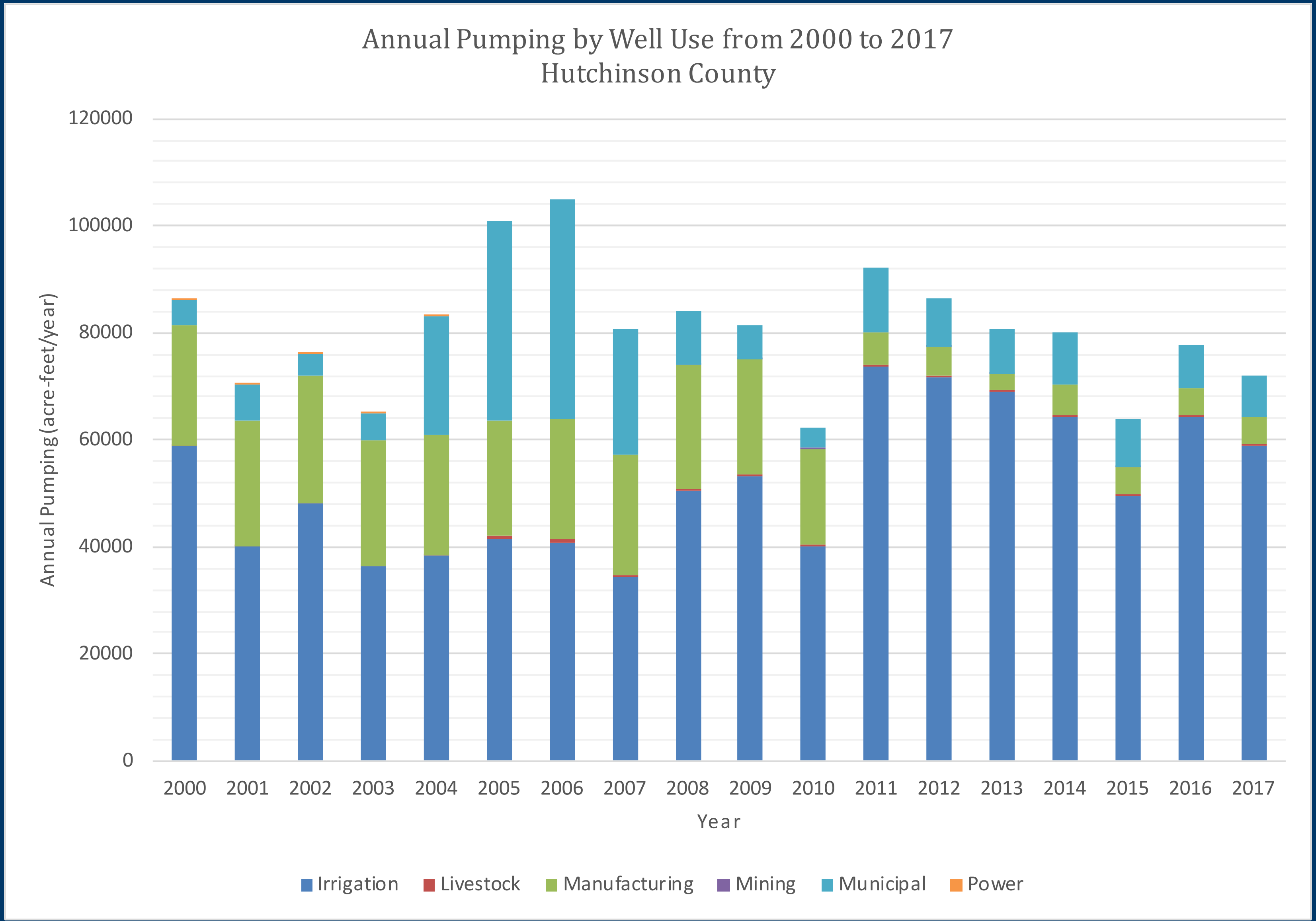
INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS



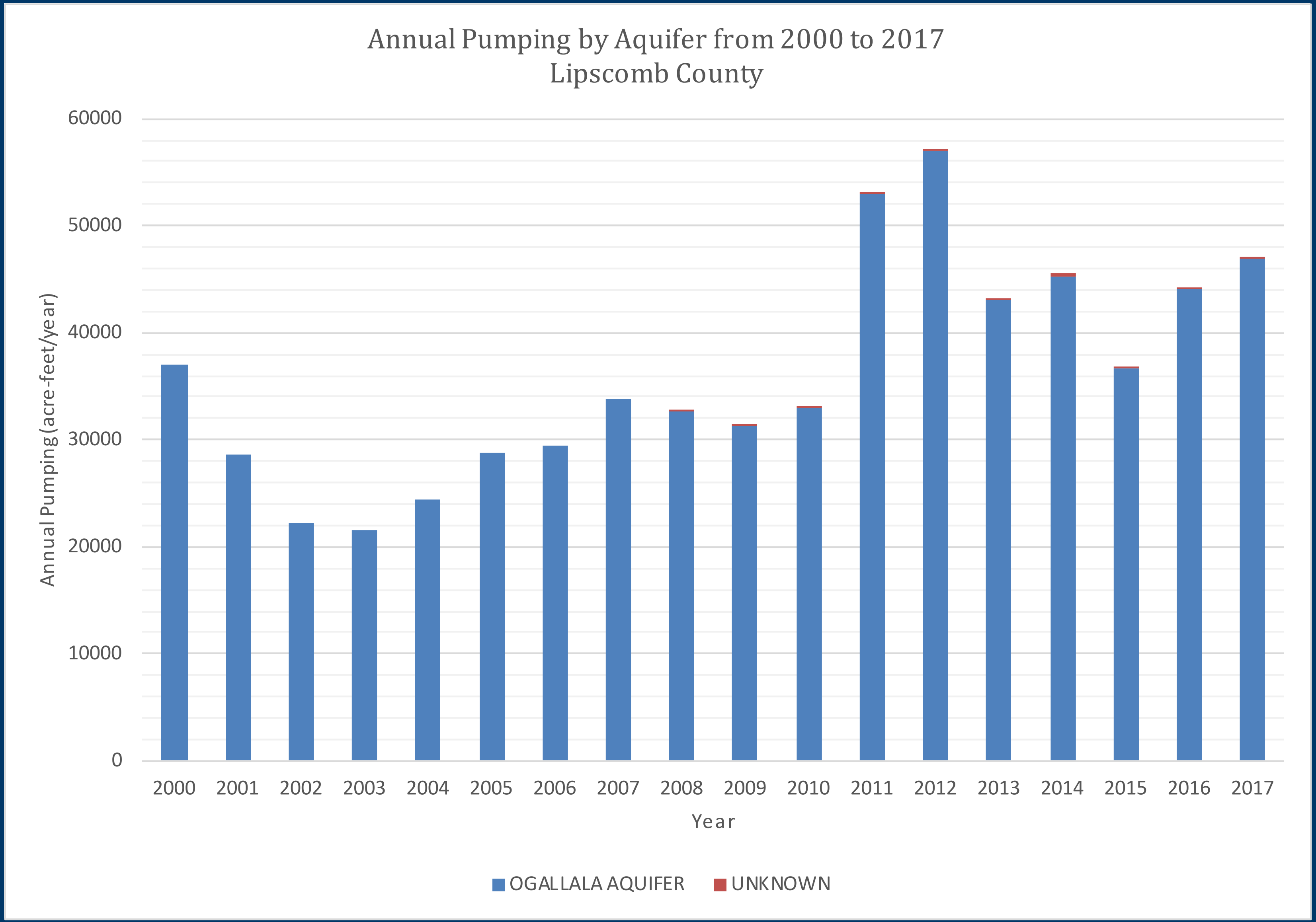
INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS



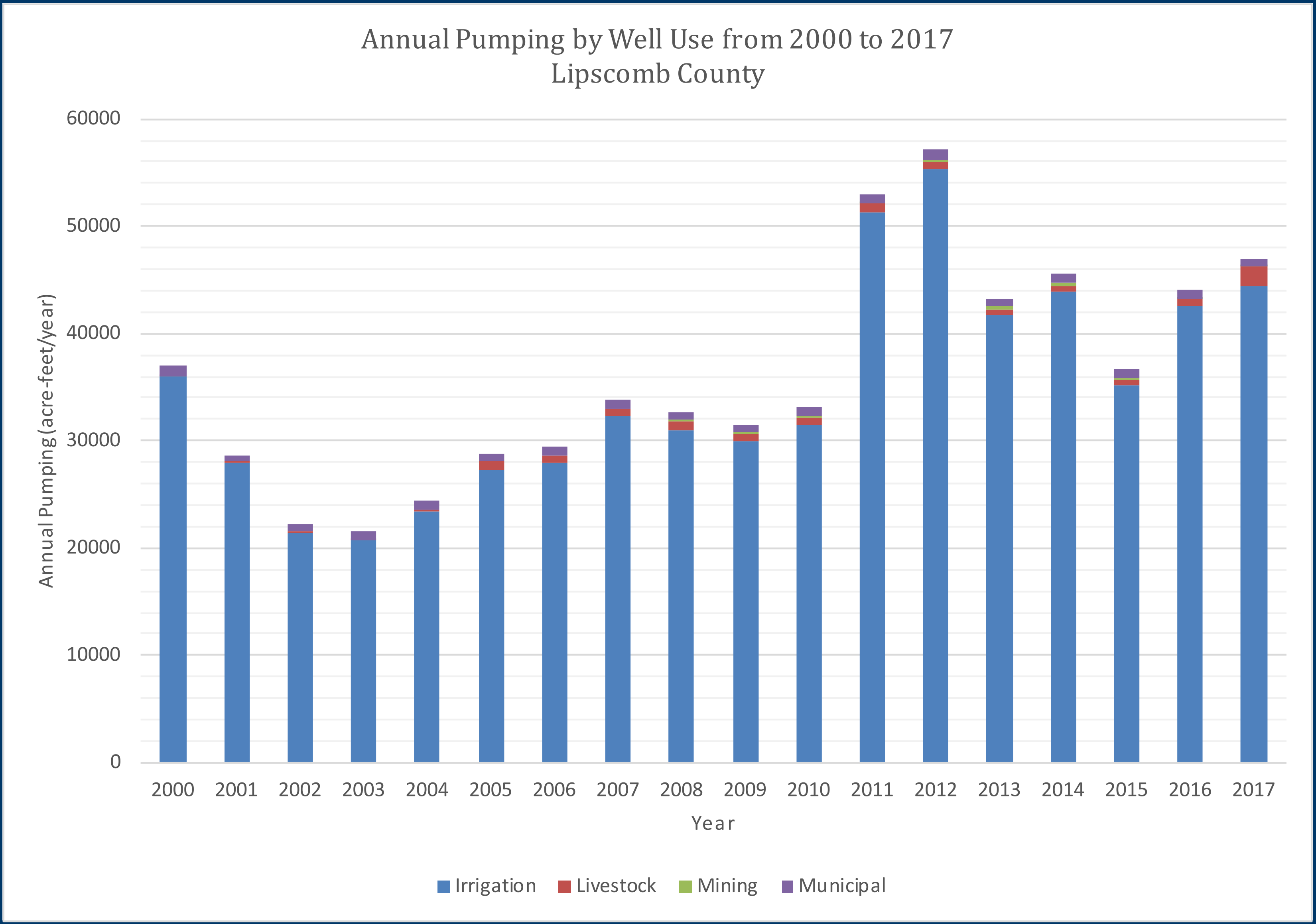
Annual Pumping by Aquifer from 2000 to 2017
Hutchinson County
Annual Pumping (acre-feet/year)
0
20000
40000
60000
80000
100000
120000
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Year
OGALLALA AQUIFER
OTHER AQUIFER
UNKNOWN



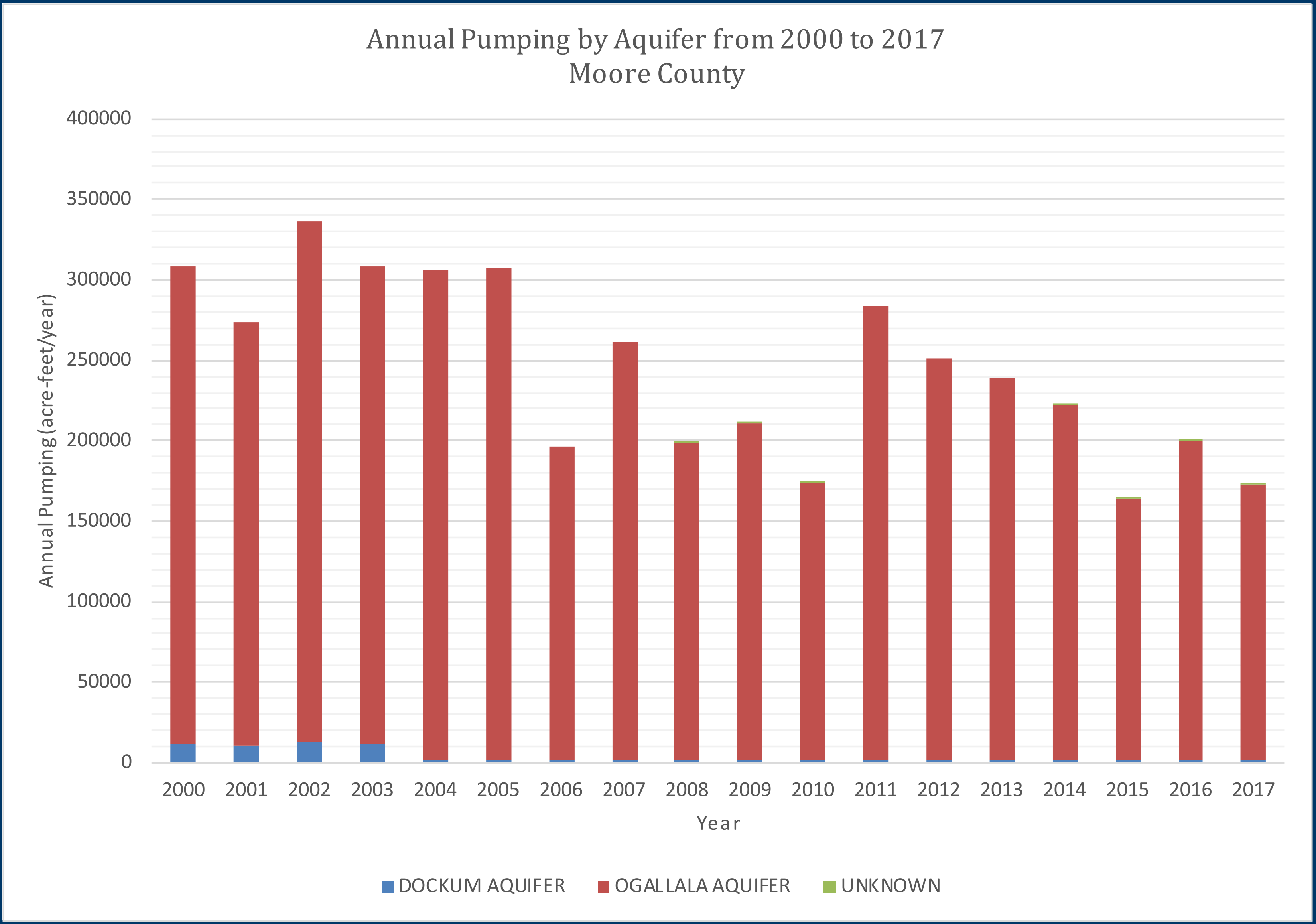
INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS

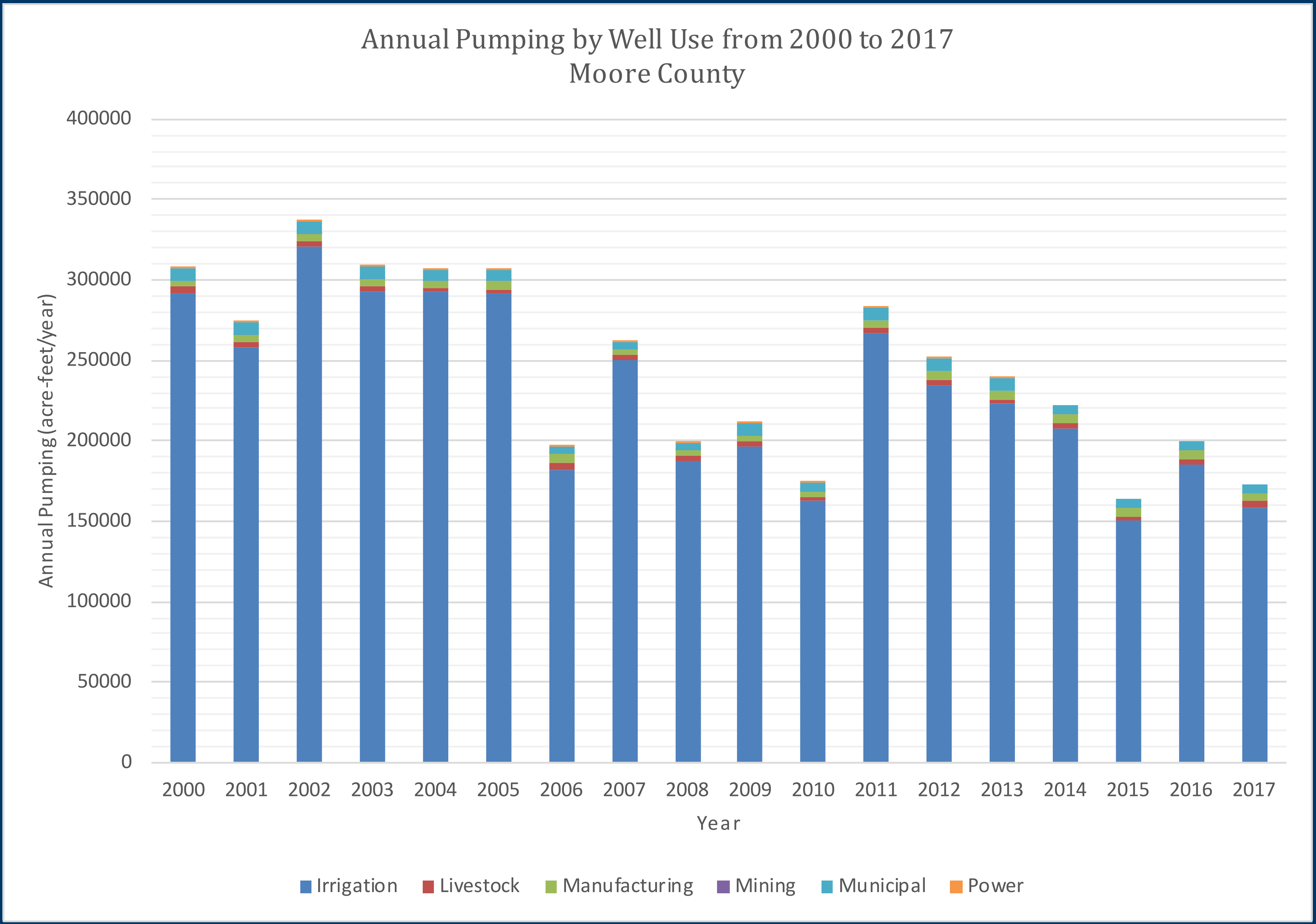


INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS

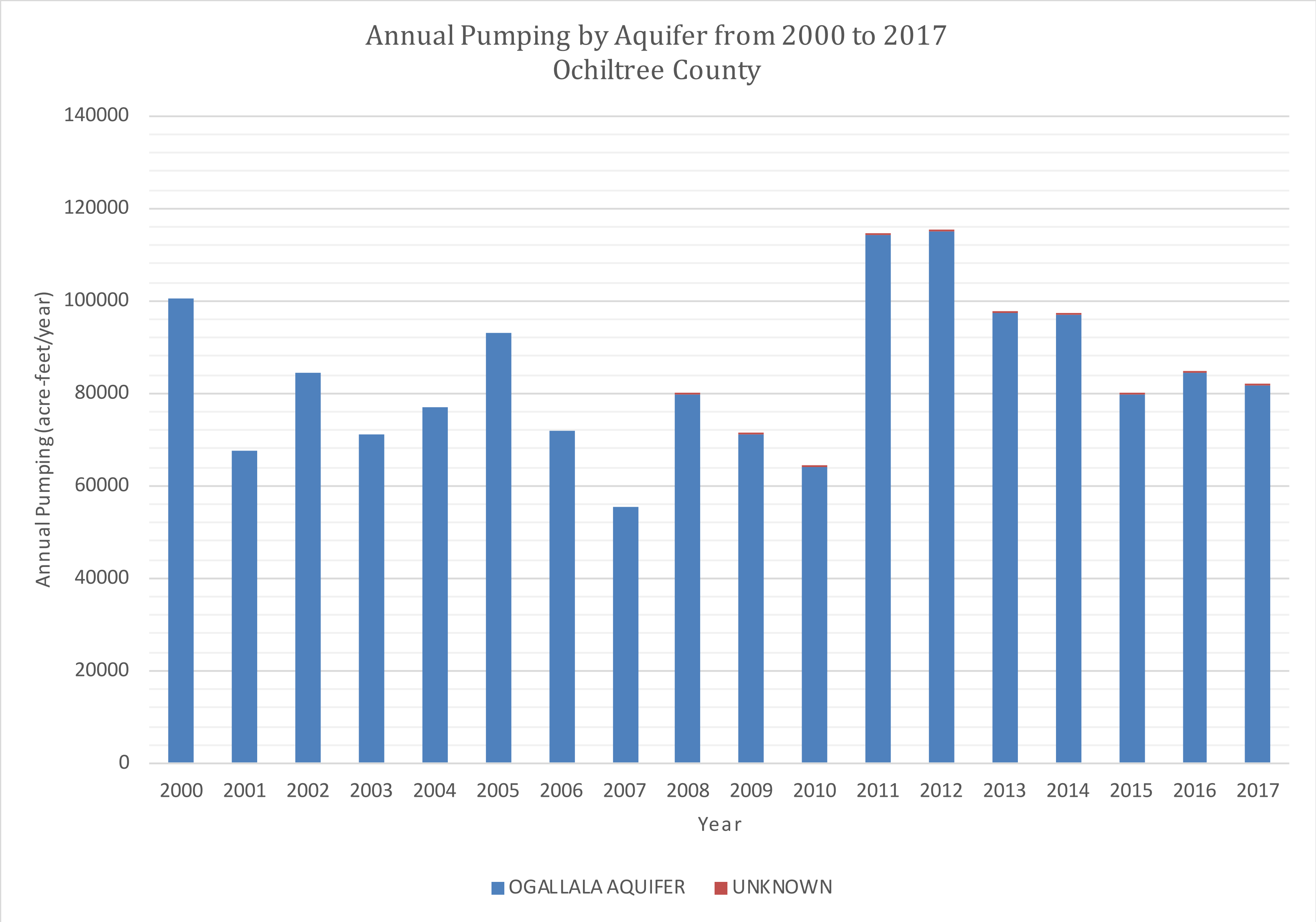


INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS

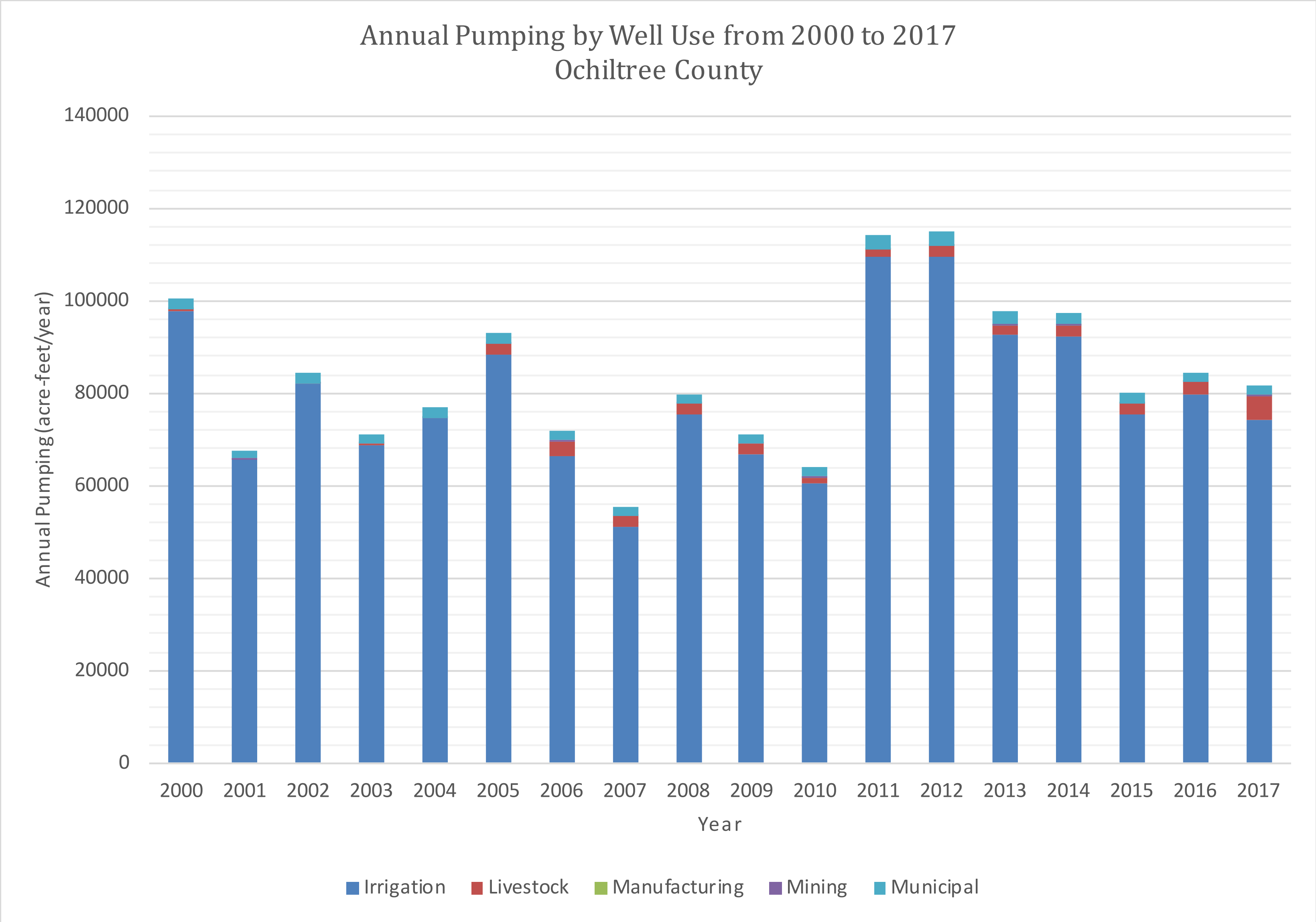

Annual Pumping by Aquifer from 2000 to 2017
Moore County
Annual Pumping (acre-feet/year)
400000
350000
300000
250000
200000
150000
100000
50000
0
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Year
DOCKUM AQUIFER
OGALLALA AQUIFER
UNKNOWN

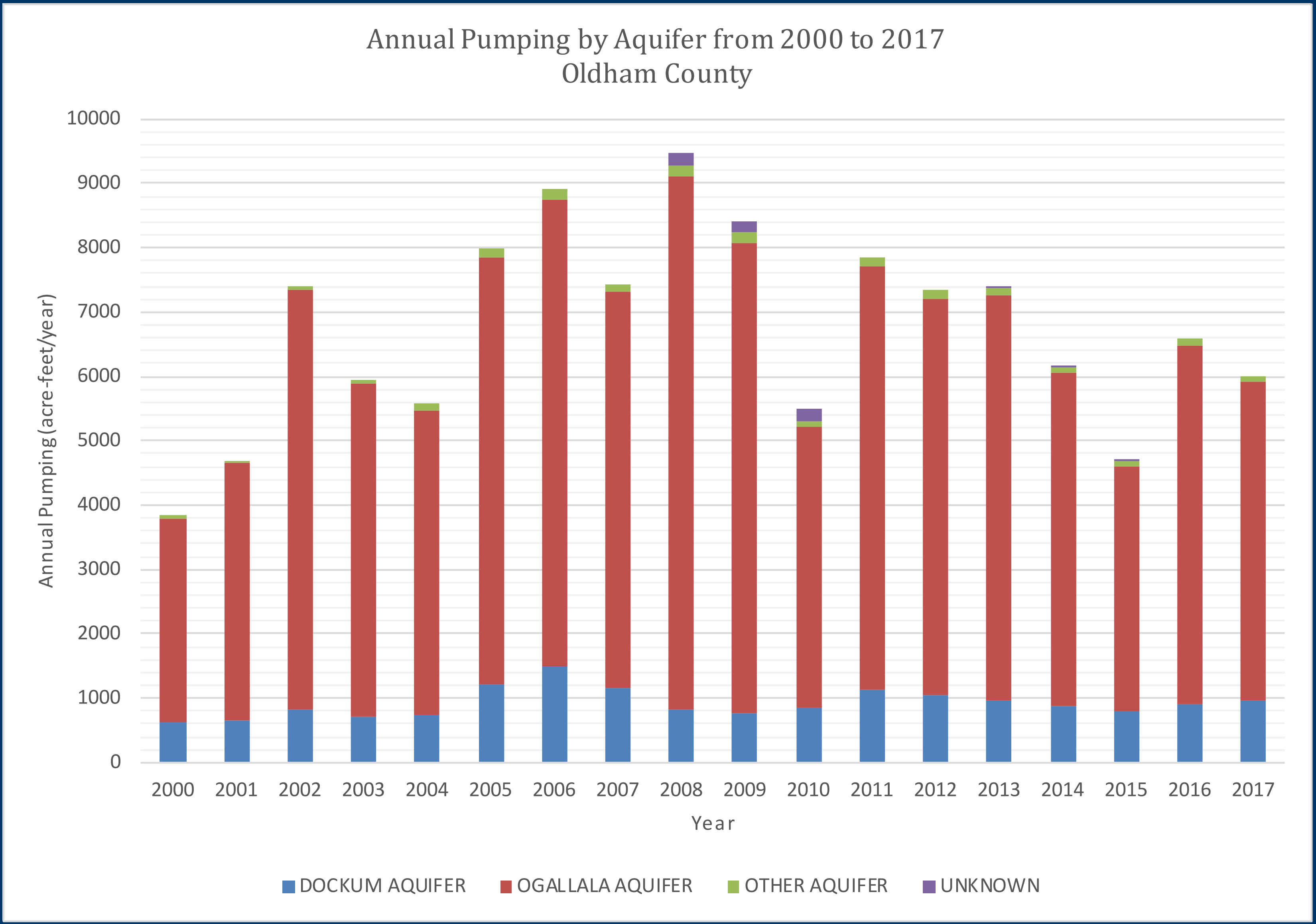


INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS

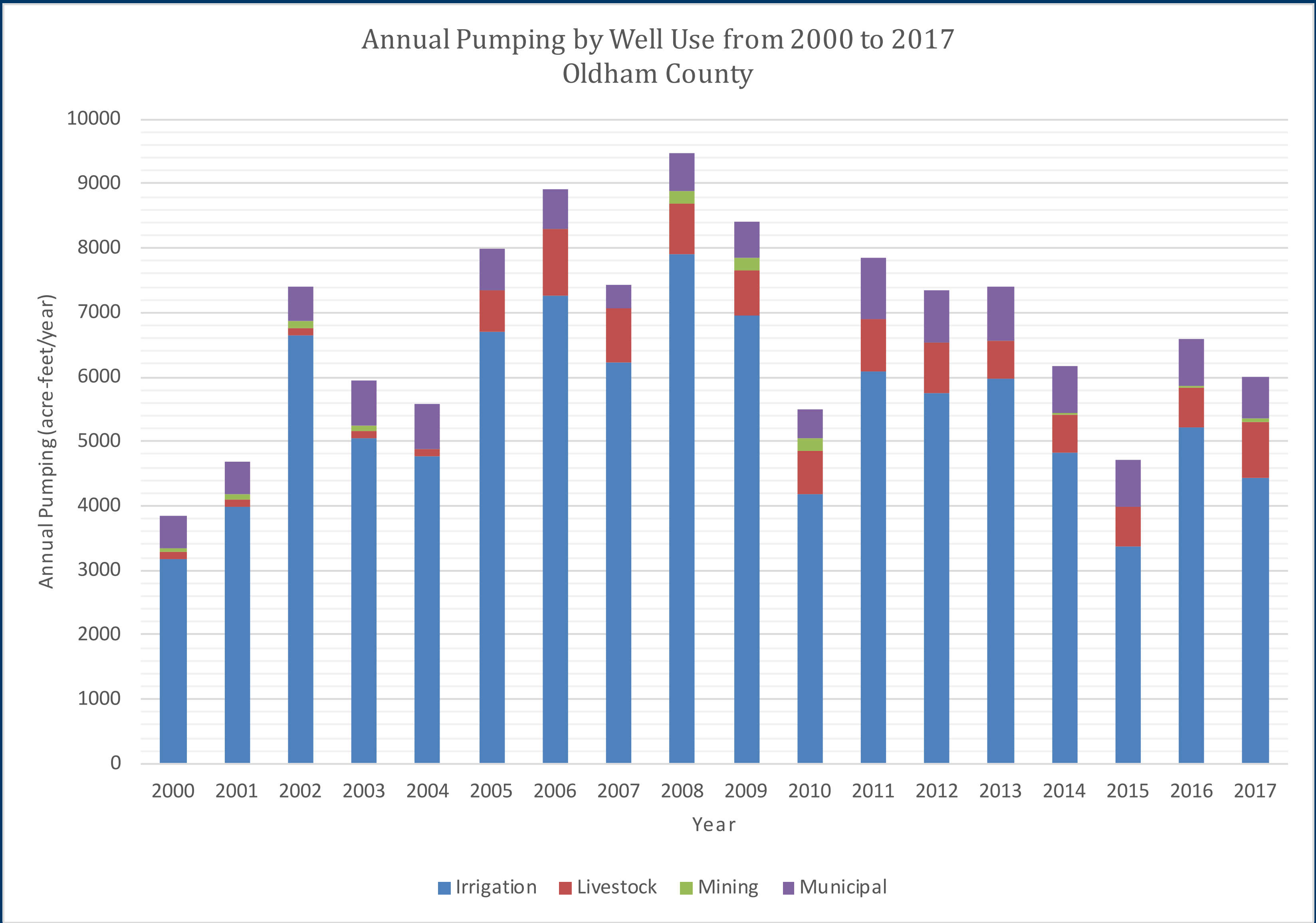


INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS

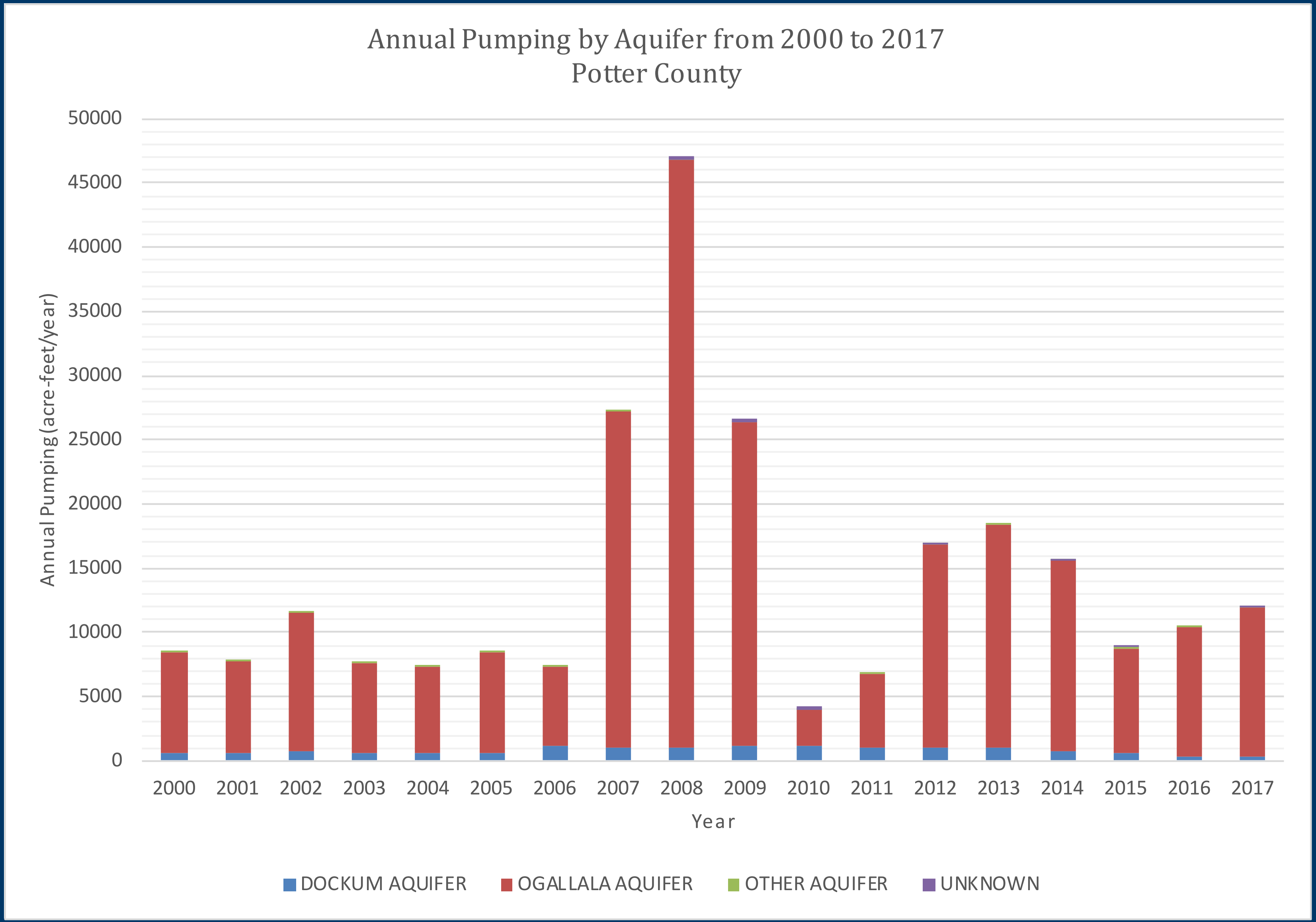

Annual Pumping by Well Use from 2000 to 2017
Ochiltree County
140000
120000
100000
80000
60000
40000
20000
0
Annual Pumping (acre-feet/year)
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Year
Irrigation
Livestock
Manufacturing
Mining
Municipal



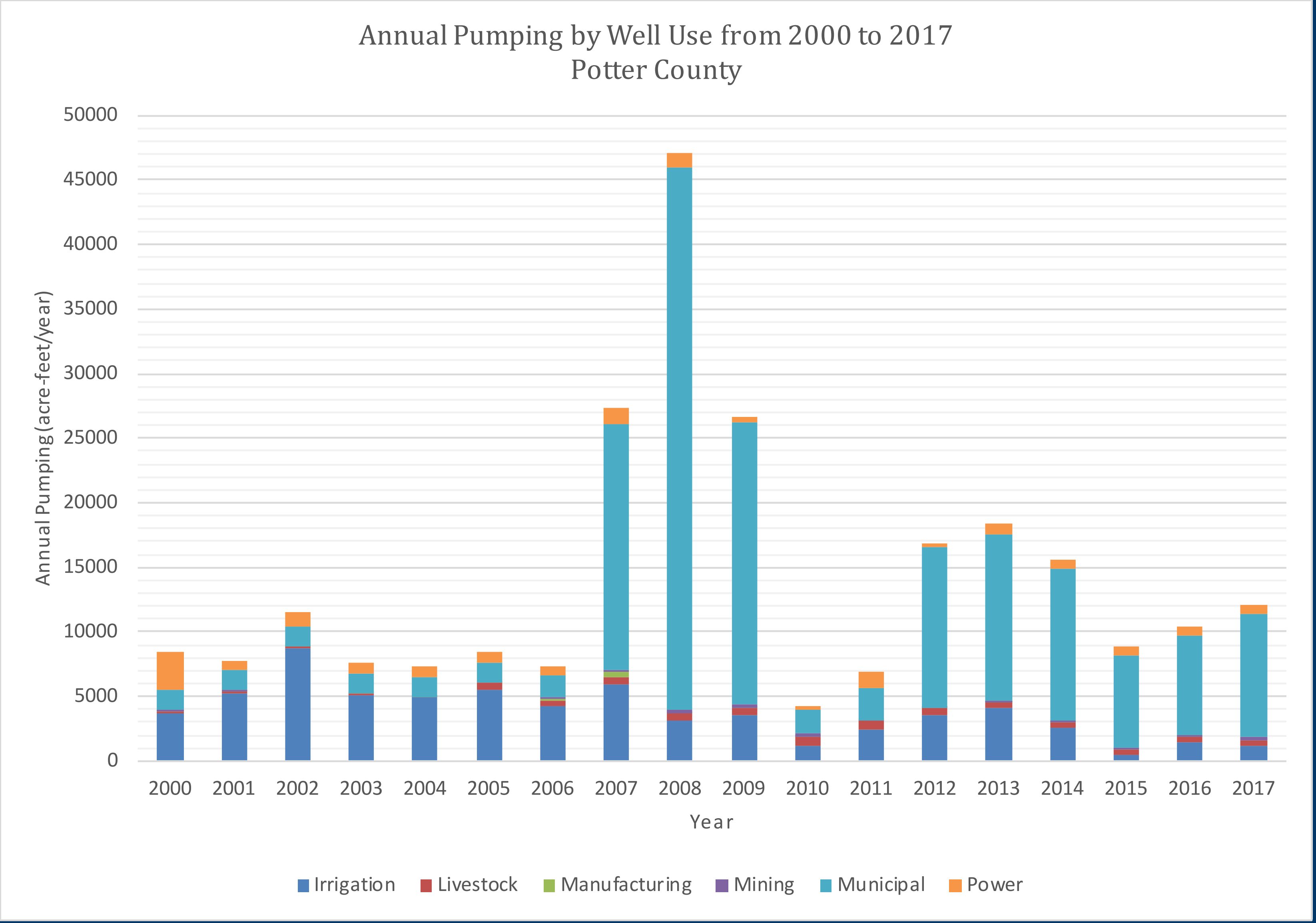
INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS

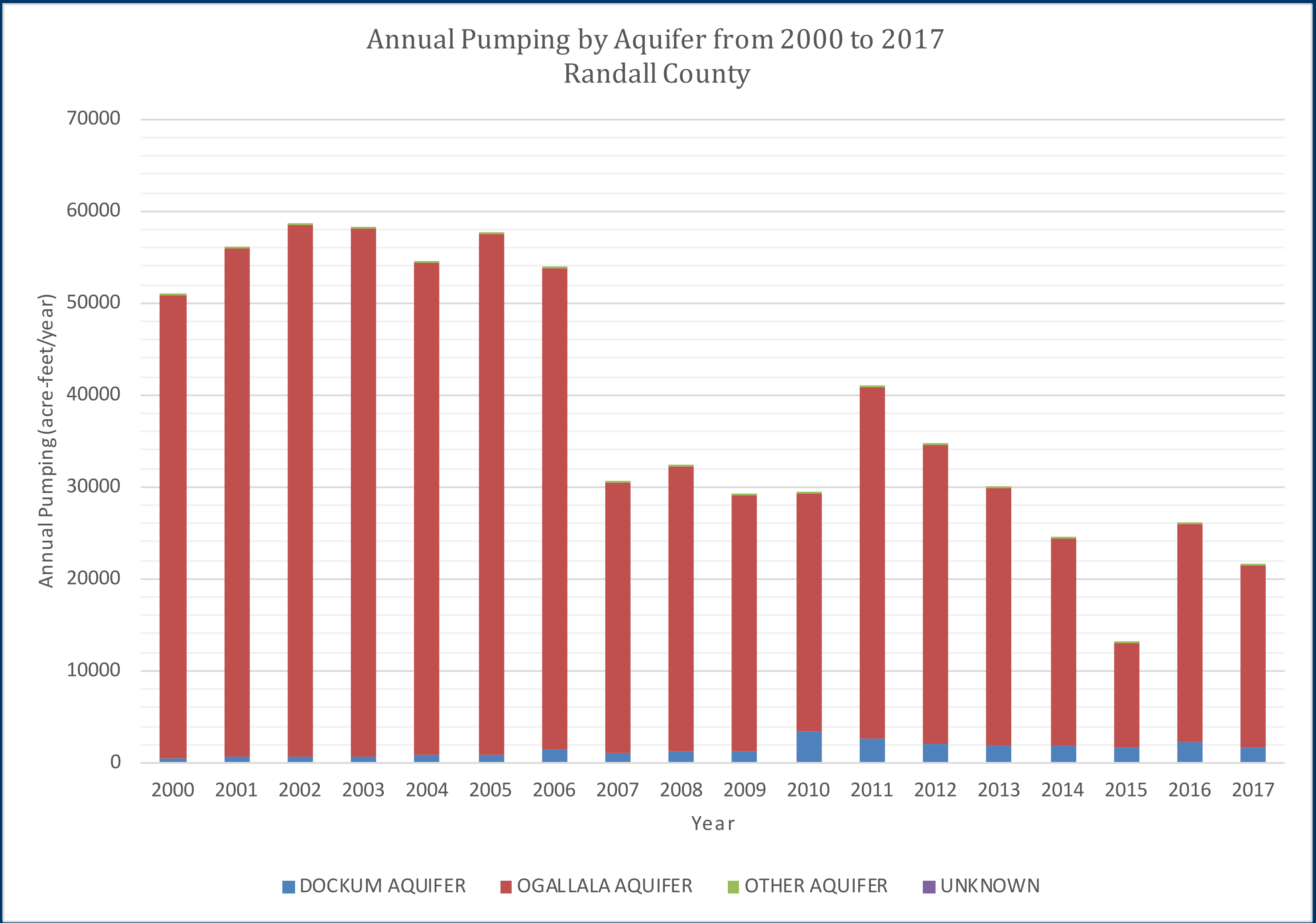


INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS

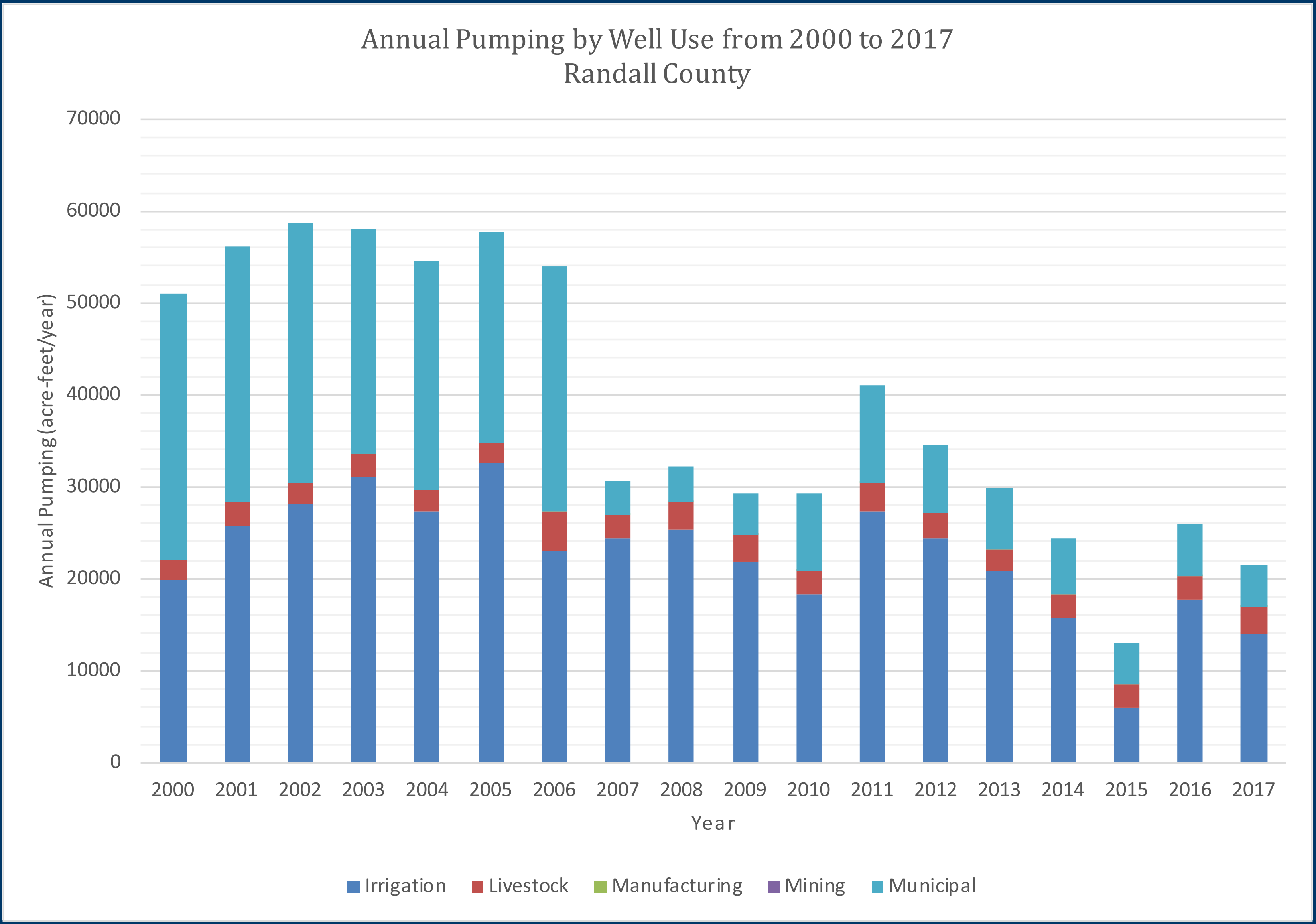


INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS

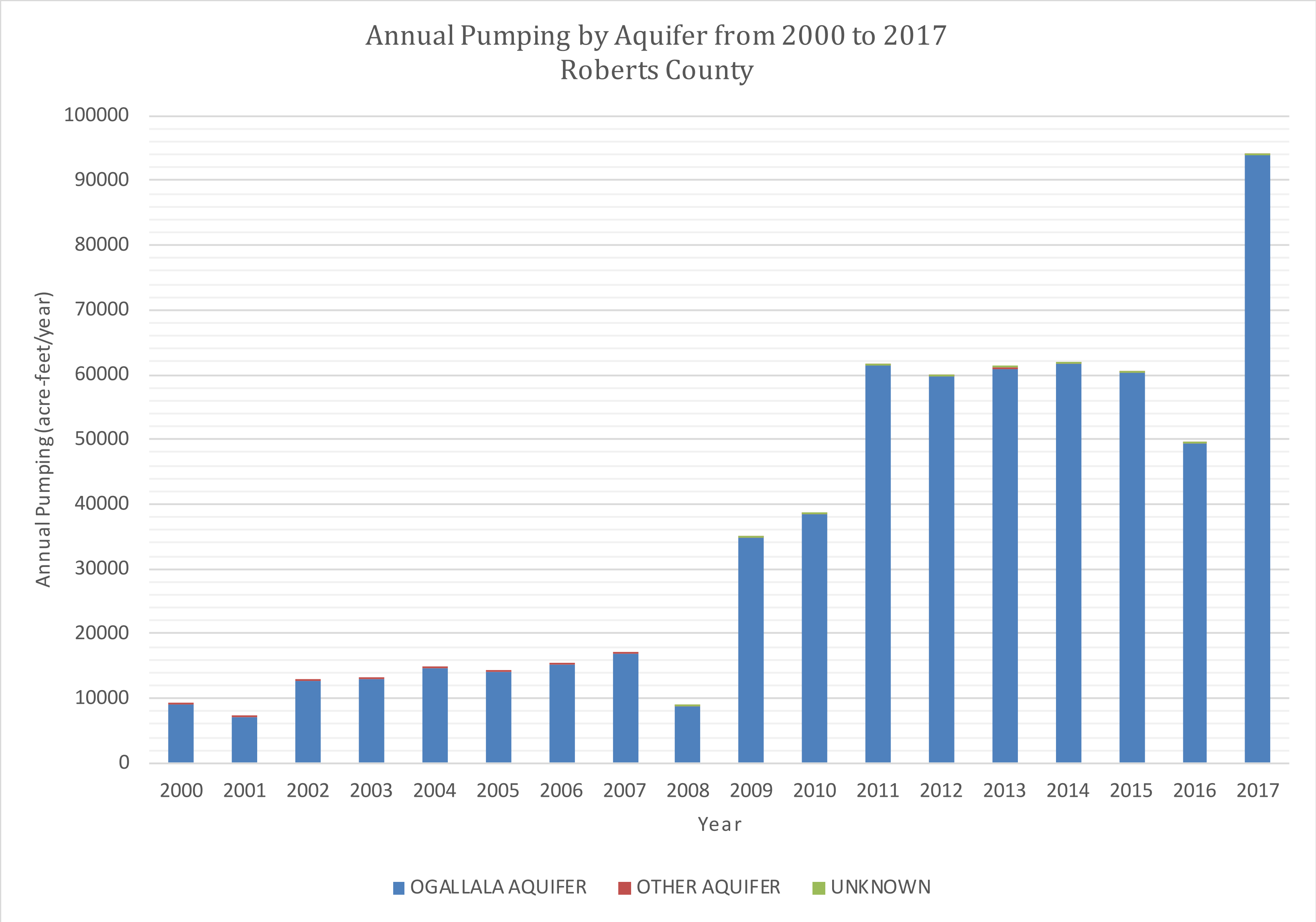

Annual Pumping by Well Use from 2000 to 2017
Potter County
Annual Pumping (acre-feet/year)
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Year
Irrigation
Livestock
Manufacturing
Mining
Municipal
Power



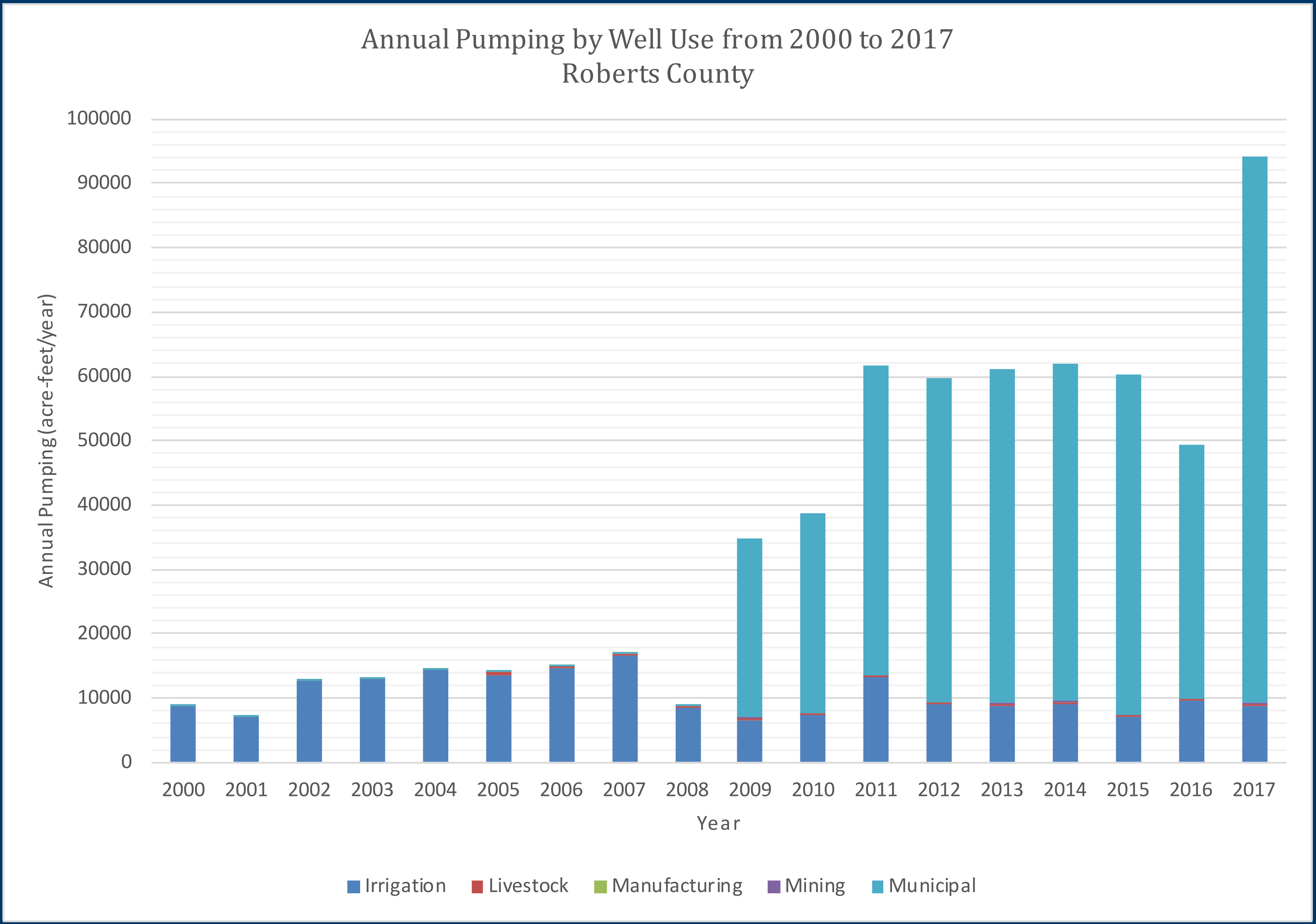
INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS



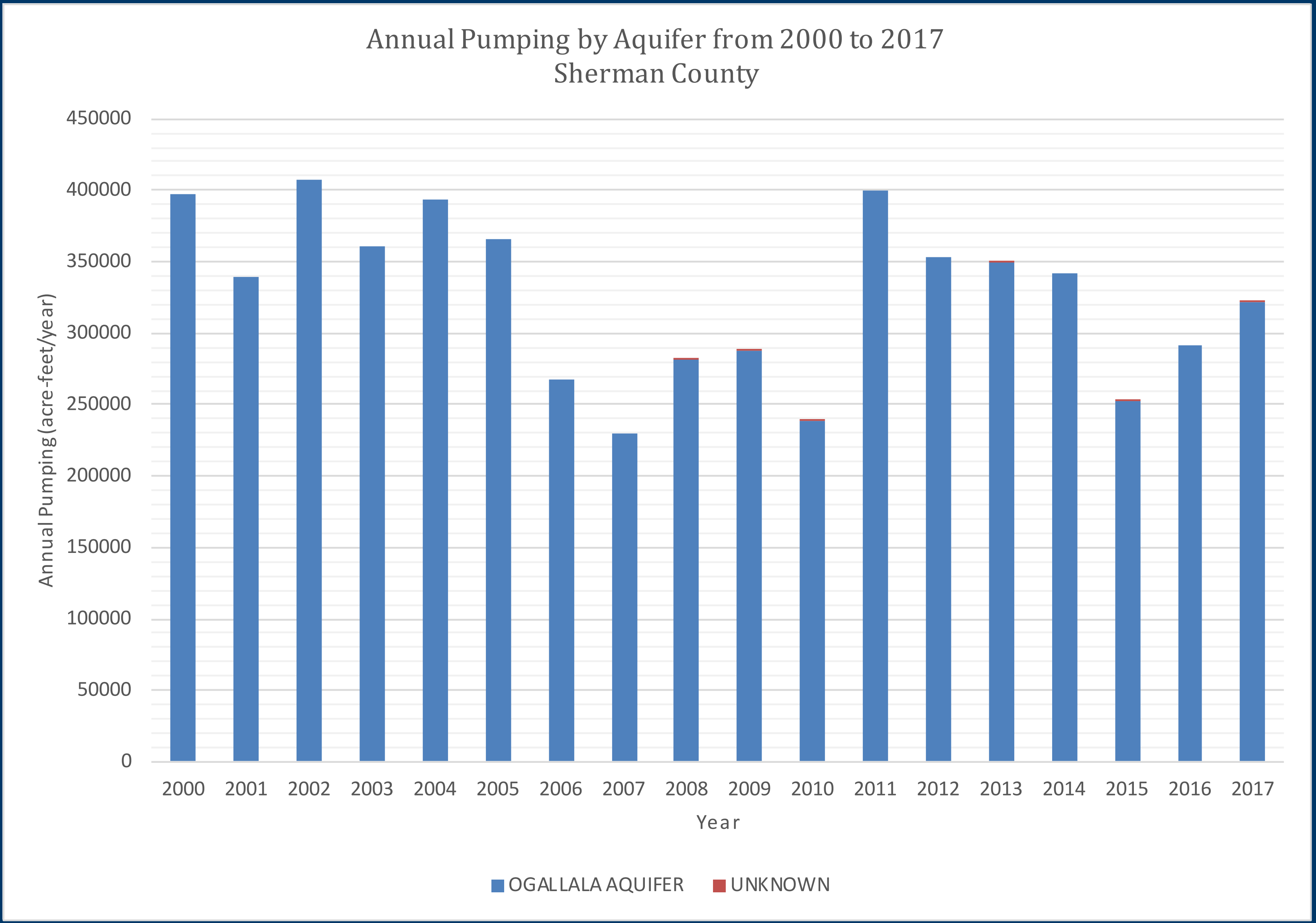
INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS



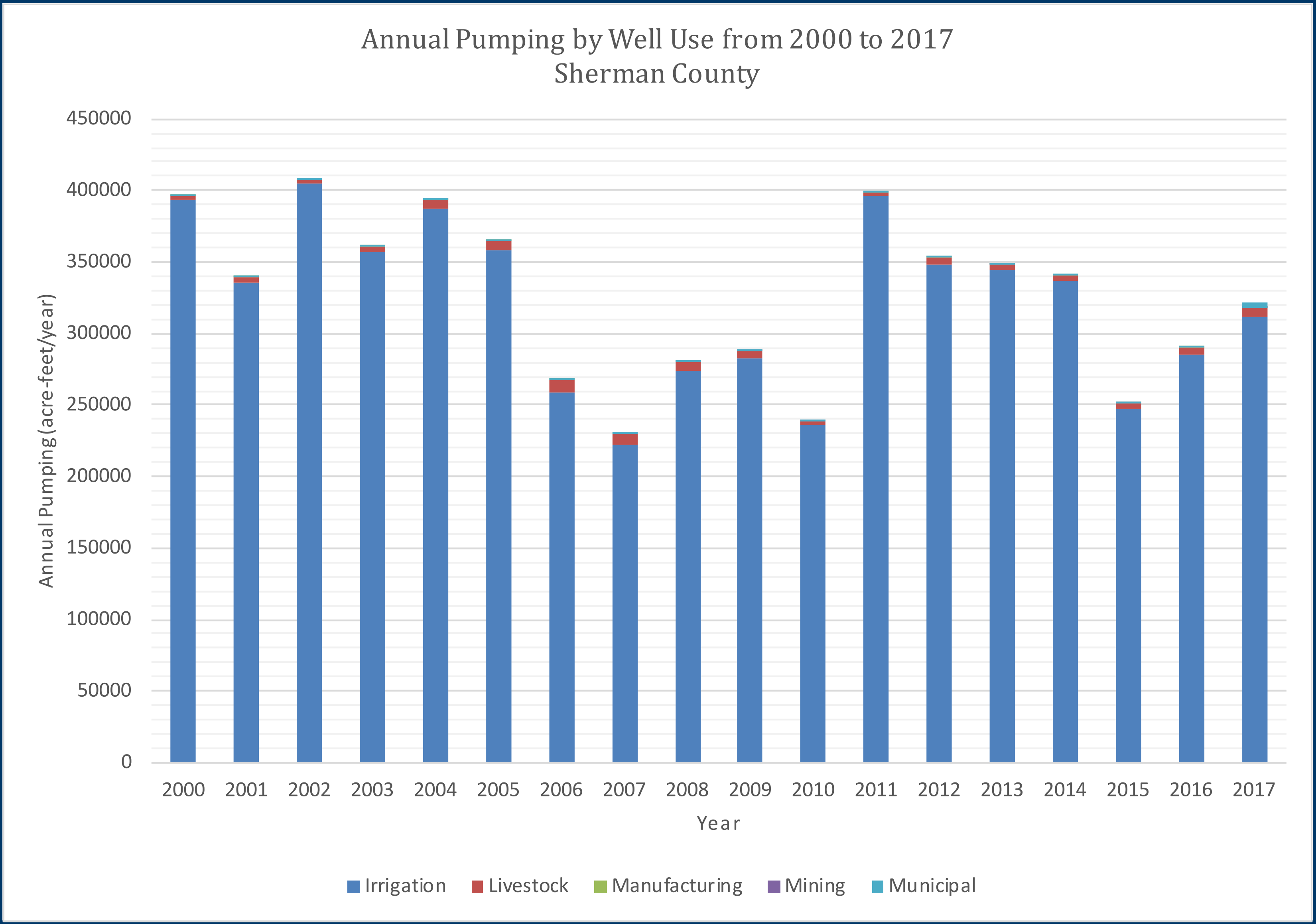
Annual Pumping by Aquifer from 2000 to 2017
Roberts County
Annual Pumping (acre-feet/year)
100000
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Year
OGALLALA AQUIFER
OTHER AQUIFER
UNKNOWN



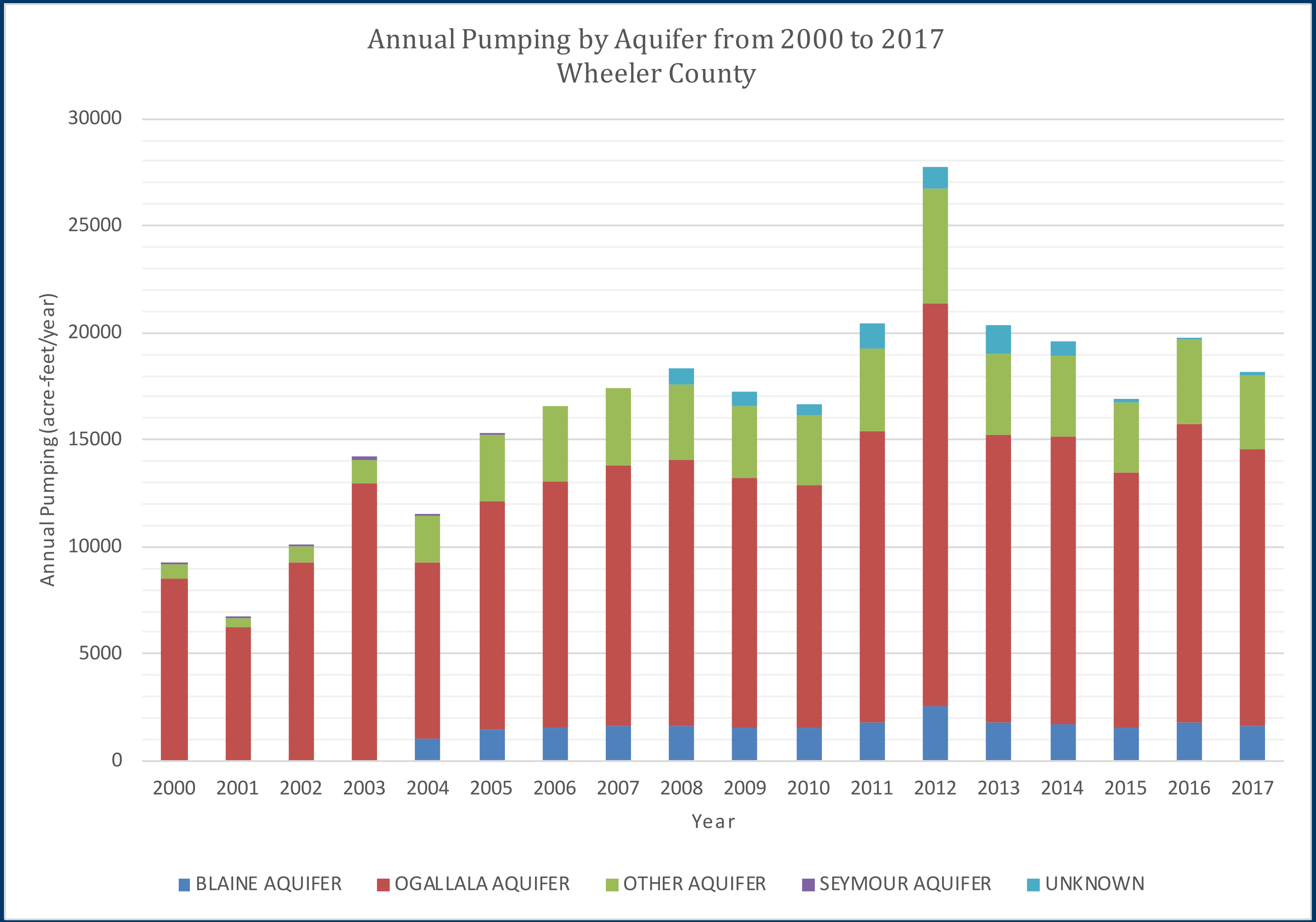
INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS



Annual Pumping by Aquifer from 2000 to 2017
Sherman County
450000
400000
350000
300000
250000
200000
150000
100000
50000
0
Annual Pumping (acre-feet/year)
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Year
OGALLALA AQUIFER
UNKNOWN



INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS



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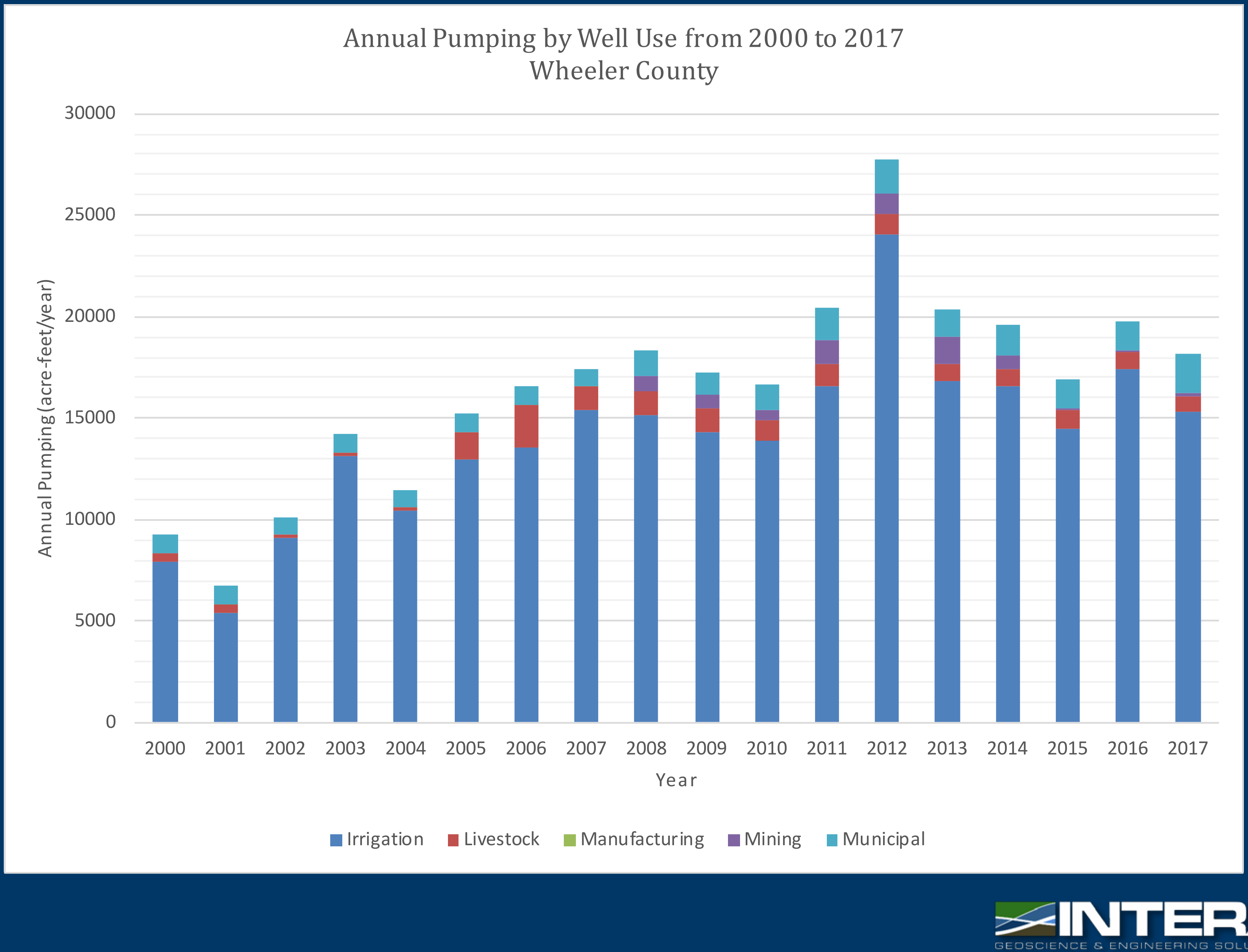
Annual Pumping by Well Use from 2000 to 2017
Wheeler County
Annual Pumping (acre-feet/year)
30000
25000
20000
15000
10000
5000
0
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Year
Irrigation
Livestock
Manufacturing
Mining
Municipal
INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS

Discussion and Consideration of Water Supply Needs and Management Strategies and Hydrological Conditions

A Presentation to GMA 1
Joint Planning Group

December 12, 2019

Presented By:
Wade Oliver, P.G.
woliver@intera.com
Office: 281.560.4562
Mobile: 832.535.5763

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Objectives

- Where We Are in the Process
- Water Supply Needs and Management Strategies in the State Water Plan
- Hydrological Conditions
  - Geologic Setting
  - Total Estimated Recoverable Storage
  - *Water Budgets (next meeting)*
- Next Steps

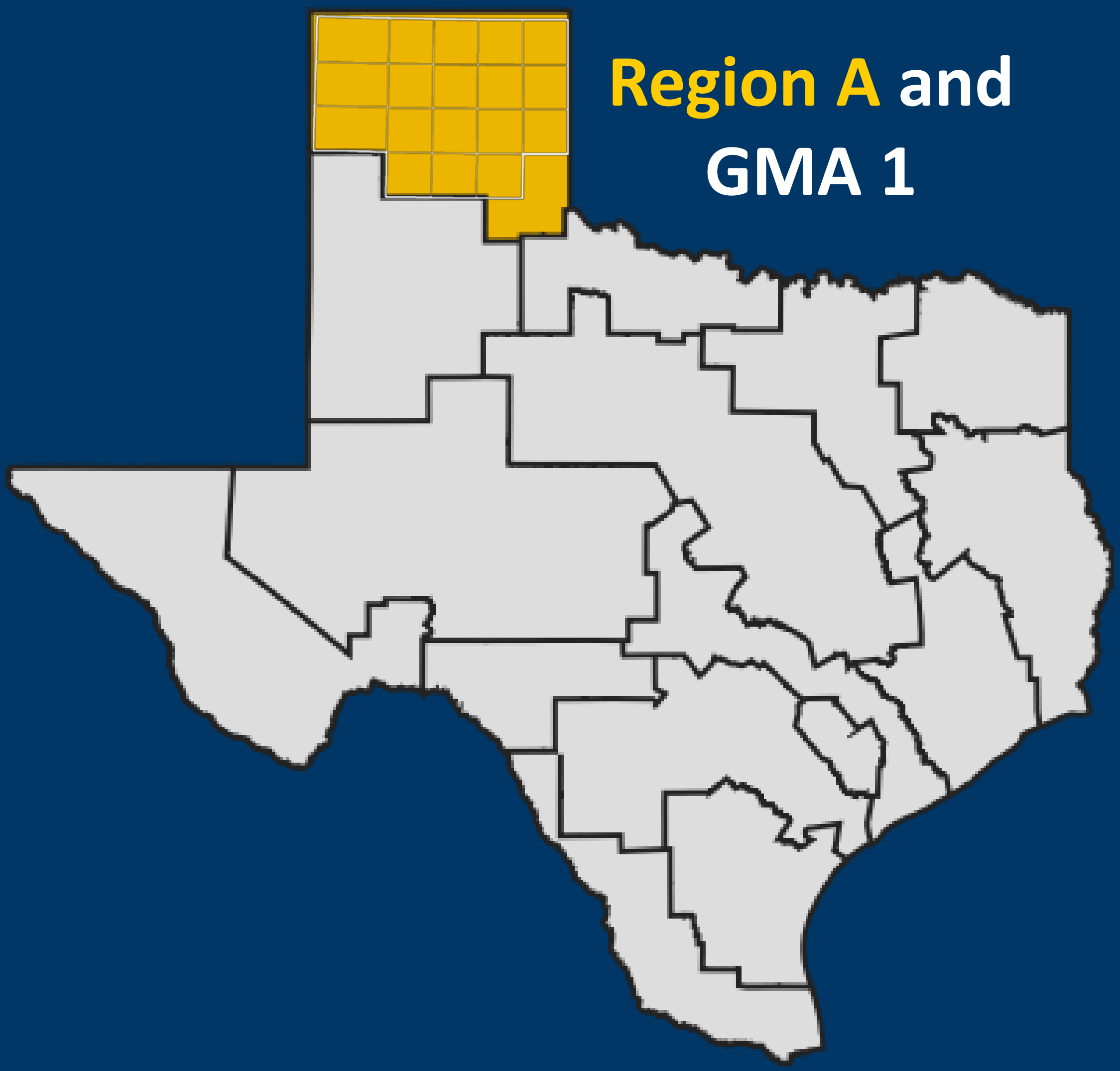
Consideration of Factors

- ✓ Aquifer uses or conditions (discussion on October 28, 2019)
- Water supply needs and management strategies (today)
- Hydrological conditions (today)
- Other environmental impacts
- Impact on subsidence
- Socioeconomic impacts
- Impact on private property rights
- Feasibility of achieving the DFC
- Any other relevant information

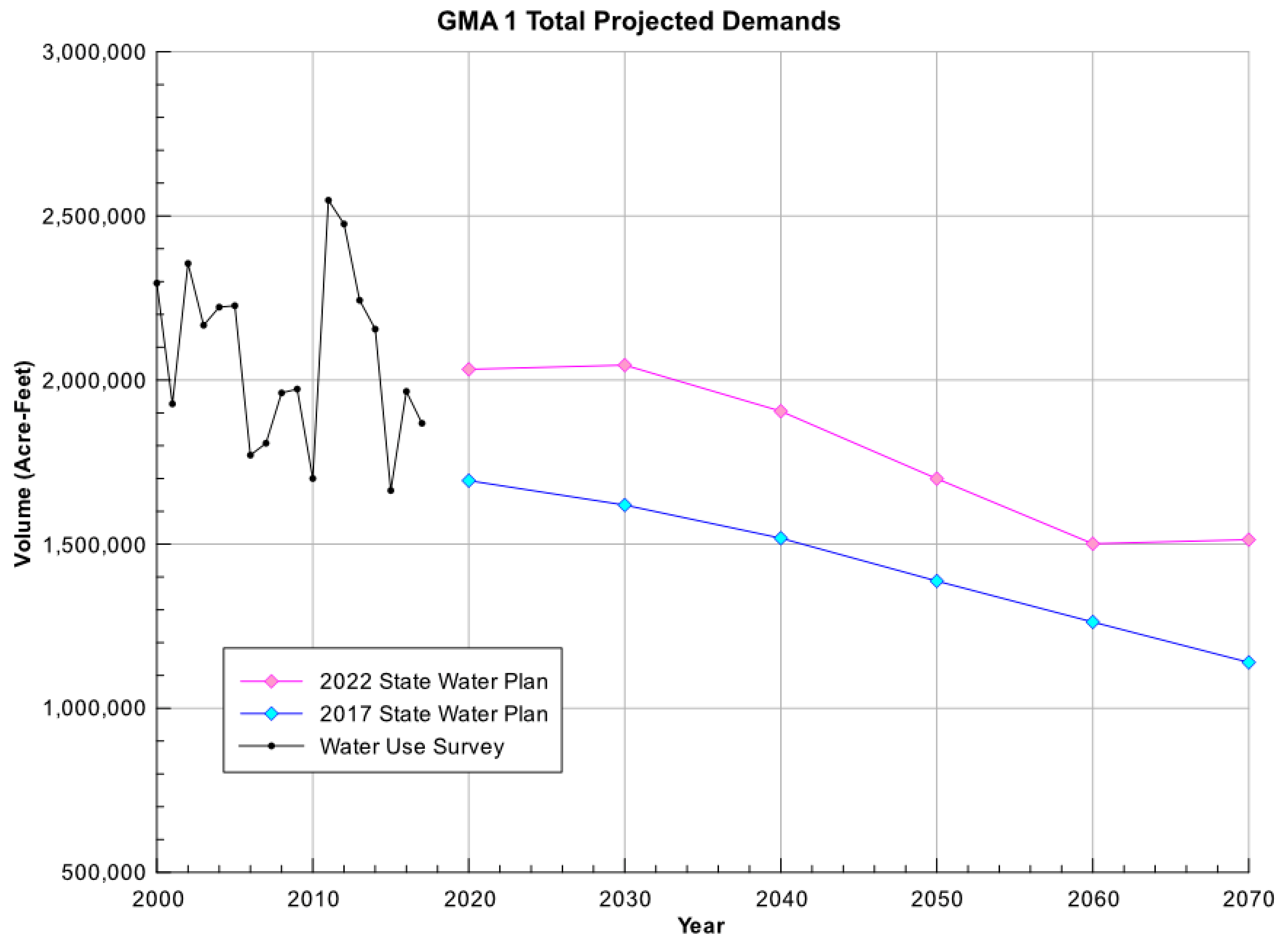
Balancing Test

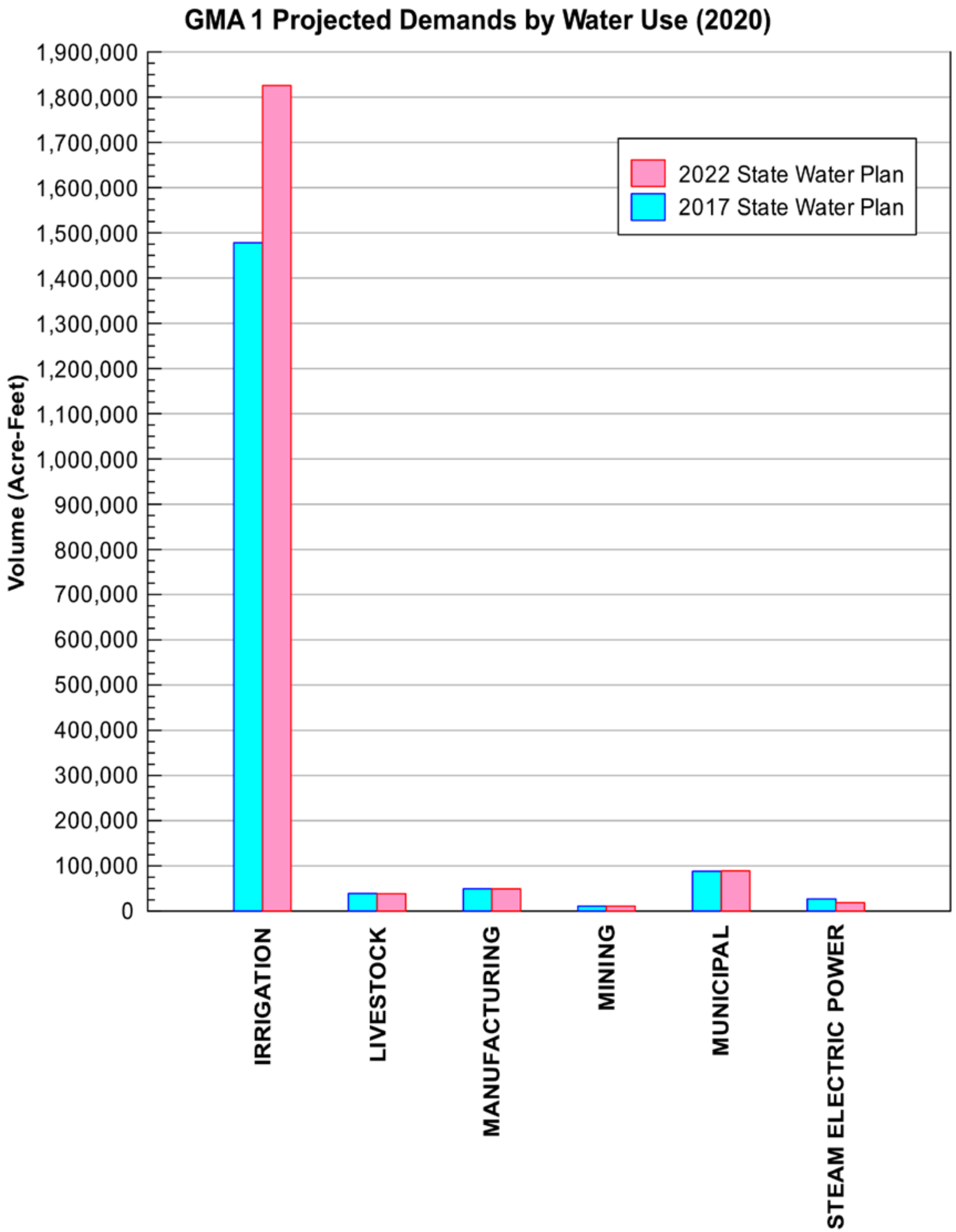
DFCs must provide "*a balance between the highest practicable level of groundwater production and the conservation, preservation, protection, recharging, and prevention of waste of groundwater and control of subsidence in the management area*"

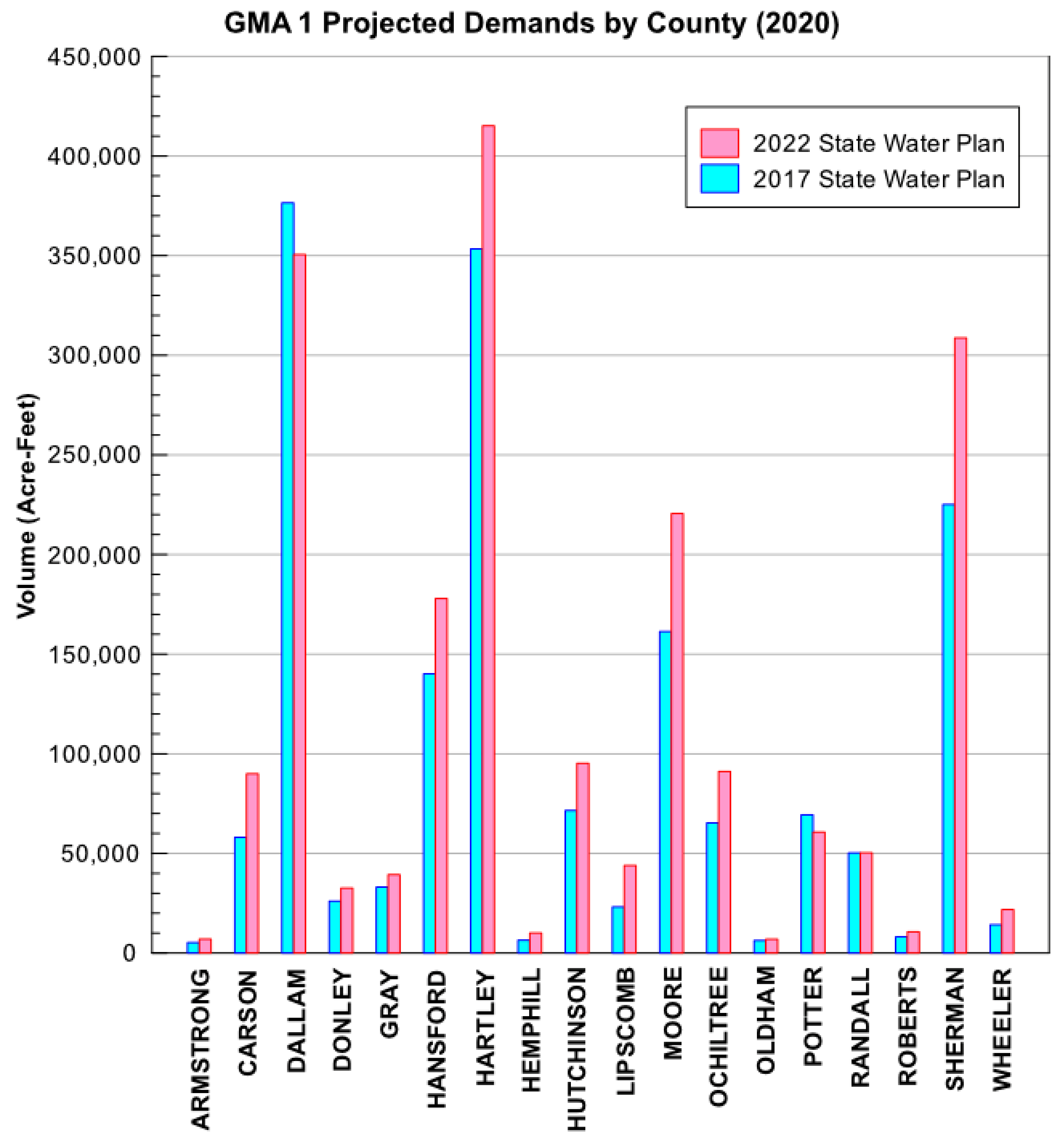
Regional Water Planning



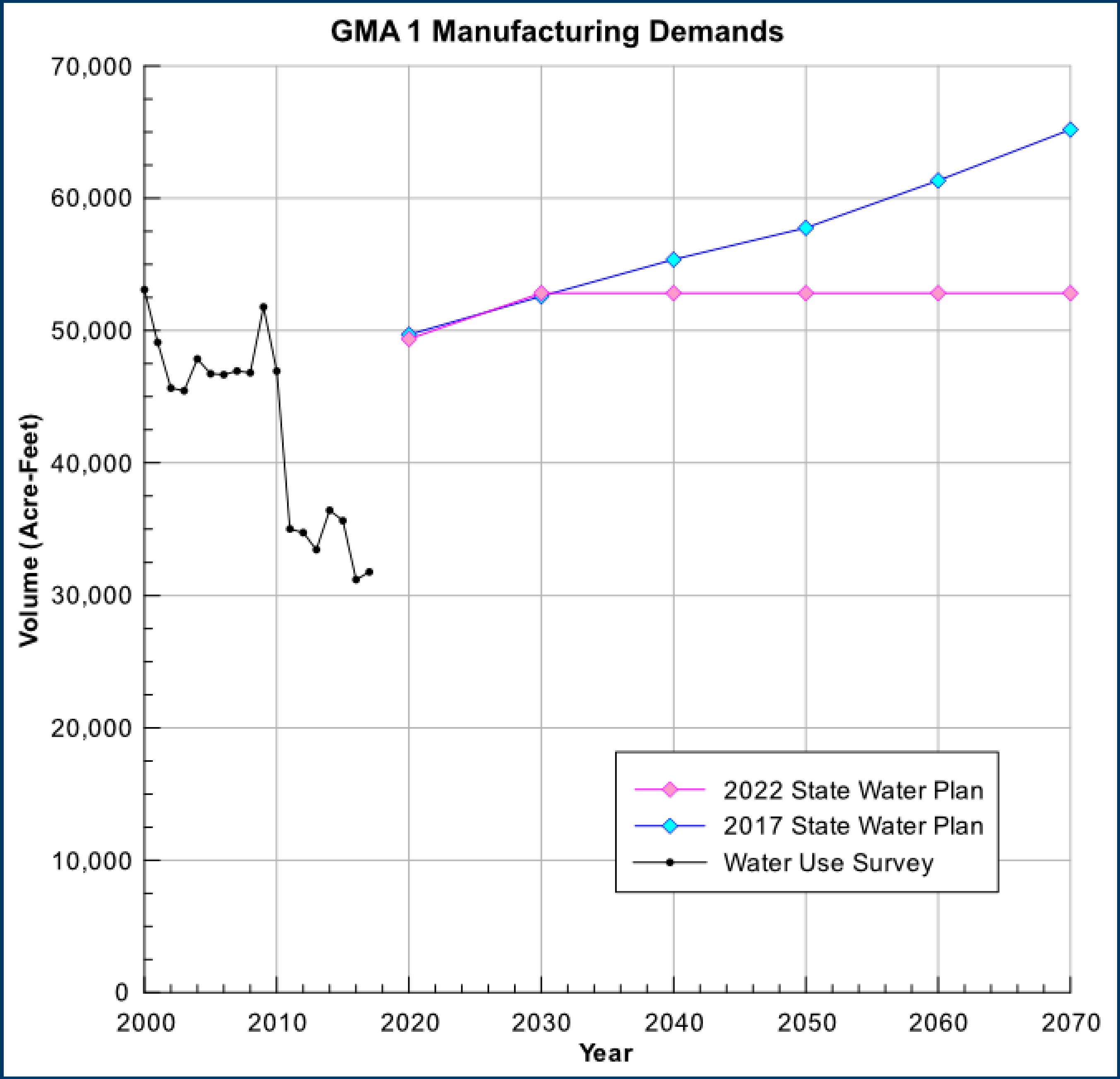
Region A and GMA 1


GMA 1 Total Projected Demands
3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000
Volume (Acre-Feet)
2000
2010
2020
2030
2040
2050
2060
2070
Year
2022 State Water Plan
2017 State Water Plan
Water Use Survey

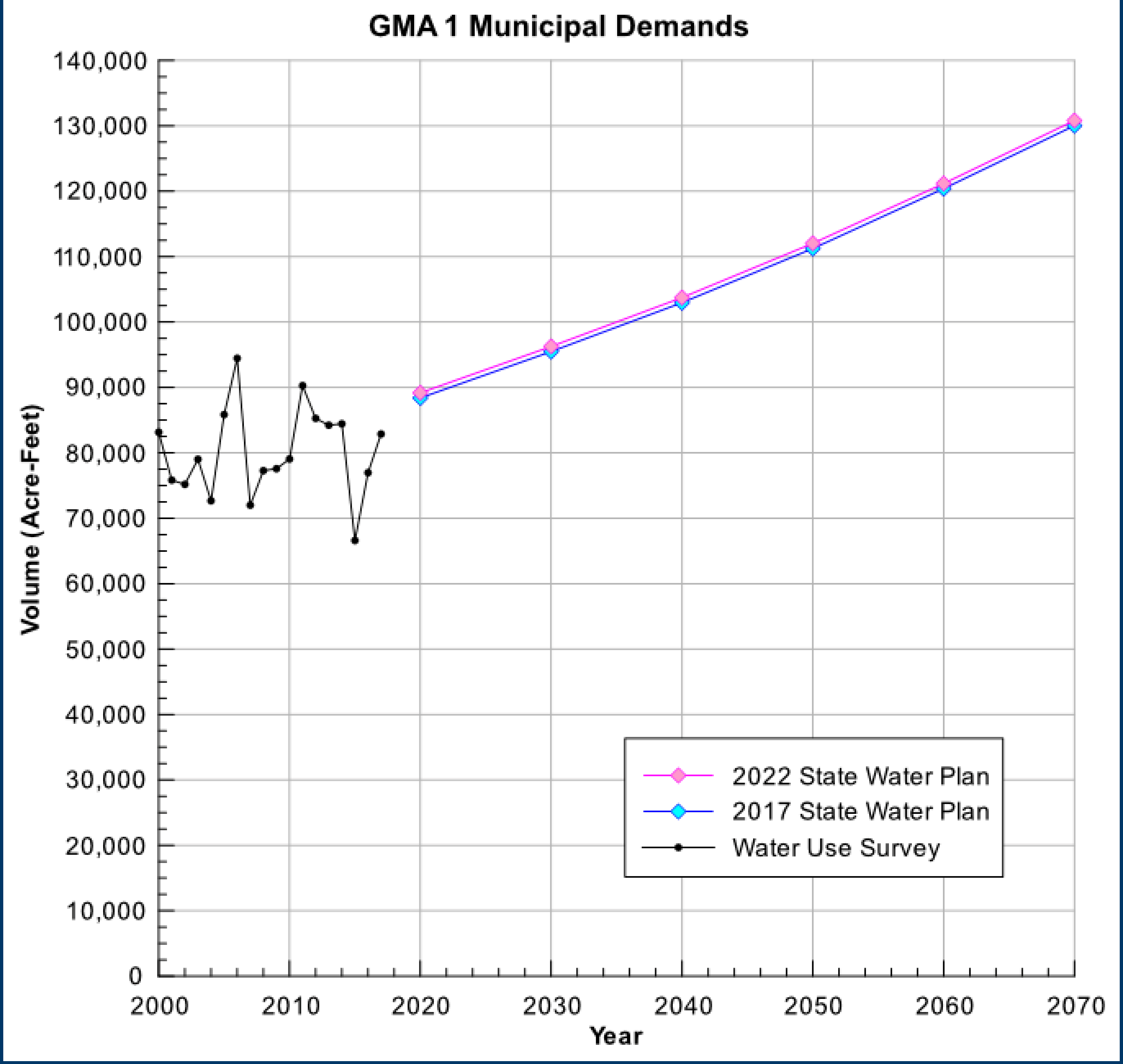

GMA 1 Projected Demands by Water Use (2020)
Volume (Acre-Feet)
1,900,000
1,800,000
1,700,000
1,600,000
1,500,000
1,400,000
1,300,000
1,200,000
1,100,000
1,000,000
900,000
800,000
700,000
600,000
500,000
400,000
300,000
200,000
100,000
0
2022 State Water Plan
2017 State Water Plan
IRRIGATION
LIVESTOCK
MANUFACTURING
MINING
MUNICIPAL
STEAM ELECTRIC POWER

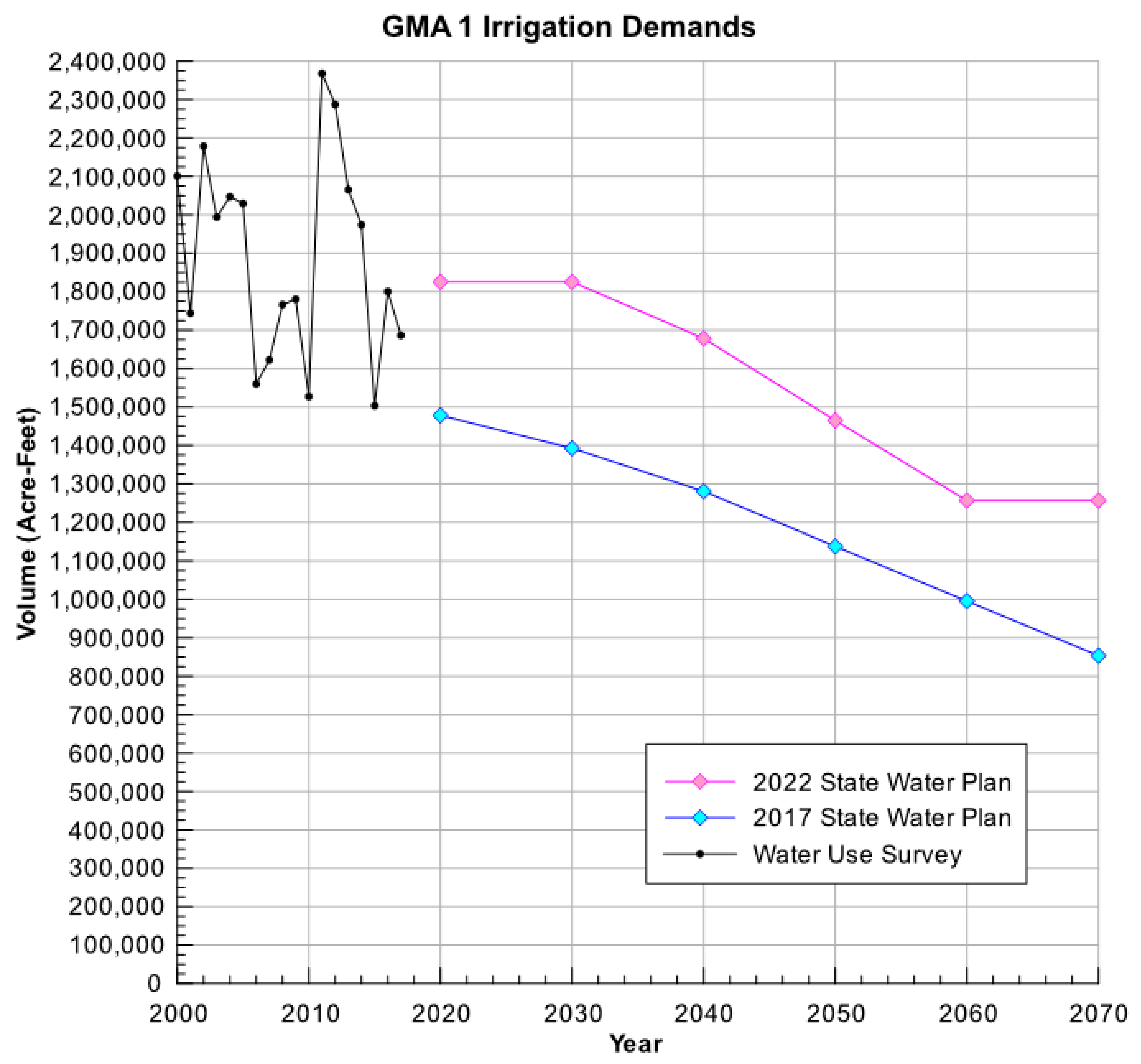


GMA 1 Projected Demands by County (2020)
Volume (Acre-Feet)
450,000
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
2022 State Water Plan
2017 State Water Plan
ARMSTRONG
CARSON
DALLAM
DONLEY
GRAY
HANSFORD
HARTLEY
HEMPHILL
HUTCHINSON
LIPSCOMB
MOORE
OCHILTREE
OLDHAM
POTTER
RANDALL
ROBERTS
SHERMAN
WHEELER

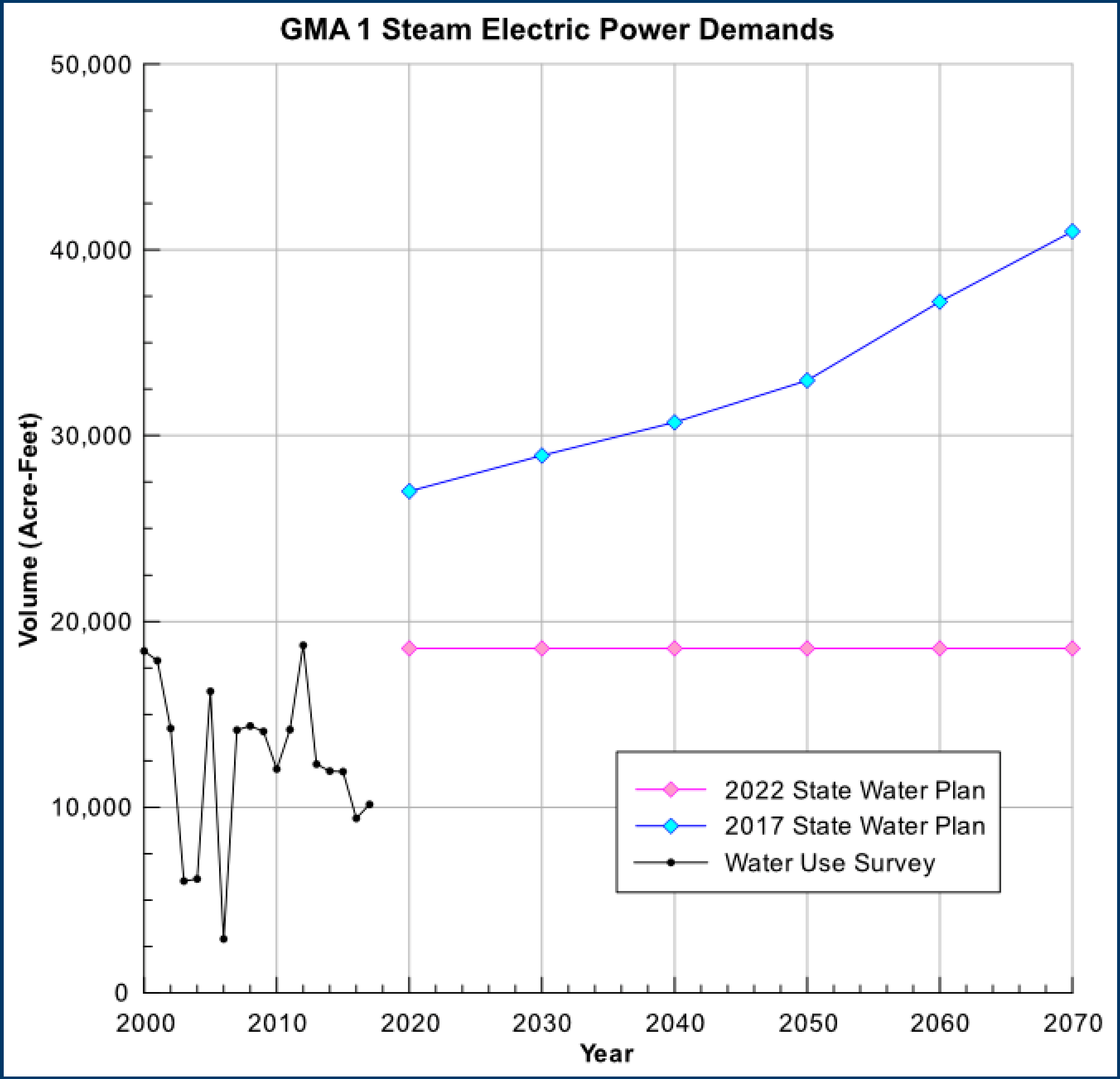


GMA 1 Manufacturing Demands
Volume (Acre-Feet)
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
2000
2010
2020
2030
2040
2050
2060
2070
Year
2022 State Water Plan
2017 State Water Plan
Water Use Survey

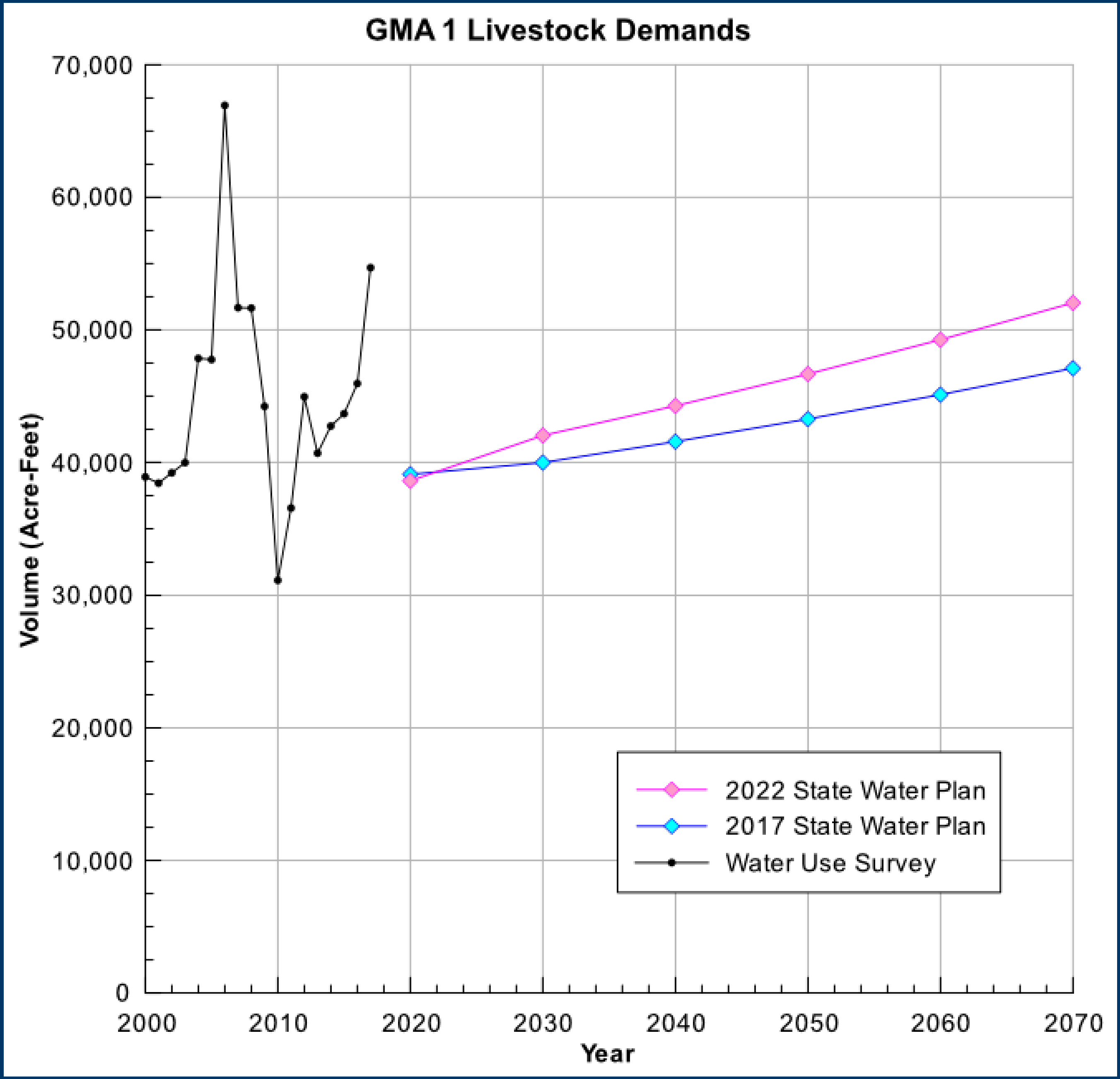

GMA 1 Municipal Demands
Volume (Acre-Feet)
140,000
130,000
120,000
110,000
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
2000
2010
2020
2030
2040
2050
2060
2070
Year
2022 State Water Plan
2017 State Water Plan
Water Use Survey

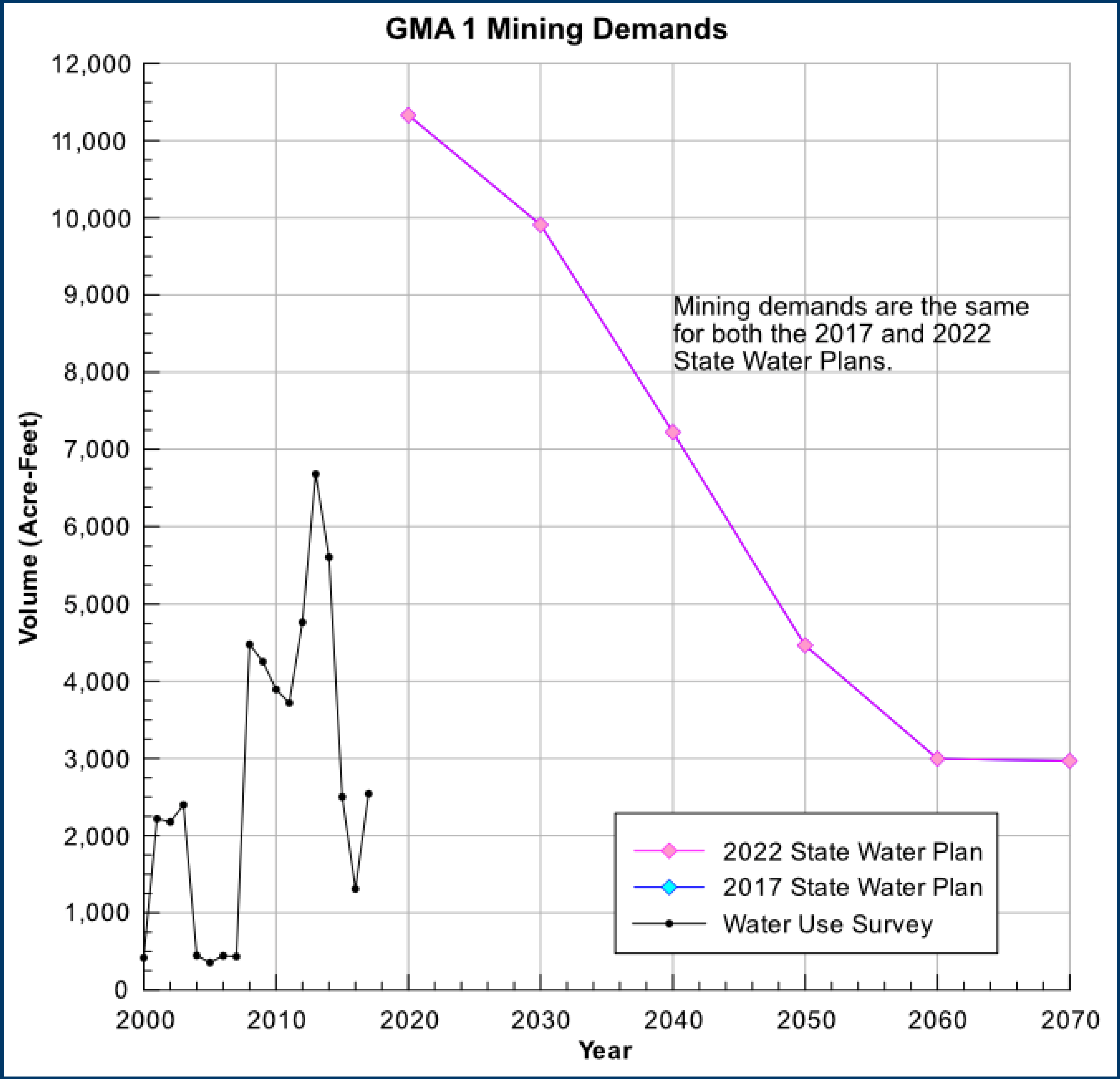


GMA 1 Irrigation Demands
Volume (Acre-Feet)
2,400,000
2,300,000
2,200,000
2,100,000
2,000,000
1,900,000
1,800,000
1,700,000
1,600,000
1,500,000
1,400,000
1,300,000
1,200,000
1,100,000
1,000,000
900,000
800,000
700,000
600,000
500,000
400,000
300,000
200,000
100,000
0
2000
2010
2020
2030
2040
2050
2060
2070
Year
2022 State Water Plan
2017 State Water Plan
Water Use Survey

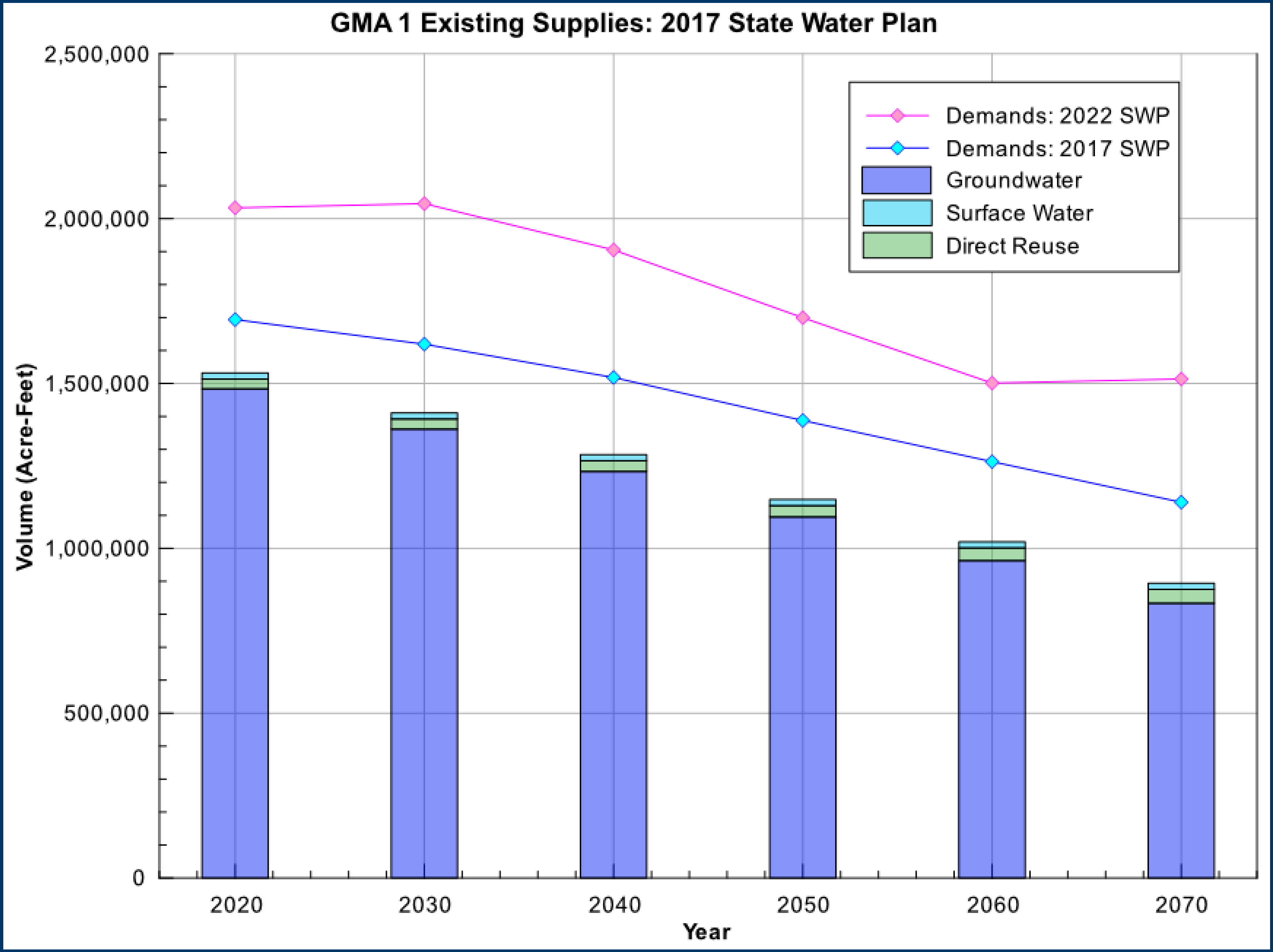


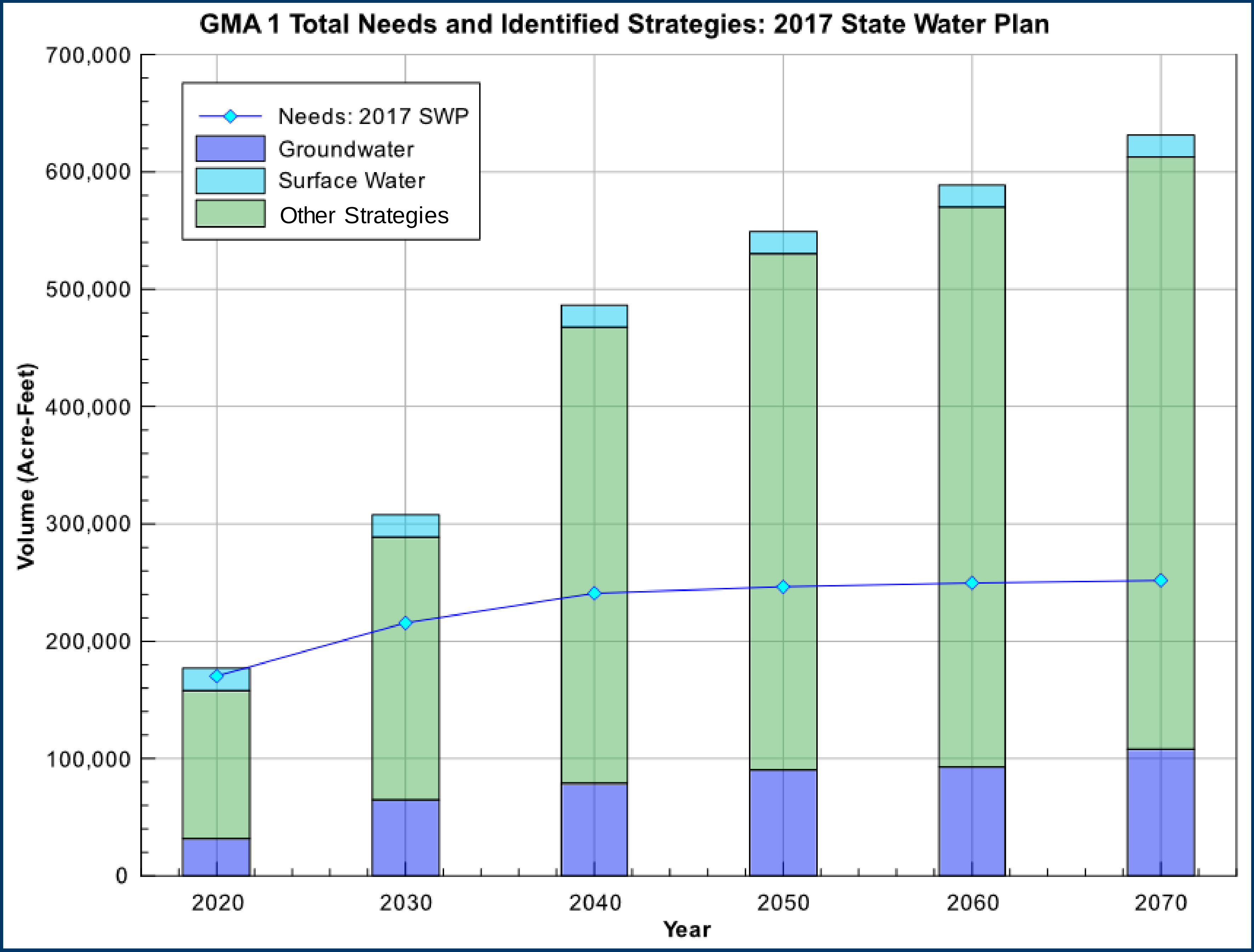
GMA 1 Steam Electric Power Demands
50,000
40,000
30,000
20,000
10,000
0
Volume (Acre-Feet)
2000
2010
2020
2030
2040
2050
2060
2070
Year
2022 State Water Plan
2017 State Water Plan
Water Use Survey

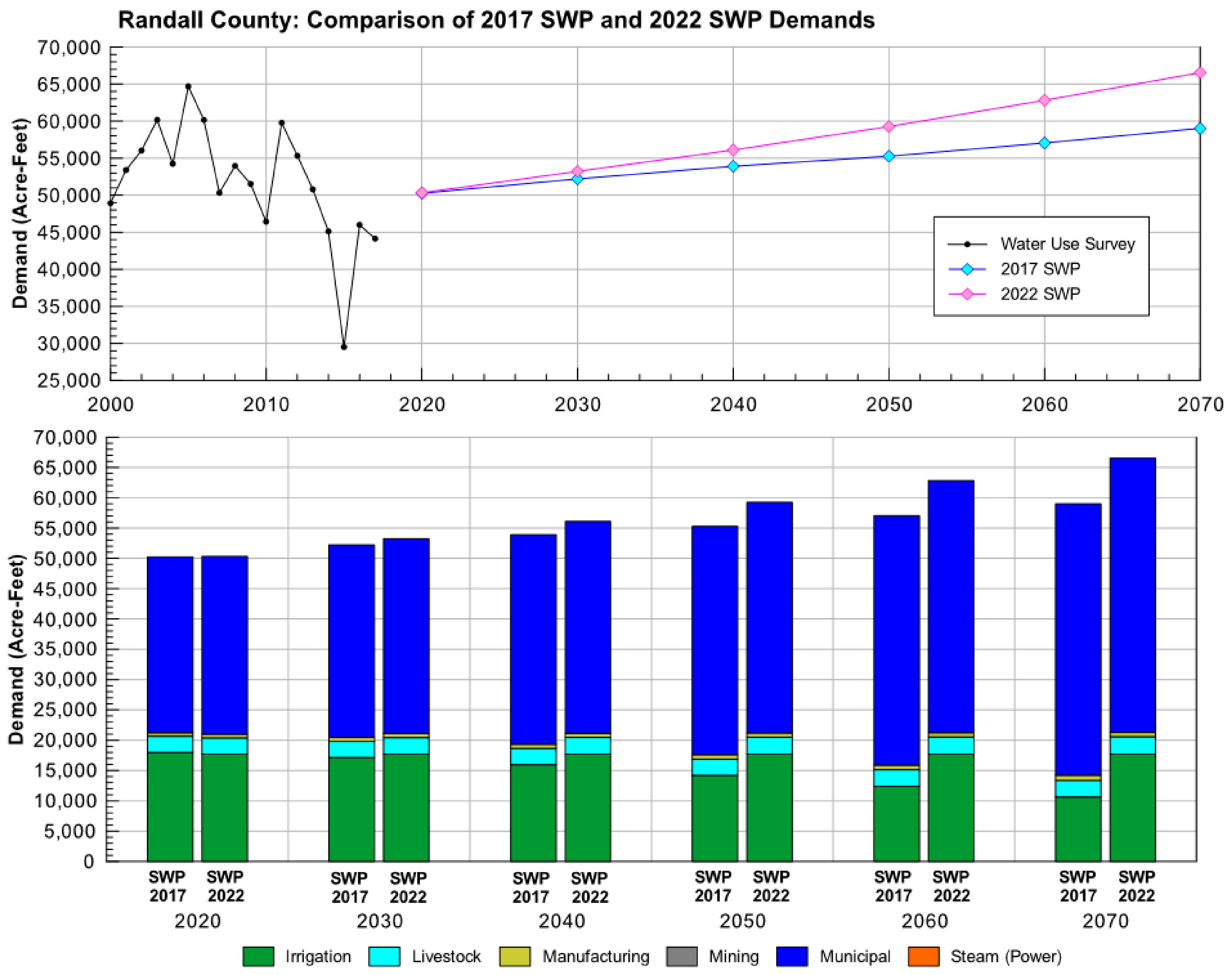

GMA 1 Livestock Demands
Volume (Acre-Feet)
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
2000
2010
2020
2030
2040
2050
2060
2070
Year
2022 State Water Plan
2017 State Water Plan
Water Use Survey



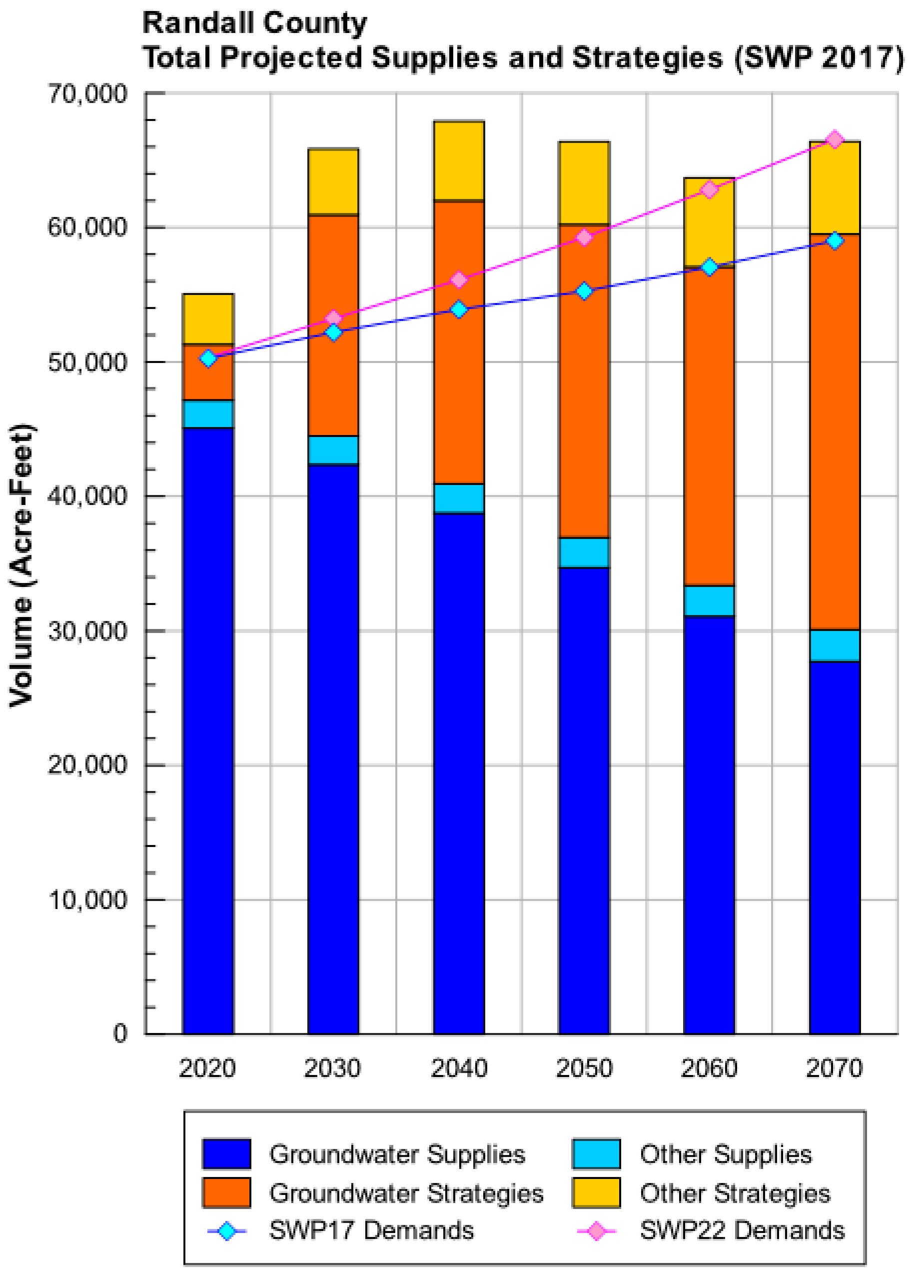
GMA 1 Mining Demands
Volume (Acre-Feet)
Year
12,000
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
2000
2010
2020
2030
2040
2050
2060
2070
Mining demands are the same for both the 2017 and 2022 State Water Plans.
2022 State Water Plan
2017 State Water Plan
Water Use Survey


GMA 1 Existing Supplies: 2017 State Water Plan
Demands: 2022 SWP
Demands: 2017 SWP
Groundwater
Surface Water
Direct Reuse
Volume (Acre-Feet)
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
2020
2030
2040
2050
2060
2070
Year

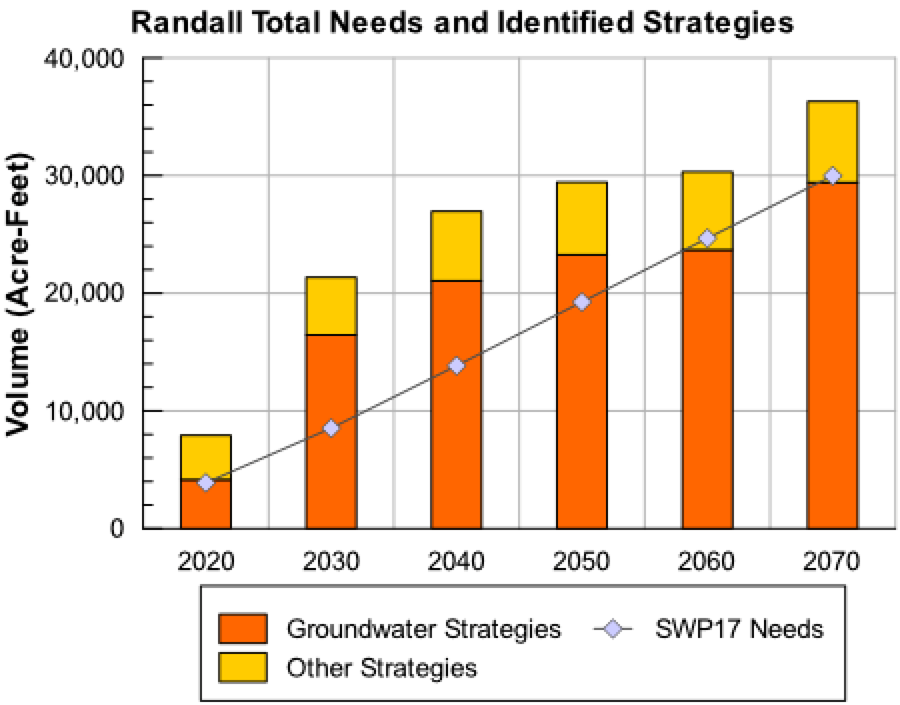

GMA 1 Total Needs and Identified Strategies: 2017 State Water Plan
Needs: 2017 SWP
Groundwater
Surface Water
Other Strategies
Volume (Acre-Feet)
700,000
600,000
500,000
400,000
300,000
200,000
100,000
0
2020
2030
2040
2050
2060
2070
Year



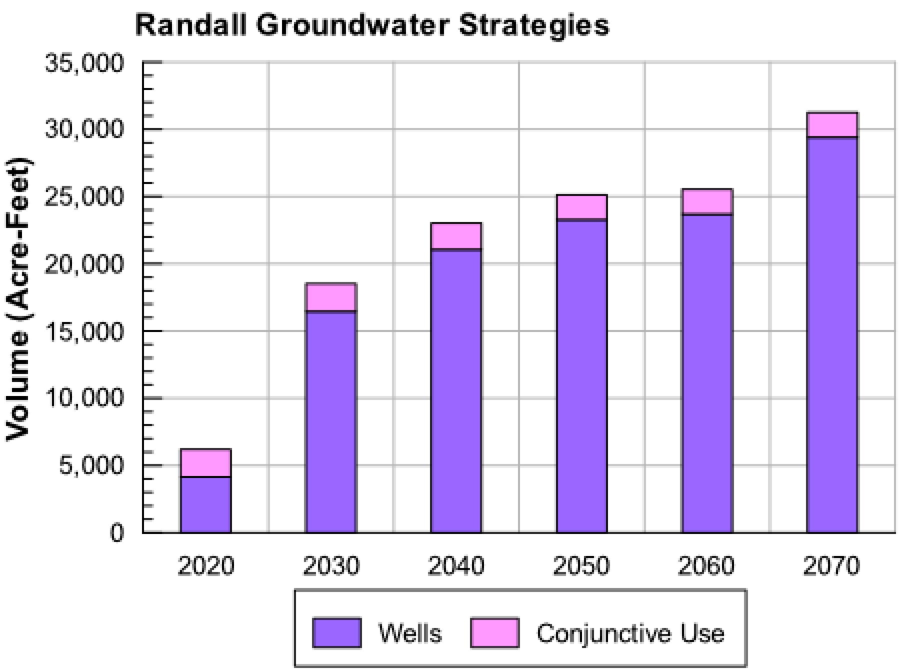
Randall County: Comparison of 2017 SWP and 2022 SWP Demands
Demand (Acre-Feet)
70,000
65,000
60,000
55,000
50,000
45,000
40,000
35,000
30,000
25,000
2000
2010
2020
2030
2040
2050
2060
2070
Water Use Survey
2017 SWP
2022 SWP
Demand (Acre-Feet)
70,000
65,000
60,000
55,000
50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
SWP 2017
SWP 2022
2020
2030
2040
2050
2060
2070
Irrigation
Livestock
Manufacturing
Mining
Municipal
Steam (Power)



Randall County
Total Projected Supplies and Strategies (SWP 2017)
Volume (Acre-Feet)
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
2020
2030
2040
2050
2060
2070
Groundwater Supplies
Other Supplies
Groundwater Strategies
Other Strategies
SWP17 Demands
SWP22 Demands



Randall Total Needs and Identified Strategies
Volume (Acre-Feet)
40,000
30,000
20,000
10,000
0
2020
2030
2040
2050
2060
2070
Groundwater Strategies
SWP17 Needs
Other Strategies

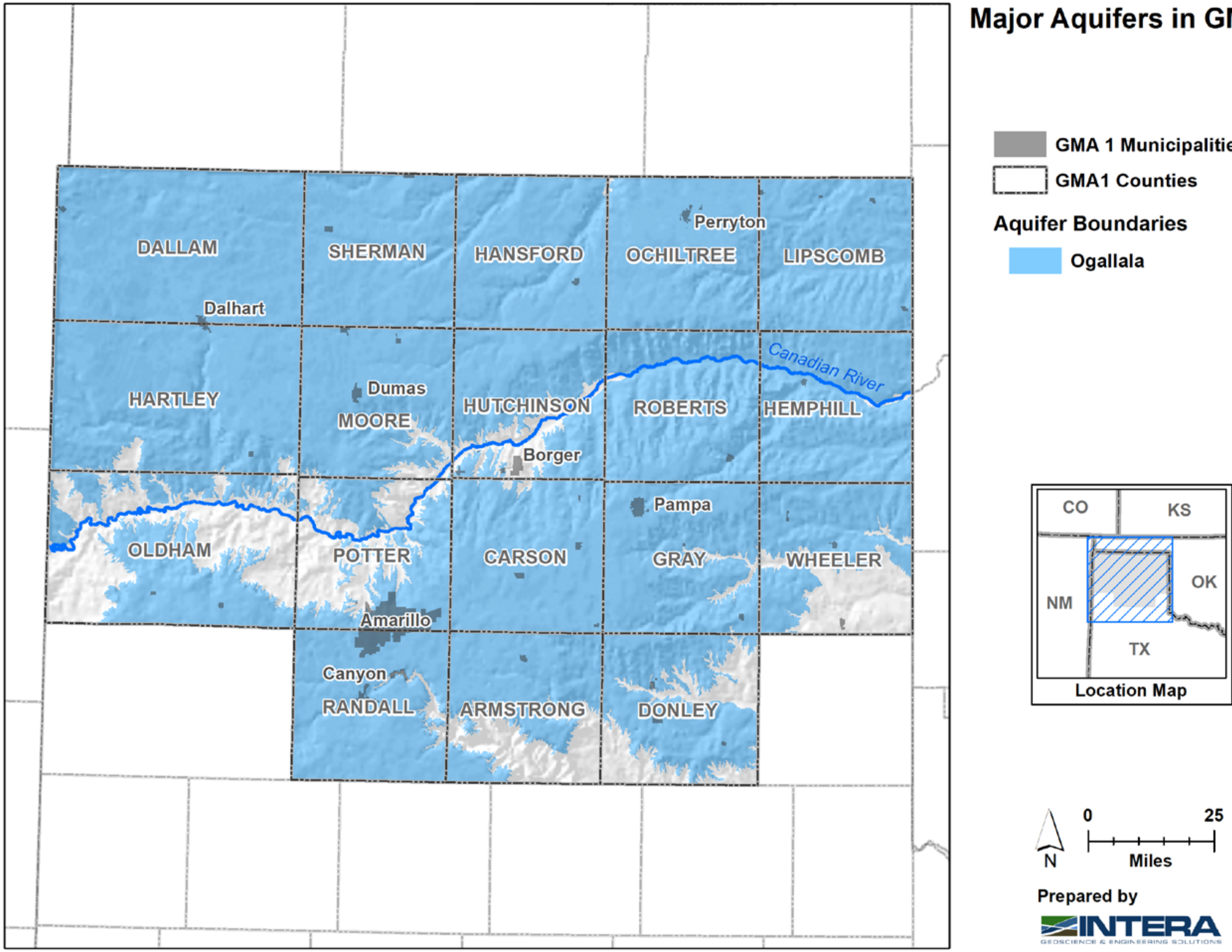


Randall Groundwater Strategies
Volume (Acre-Feet)
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
2020
2030
2040
2050
2060
2070
Wells
Conjunctive Use

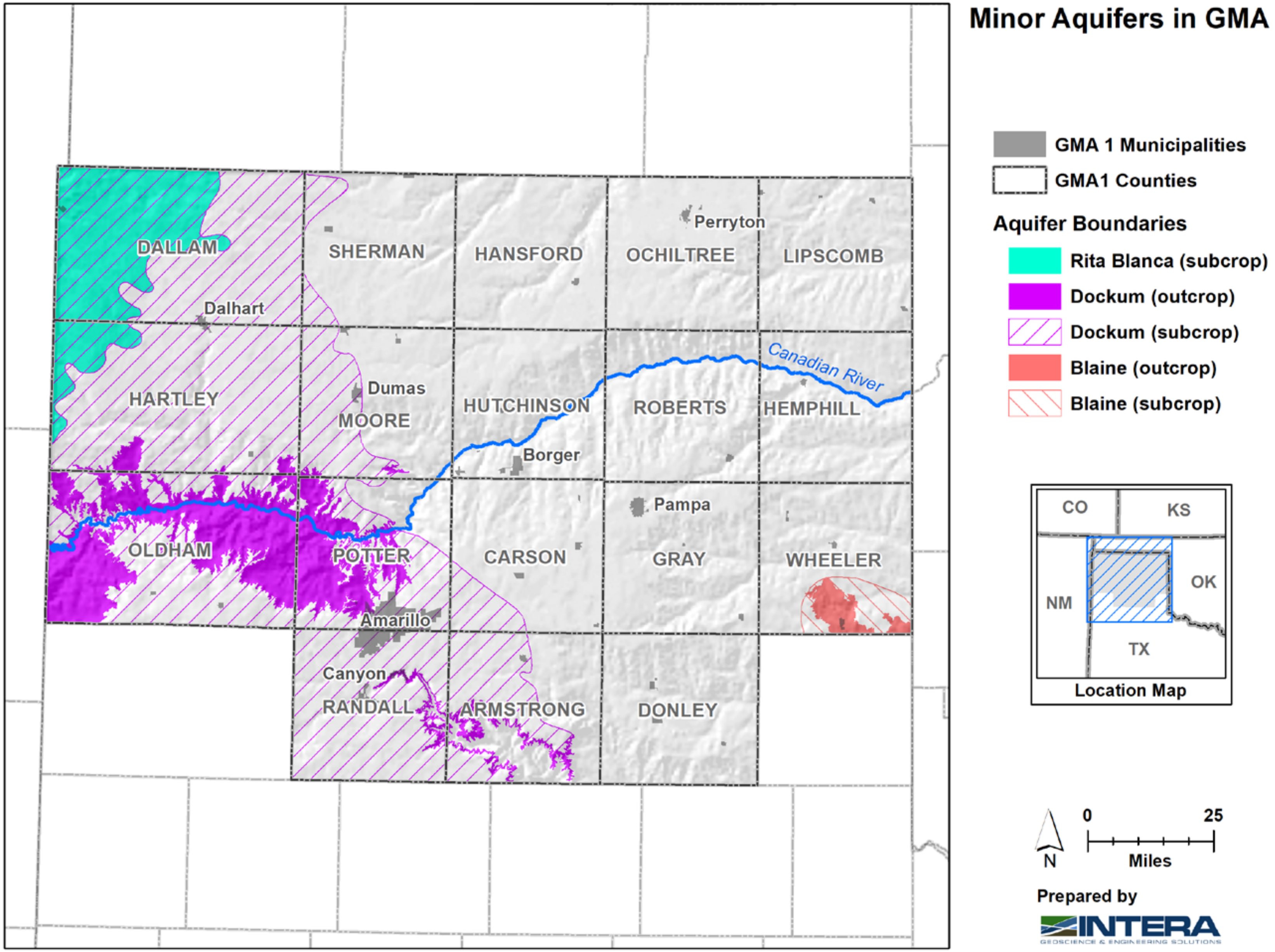
Consideration of Factors

- ✓ Aquifer uses or conditions (discussion on October 28, 2019)
- Water supply needs and management strategies (today)
- Hydrological conditions (today)
- Other environmental impacts
- Impact on subsidence
- Socioeconomic impacts
- Impact on private property rights
- Feasibility of achieving the DFC
- Any other relevant information

Major Aquifers in GMA 1



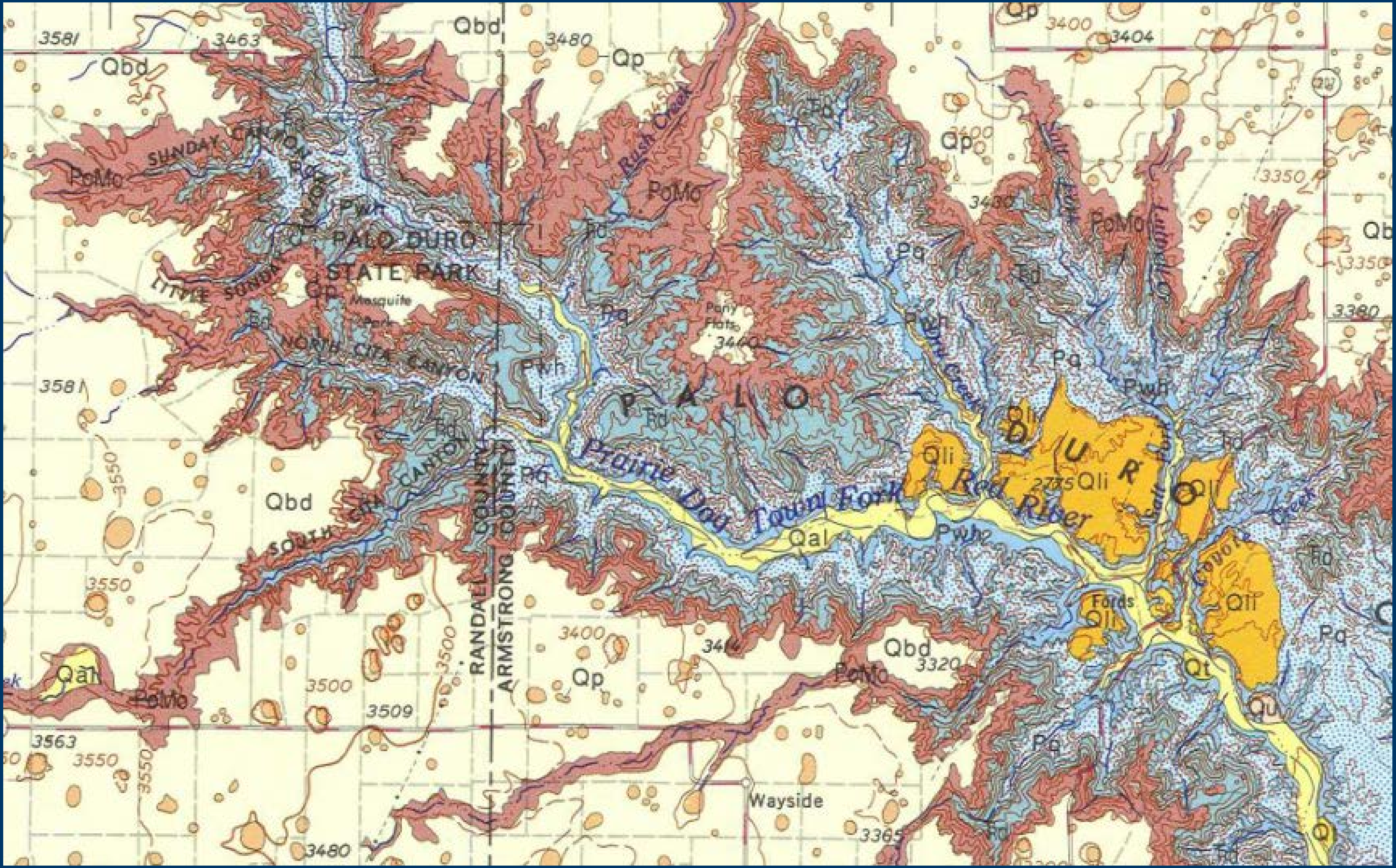
Minor Aquifers in GMA 1



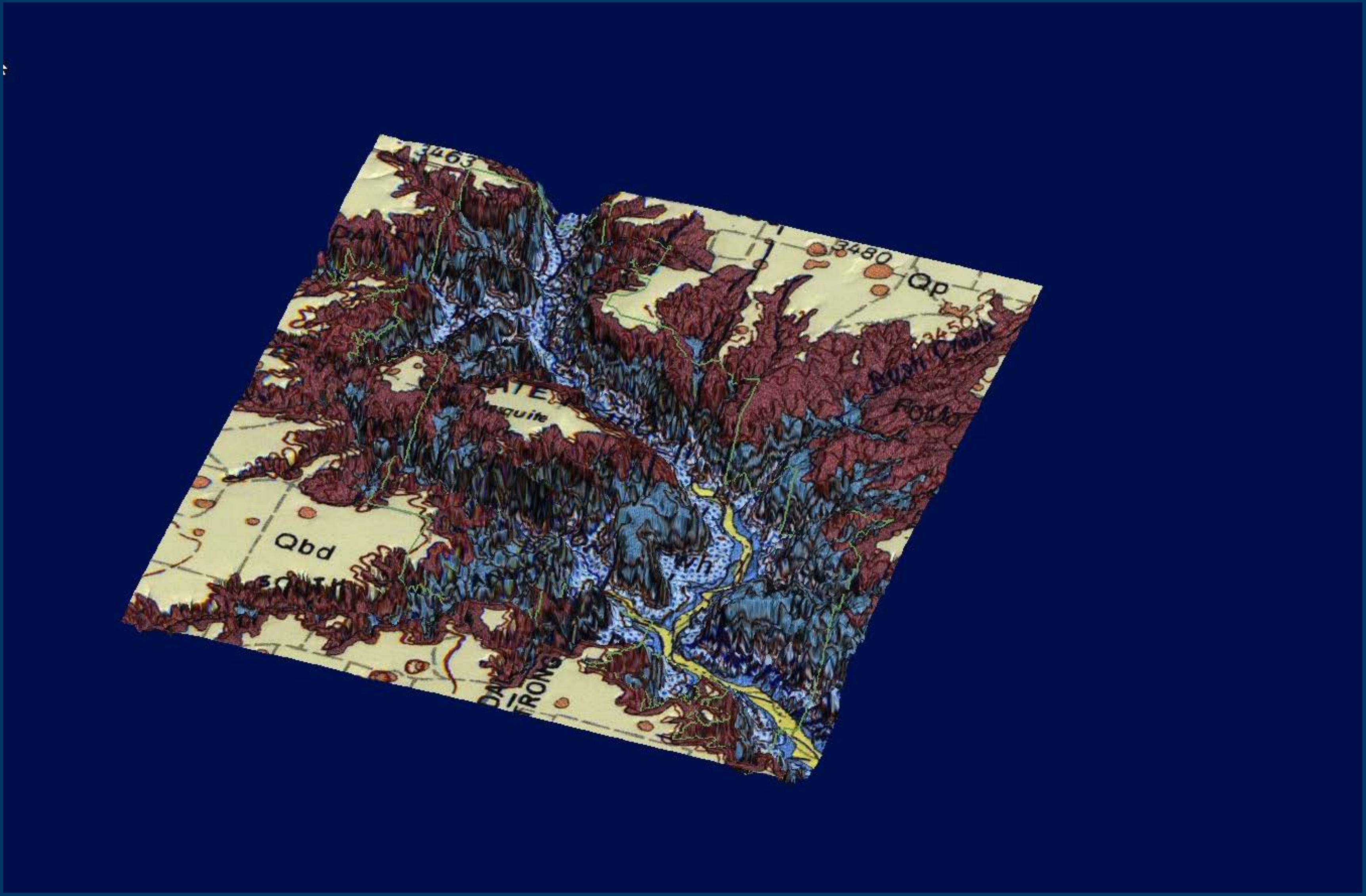
Geologic Setting

System	Formation	Aquifer
Tertiary	Ogallala	Ogallala
Jurassic	Morrison	Rita Blanca
	Exeter	
Triassic	Cooper Canyon	Upper Dockum
	Trujillo	
	Tecovas	Lower Dockum
	Santa Rosa	

Surface Geology (Geologic Atlas of Texas)

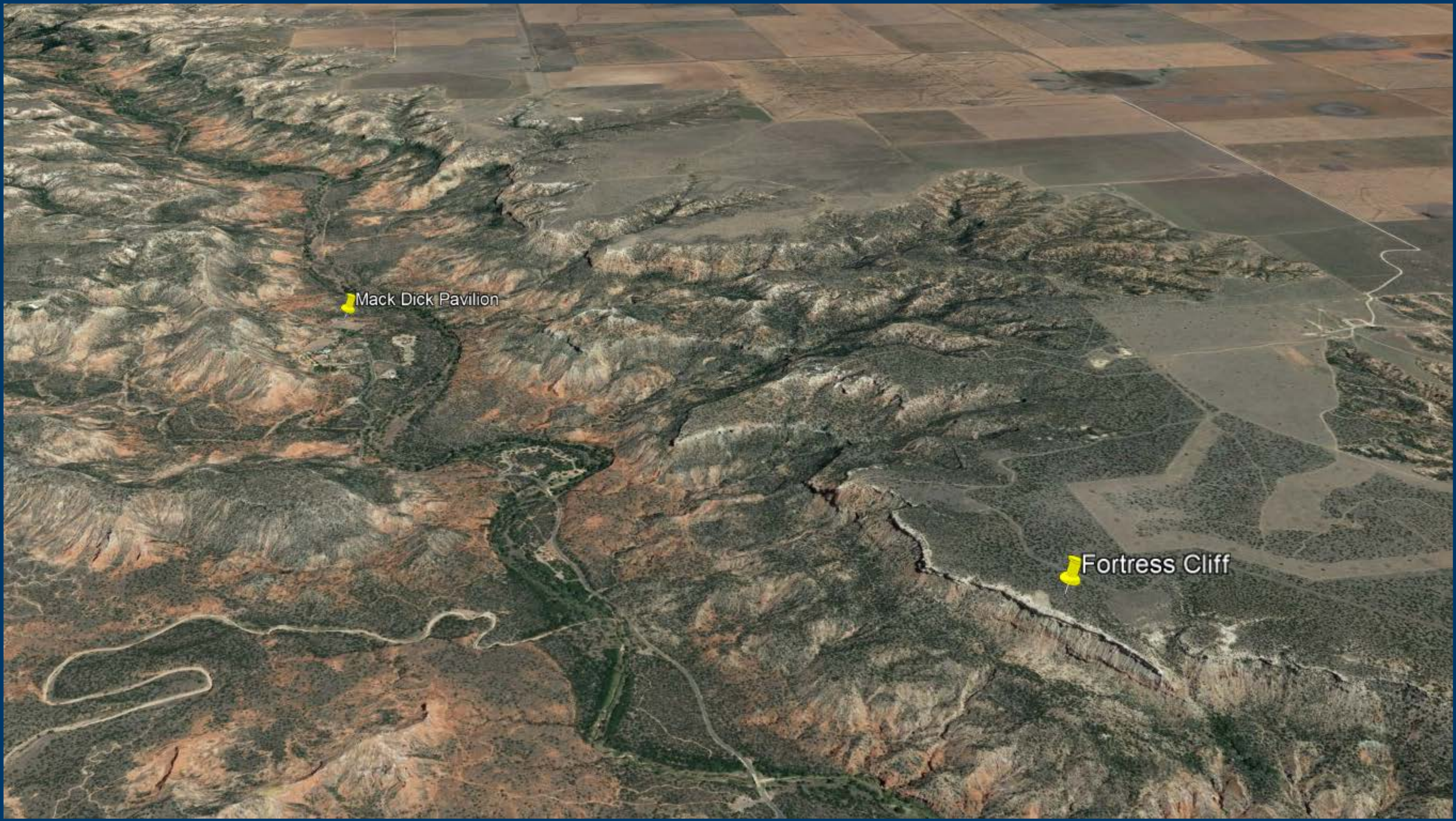


Surface Geology (Geologic Atlas of Texas)



20x Vertical Exaggeration

Fortress Cliff



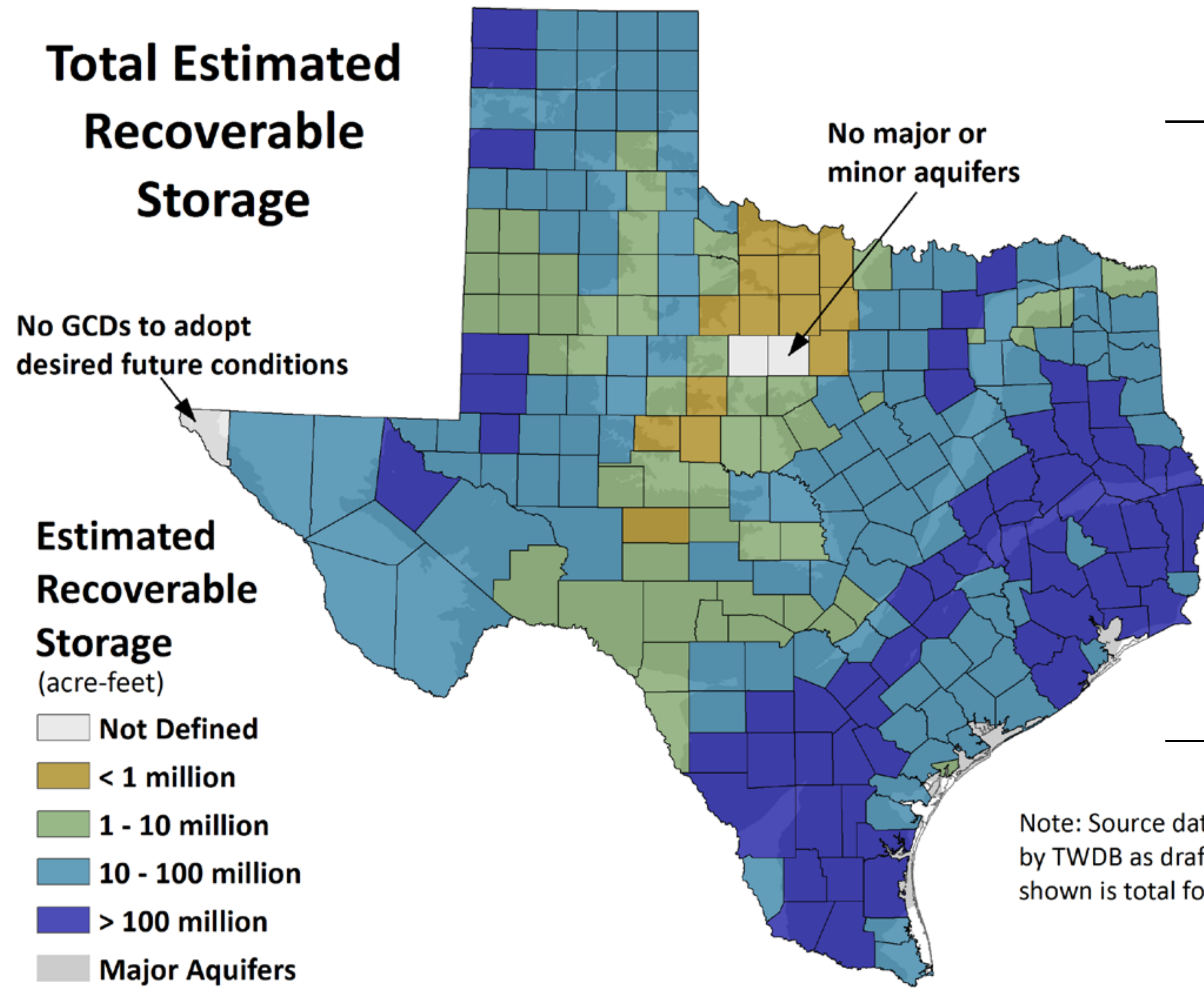
Imagery: Google Earth

Fortress Cliff

Total Estimated Recoverable Storage – The estimated amount of groundwater within an aquifer that accounts for recovery scenarios that range between 25% and 75% of the porosity-adjusted aquifer volume

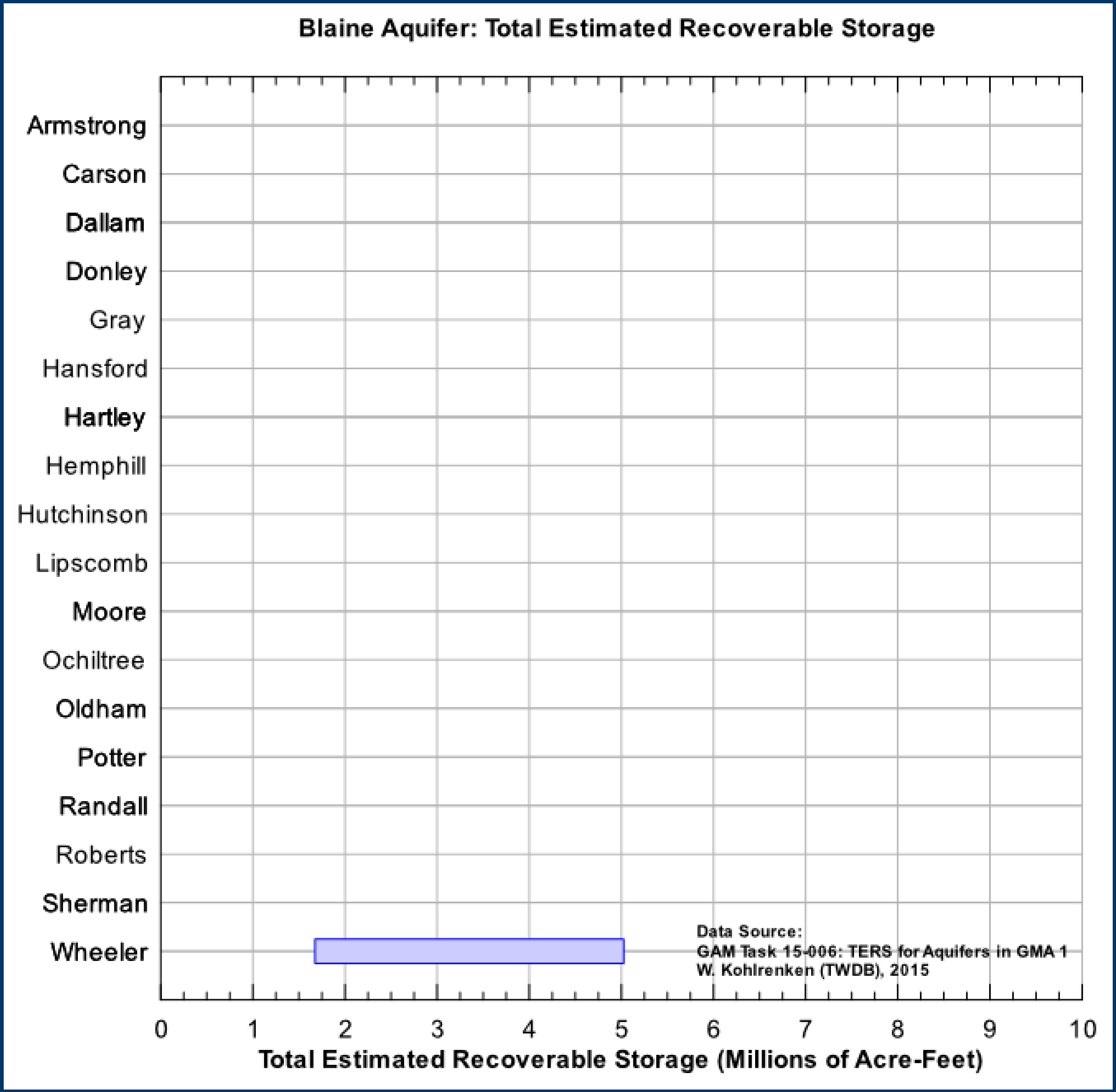
Texas Administrative Code Sec. 356.10

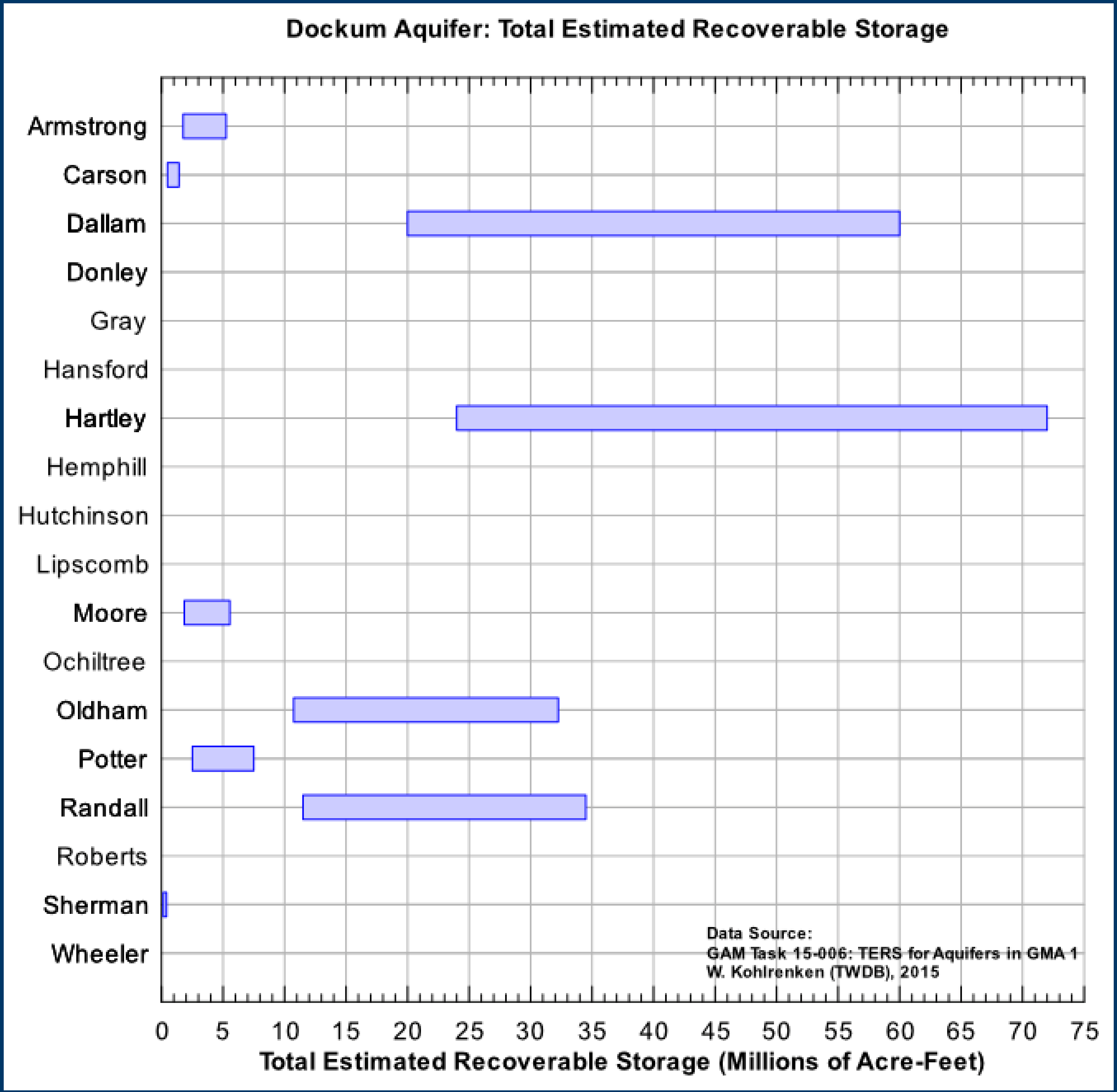
TERS Across Texas

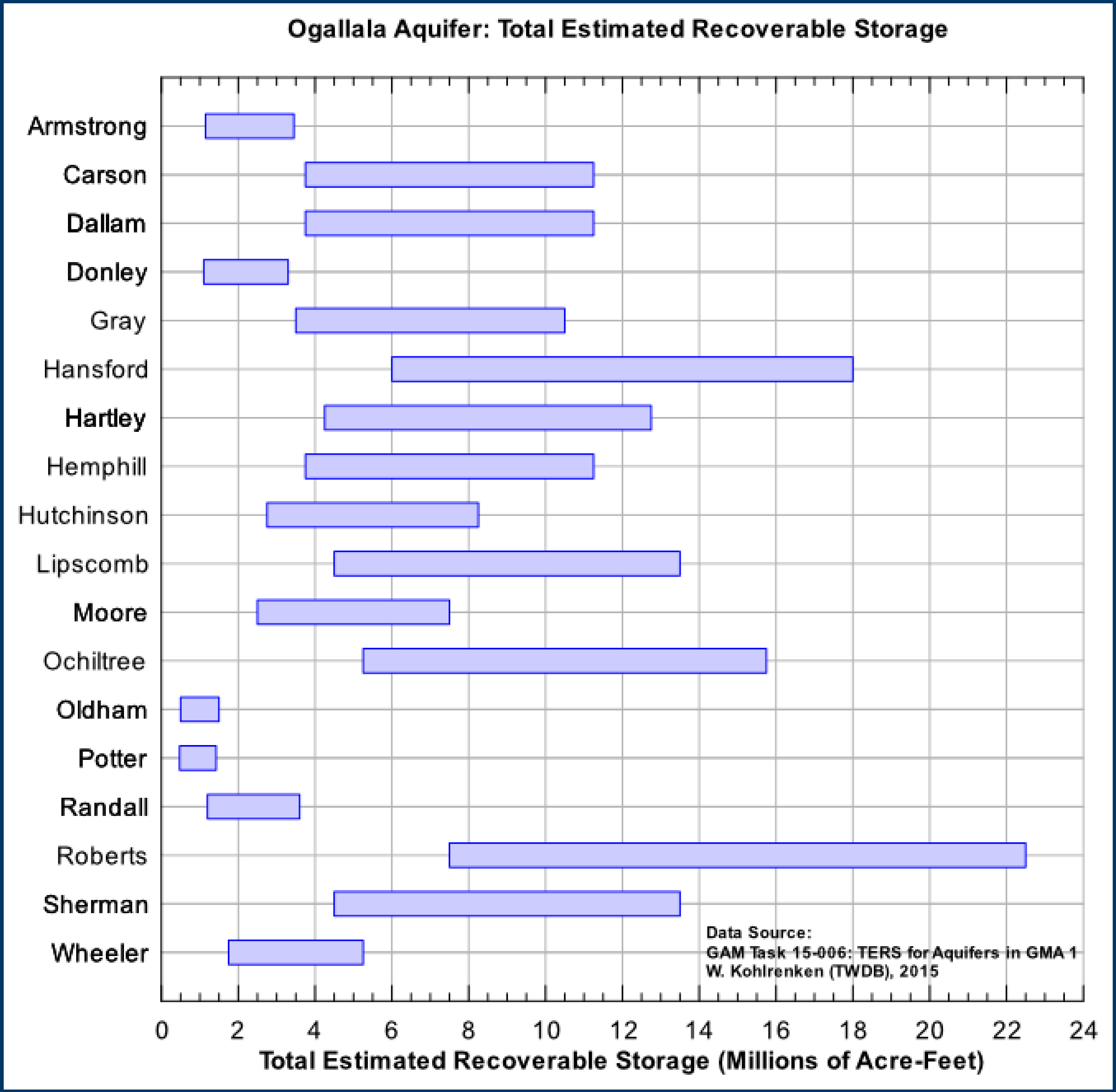


GMA	Total Estimated Storage (million acre-feet)
1	588
2	968
3	476
4	160
5	*NA*
6	180
7	447
8	1,628
9	33
10	46
11	2,488
12	1,380
13	2,756
14	3,085
15	443
16	2,205
Total	**16,883**

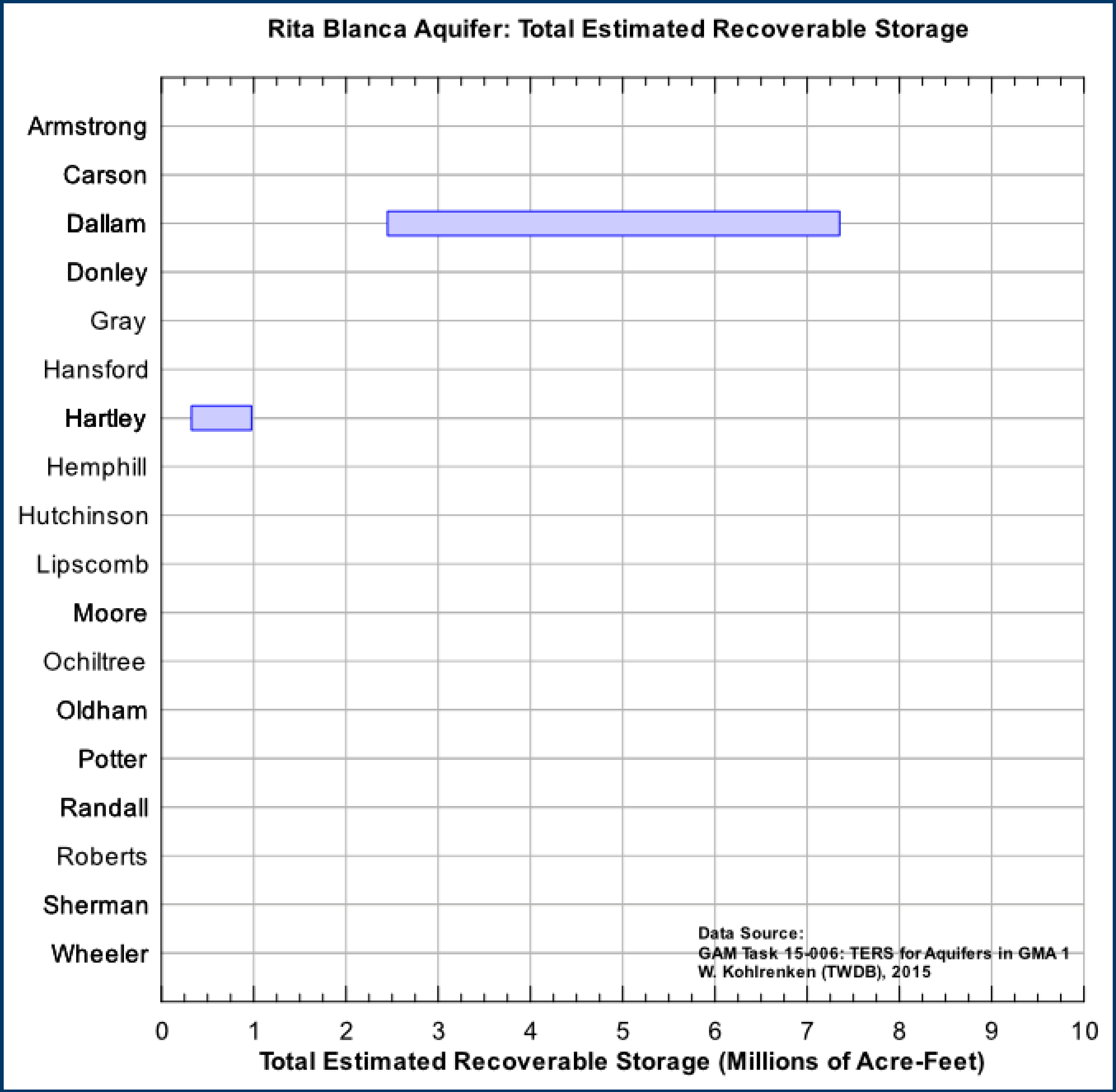
Note: Source data provided by TWDB as draft. TERS shown is total for all aquifers.

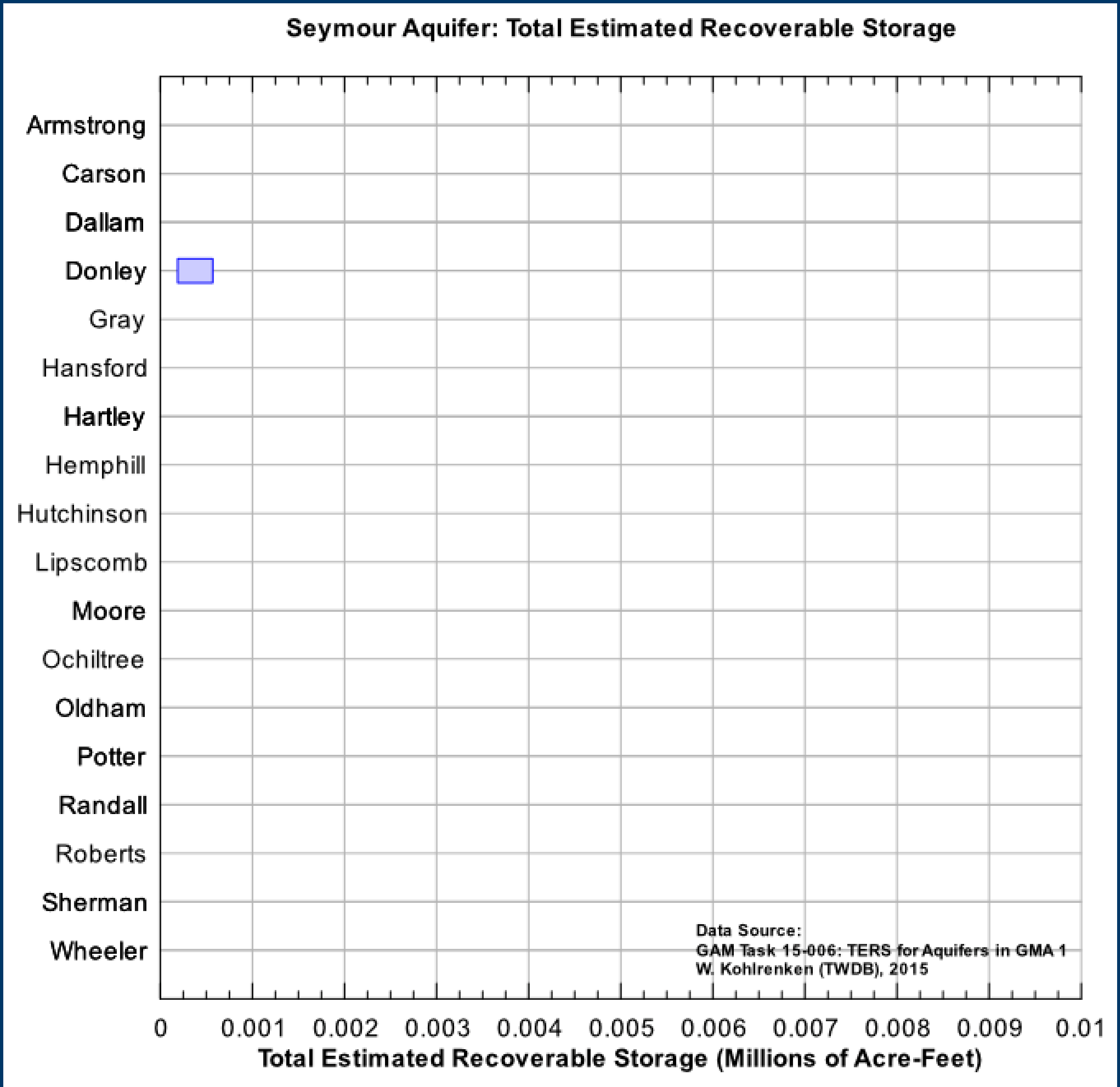

Blaine Aquifer: Total Estimated Recoverable Storage
Armstrong
Carson
Dallam
Donley
Gray
Hansford
Hartley
Hemphill
Hutchinson
Lipscomb
Moore
Ochiltree
Oldham
Potter
Randall
Roberts
Sherman
Wheeler
Data Source:
GAM Task 15-006: TERS for Aquifers in GMA 1
W. Kohlrenken (TWDB), 2015
0
1
2
3
4
5
6
7
8
9
10
Total Estimated Recoverable Storage (Millions of Acre-Feet)


Dockum Aquifer: Total Estimated Recoverable Storage
Armstrong
Carson
Dallam
Donley
Gray
Hansford
Hartley
Hemphill
Hutchinson
Lipscomb
Moore
Ochiltree
Oldham
Potter
Randall
Roberts
Sherman
Wheeler
Data Source:
GAM Task 15-006: TERS for Aquifers in GMA 1
W. Kohlrenken (TWDB), 2015
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75
Total Estimated Recoverable Storage (Millions of Acre-Feet)



Ogallala Aquifer: Total Estimated Recoverable Storage
Armstrong
Carson
Dallam
Donley
Gray
Hansford
Hartley
Hemphill
Hutchinson
Lipscomb
Moore
Ochiltree
Oldham
Potter
Randall
Roberts
Sherman
Wheeler
Data Source:
GAM Task 15-006: TERS for Aquifers in GMA 1
W. Kohlrenken (TWDB), 2015
0 2 4 6 8 10 12 14 16 18 20 22 24
Total Estimated Recoverable Storage (Millions of Acre-Feet)


Rita Blanca Aquifer: Total Estimated Recoverable Storage
Armstrong
Carson
Dallam
Donley
Gray
Hansford
Hartley
Hemphill
Hutchinson
Lipscomb
Moore
Ochiltree
Oldham
Potter
Randall
Roberts
Sherman
Wheeler
Data Source:
GAM Task 15-006: TERS for Aquifers in GMA 1
W. Kohlrenken (TWDB), 2015
0
1
2
3
4
5
6
7
8
9
10
Total Estimated Recoverable Storage (Millions of Acre-Feet)



Seymour Aquifer: Total Estimated Recoverable Storage
Armstrong
Carson
Dallam
Donley
Gray
Hansford
Hartley
Hemphill
Hutchinson
Lipscomb
Moore
Ochiltree
Oldham
Potter
Randall
Roberts
Sherman
Wheeler
Data Source:
GAM Task 15-006: TERS for Aquifers in GMA 1
W. Kohlrenken (TWDB), 2015
0
0.001
0.002
0.003
0.004
0.005
0.006
0.007
0.008
0.009
0.01
Total Estimated Recoverable Storage (Millions of Acre-Feet)

TERS - Limitations

No consideration given to:

- Aquifer water quality
- Water levels dropping below pumps
- Land surface subsidence
- Degradation of water quality
- Changes to surface water-groundwater interaction
- Recharge
- Practicality/economics of development

As calculated, the 25% to 75% TERS range represents the approximate fraction of total storage in the aquifer that is in the water-producing zones (e.g. sands), not what is "recoverable" from those zones.

TERS is a simple volumetric calculation that does not account for many important factors that limit groundwater production

Useful References

GAM Task 15-006: Total Estimated Recoverable Storage for Aquifers in GMA 14

Kohlrenken (2015)

http://www.twdb.texas.gov/groundwater/docs/GAMruns/Task15-006.pdf?d=8053.010000003269

Basic Groundwater Hydrology

Heath (1983)

https://pubs.usgs.gov/wsp/2220/report.pdf

The Geologic Story of Palo Duro Canyon

Matthews (1969)

http://www.gutenberg.readingroo.ms/5/2/1/7/52179/52179-h/52179-h.htm

The Water Budget Myth Revisited: Why Hydrogeologists Model

Bredehoeft (2005)

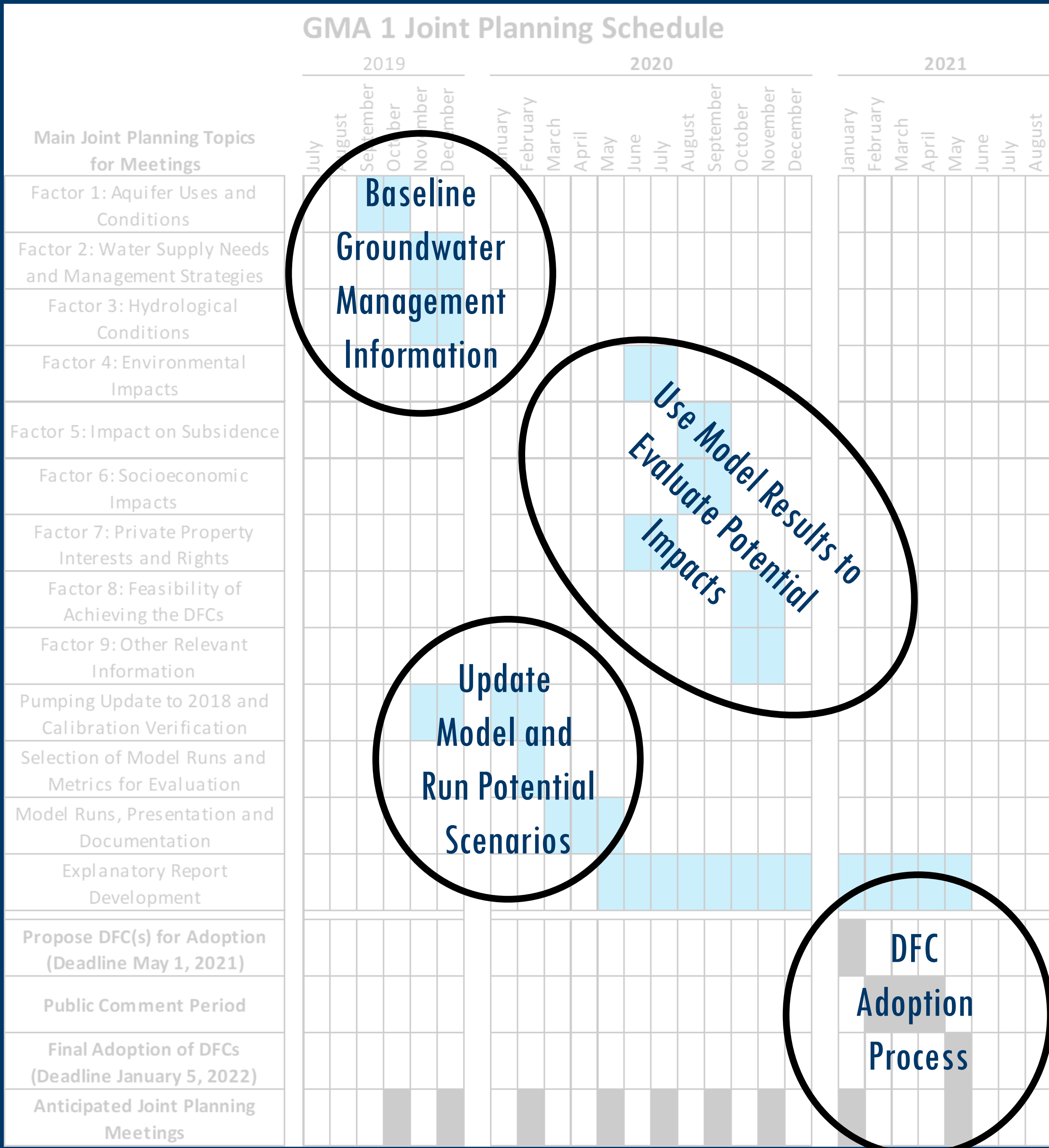
https://ngwa.onlinelibrary.wiley.com/doi/10.1111/j.1745-6584.2002.tb02511.x

Another Water Budget Myth: The Significance of Recoverable Ground Water in Storage

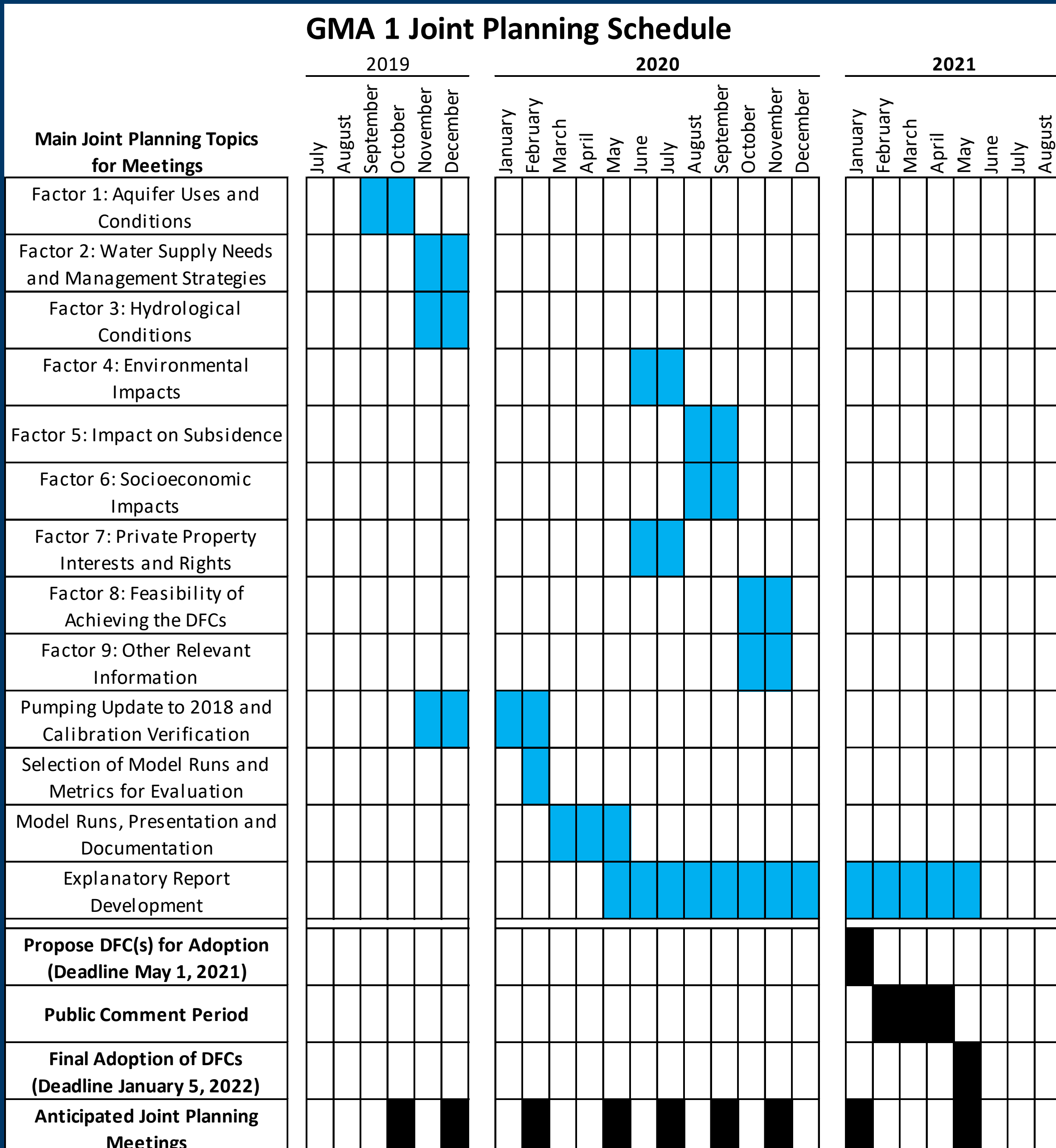
Alley (2007)

https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1601&context=usgsstaffpub

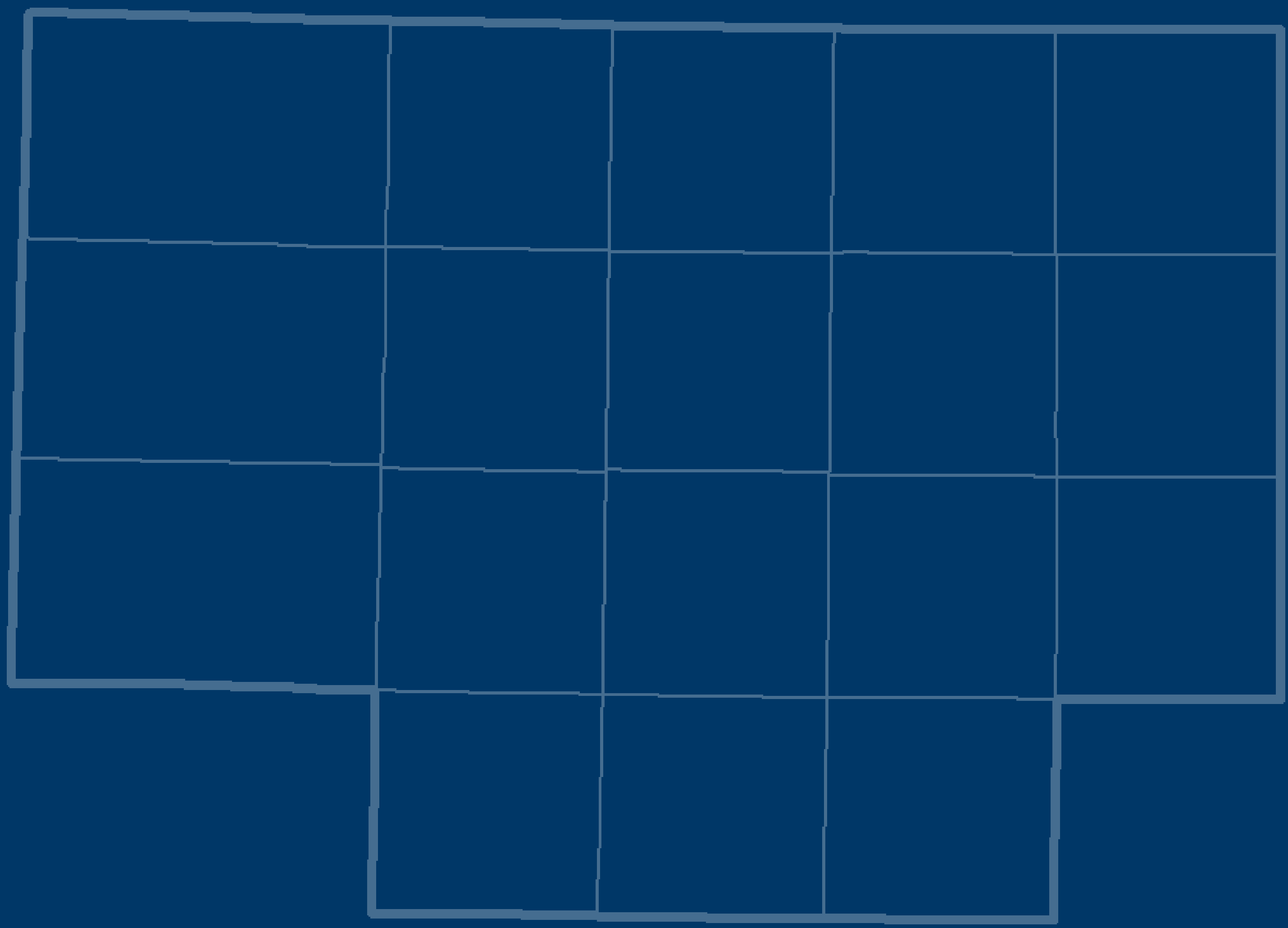
Current Schedule

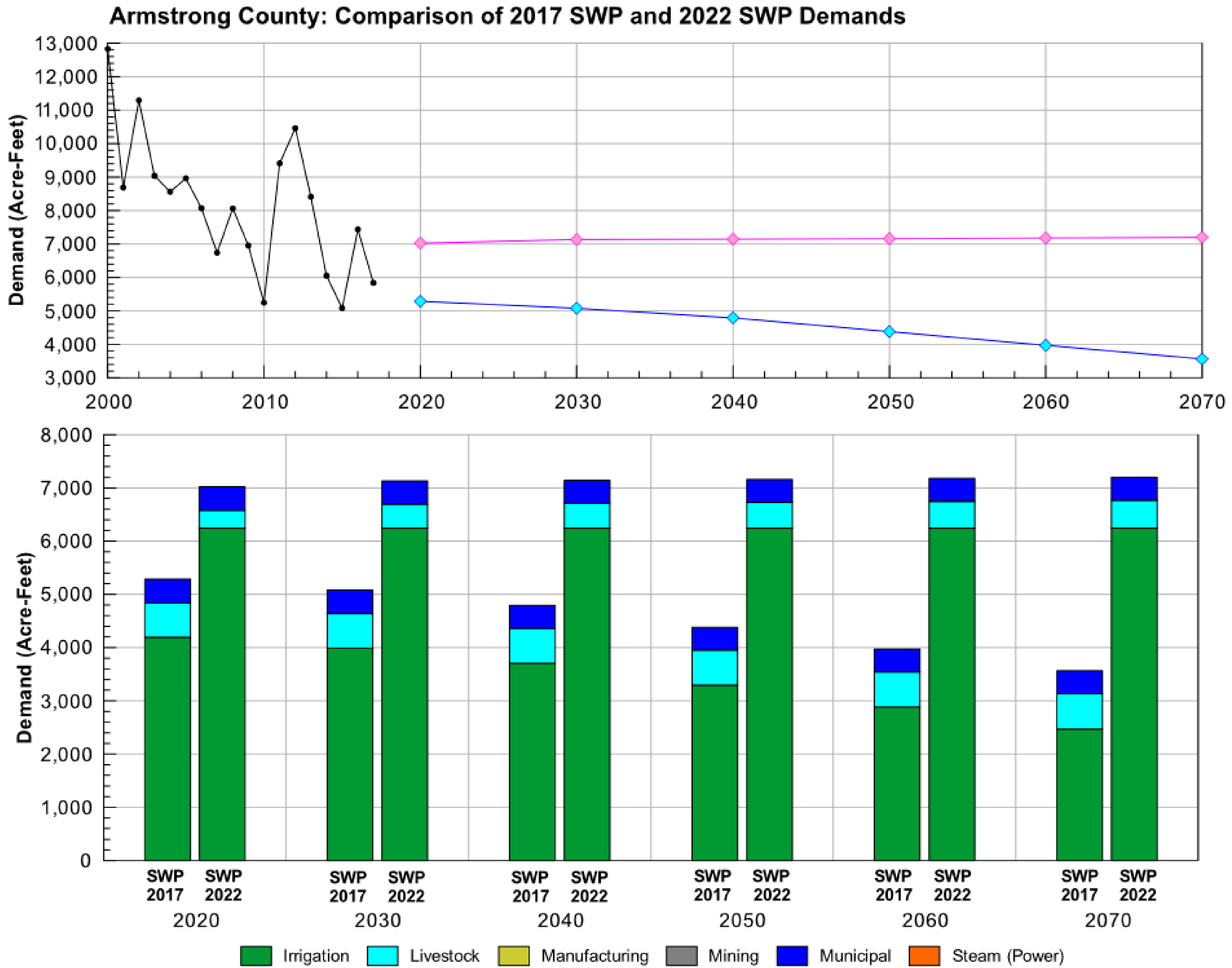


Current Schedule

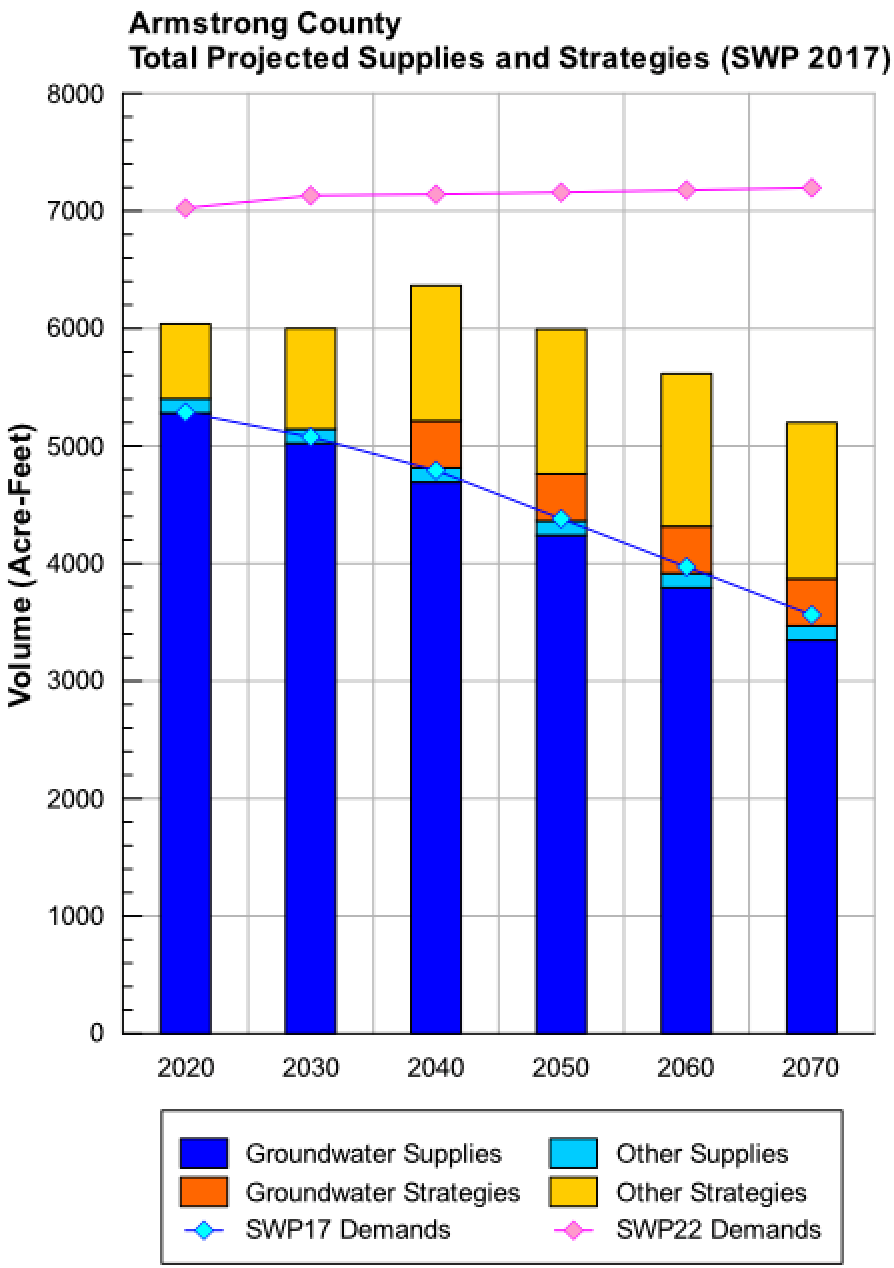


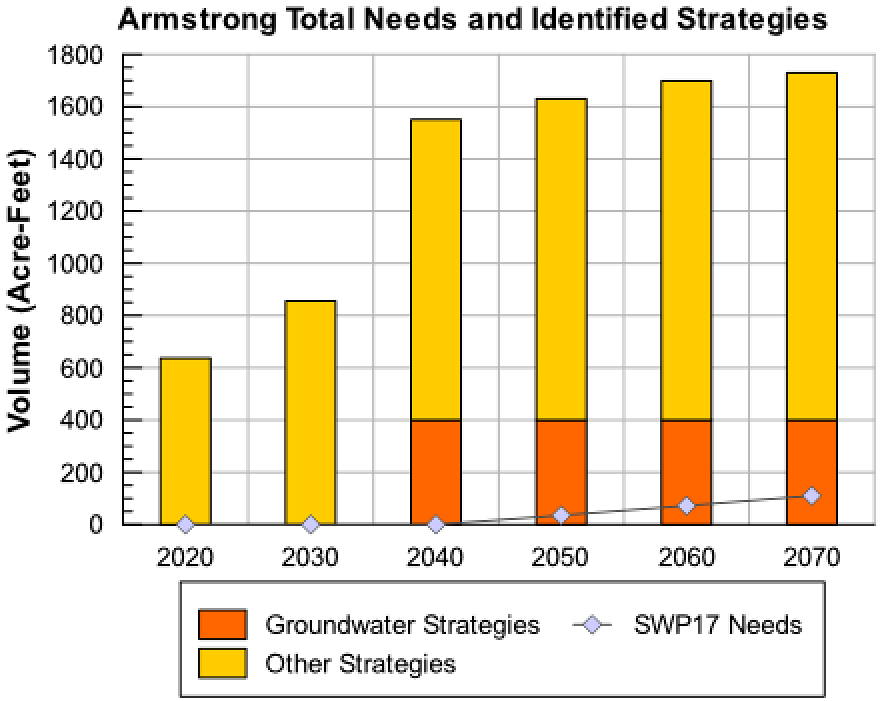
Appendix: County State Water Plan Information

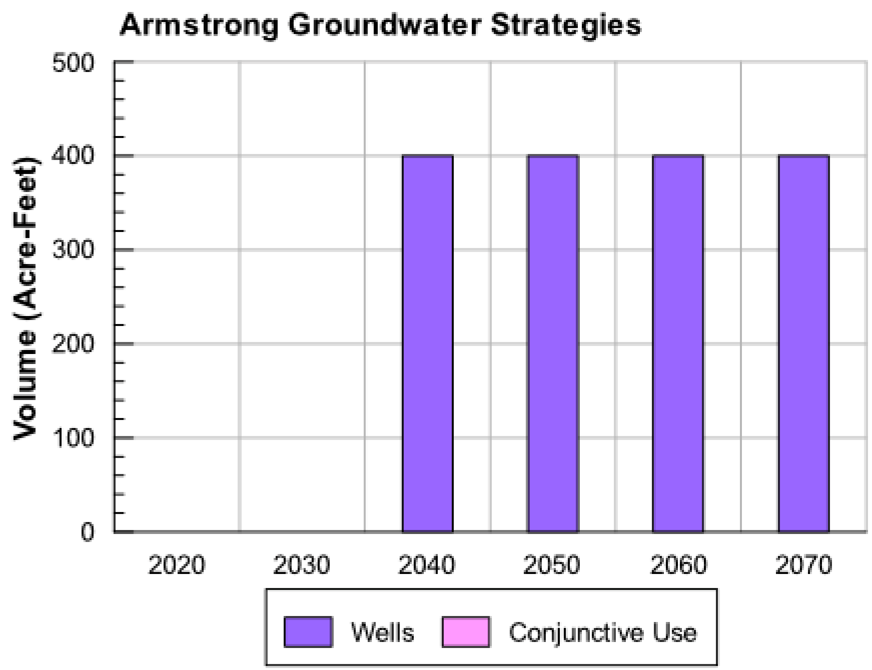


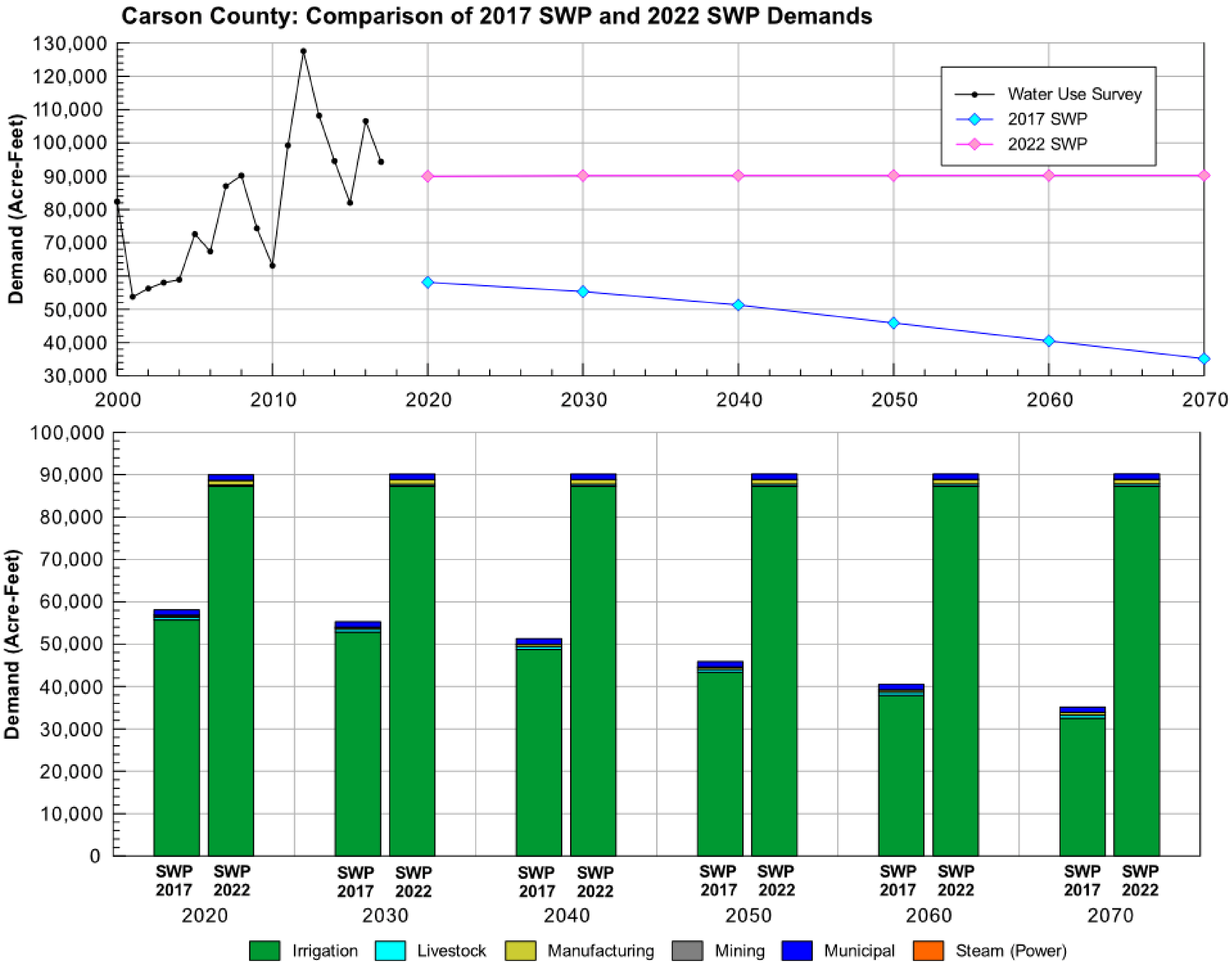


Armstrong County: Comparison of 2017 SWP and 2022 SWP Demands
13,000
12,000
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
Demand (Acre-Feet)
2000
2010
2020
2030
2040
2050
2060
2070
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Demand (Acre-Feet)
SWP 2017
SWP 2022
2020
2030
2040
2050
2060
2070
Irrigation
Livestock
Manufacturing
Mining
Municipal
Steam (Power)

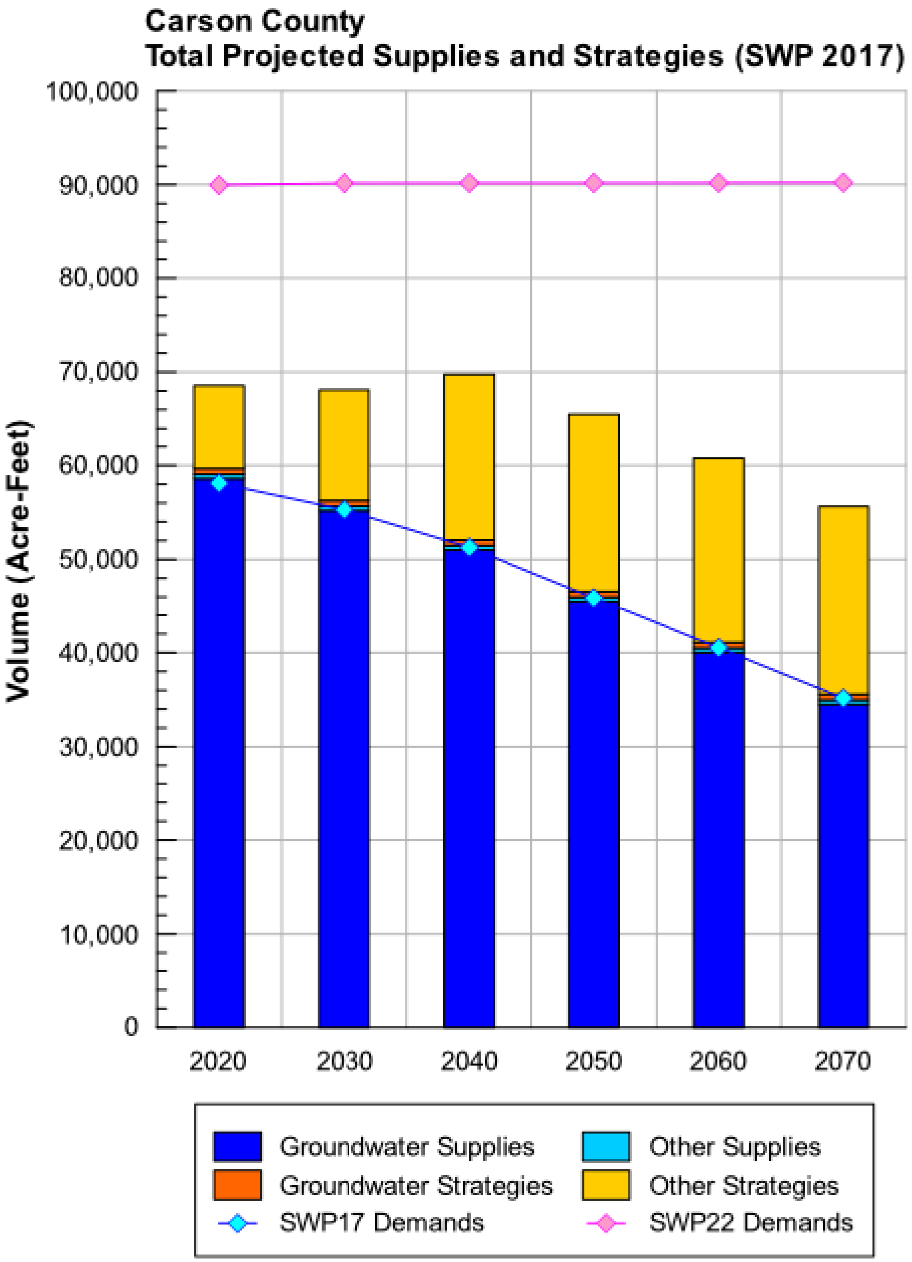

Armstrong County
Total Projected Supplies and Strategies (SWP 2017)
Volume (Acre-Feet)
0
1000
2000
3000
4000
5000
6000
7000
8000
2020
2030
2040
2050
2060
2070
Groundwater Supplies
Other Supplies
Groundwater Strategies
Other Strategies
SWP17 Demands
SWP22 Demands

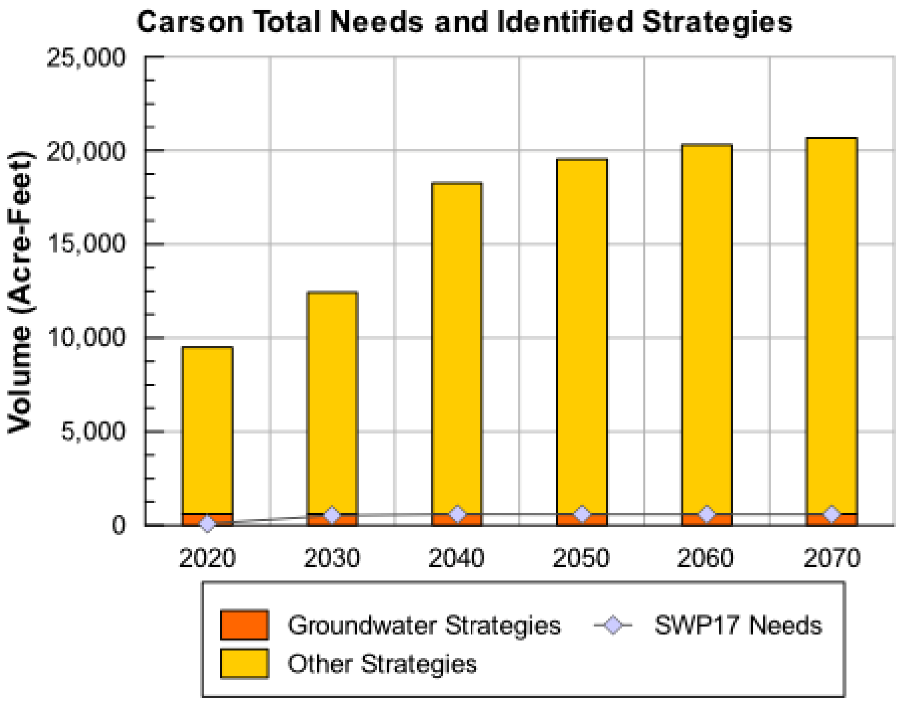

Armstrong Total Needs and Identified Strategies
Volume (Acre-Feet)
0
200
400
600
800
1000
1200
1400
1600
1800
2020
2030
2040
2050
2060
2070
Groundwater Strategies
SWP17 Needs
Other Strategies

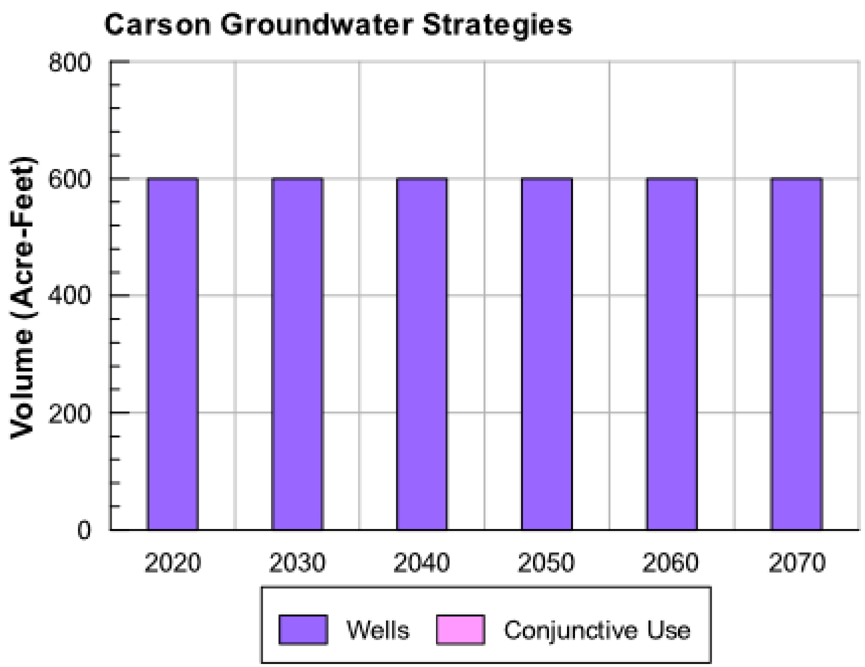

Armstrong Groundwater Strategies
Volume (Acre-Feet)
0
100
200
300
400
500
2020
2030
2040
2050
2060
2070
Wells
Conjunctive Use

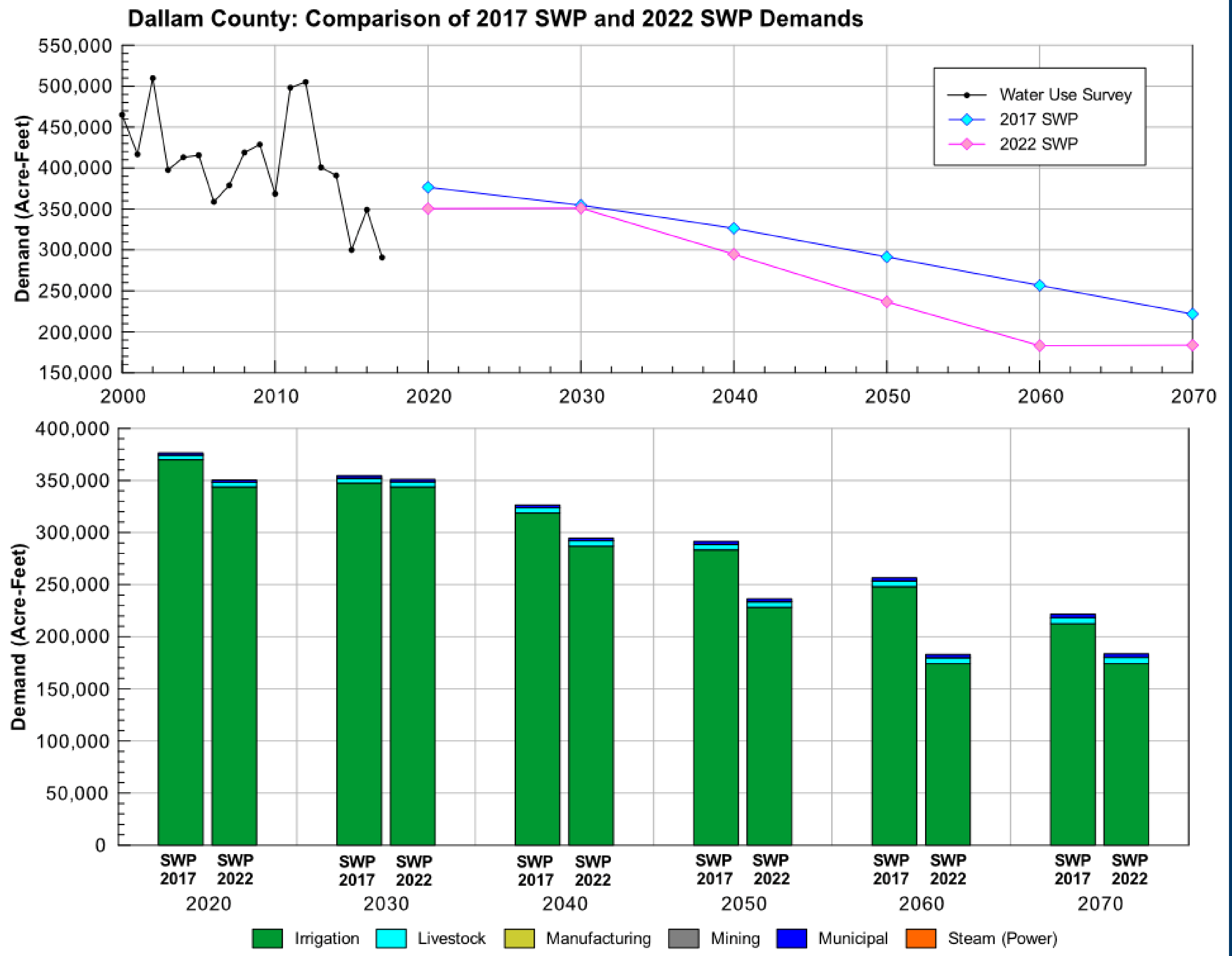


Carson County: Comparison of 2017 SWP and 2022 SWP Demands
Demand (Acre-Feet)
Water Use Survey
2017 SWP
2022 SWP
130,000
120,000
110,000
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
2000
2010
2020
2030
2040
2050
2060
2070
Demand (Acre-Feet)
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
SWP 2017
SWP 2022
2020
2030
2040
2050
2060
2070
Irrigation
Livestock
Manufacturing
Mining
Municipal
Steam (Power)

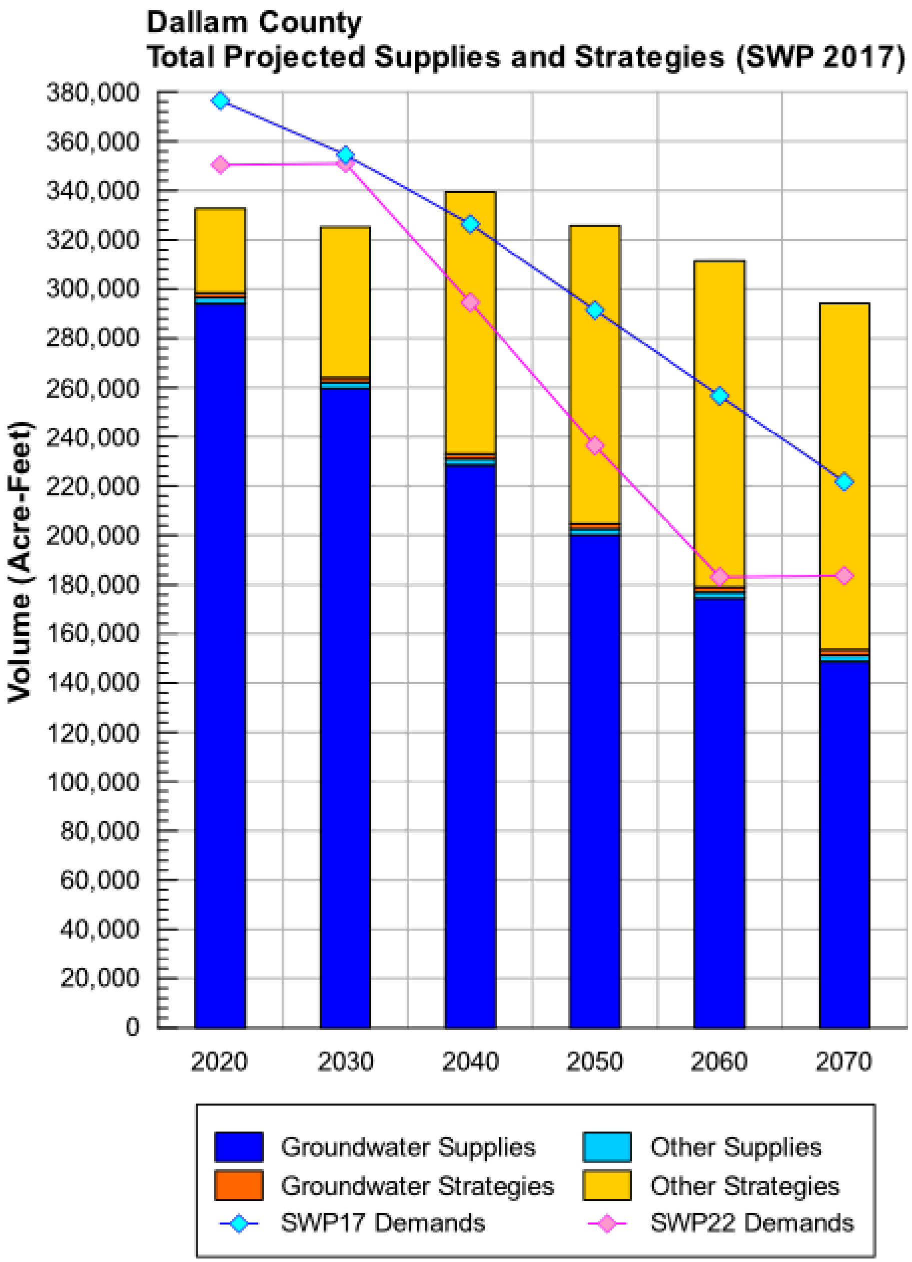

Carson County
Total Projected Supplies and Strategies (SWP 2017)
Volume (Acre-Feet)
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
2020
2030
2040
2050
2060
2070
Groundwater Supplies
Other Supplies
Groundwater Strategies
Other Strategies
SWP17 Demands
SWP22 Demands


Carson Total Needs and Identified Strategies
Volume (Acre-Feet)
25,000
20,000
15,000
10,000
5,000
0
2020
2030
2040
2050
2060
2070
Groundwater Strategies
SWP17 Needs
Other Strategies

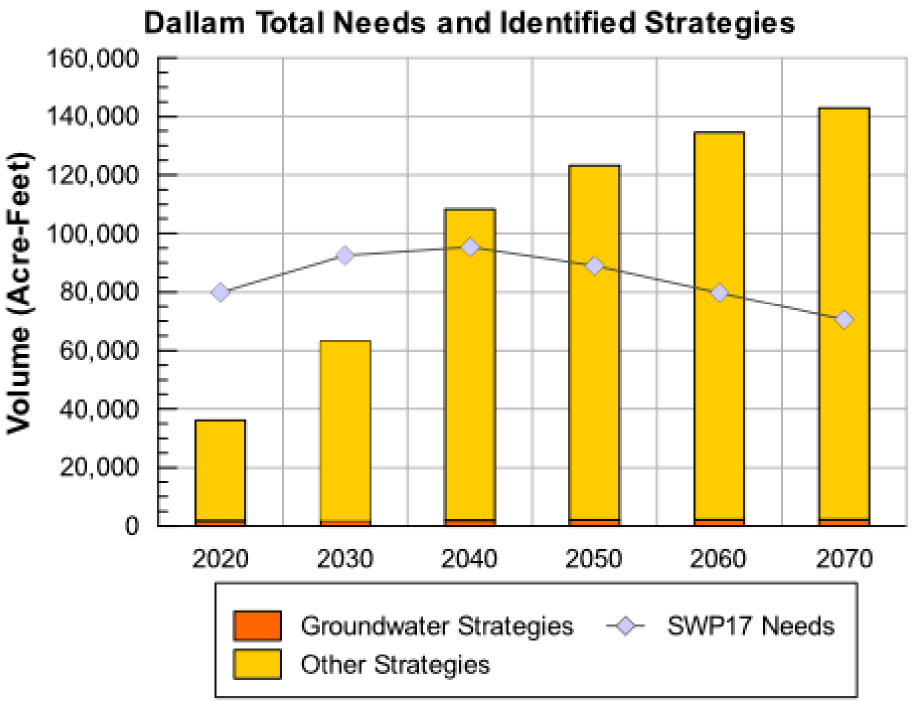

Carson Groundwater Strategies
Volume (Acre-Feet)
800
600
400
200
0
2020
2030
2040
2050
2060
2070
Wells
Conjunctive Use



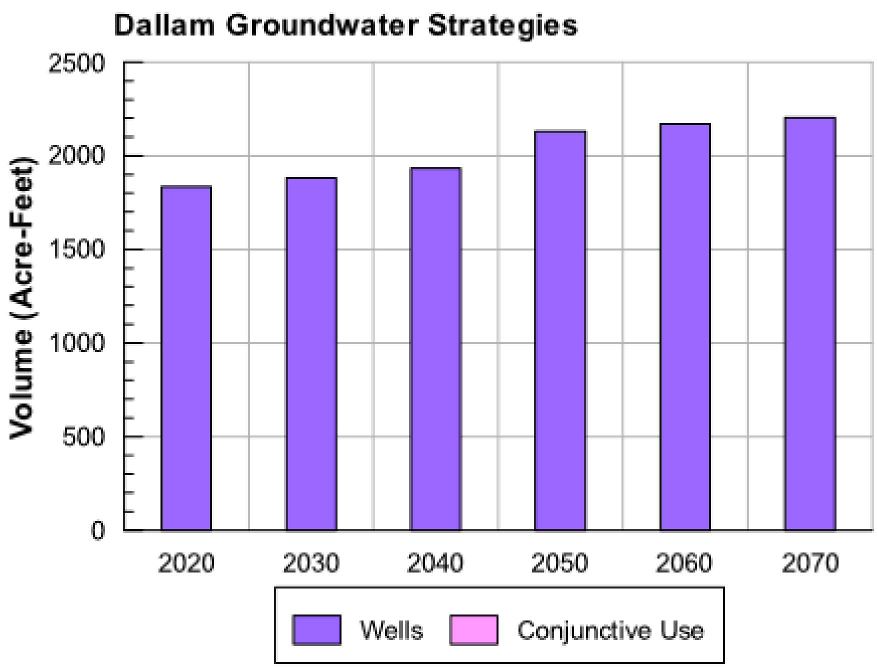
Dallam County: Comparison of 2017 SWP and 2022 SWP Demands
Demand (Acre-Feet)
550,000
500,000
450,000
400,000
350,000
300,000
250,000
200,000
150,000
2000
2010
2020
2030
2040
2050
2060
2070
Water Use Survey
2017 SWP
2022 SWP
Demand (Acre-Feet)
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
SWP 2017
SWP 2022
2020
2030
2040
2050
2060
2070
Irrigation
Livestock
Manufacturing
Mining
Municipal
Steam (Power)



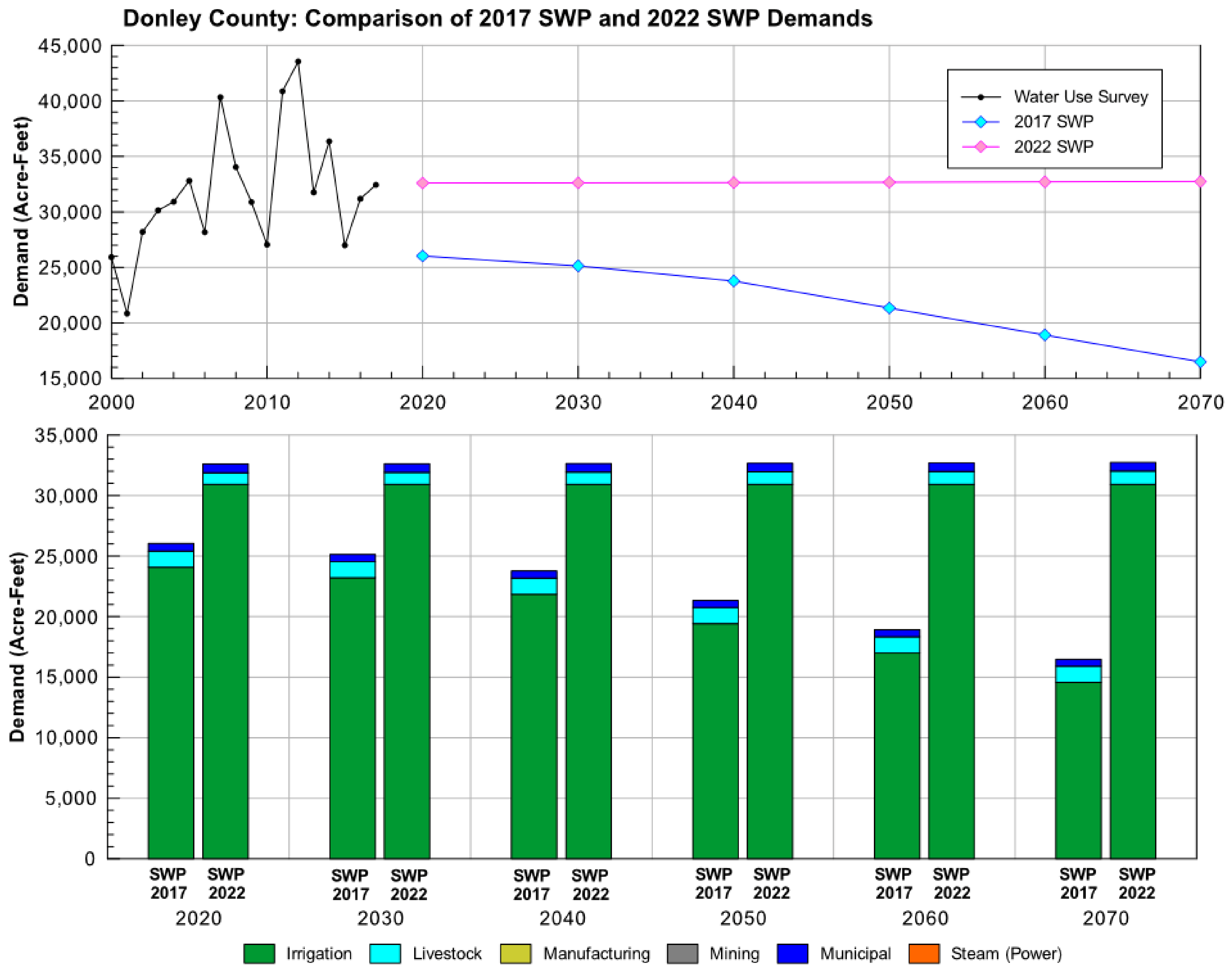
Dallam County
Total Projected Supplies and Strategies (SWP 2017)
Volume (Acre-Feet)
380,000
360,000
340,000
320,000
300,000
280,000
260,000
240,000
220,000
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
2020
2030
2040
2050
2060
2070
Groundwater Supplies
Other Supplies
Groundwater Strategies
Other Strategies
SWP17 Demands
SWP22 Demands



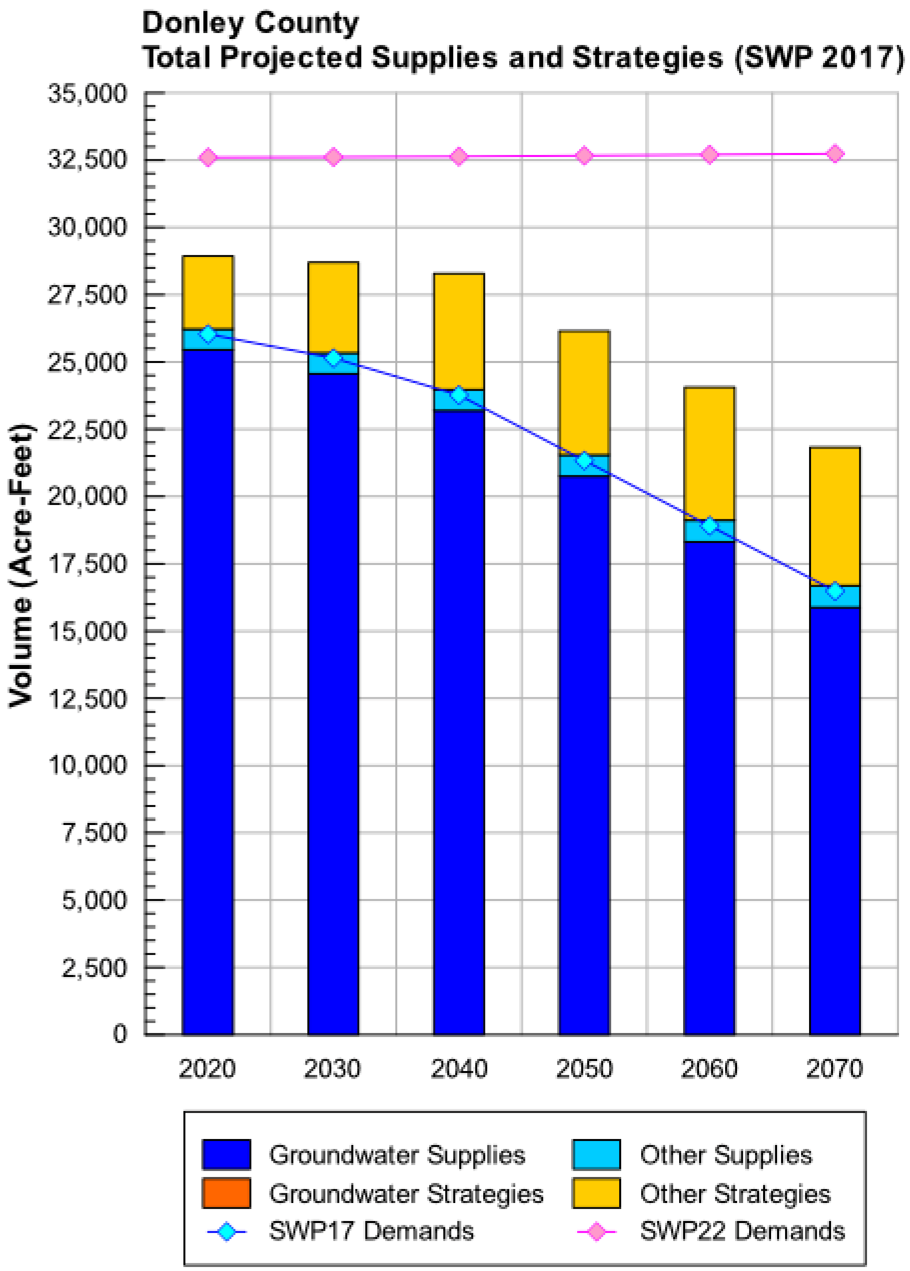
Dallam Total Needs and Identified Strategies
Volume (Acre-Feet)
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
2020
2030
2040
2050
2060
2070
Groundwater Strategies
SWP17 Needs
Other Strategies

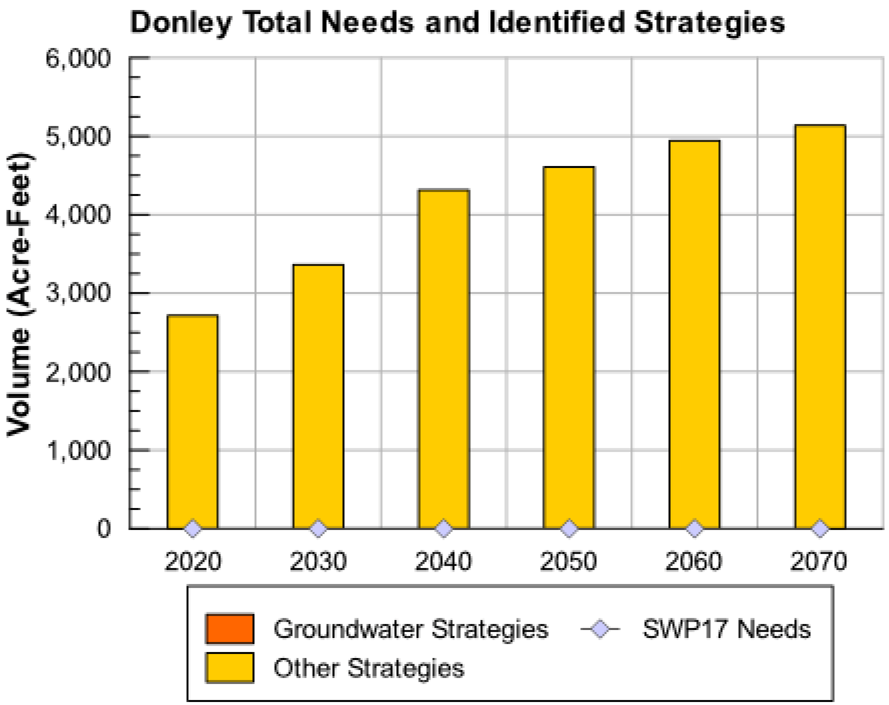


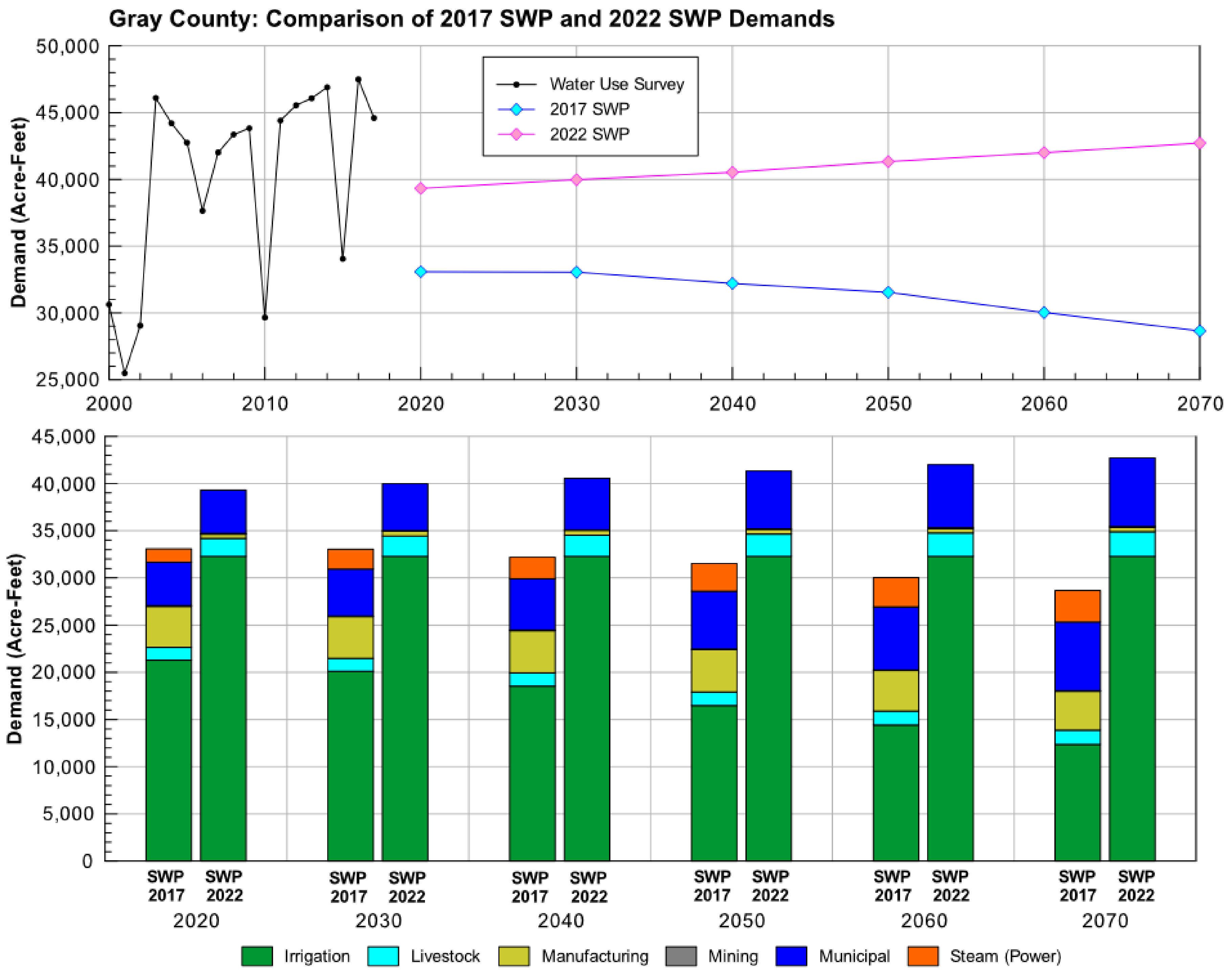
Dallam Groundwater Strategies
Volume (Acre-Feet)
2500
2000
1500
1000
500
0
2020
2030
2040
2050
2060
2070
Wells
Conjunctive Use



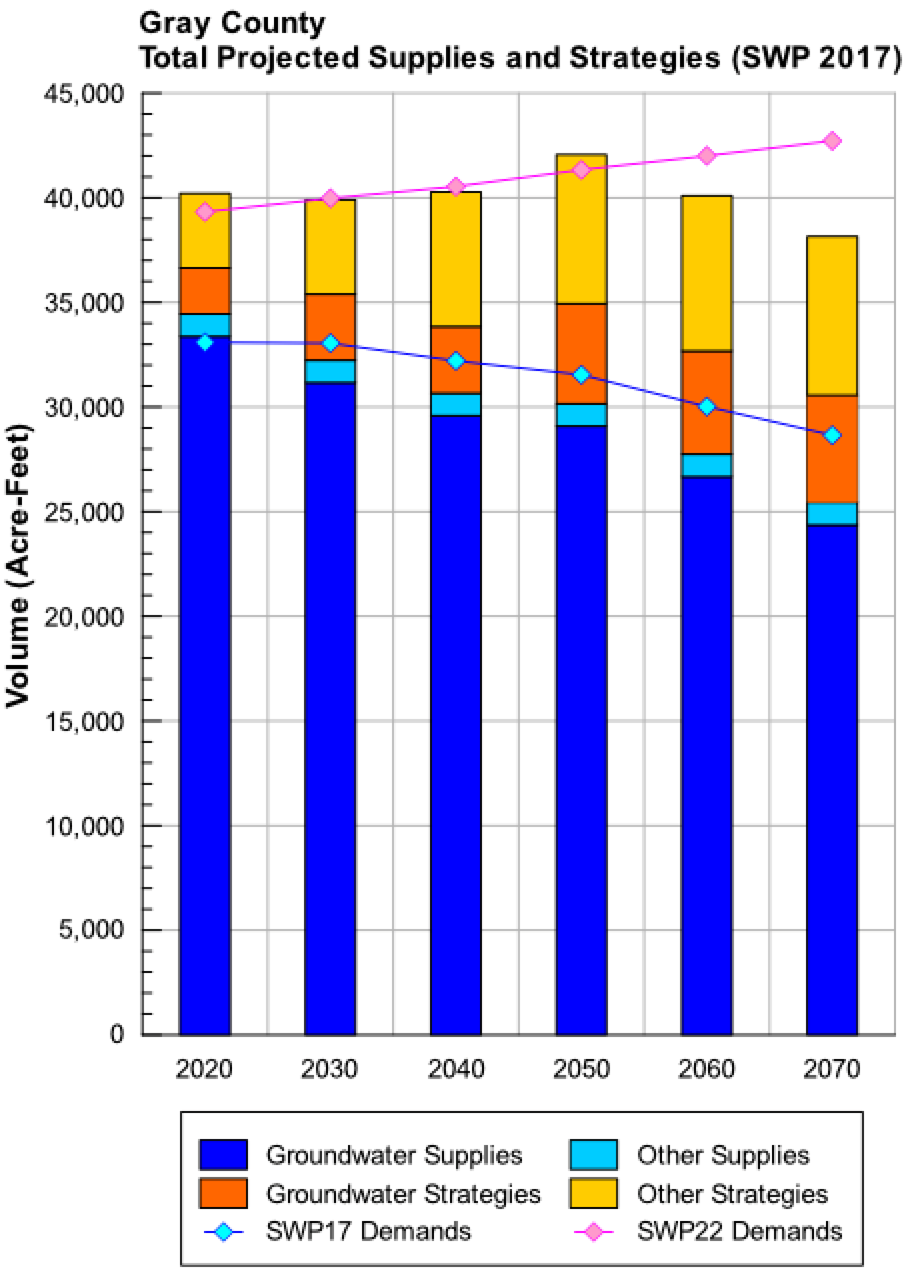
Donley County: Comparison of 2017 SWP and 2022 SWP Demands
Water Use Survey
2017 SWP
2022 SWP
Demand (Acre-Feet)
45,000
40,000
35,000
30,000
25,000
20,000
15,000
2000
2010
2020
2030
2040
2050
2060
2070
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
SWP 2017
SWP 2022
Irrigation
Livestock
Manufacturing
Mining
Municipal
Steam (Power)


Donley County
Total Projected Supplies and Strategies (SWP 2017)
Volume (Acre-Feet)
35,000
32,500
30,000
27,500
25,000
22,500
20,000
17,500
15,000
12,500
10,000
7,500
5,000
2,500
0
2020
2030
2040
2050
2060
2070
Groundwater Supplies
Other Supplies
Groundwater Strategies
Other Strategies
SWP17 Demands
SWP22 Demands

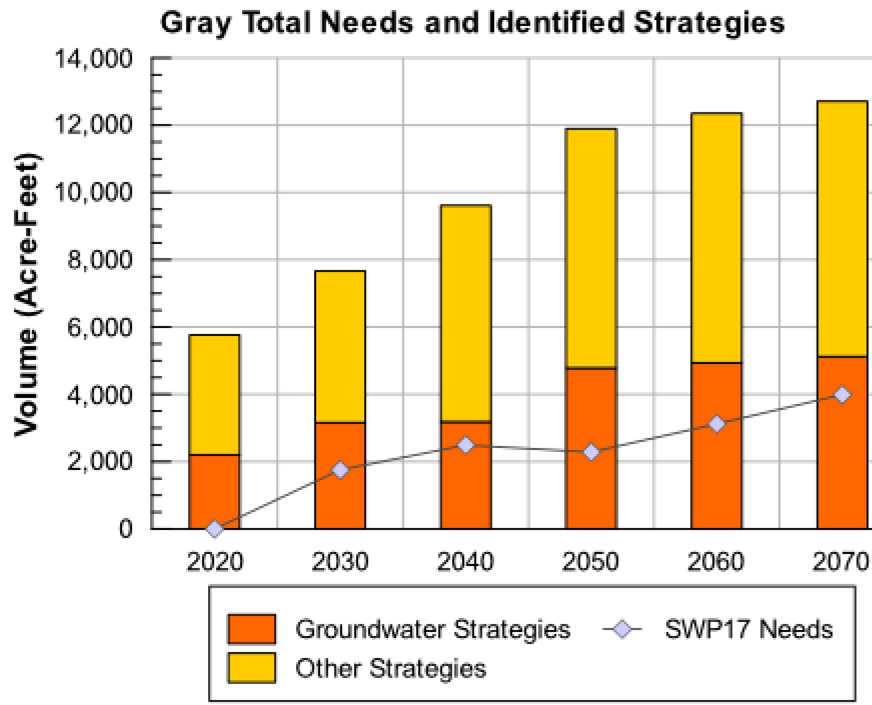

Donley Total Needs and Identified Strategies
Volume (Acre-Feet)
6,000
5,000
4,000
3,000
2,000
1,000
0
2020
2030
2040
2050
2060
2070
Groundwater Strategies
SWP17 Needs
Other Strategies



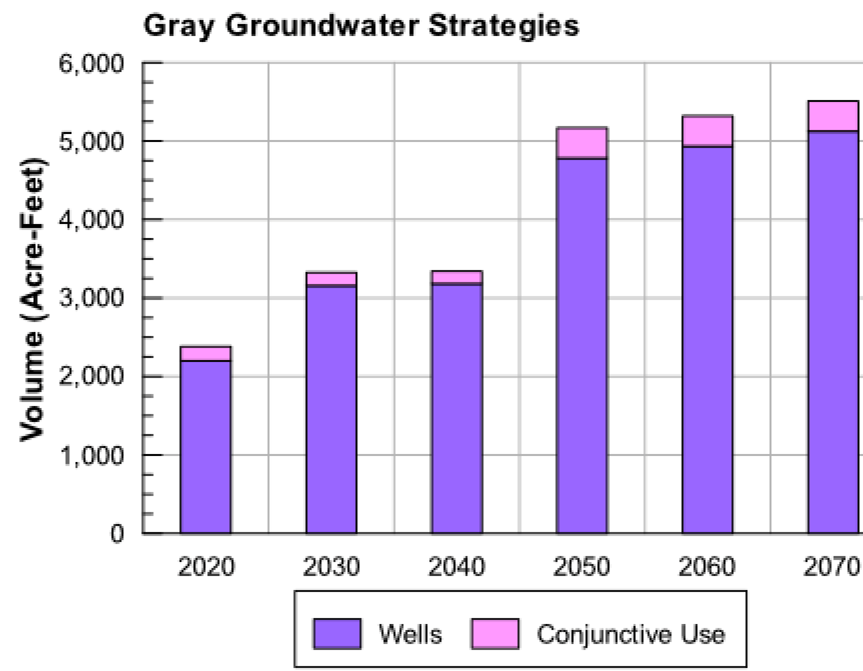
Gray County: Comparison of 2017 SWP and 2022 SWP Demands
Demand (Acre-Feet)
50,000
45,000
40,000
35,000
30,000
25,000
2000
2010
2020
2030
2040
2050
2060
2070
Water Use Survey
2017 SWP
2022 SWP
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
SWP 2017
SWP 2022
Irrigation
Livestock
Manufacturing
Mining
Municipal
Steam (Power)



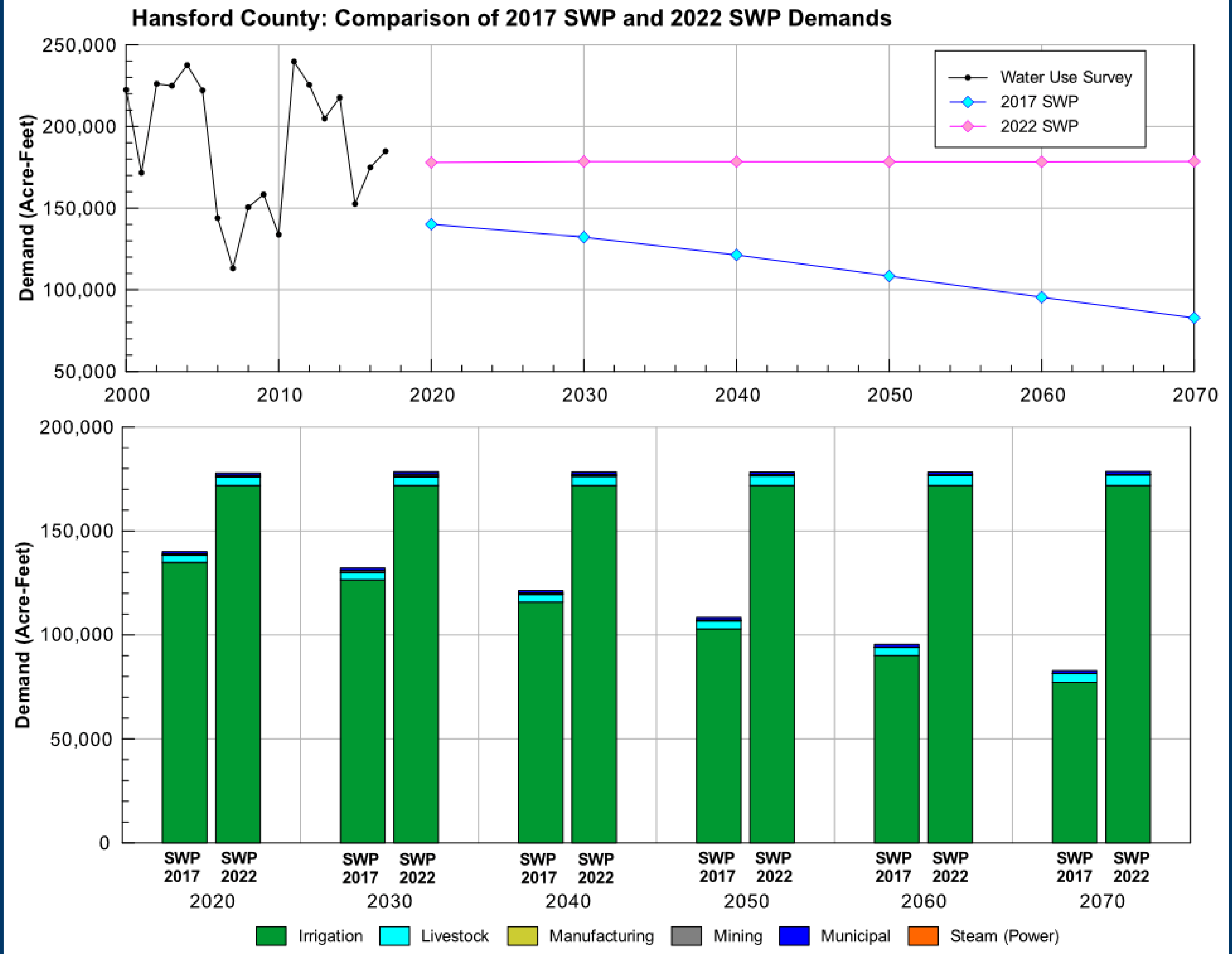
Gray County
Total Projected Supplies and Strategies (SWP 2017)
Volume (Acre-Feet)
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
2020
2030
2040
2050
2060
2070
Groundwater Supplies
Other Supplies
Groundwater Strategies
Other Strategies
SWP17 Demands
SWP22 Demands

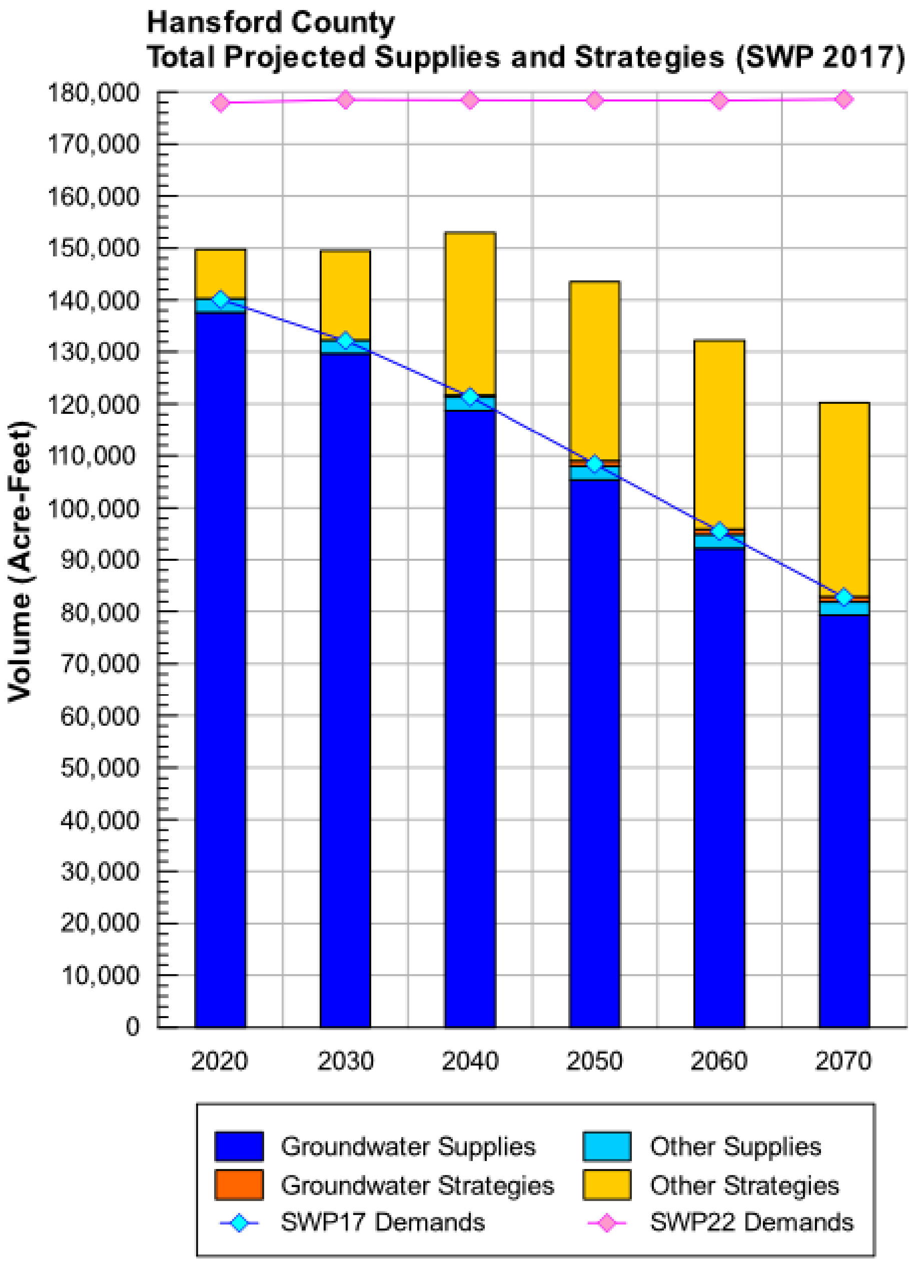


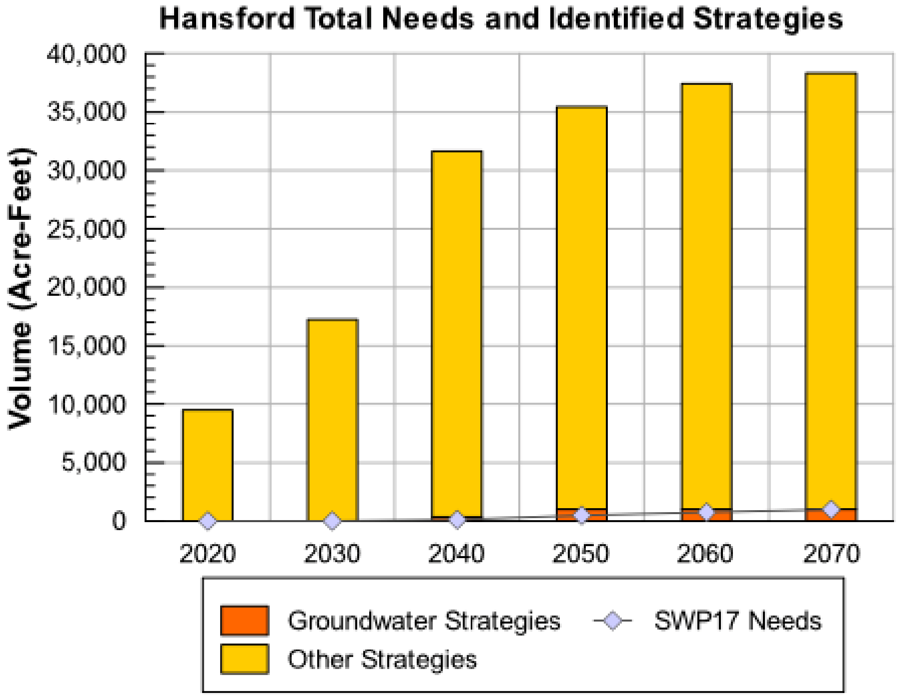
Gray Total Needs and Identified Strategies
Volume (Acre-Feet)
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
2020
2030
2040
2050
2060
2070
Groundwater Strategies
SWP17 Needs
Other Strategies

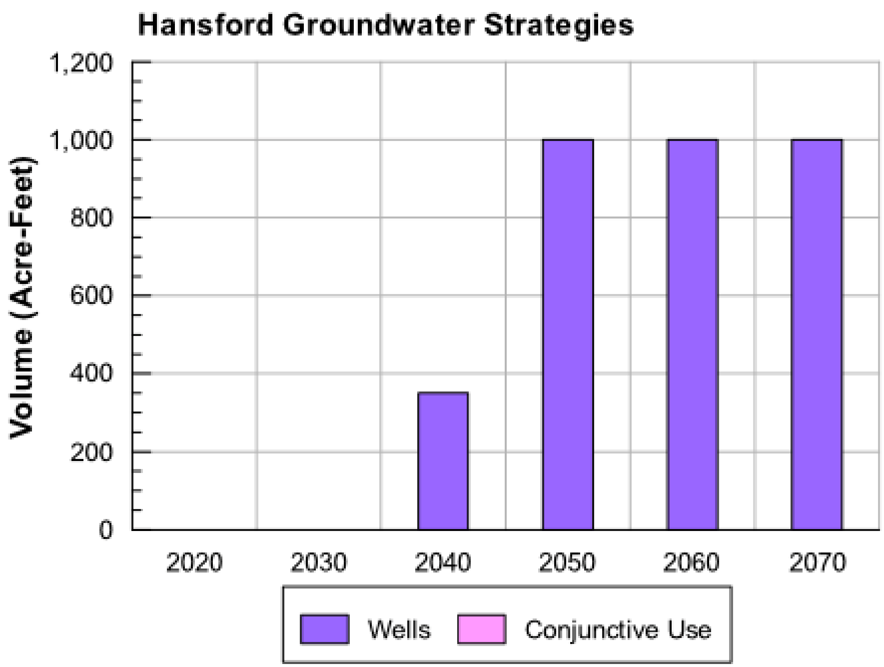


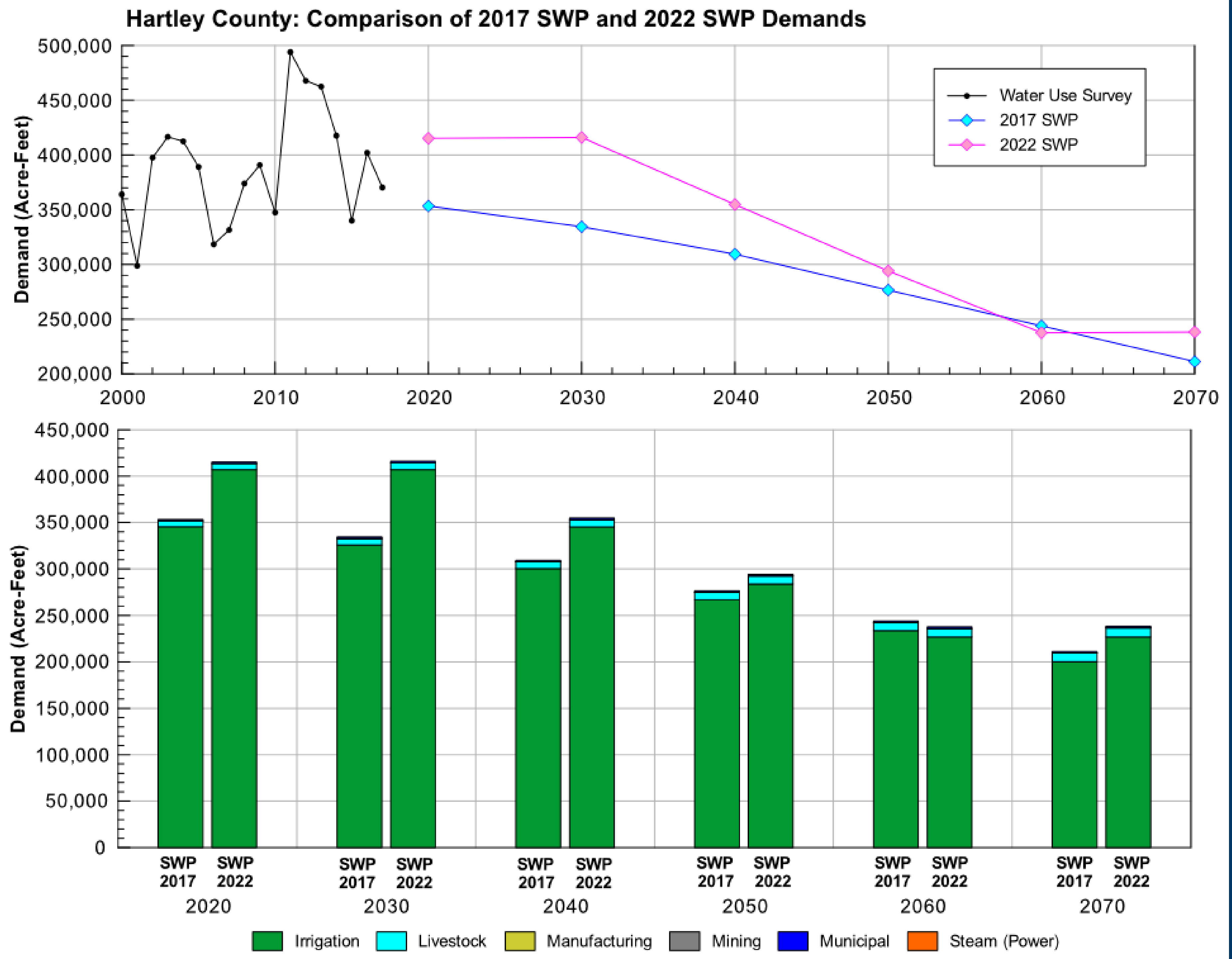
Gray Groundwater Strategies
Volume (Acre-Feet)
6,000
5,000
4,000
3,000
2,000
1,000
0
2020
2030
2040
2050
2060
2070
Wells
Conjunctive Use


Hansford County: Comparison of 2017 SWP and 2022 SWP Demands
Demand (Acre-Feet)
250,000
200,000
150,000
100,000
50,000
2000
2010
2020
2030
2040
2050
2060
2070
Water Use Survey
2017 SWP
2022 SWP
Demand (Acre-Feet)
200,000
150,000
100,000
50,000
0
SWP 2017
SWP 2022
2020
2030
2040
2050
2060
2070
Irrigation
Livestock
Manufacturing
Mining
Municipal
Steam (Power)

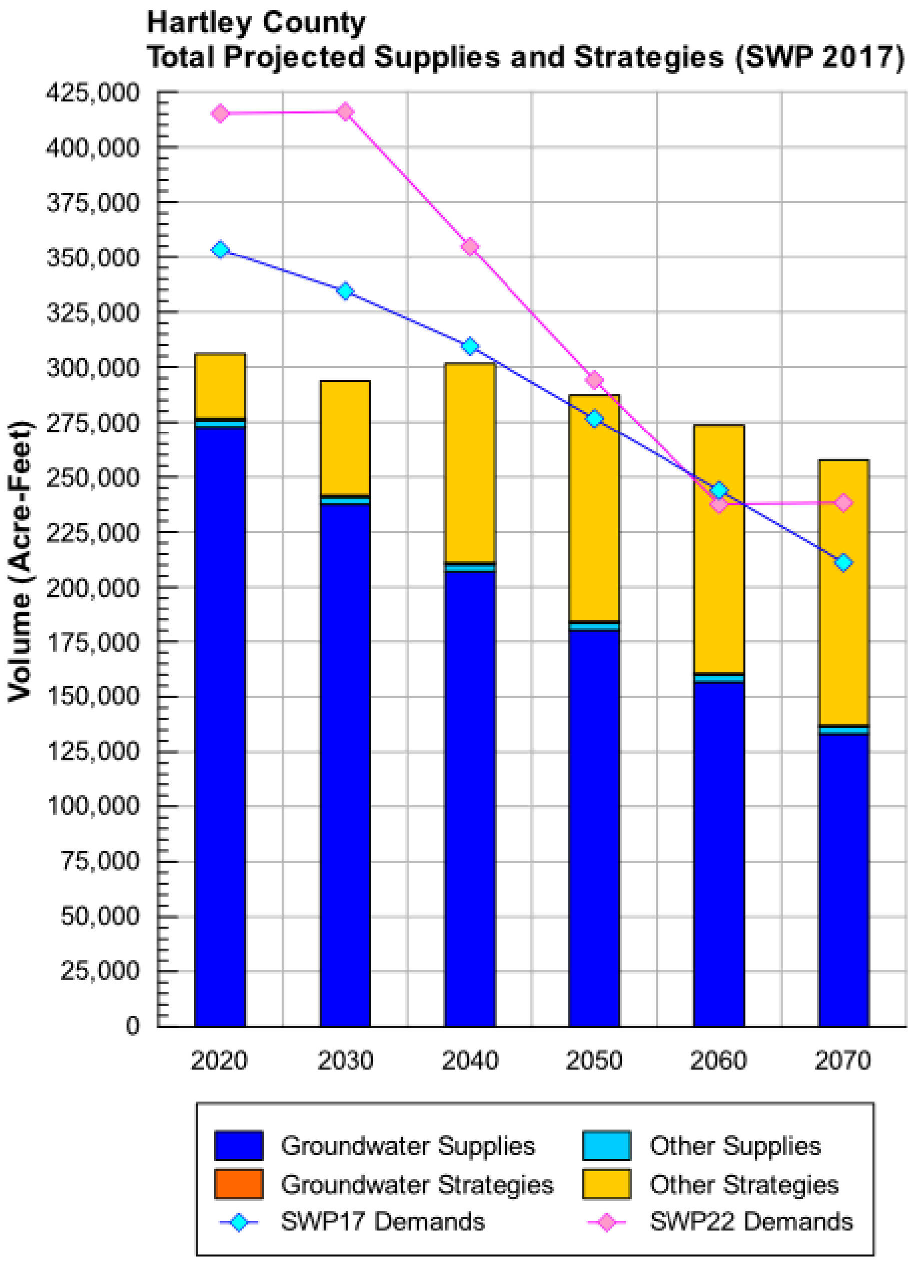

Hansford County
Total Projected Supplies and Strategies (SWP 2017)
180,000
170,000
160,000
150,000
140,000
130,000
120,000
110,000
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
Volume (Acre-Feet)
2020
2030
2040
2050
2060
2070
Groundwater Supplies
Other Supplies
Groundwater Strategies
Other Strategies
SWP17 Demands
SWP22 Demands


Hansford Total Needs and Identified Strategies
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
Volume (Acre-Feet)
2020
2030
2040
2050
2060
2070
Groundwater Strategies
SWP17 Needs
Other Strategies

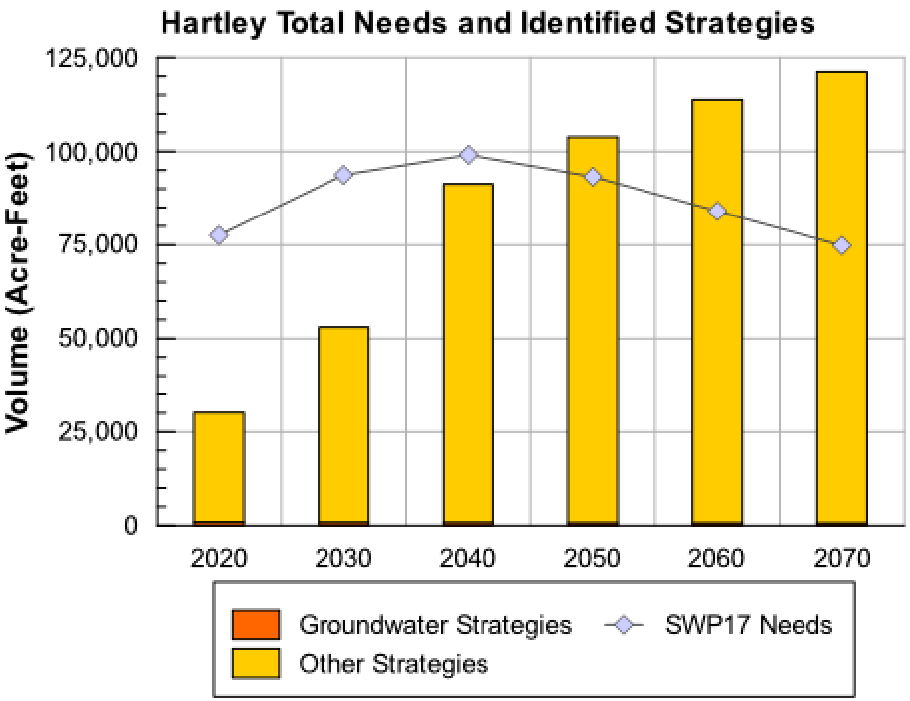

Hansford Groundwater Strategies
1,200
1,000
800
600
400
200
0
Volume (Acre-Feet)
2020
2030
2040
2050
2060
2070
Wells
Conjunctive Use



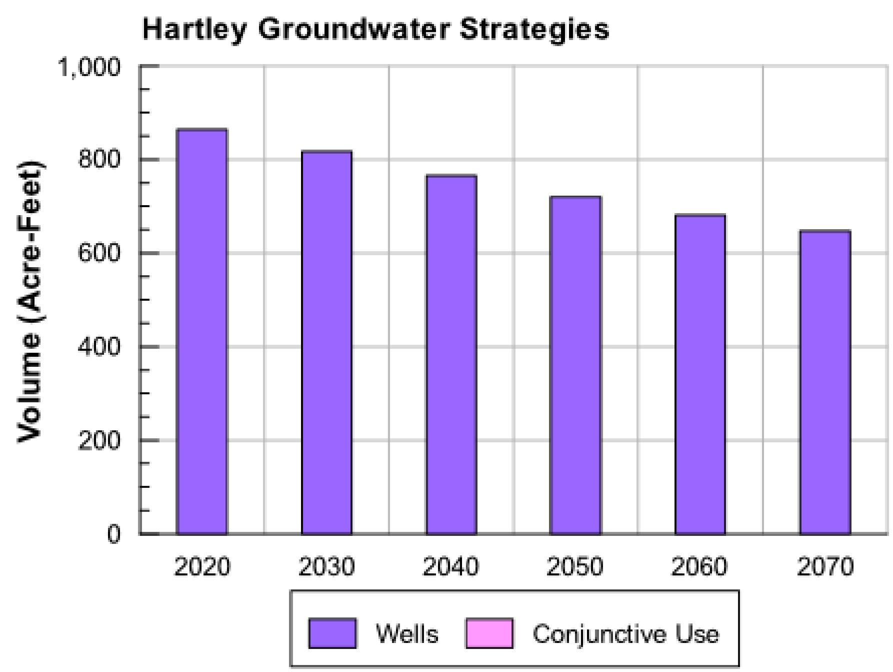
Hartley County: Comparison of 2017 SWP and 2022 SWP Demands
Demand (Acre-Feet)
500,000
450,000
400,000
350,000
300,000
250,000
200,000
2000
2010
2020
2030
2040
2050
2060
2070
Water Use Survey
2017 SWP
2022 SWP
Demand (Acre-Feet)
450,000
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
SWP 2017
SWP 2022
2020
2030
2040
2050
2060
2070
Irrigation
Livestock
Manufacturing
Mining
Municipal
Steam (Power)



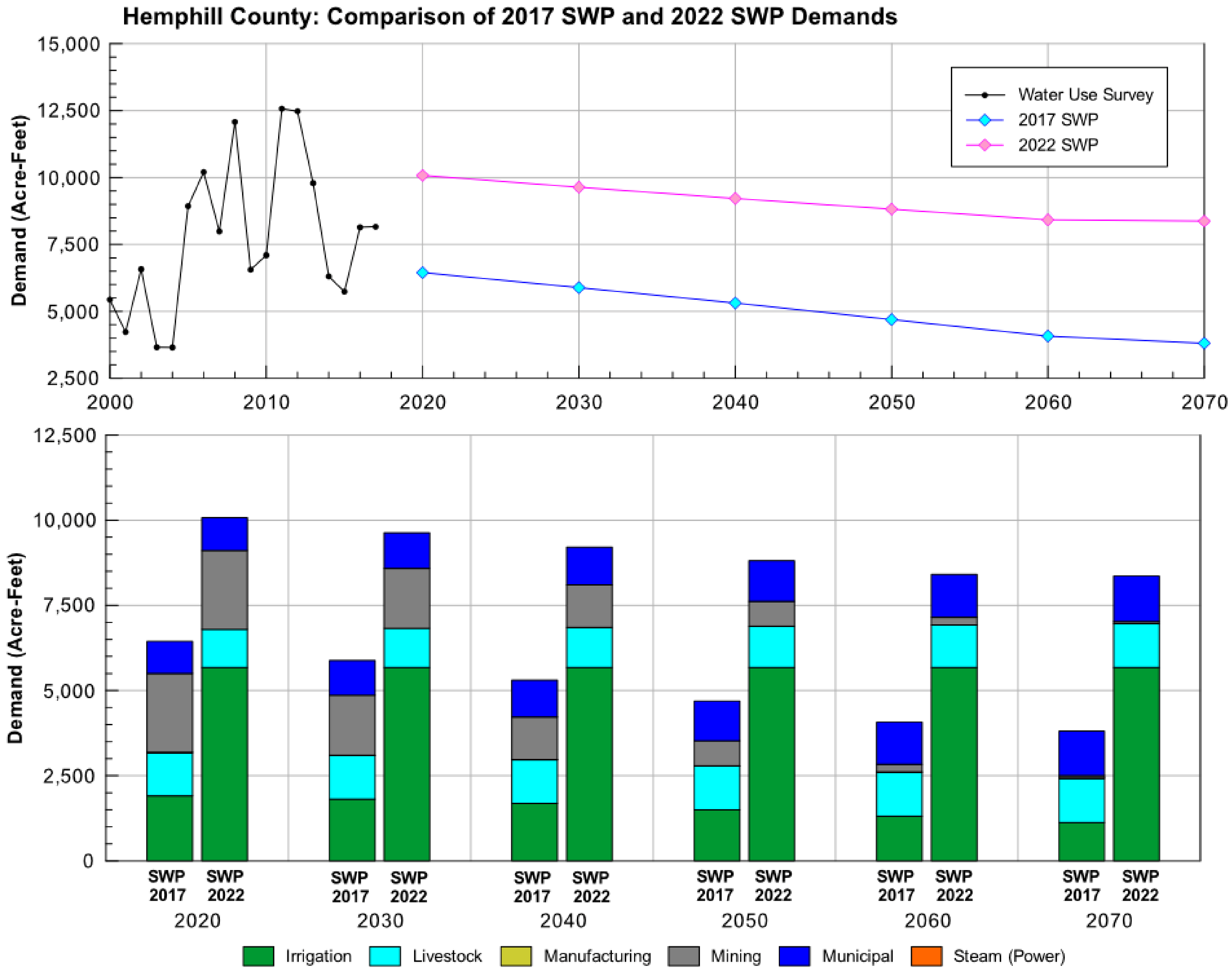
Hartley County
Total Projected Supplies and Strategies (SWP 2017)
Volume (Acre-Feet)
425,000
400,000
375,000
350,000
325,000
300,000
275,000
250,000
225,000
200,000
175,000
150,000
125,000
100,000
75,000
50,000
25,000
0
2020
2030
2040
2050
2060
2070
Groundwater Supplies
Other Supplies
Groundwater Strategies
Other Strategies
SWP17 Demands
SWP22 Demands



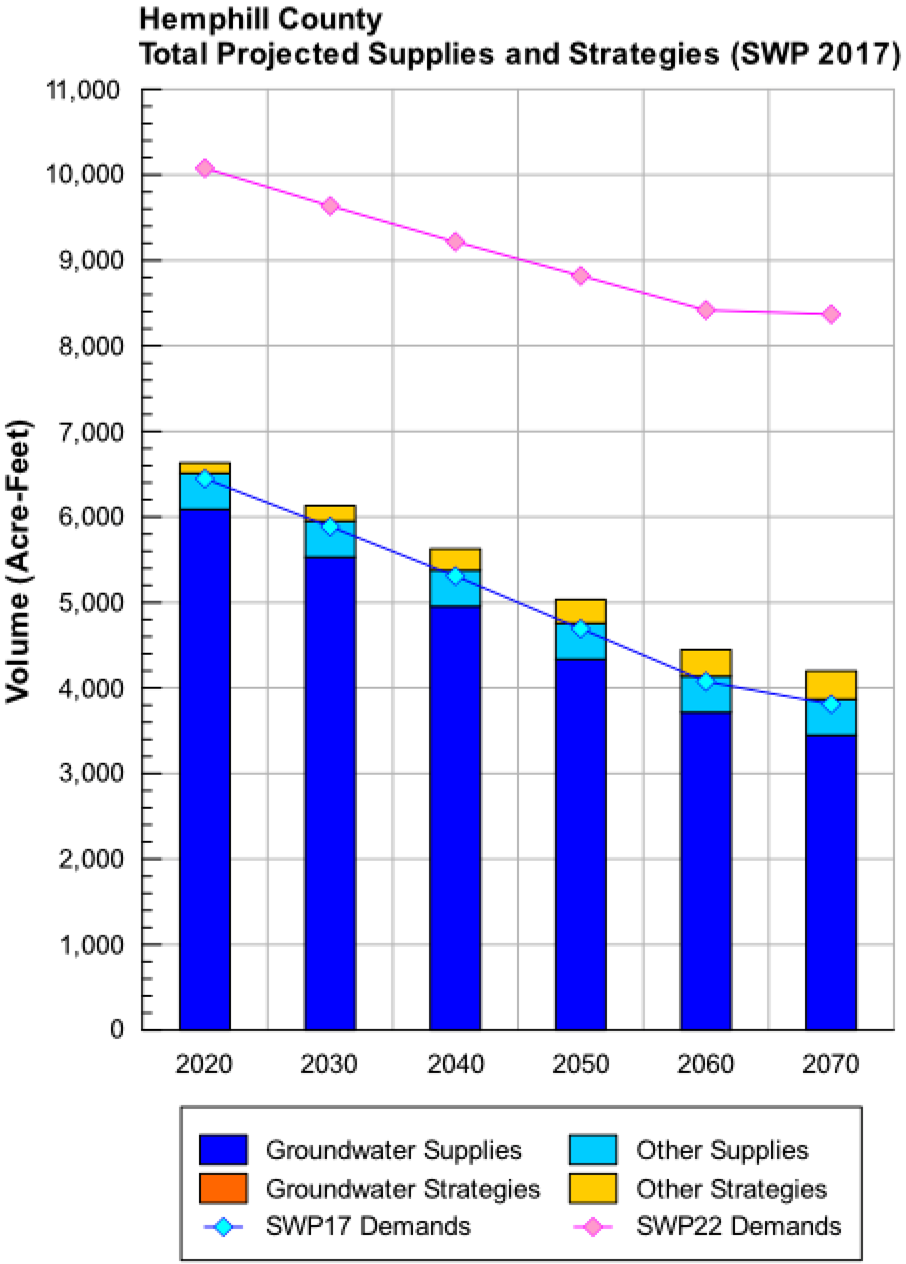
Hartley Total Needs and Identified Strategies
Volume (Acre-Feet)
125,000
100,000
75,000
50,000
25,000
0
2020
2030
2040
2050
2060
2070
Groundwater Strategies
SWP17 Needs
Other Strategies

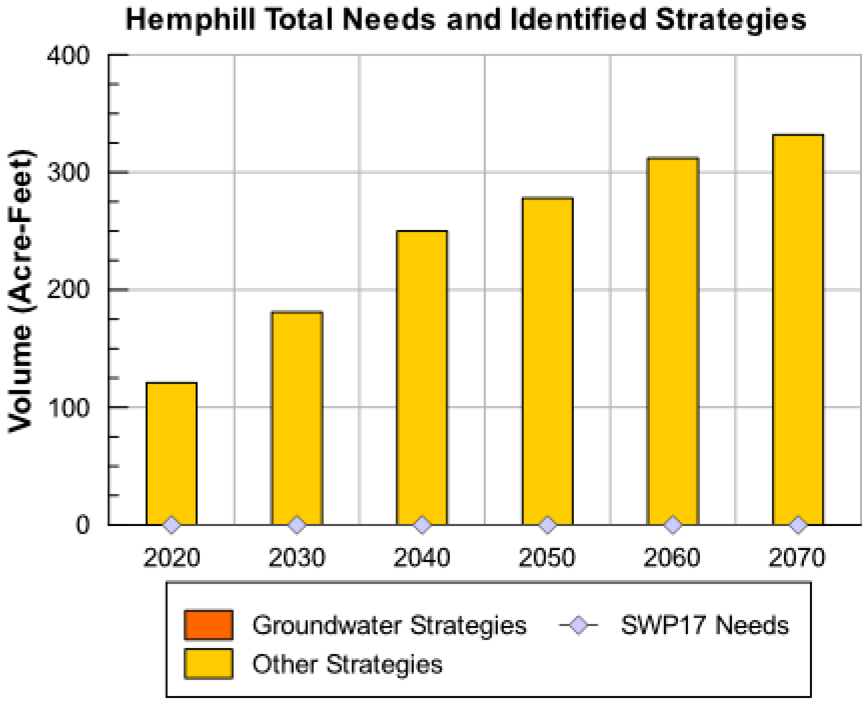


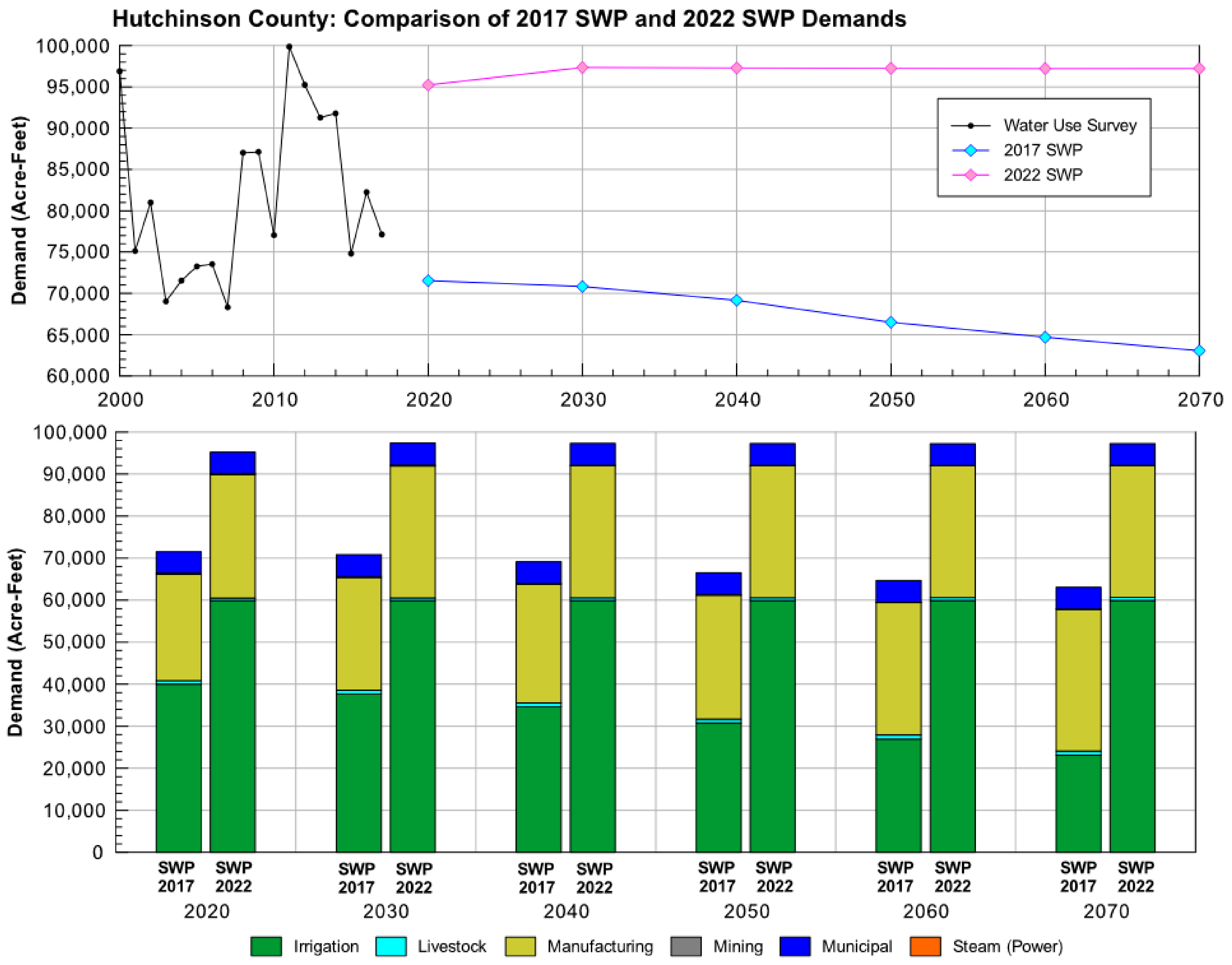
Hartley Groundwater Strategies
Volume (Acre-Feet)
1,000
800
600
400
200
0
2020
2030
2040
2050
2060
2070
Wells
Conjunctive Use

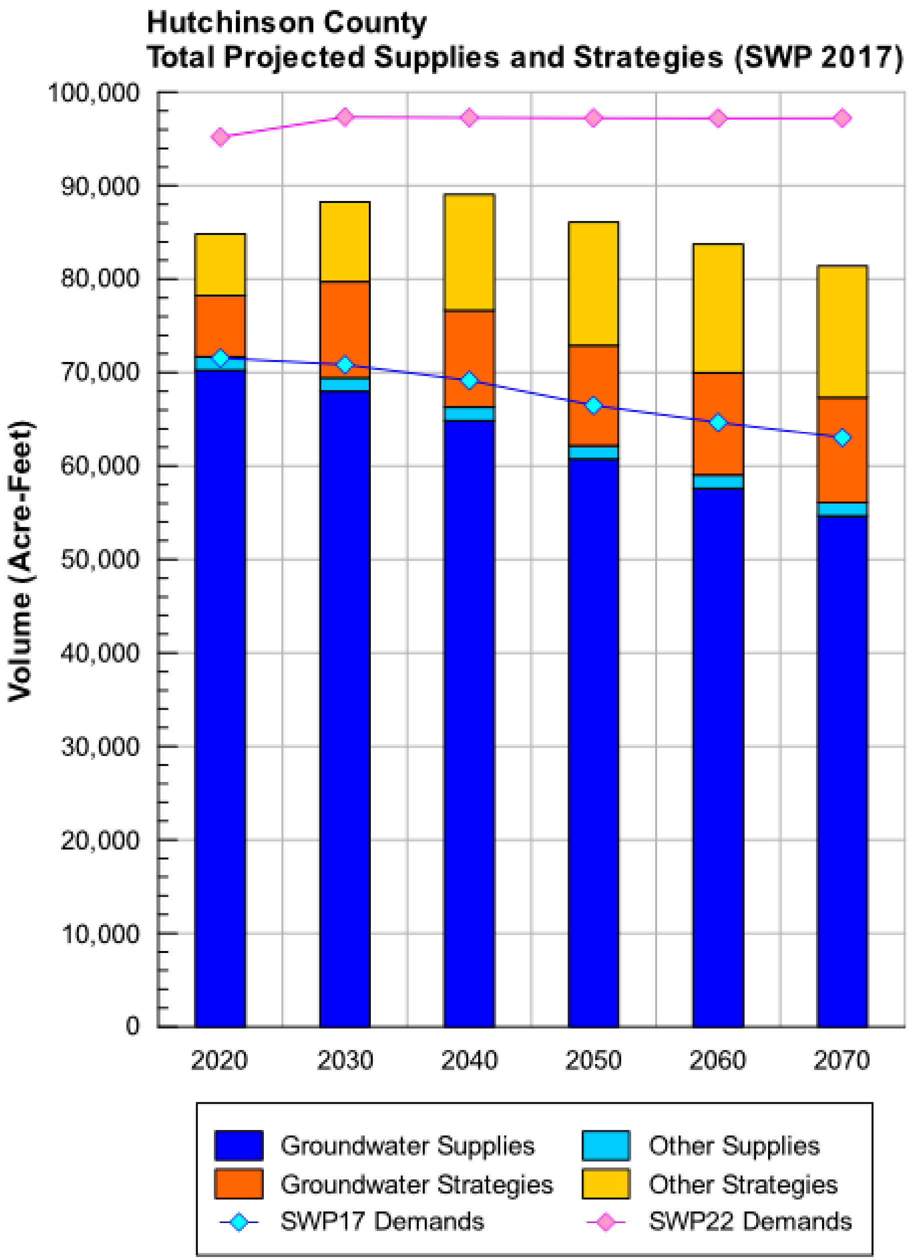


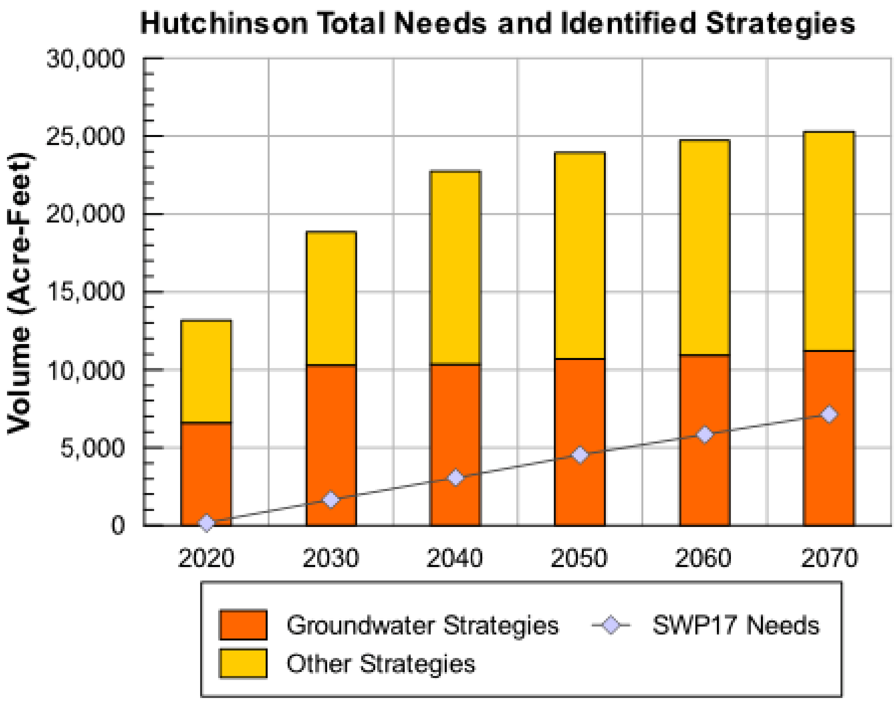
Hemphill County: Comparison of 2017 SWP and 2022 SWP Demands
Demand (Acre-Feet)
15,000
12,500
10,000
7,500
5,000
2,500
2000
2010
2020
2030
2040
2050
2060
2070
Water Use Survey
2017 SWP
2022 SWP
Demand (Acre-Feet)
12,500
10,000
7,500
5,000
2,500
0
SWP 2017
SWP 2022
2020
2030
2040
2050
2060
2070
Irrigation
Livestock
Manufacturing
Mining
Municipal
Steam (Power)

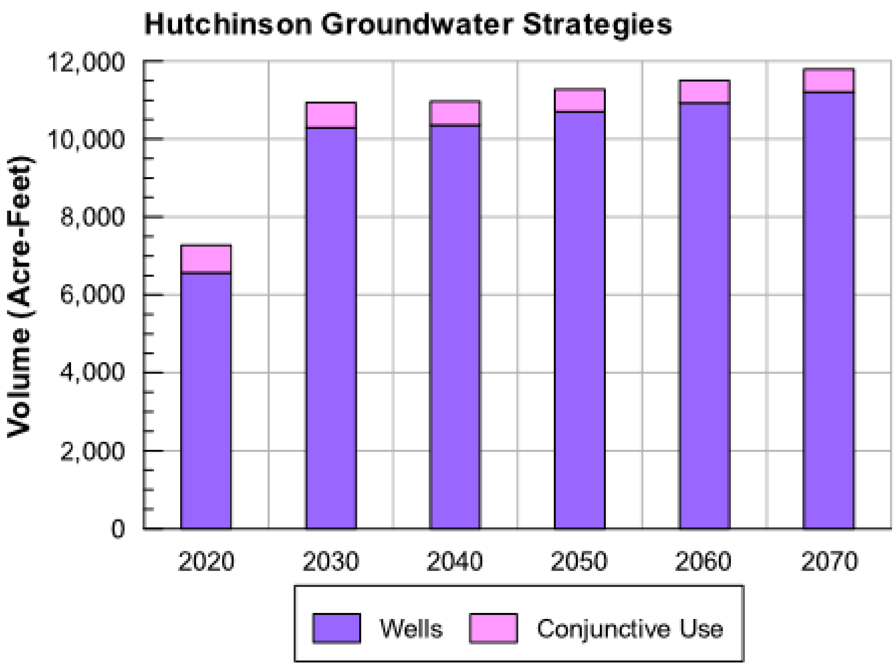

Hemphill County
Total Projected Supplies and Strategies (SWP 2017)
Volume (Acre-Feet)
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
2020
2030
2040
2050
2060
2070
Groundwater Supplies
Other Supplies
Groundwater Strategies
Other Strategies
SWP17 Demands
SWP22 Demands


Hemphill Total Needs and Identified Strategies
Volume (Acre-Feet)
400
300
200
100
0
2020
2030
2040
2050
2060
2070
Groundwater Strategies
SWP17 Needs
Other Strategies

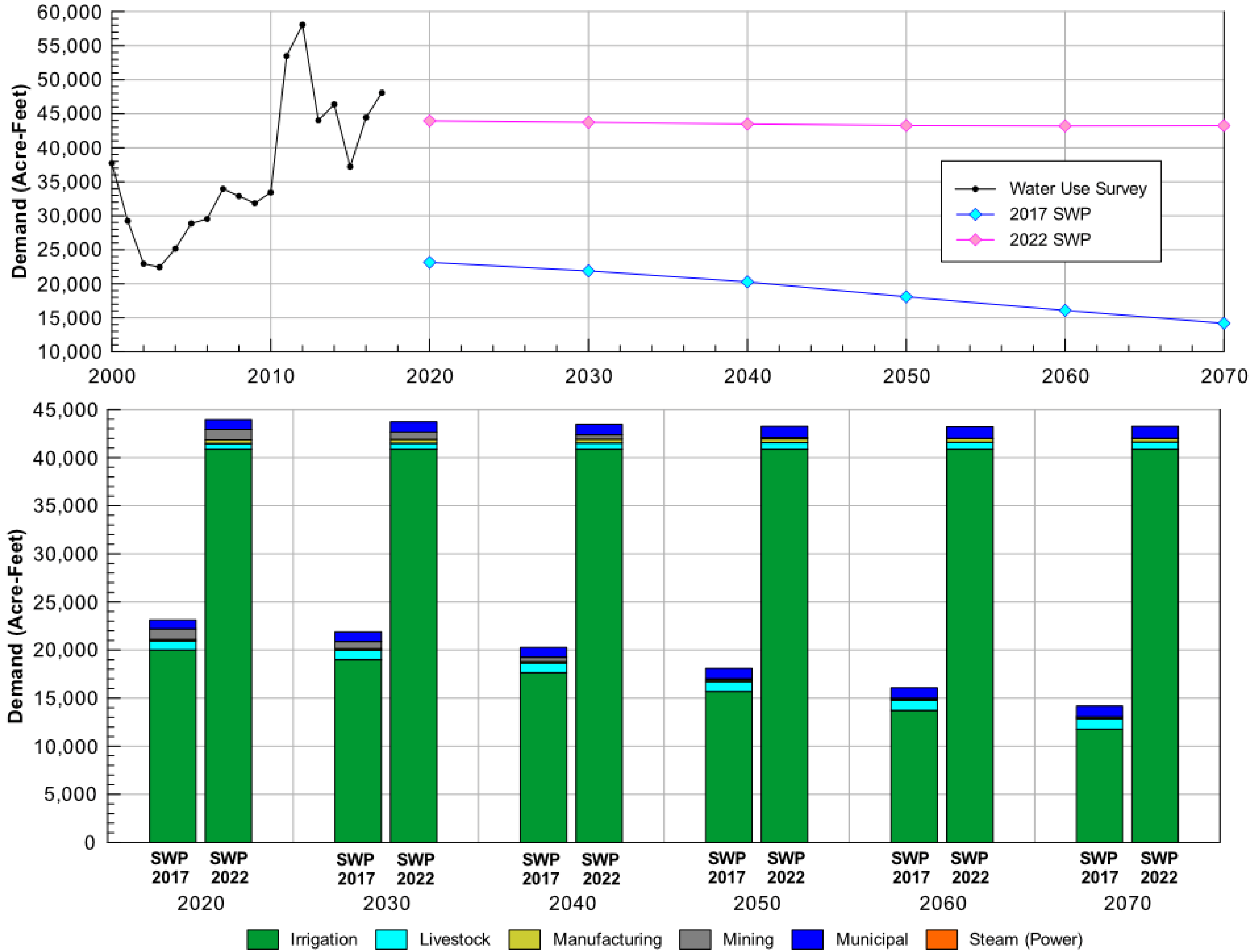

Hutchinson County: Comparison of 2017 SWP and 2022 SWP Demands
Demand (Acre-Feet)
Water Use Survey
2017 SWP
2022 SWP
SWP 2017
SWP 2022
2020
2030
2040
2050
2060
2070
Irrigation
Livestock
Manufacturing
Mining
Municipal
Steam (Power)

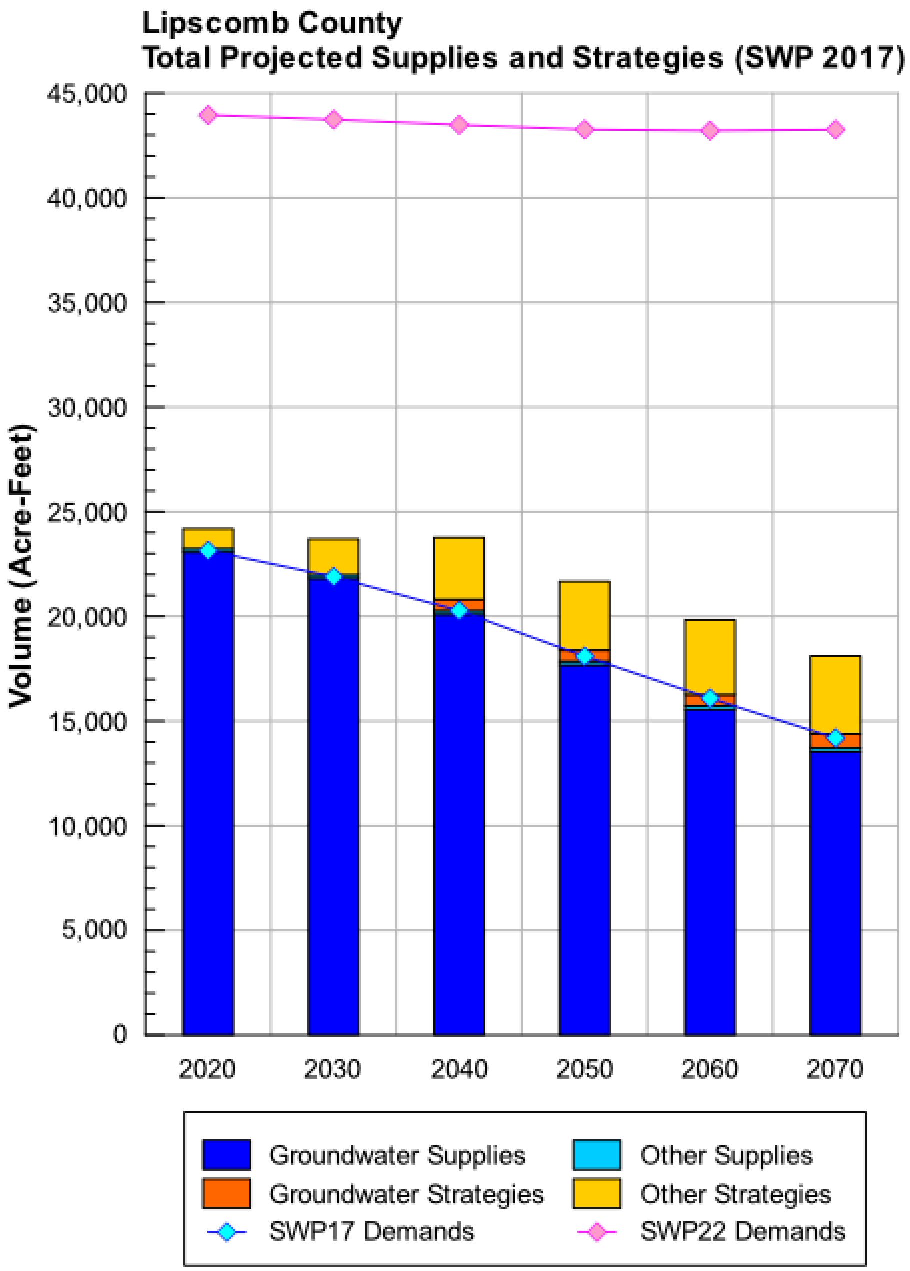

Hutchinson County
Total Projected Supplies and Strategies (SWP 2017)
Volume (Acre-Feet)
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
2020
2030
2040
2050
2060
2070
Groundwater Supplies
Other Supplies
Groundwater Strategies
Other Strategies
SWP17 Demands
SWP22 Demands


Hutchinson Total Needs and Identified Strategies
Volume (Acre-Feet)
30,000
25,000
20,000
15,000
10,000
5,000
0
2020
2030
2040
2050
2060
2070
Groundwater Strategies
SWP17 Needs
Other Strategies

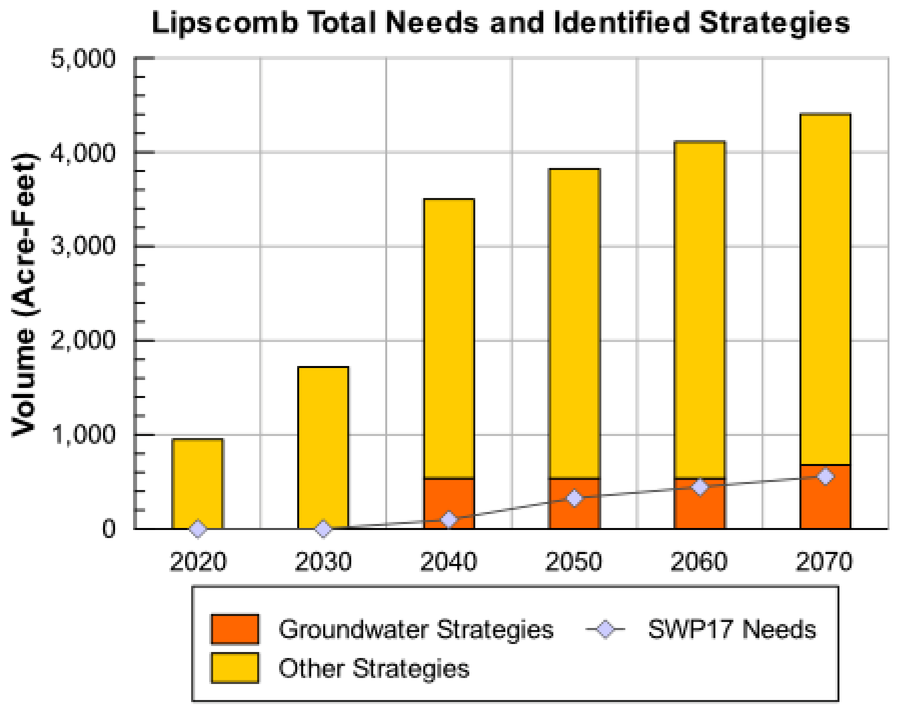

Hutchinson Groundwater Strategies
Volume (Acre-Feet)
12,000
10,000
8,000
6,000
4,000
2,000
0
2020
2030
2040
2050
2060
2070
Wells
Conjunctive Use

Lipscomb County: Comparison of 2017 SWP and 2022 SWP Demands

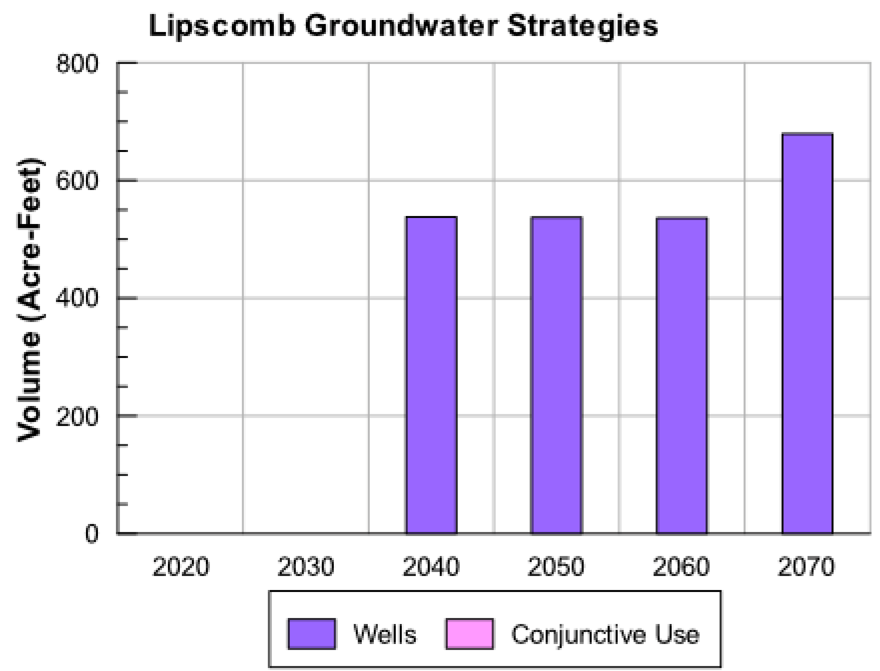




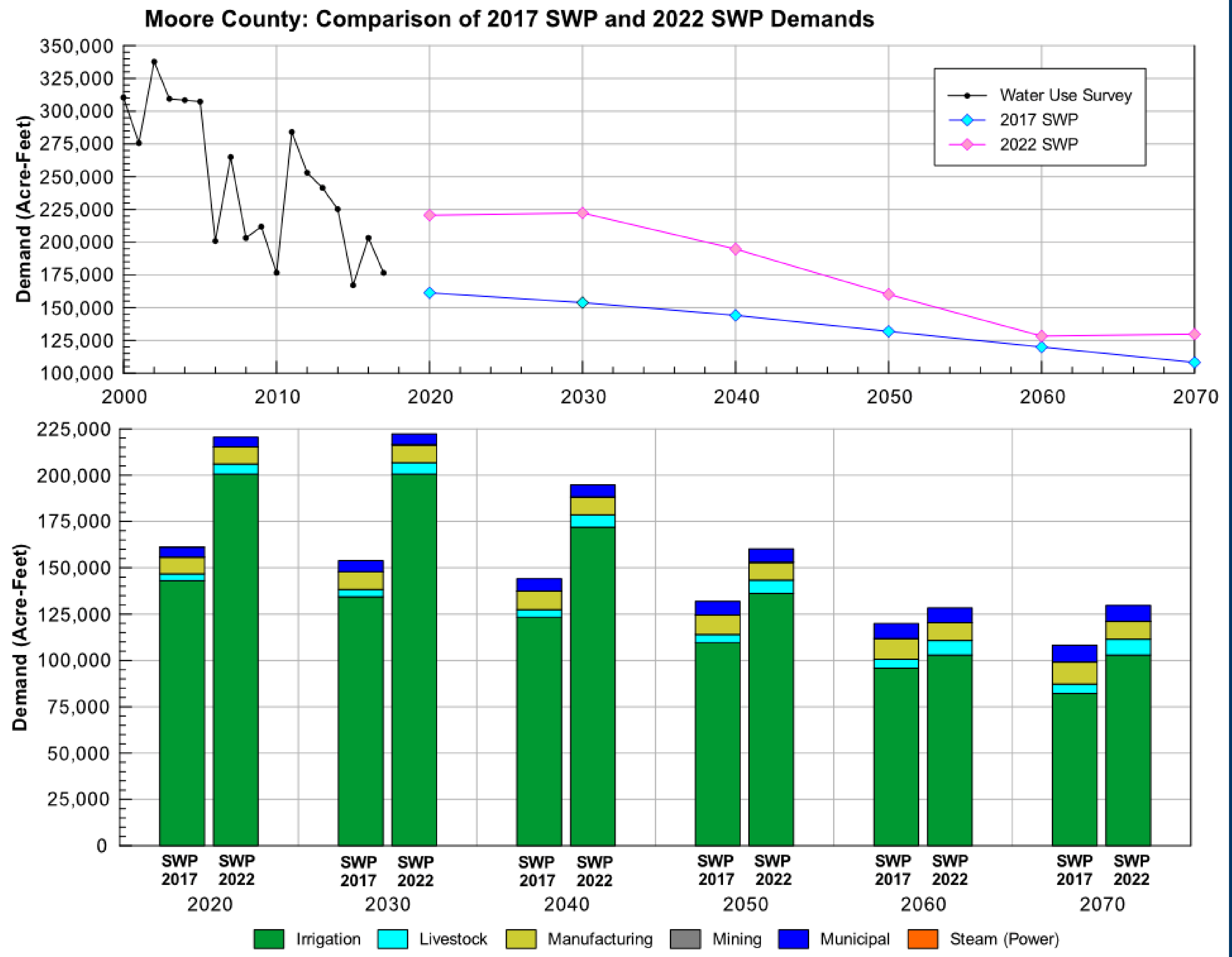
Lipscomb County
Total Projected Supplies and Strategies (SWP 2017)
Volume (Acre-Feet)
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
2020
2030
2040
2050
2060
2070
Groundwater Supplies
Other Supplies
Groundwater Strategies
Other Strategies
SWP17 Demands
SWP22 Demands

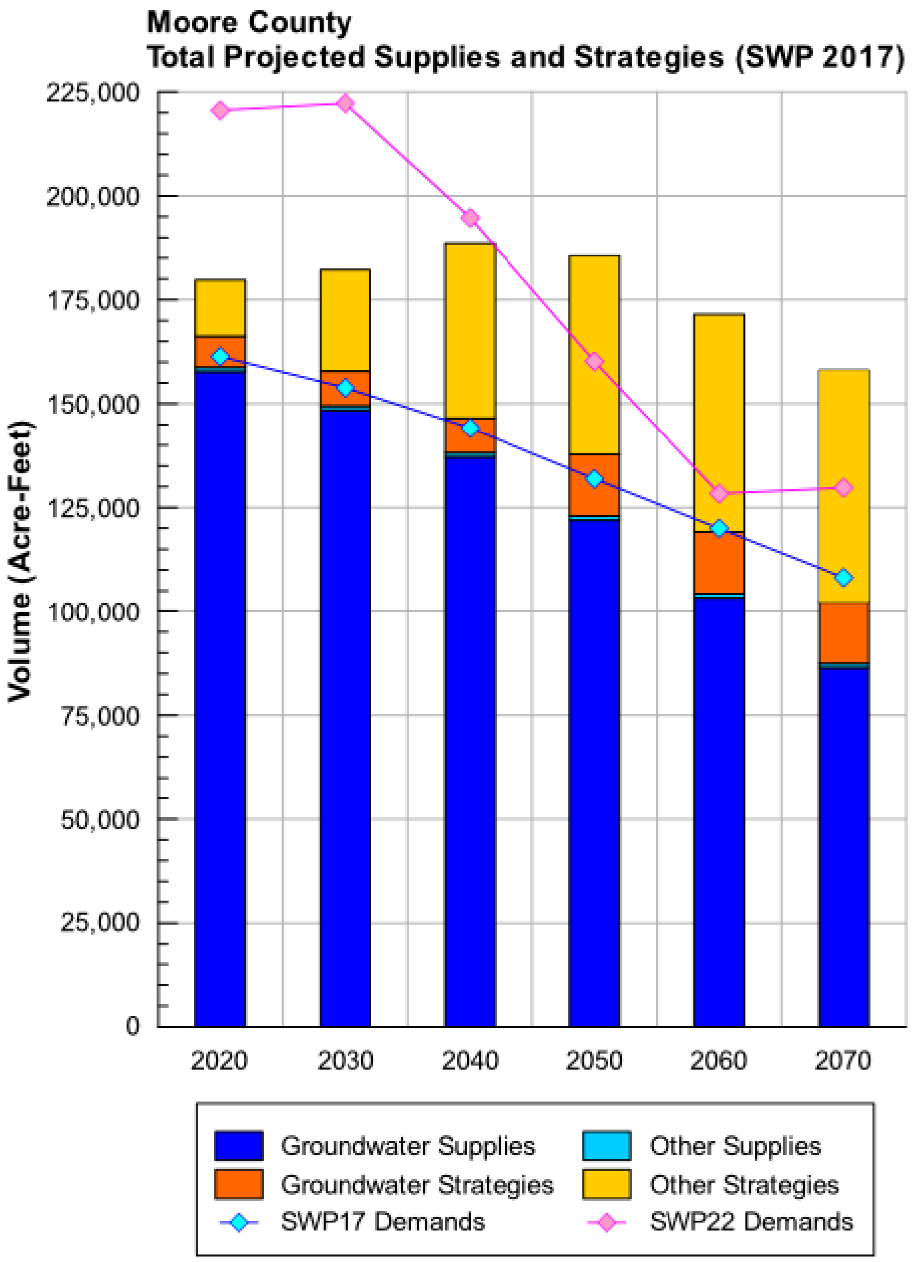


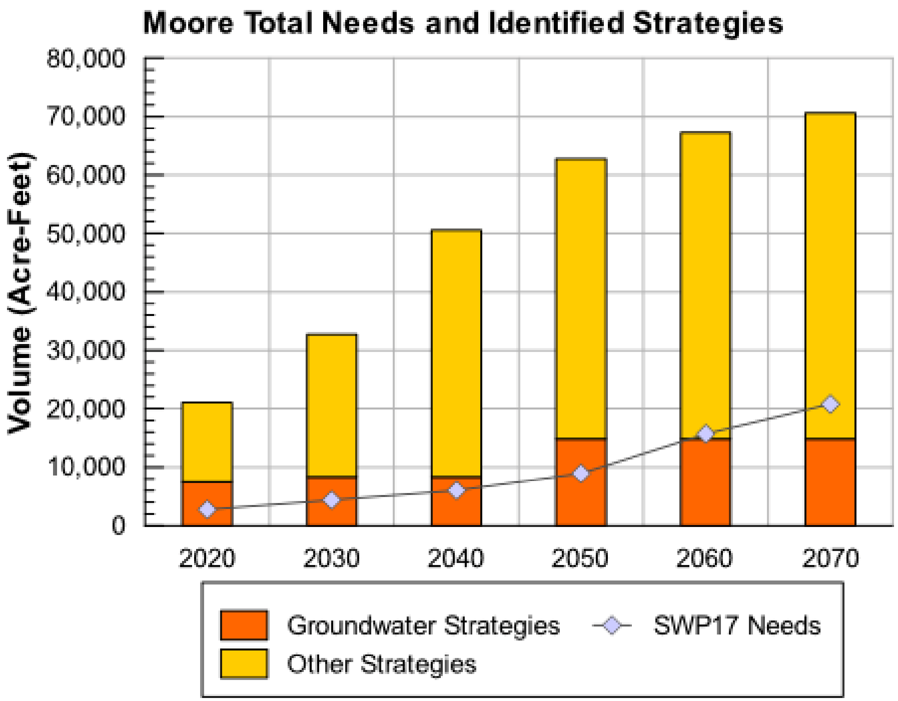
Lipscomb Total Needs and Identified Strategies
Volume (Acre-Feet)
5,000
4,000
3,000
2,000
1,000
0
2020
2030
2040
2050
2060
2070
Groundwater Strategies
SWP17 Needs
Other Strategies

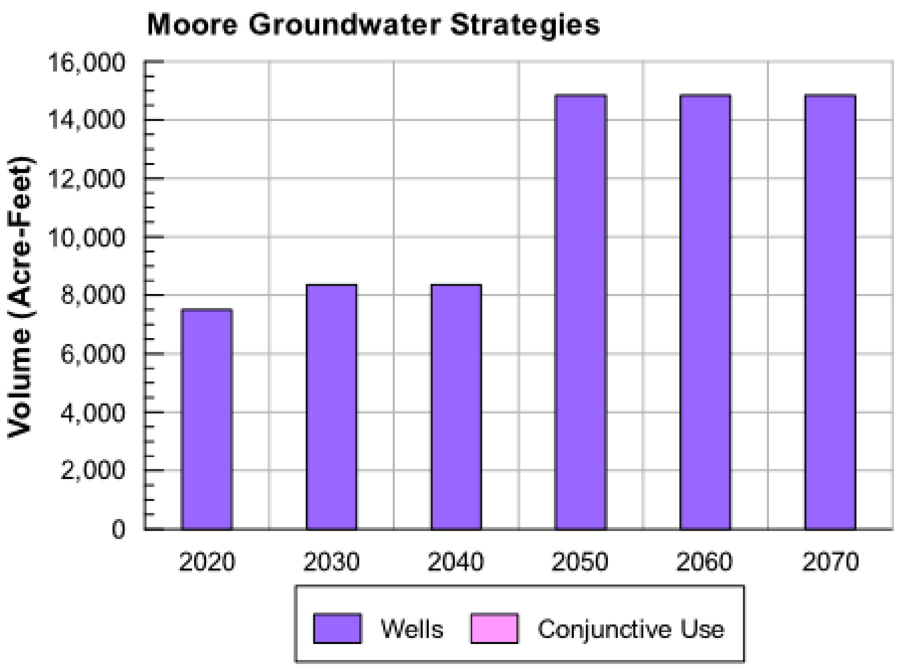


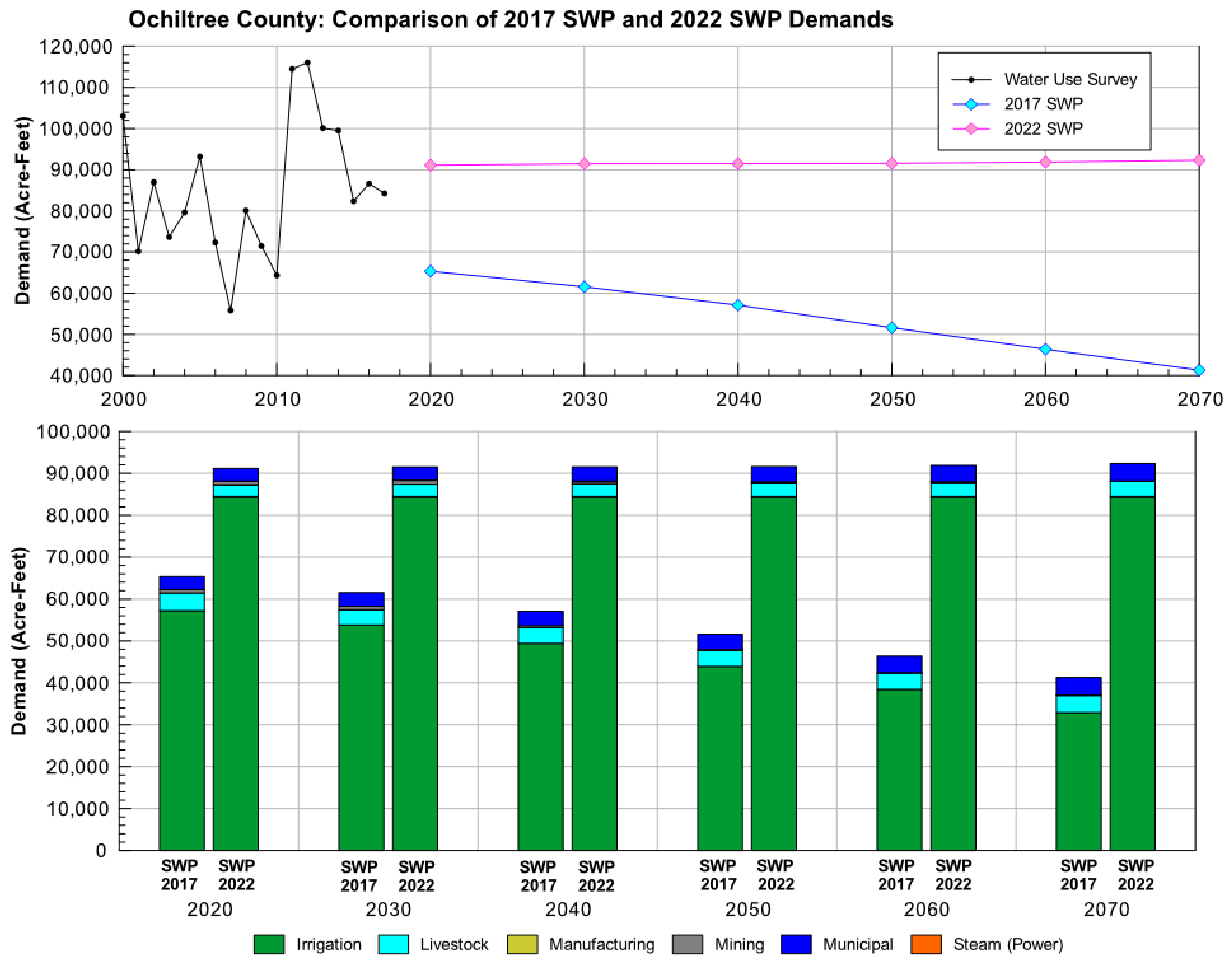
Lipscomb Groundwater Strategies
Volume (Acre-Feet)
800
600
400
200
0
2020
2030
2040
2050
2060
2070
Wells
Conjunctive Use


Moore County: Comparison of 2017 SWP and 2022 SWP Demands
Demand (Acre-Feet)
350,000
325,000
300,000
275,000
250,000
225,000
200,000
175,000
150,000
125,000
100,000
2000
2010
2020
2030
2040
2050
2060
2070
Water Use Survey
2017 SWP
2022 SWP
Demand (Acre-Feet)
225,000
200,000
175,000
150,000
125,000
100,000
75,000
50,000
25,000
0
SWP 2017
SWP 2022
2020
2030
2040
2050
2060
2070
Irrigation
Livestock
Manufacturing
Mining
Municipal
Steam (Power)

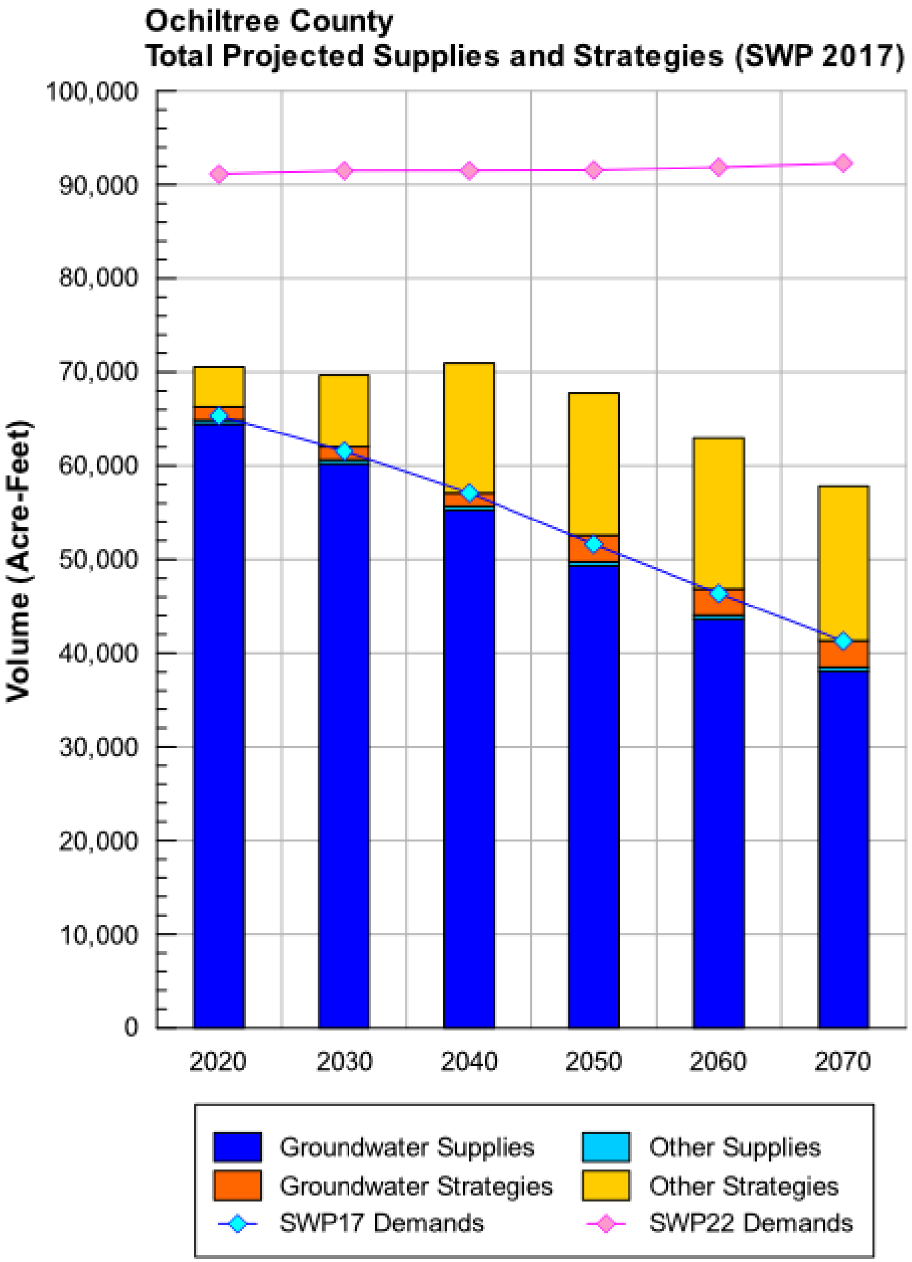

Moore County
Total Projected Supplies and Strategies (SWP 2017)
225,000
200,000
175,000
150,000
125,000
100,000
75,000
50,000
25,000
0
Volume (Acre-Feet)
2020
2030
2040
2050
2060
2070
Groundwater Supplies
Other Supplies
Groundwater Strategies
Other Strategies
SWP17 Demands
SWP22 Demands

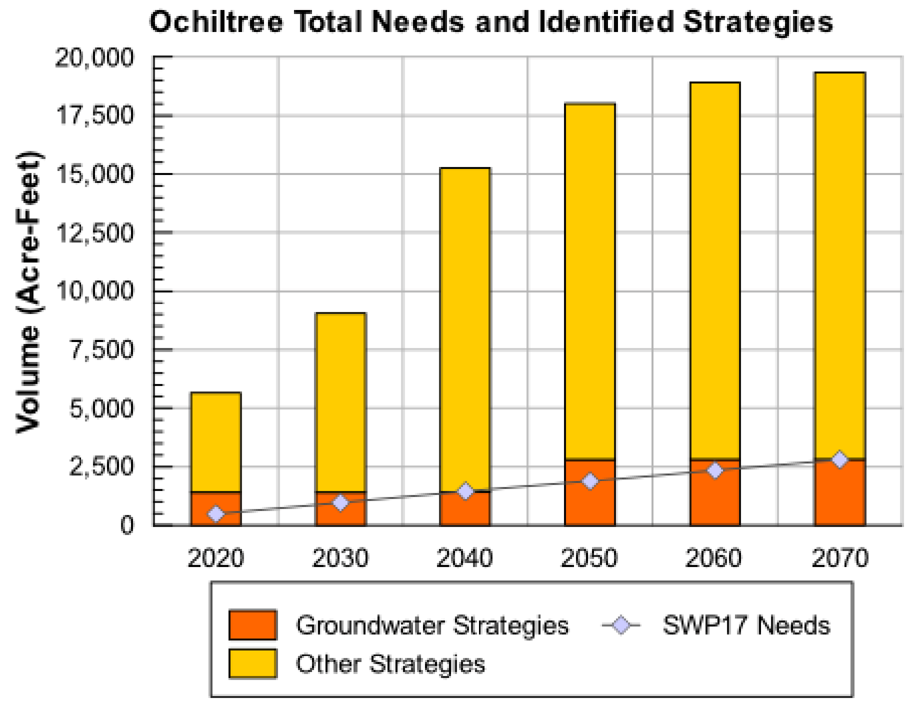

Moore Total Needs and Identified Strategies
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
Volume (Acre-Feet)
2020
2030
2040
2050
2060
2070
Groundwater Strategies
SWP17 Needs
Other Strategies

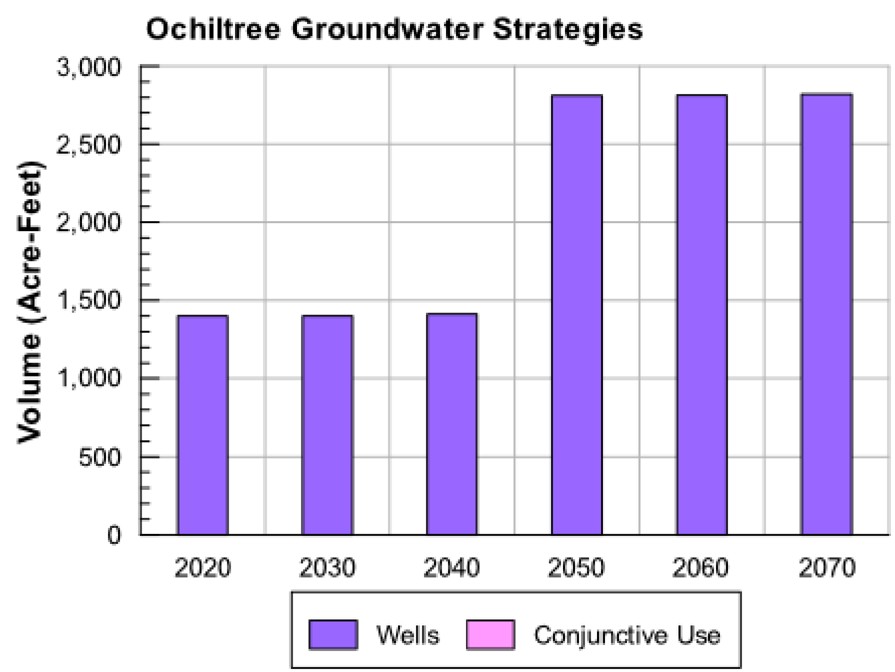

Moore Groundwater Strategies
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
Volume (Acre-Feet)
2020
2030
2040
2050
2060
2070
Wells
Conjunctive Use

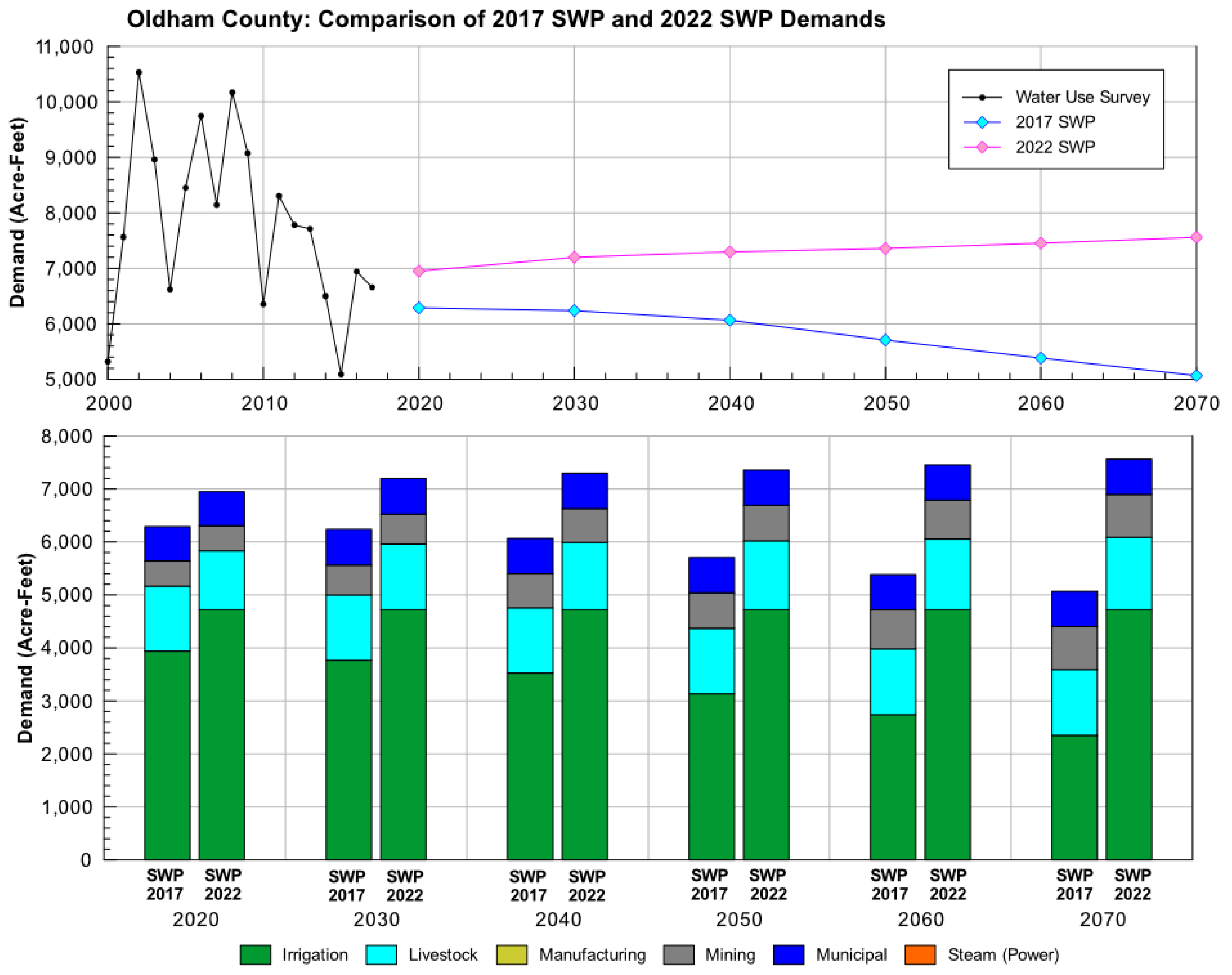


Ochiltree County: Comparison of 2017 SWP and 2022 SWP Demands
Demand (Acre-Feet)
120,000
110,000
100,000
90,000
80,000
70,000
60,000
50,000
40,000
2000
2010
2020
2030
2040
2050
2060
2070
Water Use Survey
2017 SWP
2022 SWP
Demand (Acre-Feet)
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
SWP 2017
SWP 2022
2020
2030
2040
2050
2060
2070
Irrigation
Livestock
Manufacturing
Mining
Municipal
Steam (Power)

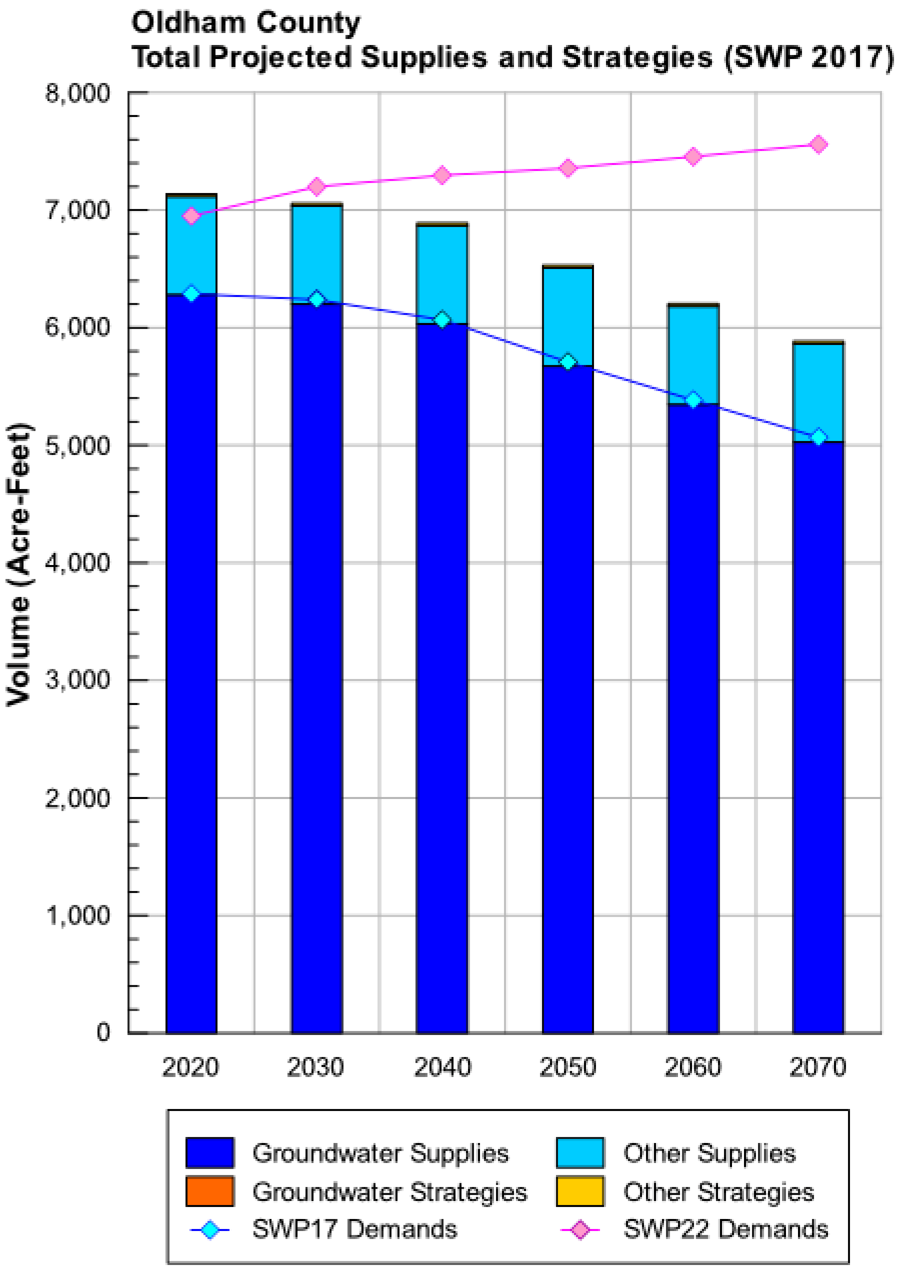

Ochiltree County
Total Projected Supplies and Strategies (SWP 2017)
Volume (Acre-Feet)
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
2020
2030
2040
2050
2060
2070
Groundwater Supplies
Other Supplies
Groundwater Strategies
Other Strategies
SWP17 Demands
SWP22 Demands

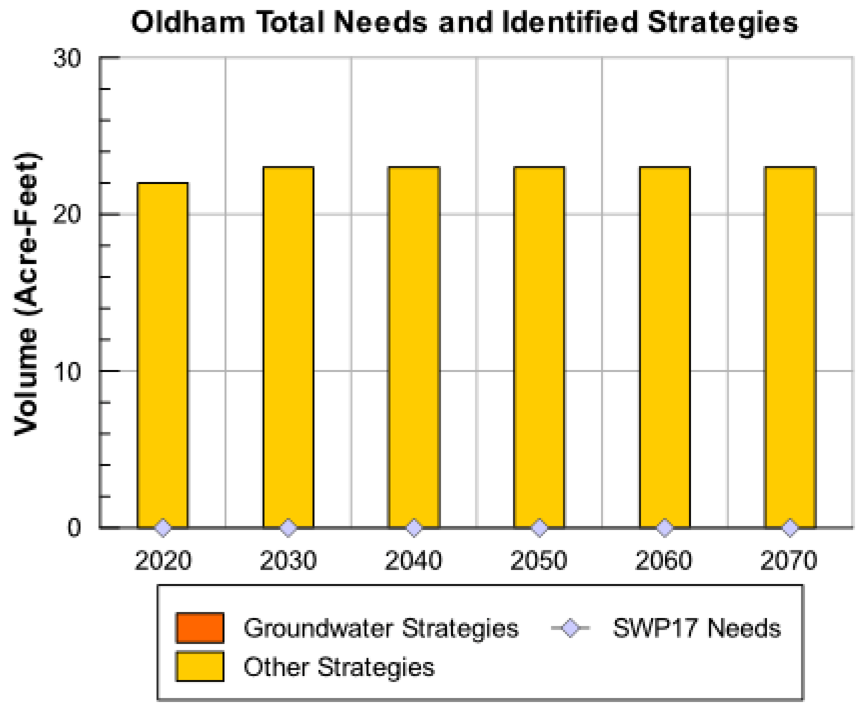

Ochiltree Total Needs and Identified Strategies
Volume (Acre-Feet)
20,000
17,500
15,000
12,500
10,000
7,500
5,000
2,500
0
2020
2030
2040
2050
2060
2070
Groundwater Strategies
SWP17 Needs
Other Strategies

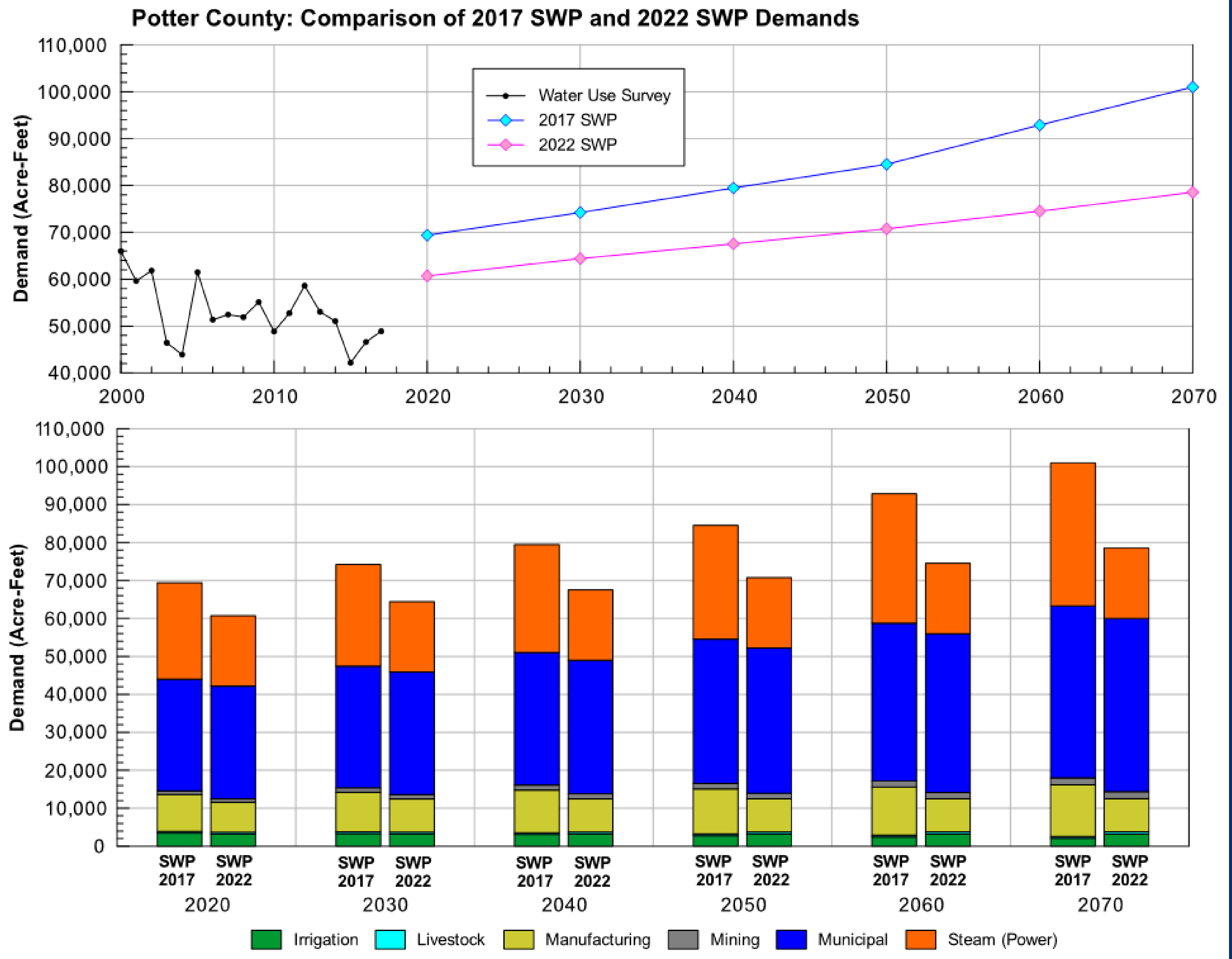

Ochiltree Groundwater Strategies
Volume (Acre-Feet)
3,000
2,500
2,000
1,500
1,000
500
0
2020
2030
2040
2050
2060
2070
Wells
Conjunctive Use



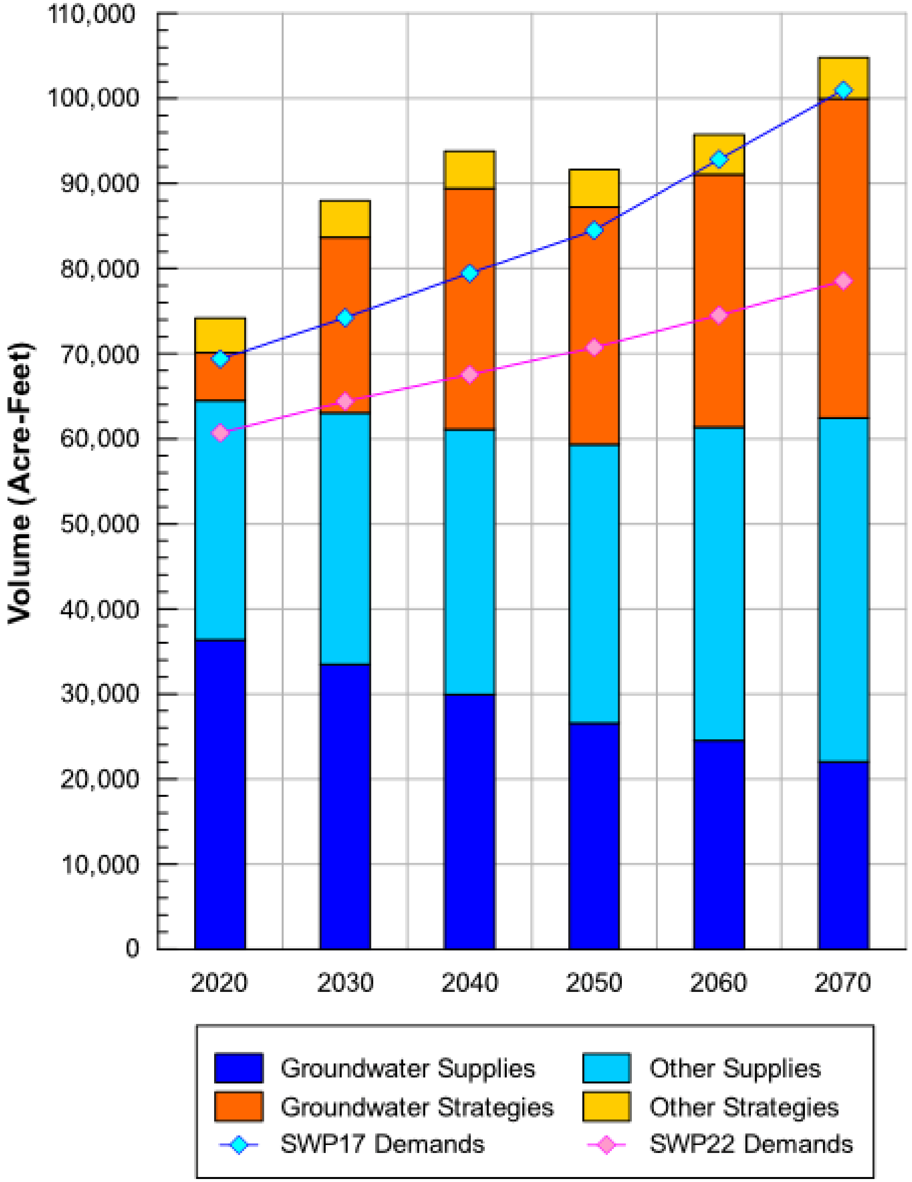
Oldham County: Comparison of 2017 SWP and 2022 SWP Demands
Demand (Acre-Feet)
11,000
10,000
9,000
8,000
7,000
6,000
5,000
2000
2010
2020
2030
2040
2050
2060
2070
Water Use Survey
2017 SWP
2022 SWP
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Demand (Acre-Feet)
SWP 2017
SWP 2022
2020
2030
2040
2050
2060
2070
Irrigation
Livestock
Manufacturing
Mining
Municipal
Steam (Power)


Oldham County
Total Projected Supplies and Strategies (SWP 2017)
Volume (Acre-Feet)
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
2020
2030
2040
2050
2060
2070
Groundwater Supplies
Other Supplies
Groundwater Strategies
Other Strategies
SWP17 Demands
SWP22 Demands

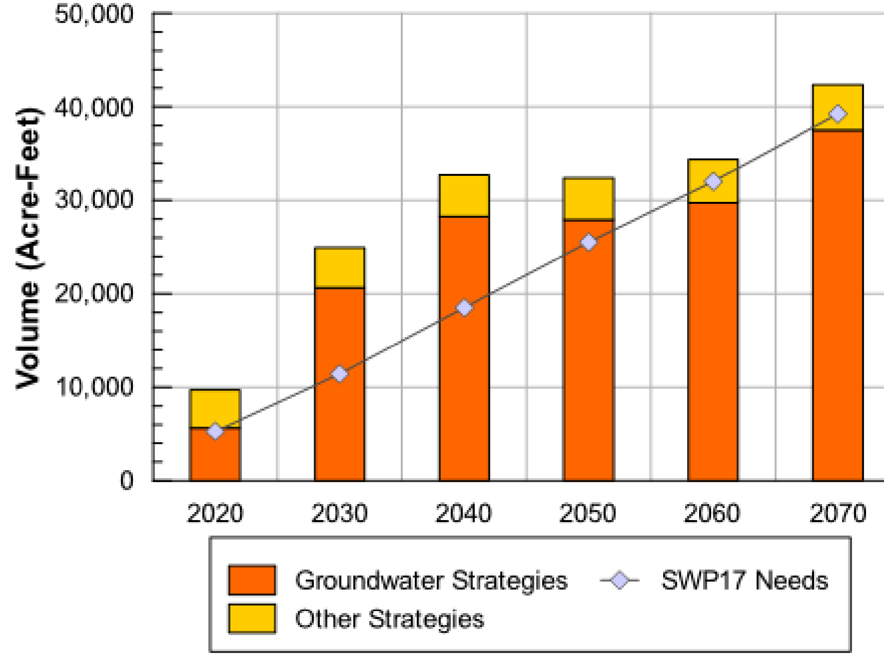

Oldham Total Needs and Identified Strategies
Volume (Acre-Feet)
30
20
10
0
2020
2030
2040
2050
2060
2070
Groundwater Strategies
SWP17 Needs
Other Strategies


Potter County: Comparison of 2017 SWP and 2022 SWP Demands
Demand (Acre-Feet)
110,000
100,000
90,000
80,000
70,000
60,000
50,000
40,000
2000
2010
2020
2030
2040
2050
2060
2070
Water Use Survey
2017 SWP
2022 SWP
Demand (Acre-Feet)
110,000
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
SWP 2017
SWP 2022
2020
2030
2040
2050
2060
2070
Irrigation
Livestock
Manufacturing
Mining
Municipal
Steam (Power)

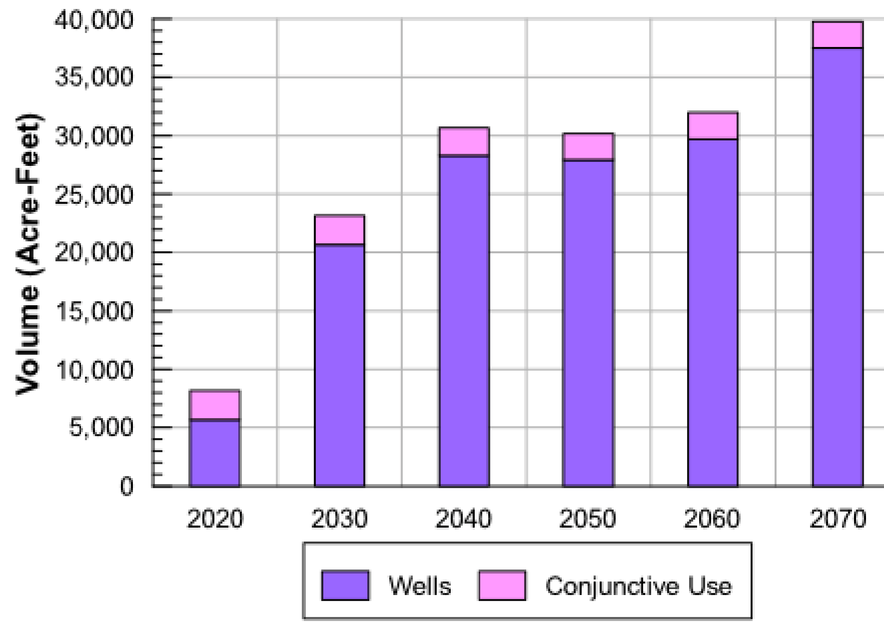
Potter County
Total Projected Supplies and Strategies (SWP 2017)



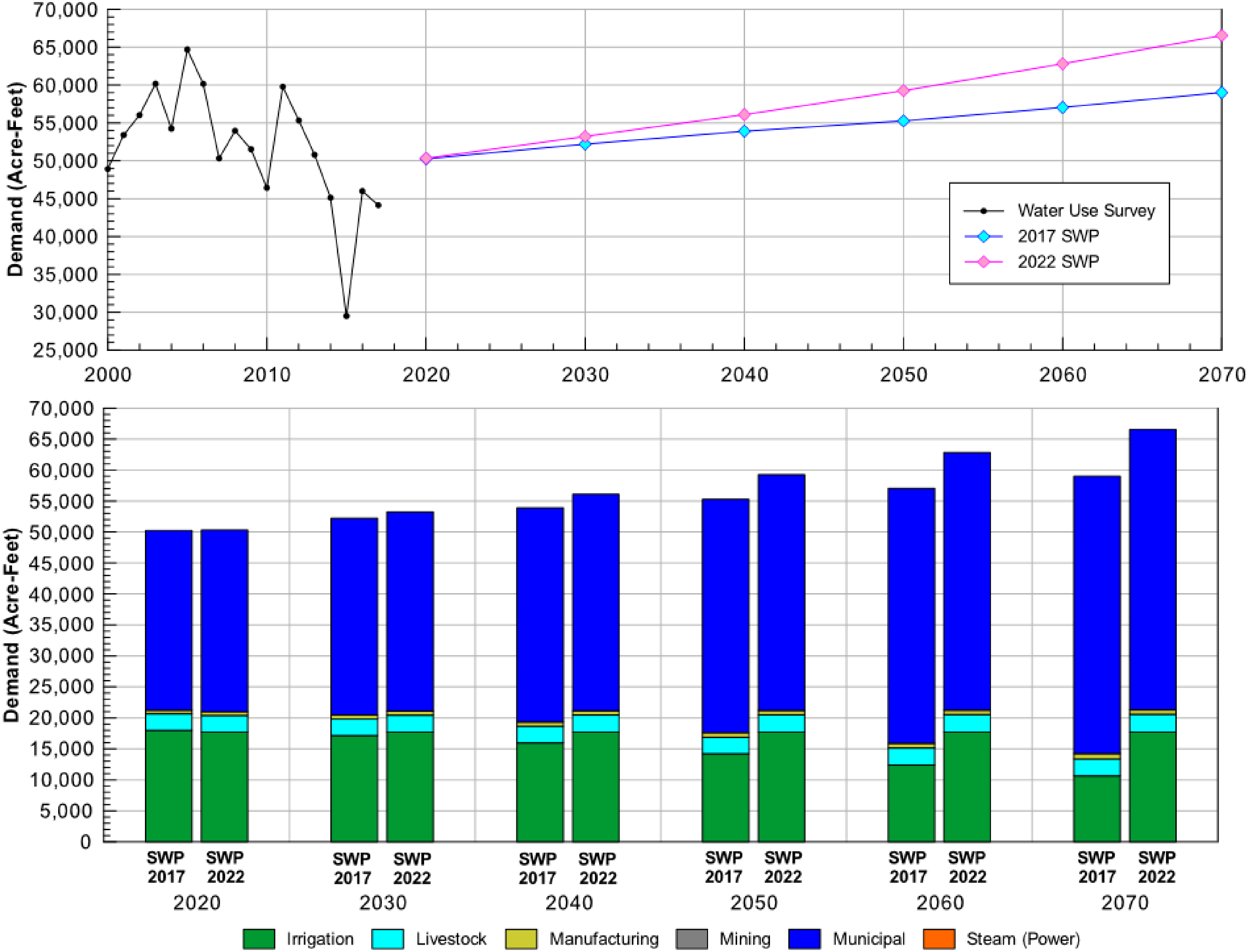
Potter Total Needs and Identified Strategies

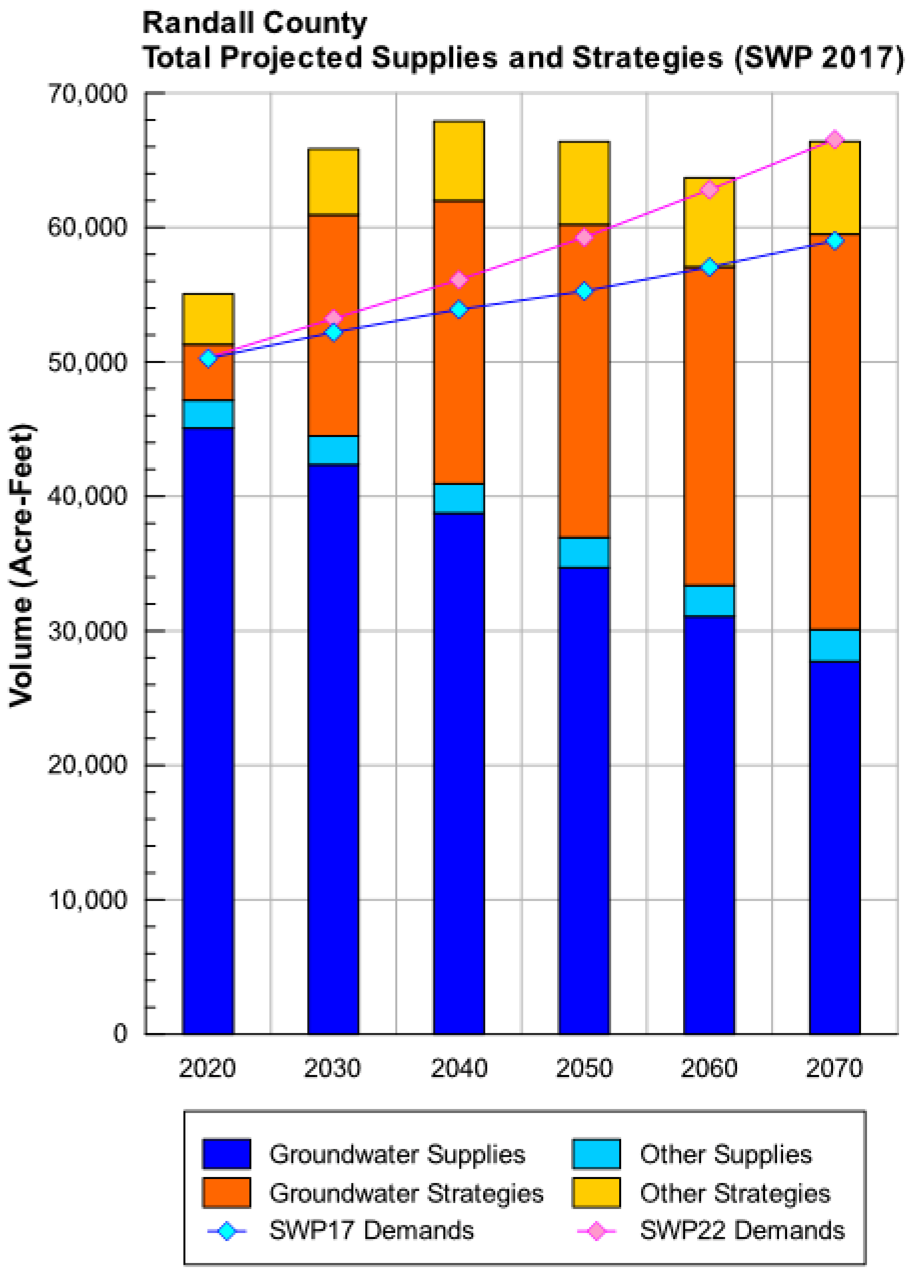


Potter Groundwater Strategies

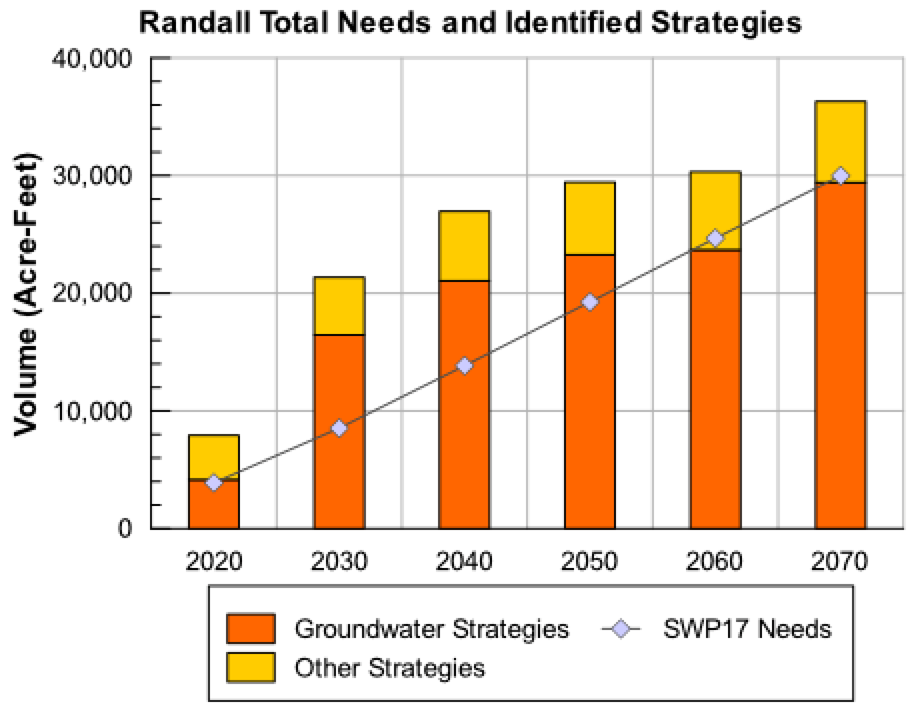


Randall County: Comparison of 2017 SWP and 2022 SWP Demands

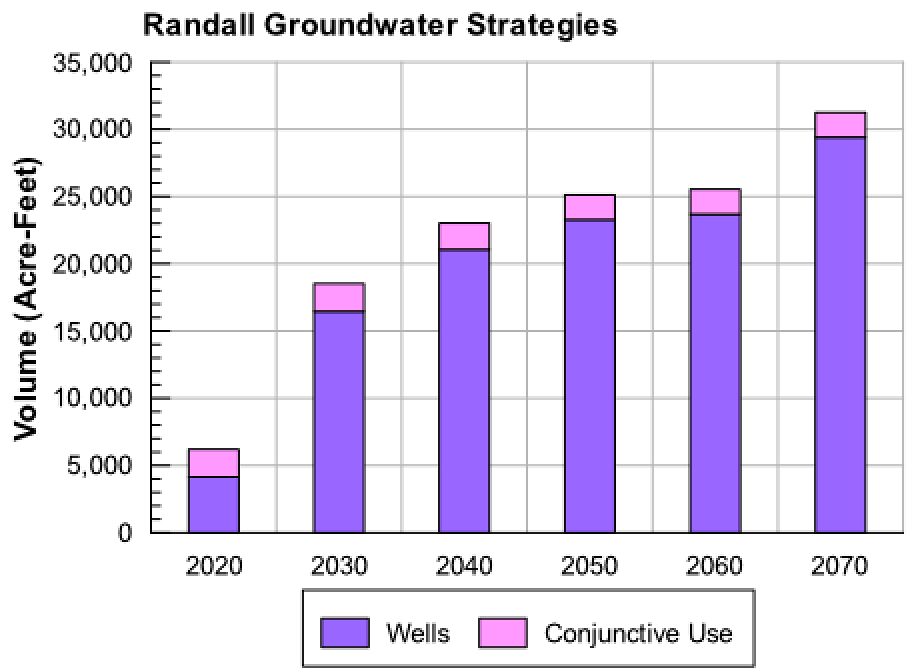




Randall County
Total Projected Supplies and Strategies (SWP 2017)
Volume (Acre-Feet)
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
2020
2030
2040
2050
2060
2070
Groundwater Supplies
Other Supplies
Groundwater Strategies
Other Strategies
SWP17 Demands
SWP22 Demands

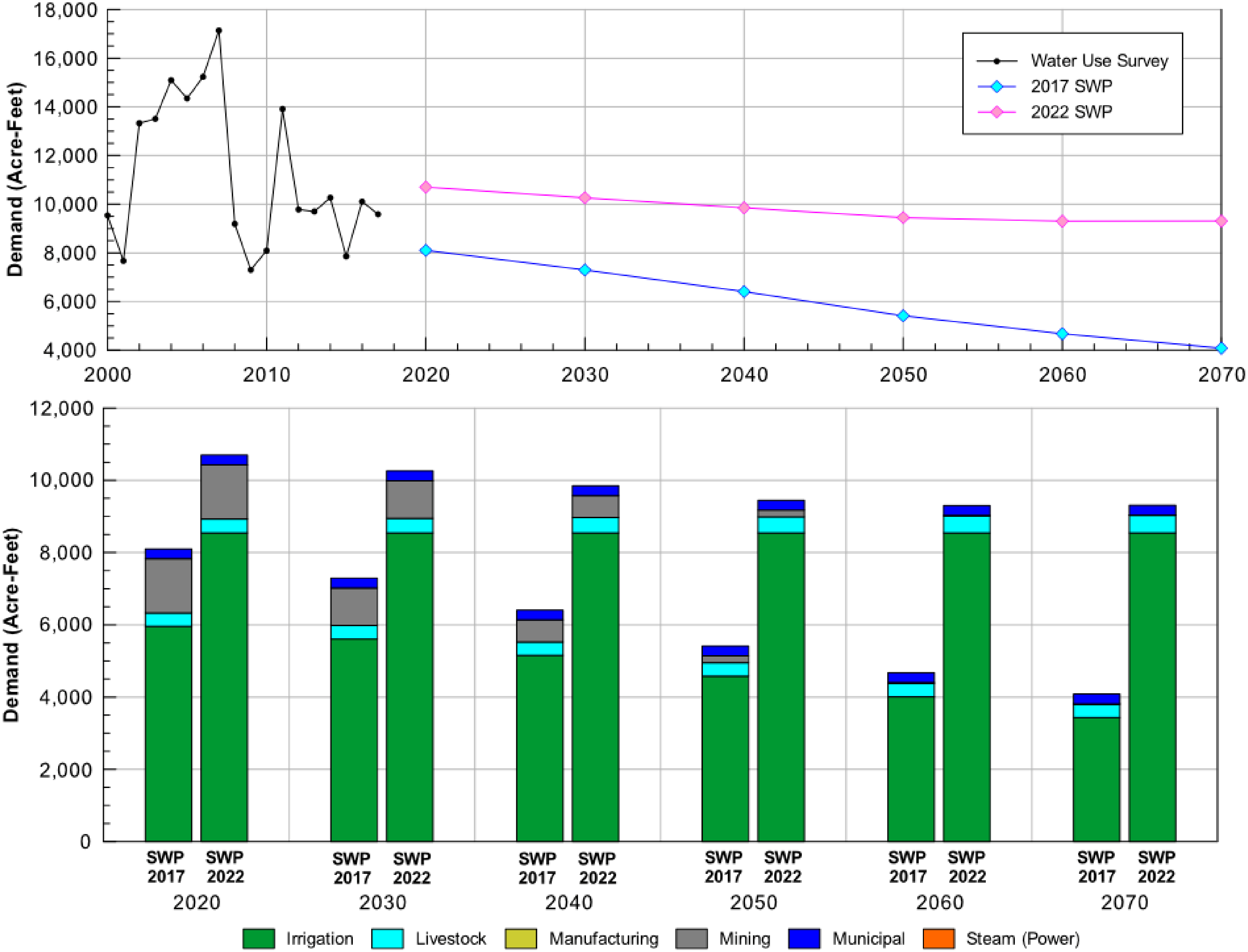


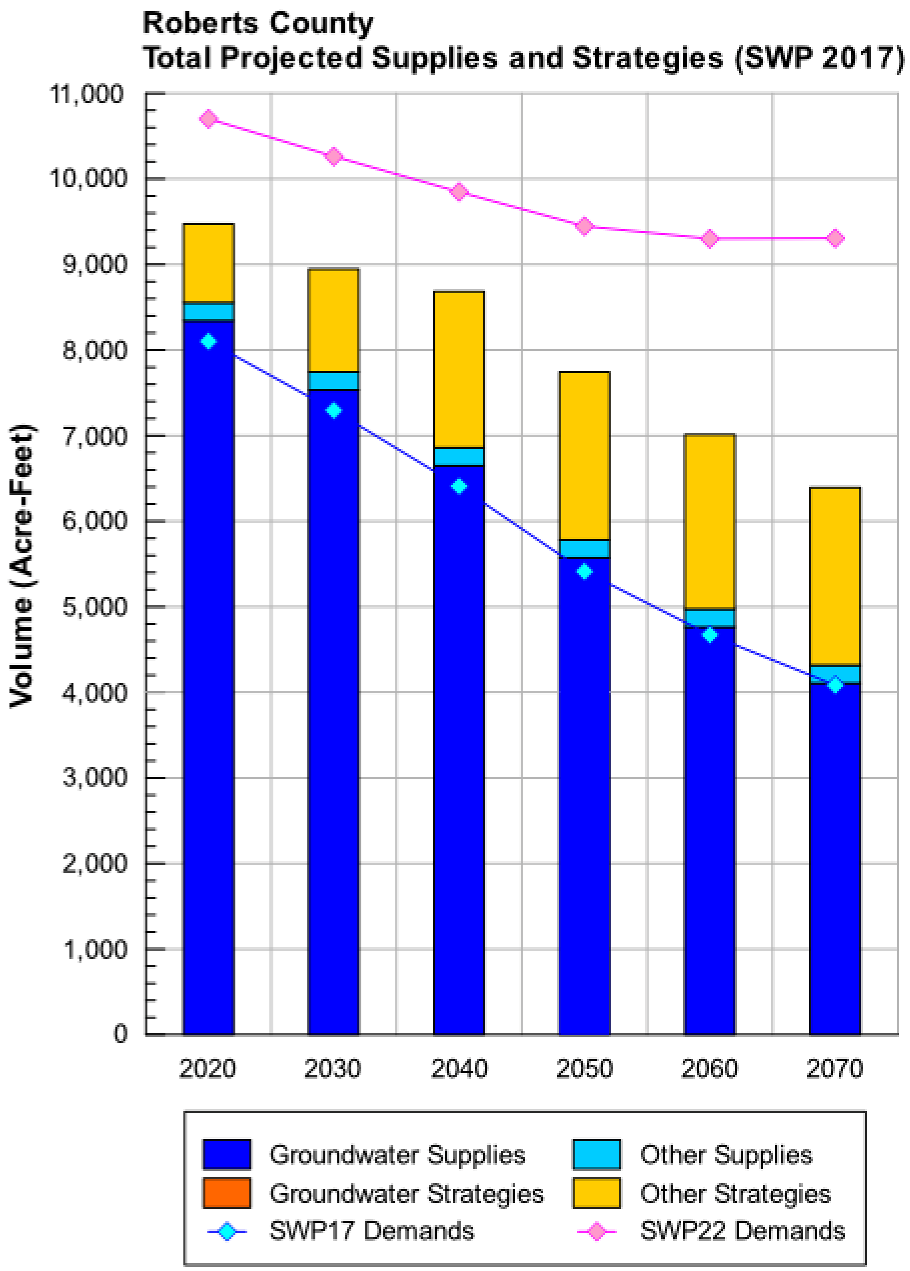
Randall Total Needs and Identified Strategies
Volume (Acre-Feet)
40,000
30,000
20,000
10,000
0
2020
2030
2040
2050
2060
2070
Groundwater Strategies
SWP17 Needs
Other Strategies

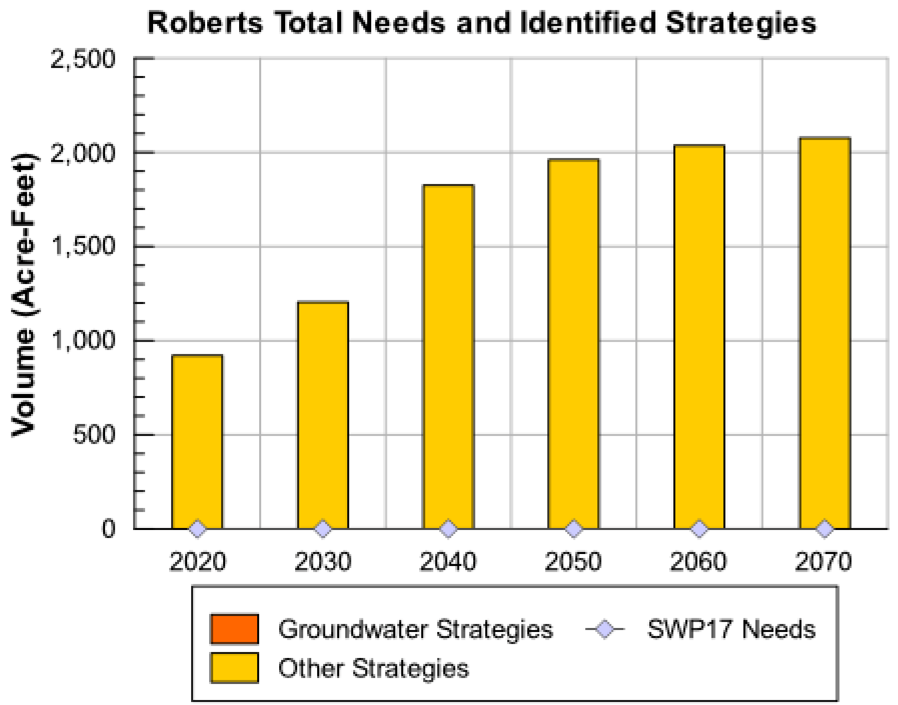


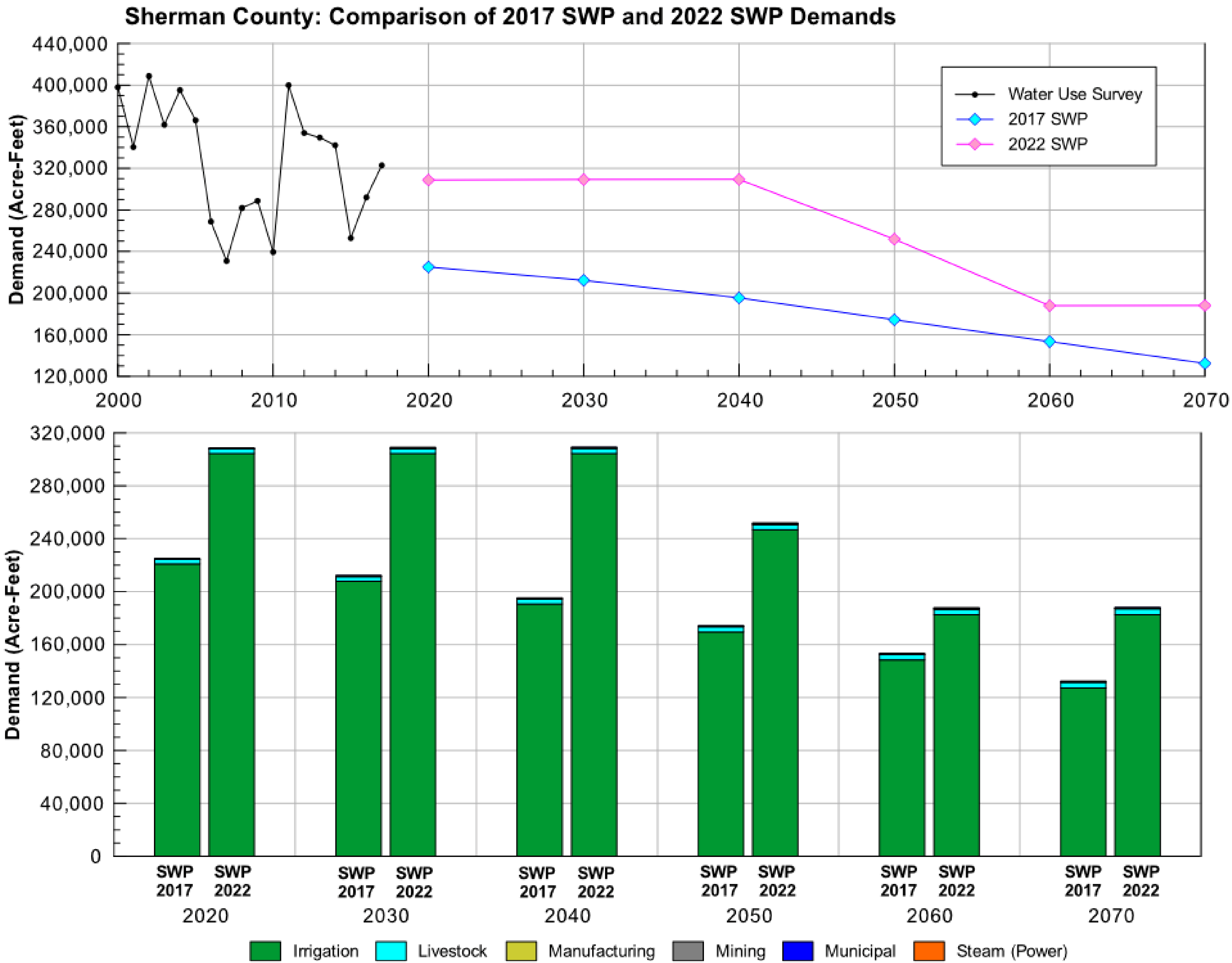
Randall Groundwater Strategies
Volume (Acre-Feet)
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
2020
2030
2040
2050
2060
2070
Wells
Conjunctive Use

Roberts County: Comparison of 2017 SWP and 2022 SWP Demands

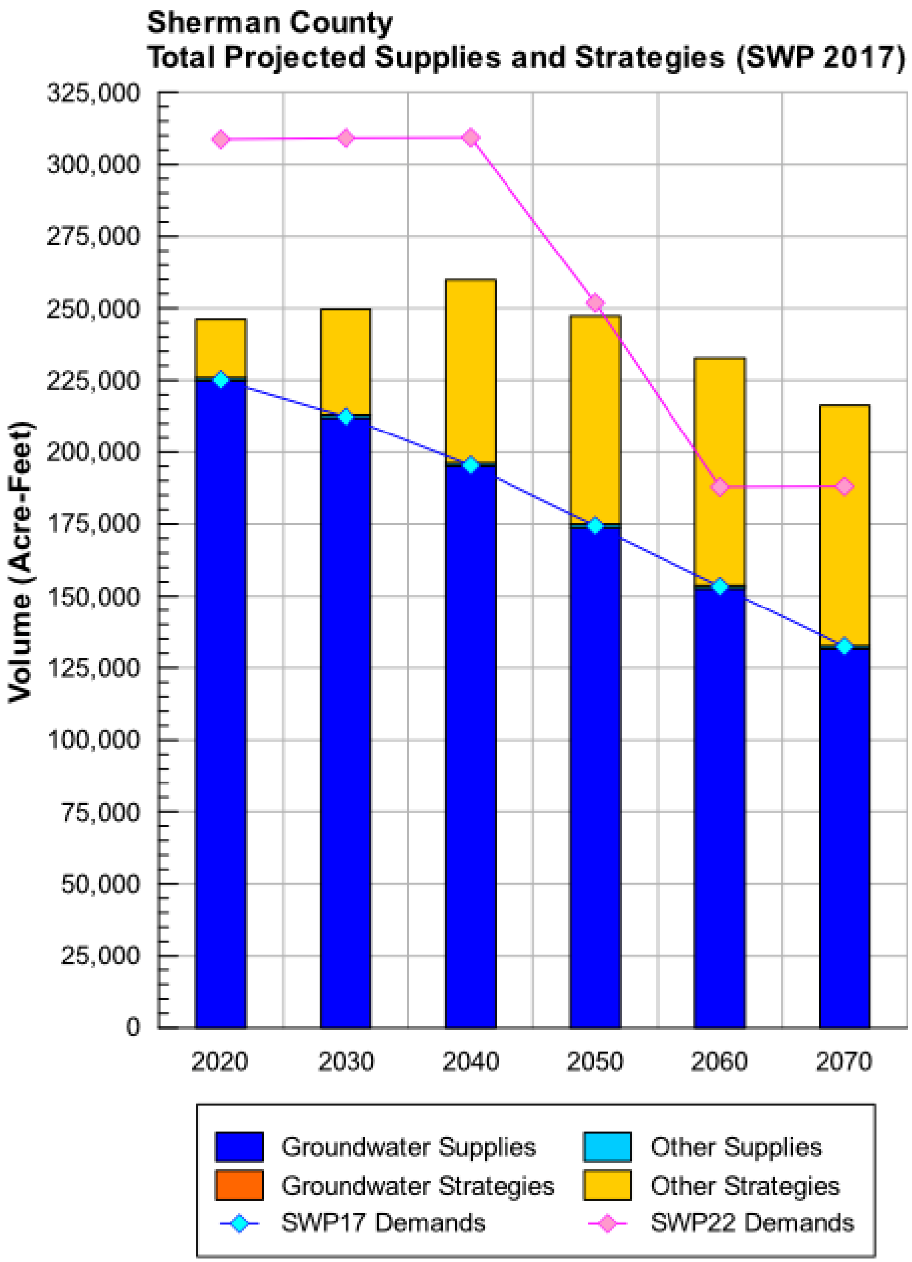


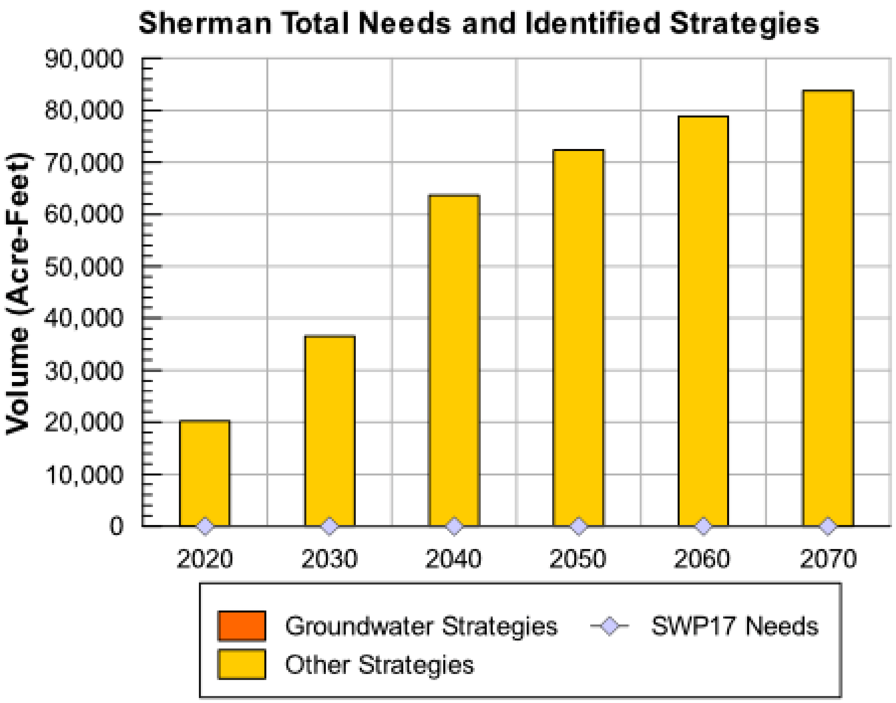

Roberts County
Total Projected Supplies and Strategies (SWP 2017)
Volume (Acre-Feet)
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
2020
2030
2040
2050
2060
2070
Groundwater Supplies
Other Supplies
Groundwater Strategies
Other Strategies
SWP17 Demands
SWP22 Demands

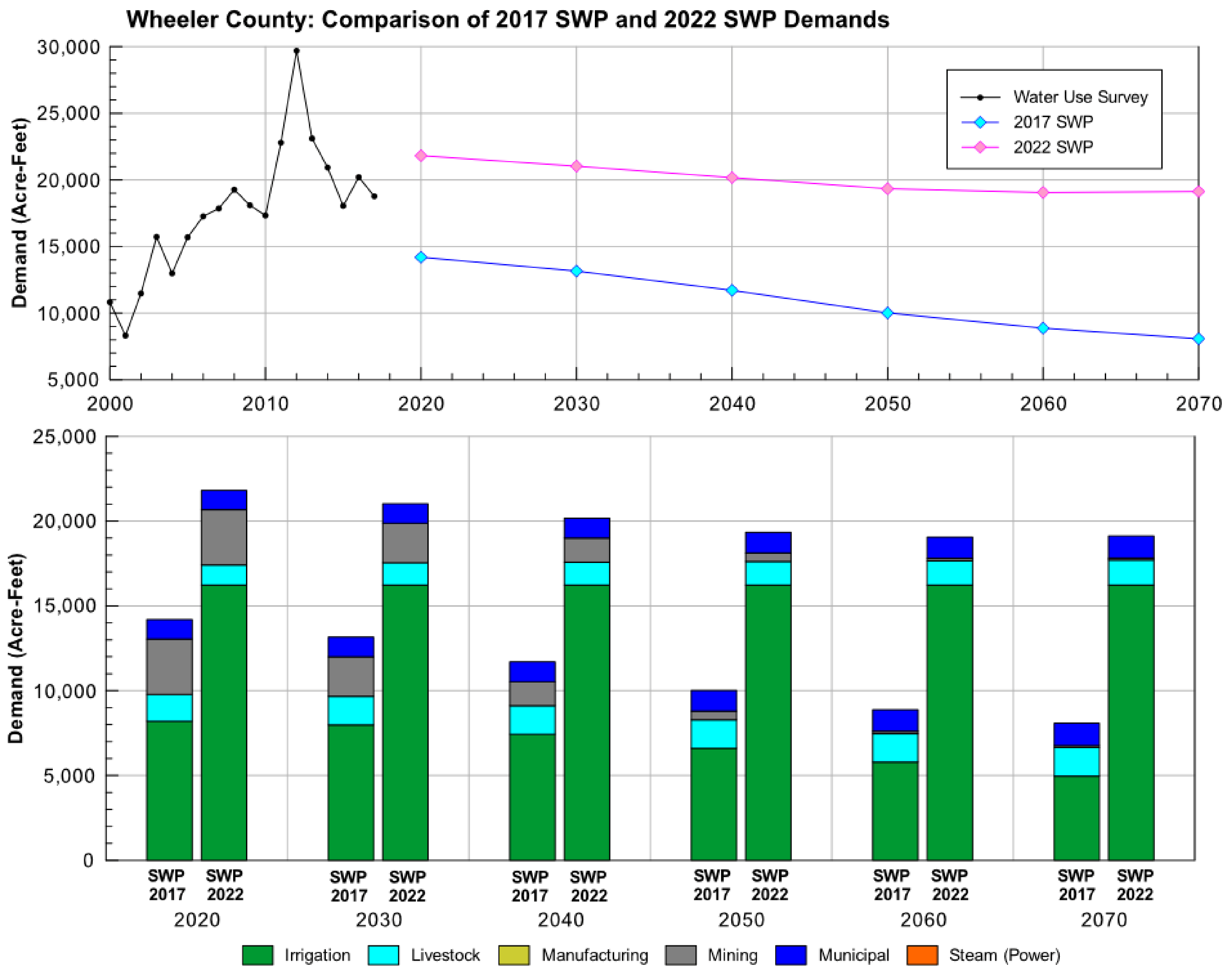

Roberts Total Needs and Identified Strategies
Volume (Acre-Feet)
2,500
2,000
1,500
1,000
500
0
2020
2030
2040
2050
2060
2070
Groundwater Strategies
SWP17 Needs
Other Strategies

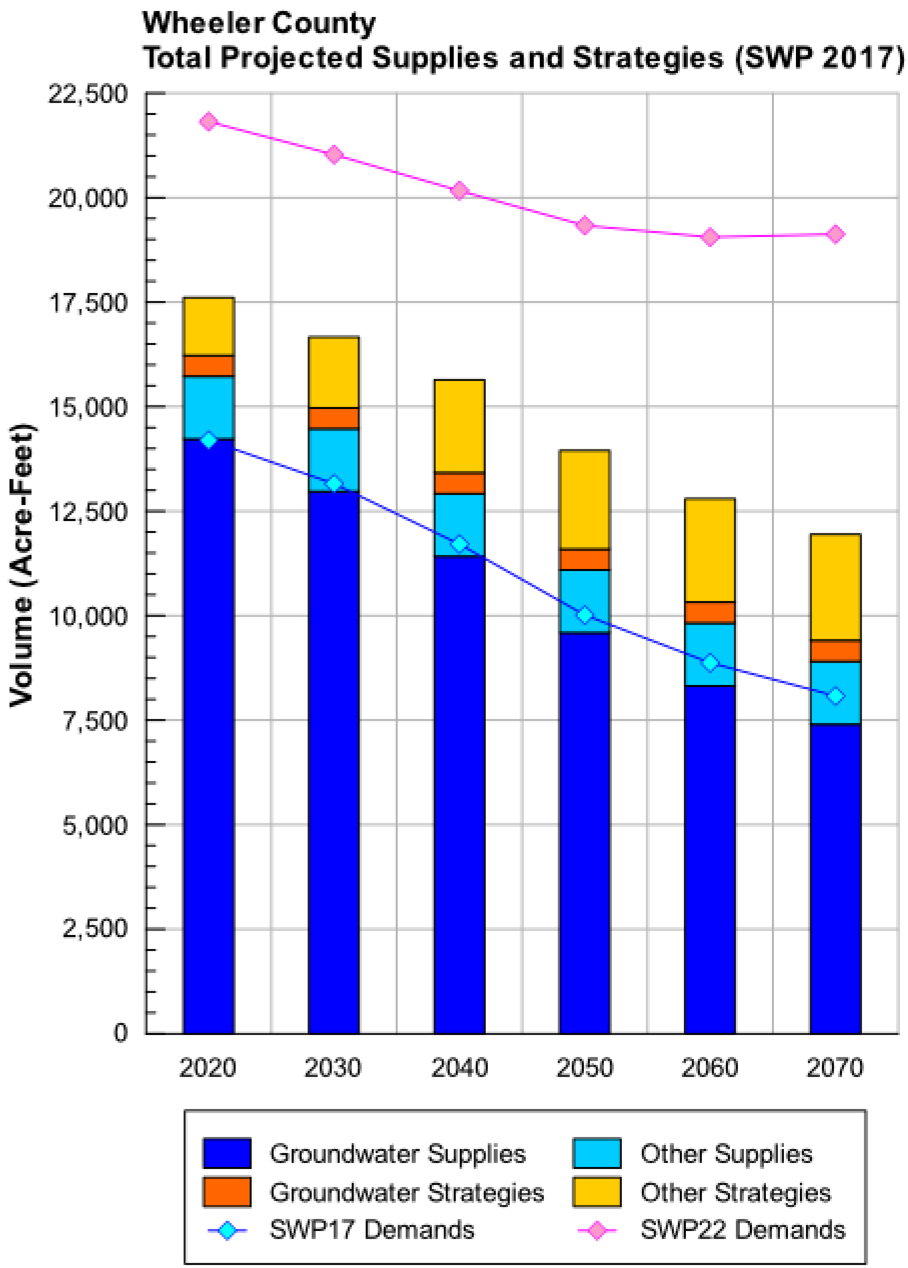


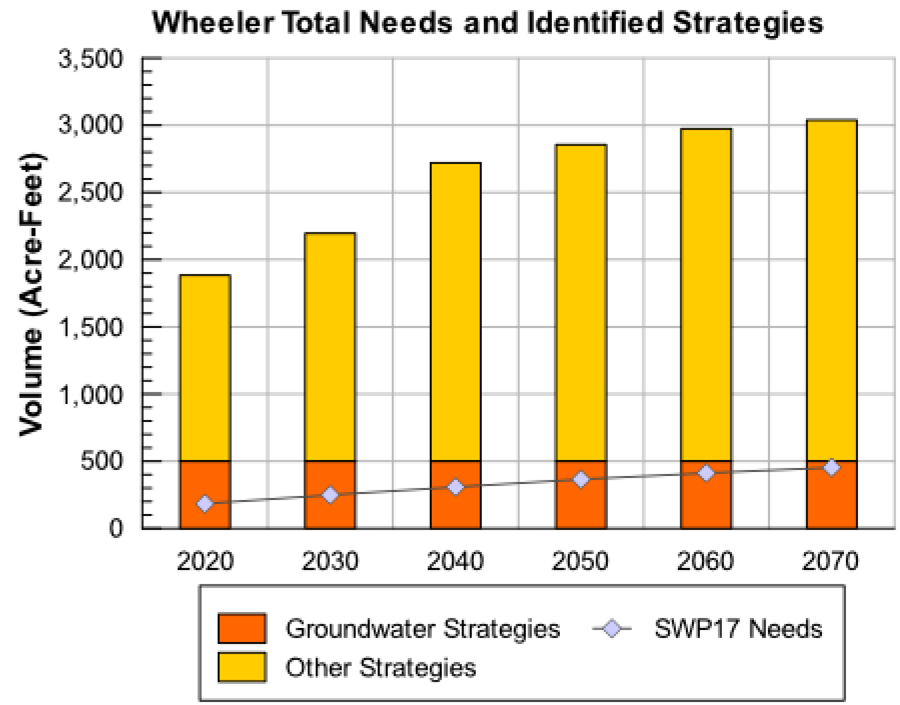
Sherman County: Comparison of 2017 SWP and 2022 SWP Demands
Demand (Acre-Feet)
440,000
400,000
360,000
320,000
280,000
240,000
200,000
160,000
120,000
2000
2010
2020
2030
2040
2050
2060
2070
Water Use Survey
2017 SWP
2022 SWP
Demand (Acre-Feet)
320,000
280,000
240,000
200,000
160,000
120,000
80,000
40,000
0
SWP 2017
SWP 2022
2020
2030
2040
2050
2060
2070
Irrigation
Livestock
Manufacturing
Mining
Municipal
Steam (Power)

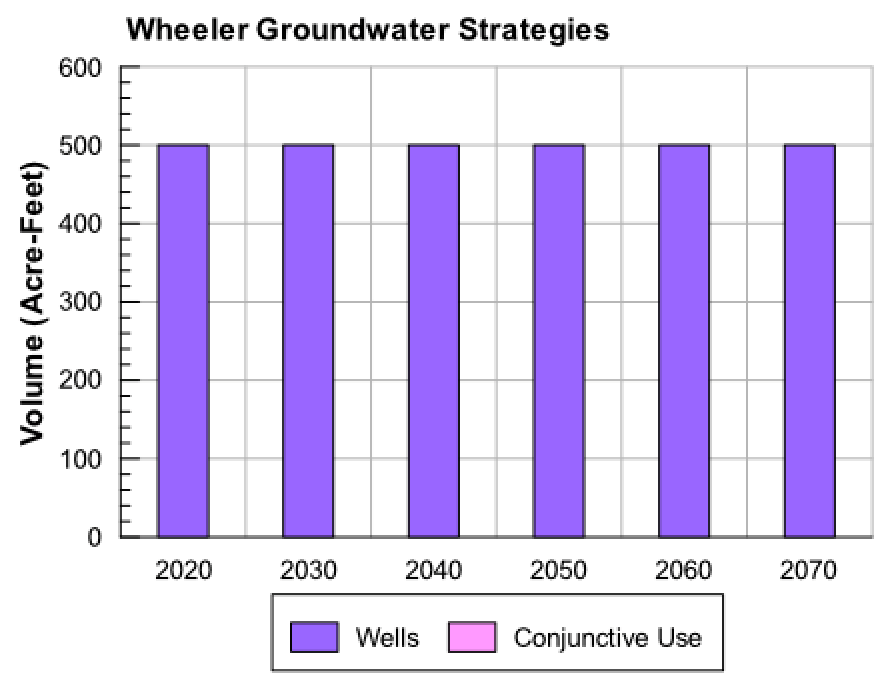

Sherman County
Total Projected Supplies and Strategies (SWP 2017)
Volume (Acre-Feet)
325,000
300,000
275,000
250,000
225,000
200,000
175,000
150,000
125,000
100,000
75,000
50,000
25,000
0
2020
2030
2040
2050
2060
2070
Groundwater Supplies
Other Supplies
Groundwater Strategies
Other Strategies
SWP17 Demands
SWP22 Demands


Sherman Total Needs and Identified Strategies
Volume (Acre-Feet)
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
2020
2030
2040
2050
2060
2070
Groundwater Strategies
SWP17 Needs
Other Strategies


Wheeler County: Comparison of 2017 SWP and 2022 SWP Demands
Demand (Acre-Feet)
30,000
25,000
20,000
15,000
10,000
5,000
2000
2010
2020
2030
2040
2050
2060
2070
Water Use Survey
2017 SWP
2022 SWP
Demand (Acre-Feet)
25,000
20,000
15,000
10,000
5,000
0
SWP 2017
SWP 2022
2020
2030
2040
2050
2060
2070
Irrigation
Livestock
Manufacturing
Mining
Municipal
Steam (Power)


Wheeler County
Total Projected Supplies and Strategies (SWP 2017)
Volume (Acre-Feet)
22,500
20,000
17,500
15,000
12,500
10,000
7,500
5,000
2,500
0
2020
2030
2040
2050
2060
2070
Groundwater Supplies
Other Supplies
Groundwater Strategies
Other Strategies
SWP17 Demands
SWP22 Demands


Wheeler Total Needs and Identified Strategies
Volume (Acre-Feet)
3,500
3,000
2,500
2,000
1,500
1,000
500
0
2020
2030
2040
2050
2060
2070
Groundwater Strategies
SWP17 Needs
Other Strategies


Wheeler Groundwater Strategies
Volume (Acre-Feet)
600
500
400
300
200
100
0
2020
2030
2040
2050
2060
2070
Wells
Conjunctive Use

High Plains Aquifer System GAM Pumping Update and Consideration of Model Run Scenarios and Metrics

A Presentation to GMA 1
Joint Planning Group

February 18. 2020

Lakin Beal
LBeal@intera.com
512.425.2009

Wade Oliver, P.G.
WOliver@intera.com
281.560.4562

INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS

Agenda Items

- Item 7: Presentation by INTERA of ther esults of the model run as requested by GMA #1 at the meeting on 2/18/2020
- Item 8: Discuss and consider potential paths forward in the joint planning process, including but not limited to selection of additional model run scenario(s) and metric(s) for further evaluation

Model run results should include

- Restatement of Model Run Request
- Maps of drawdown by aquifer
- Maps of percent remaining by aquifer
- Table of MAGs

Agenda Item 7

Purpose of Pumping Update

- Allows for GMA 1 to set a base year for DFC that:
  - Better reflects more current water level conditions
  - Better reflects current monitoring network

Process for Updating Pumping

Pumping Data from Districts + Water Use Survey Data → Updated GAM Pumping

↓

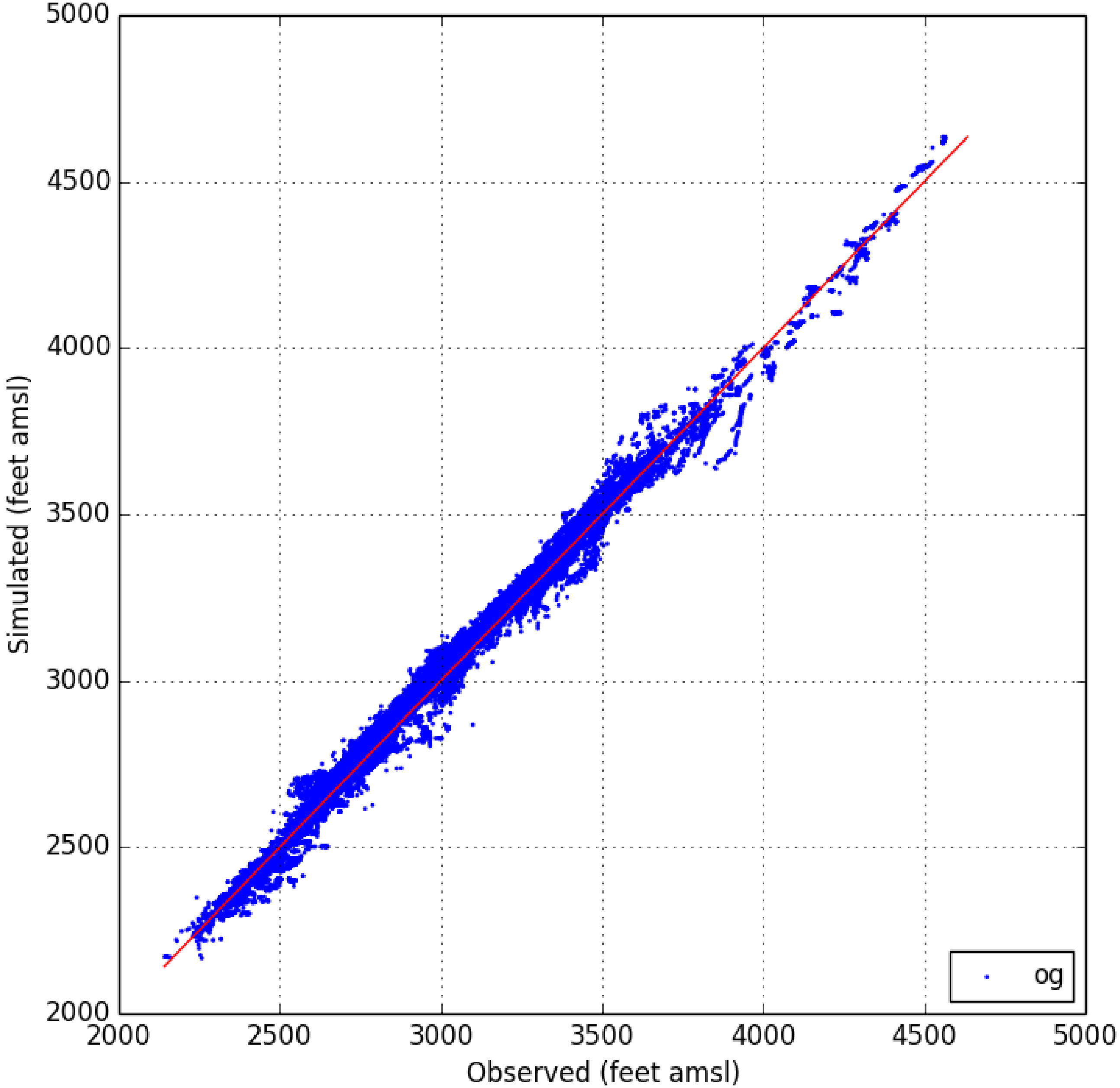
Water Level Data from TWDB Groundwater Database → Updated Target Water Levels

↓

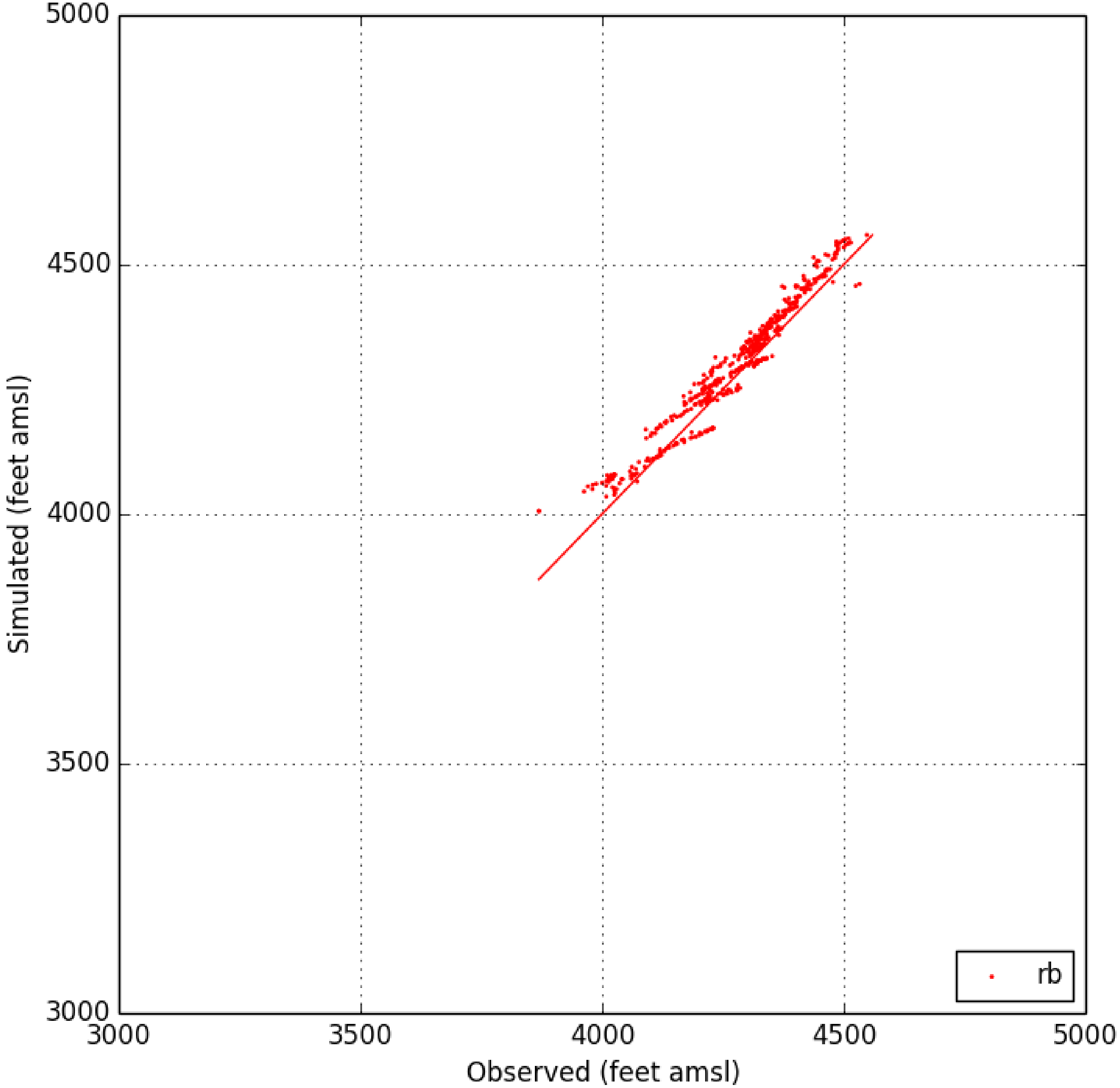
Run and Compare Modeled Water Levels Against Measured Water Levels

Measured vs. Modeled Water Levels – Just for GMA 1

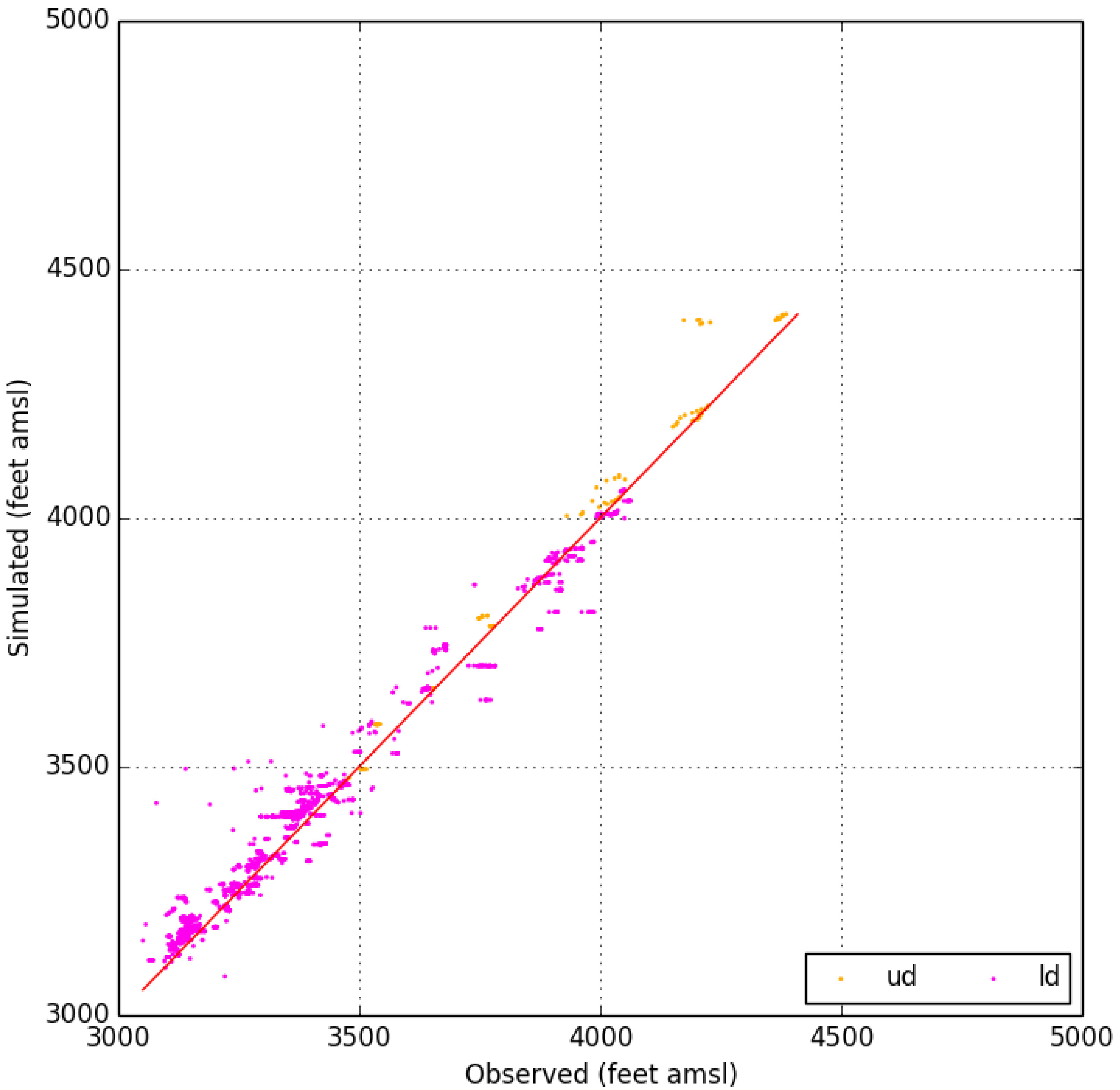
	Mean Absolute Error	MAE/Range of Water Levels	Count
Ogallala	28.8	0.012	62,367
Rita Blanca	30.7	0.045	540
Upper Dockum	31.2	0.034	105
Lower Dockum	35.5	0.035	2,153



5000
4500
4000
3500
3000
2500
2000
Simulated (feet amsl)
2000
2500
3000
3500
4000
4500
5000
Observed (feet amsl)
og

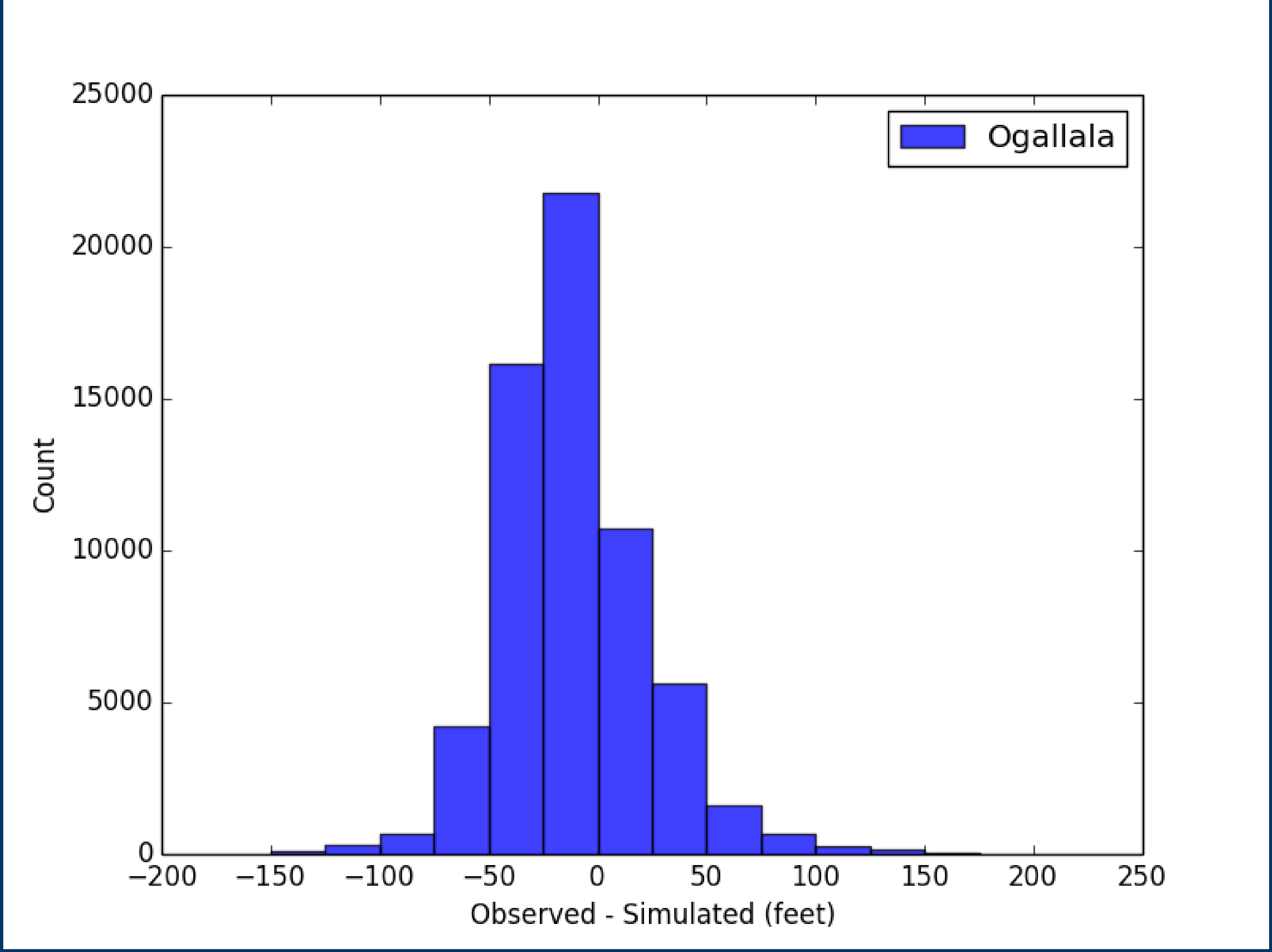


5000
4500
4000
3500
3000
3000
3500
4000
4500
5000
Simulated (feet amsl)
Observed (feet amsl)
rb

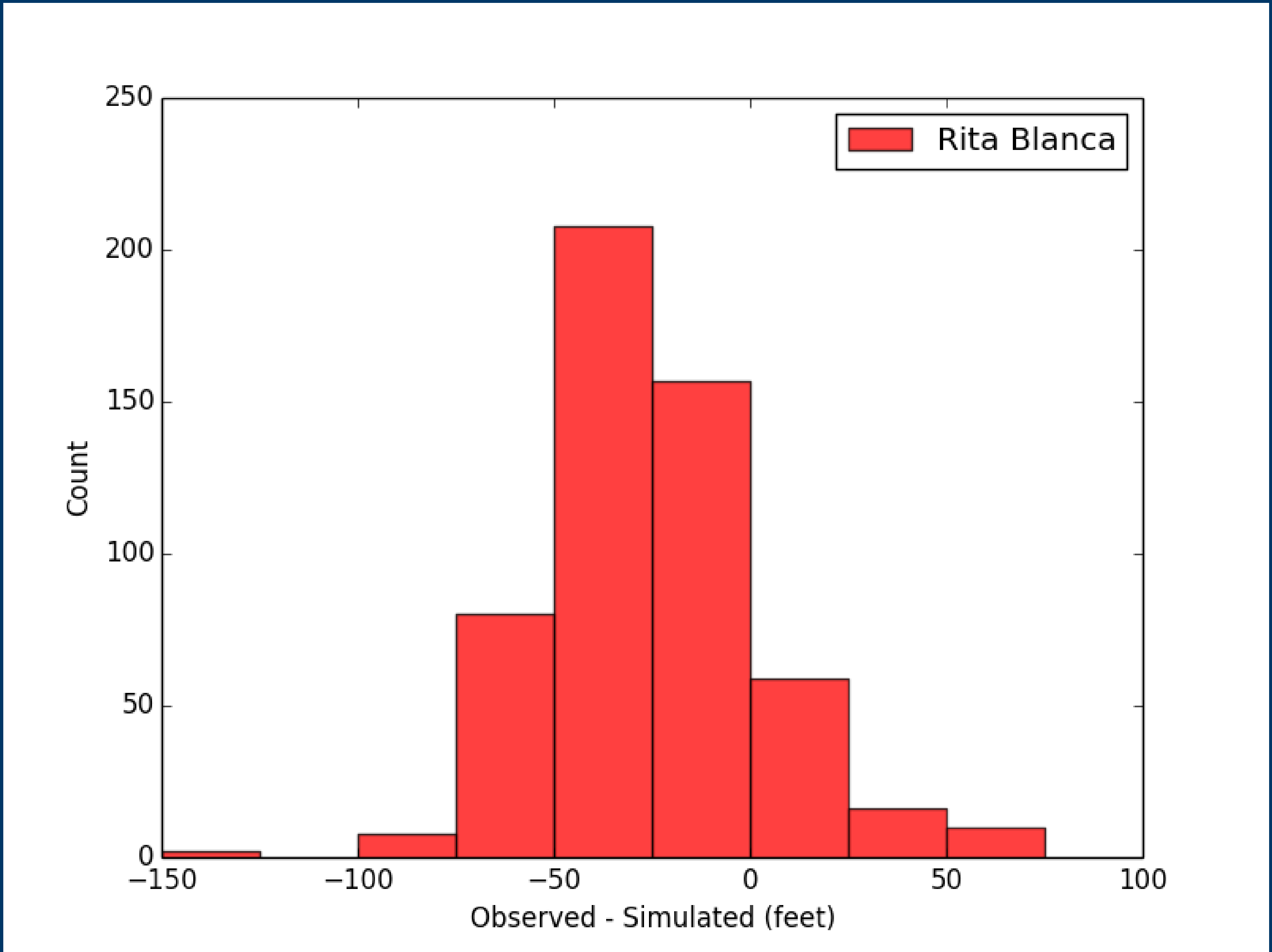


5000
4500
4000
3500
3000
3000
3500
4000
4500
5000
Simulated (feet amsl)
Observed (feet amsl)
ud
ld

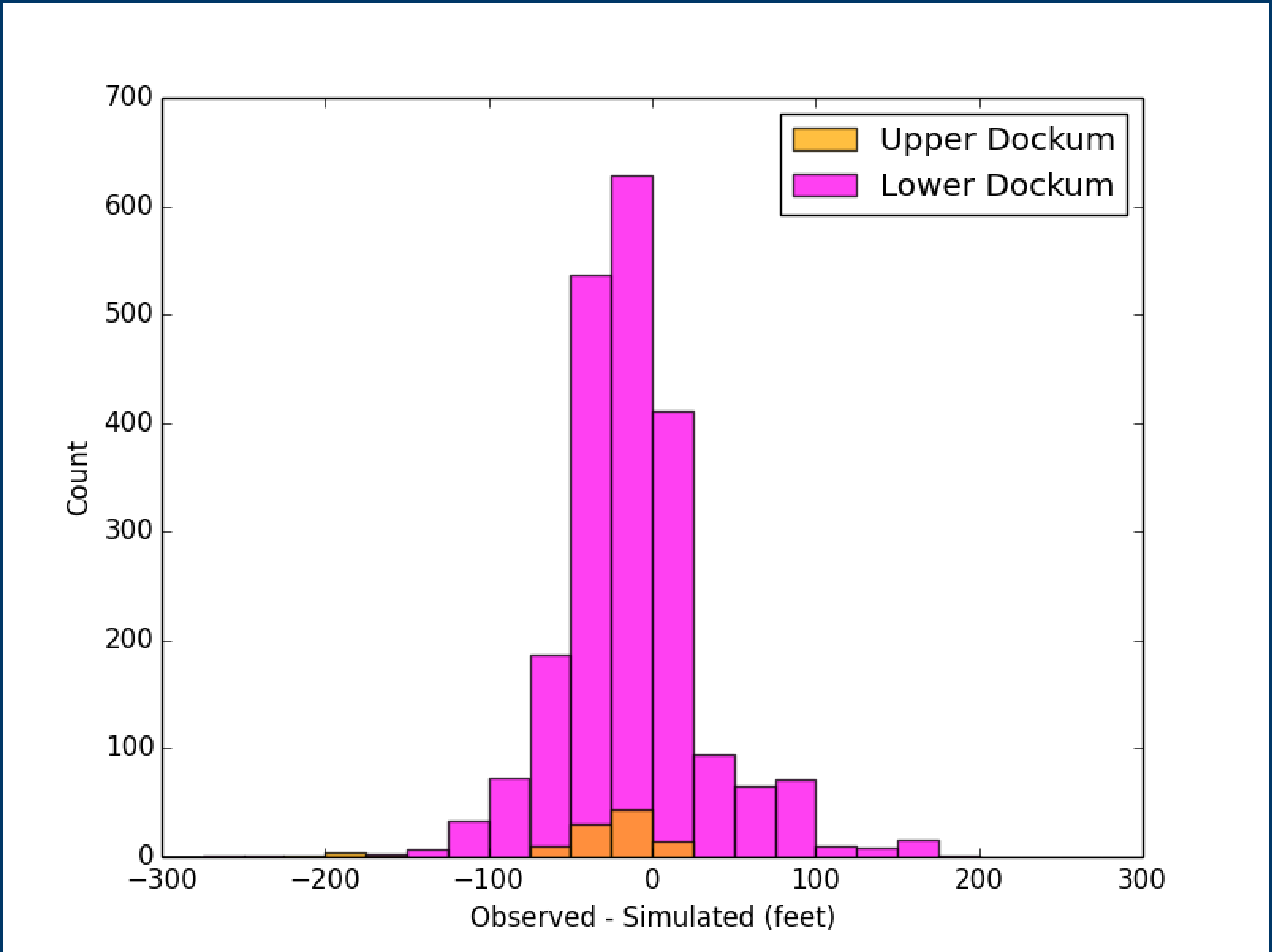
Measured vs. Modeled Water Levels



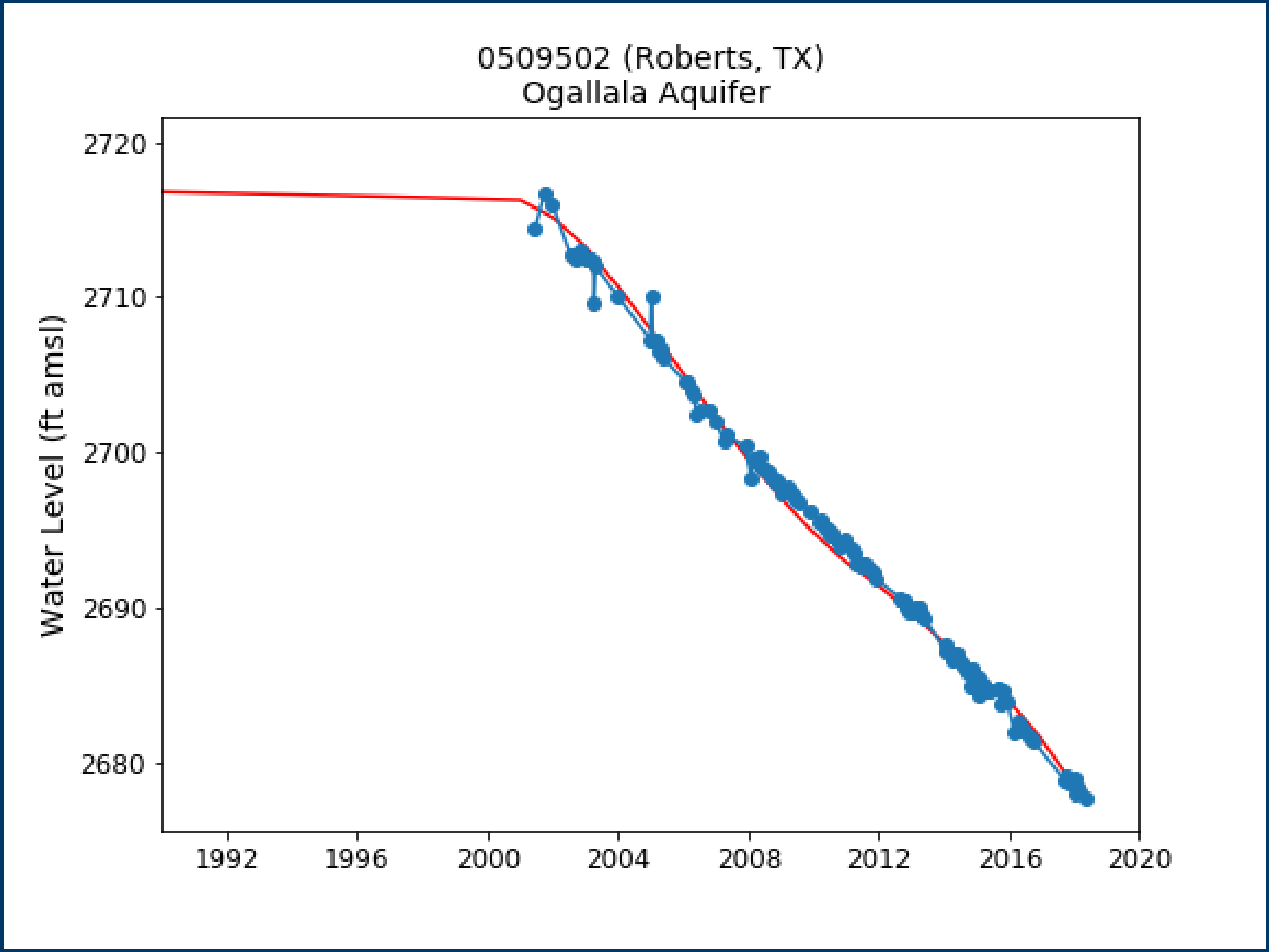
Measured vs. Modeled Water Levels



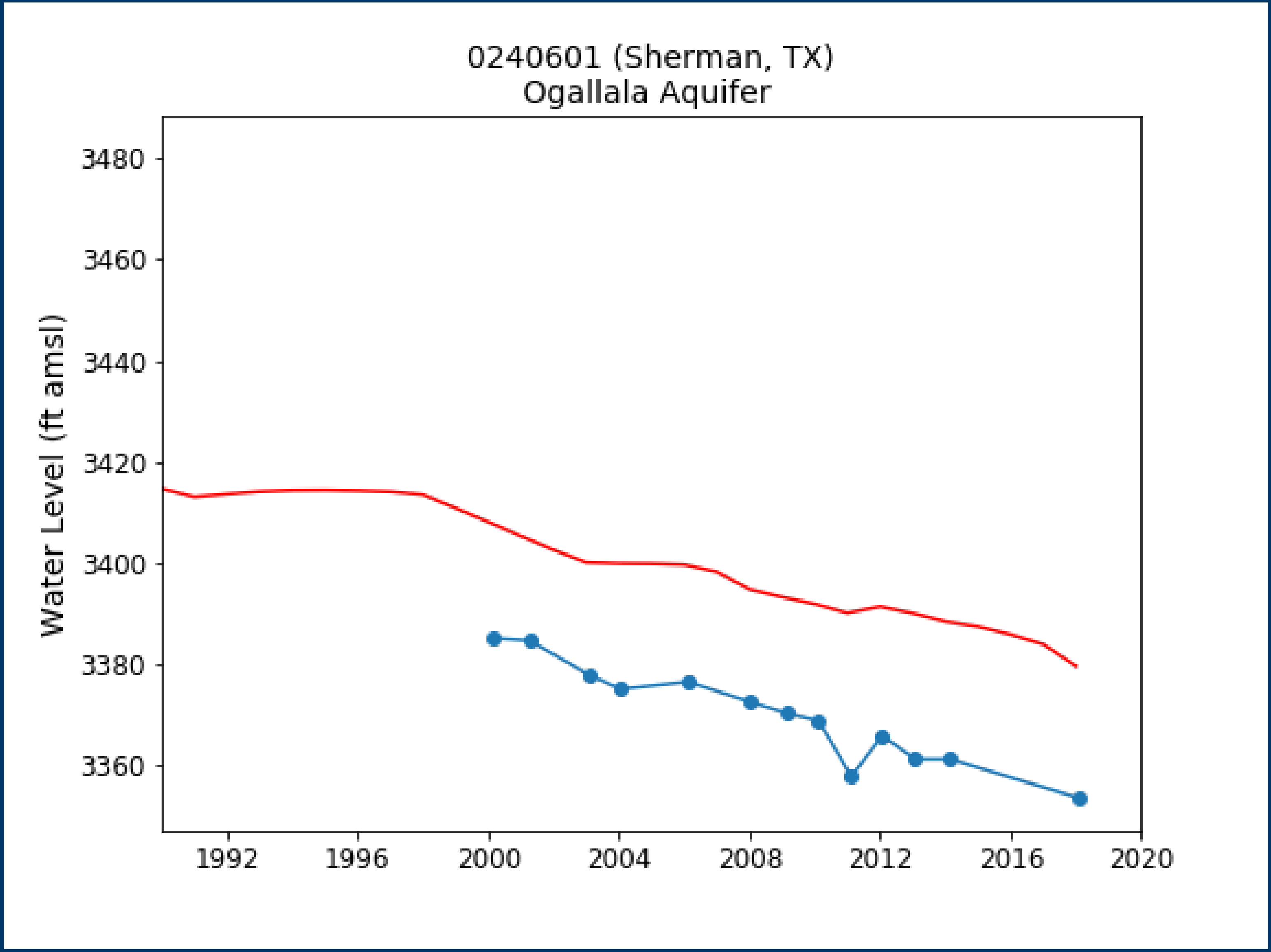
Measured vs. Modeled Water Levels



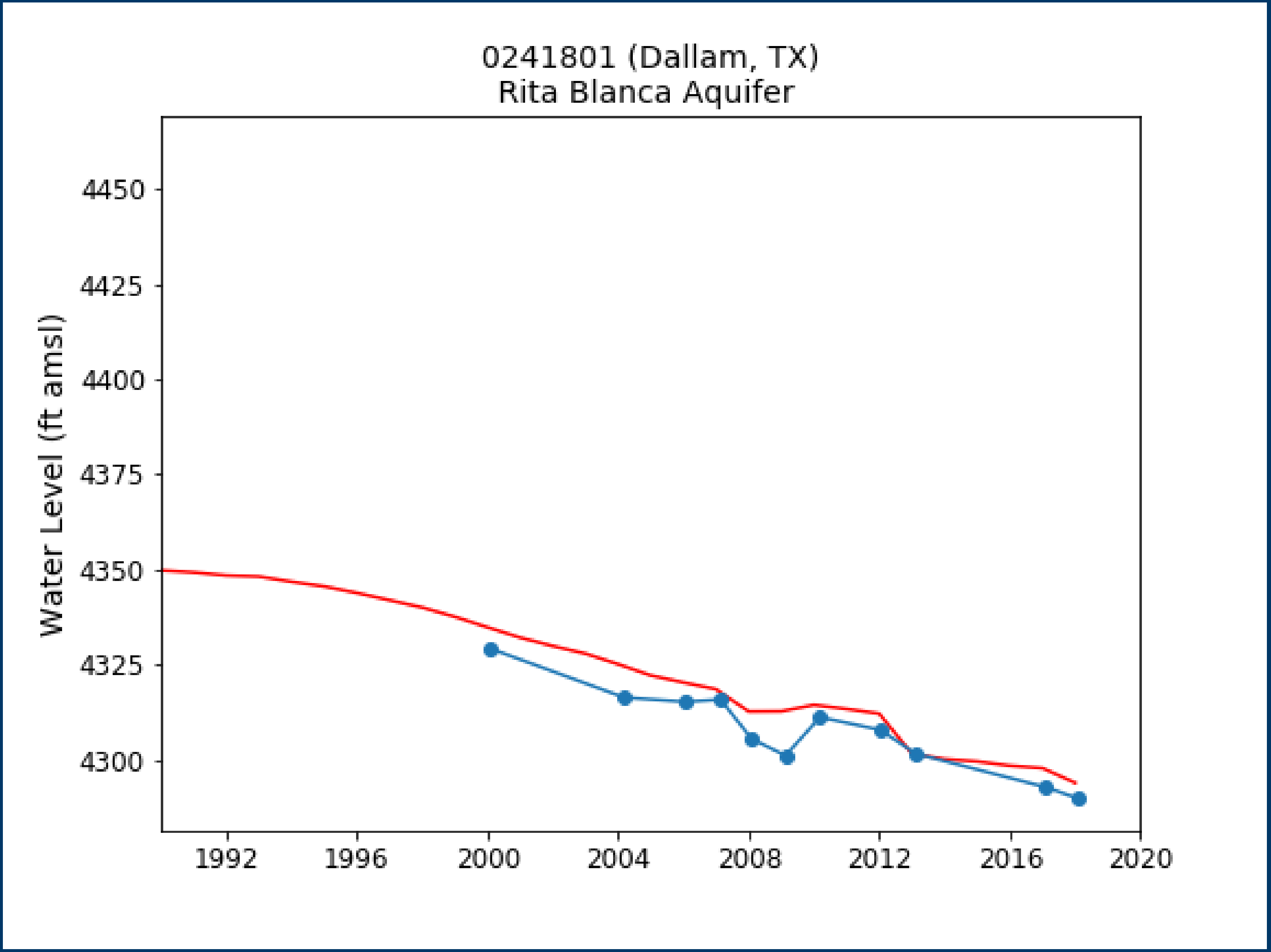
Measured vs. Modeled Water Levels



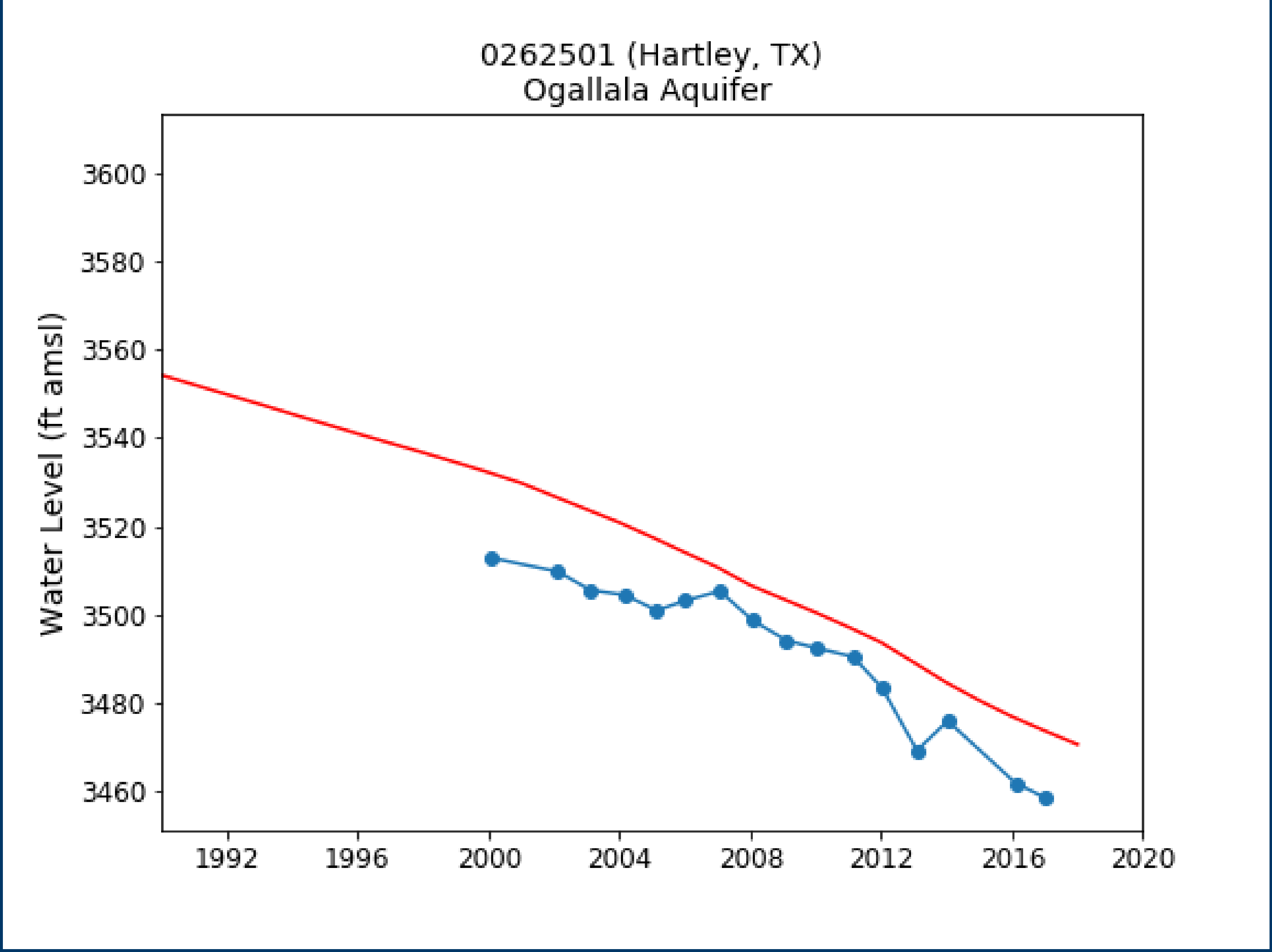
Measured vs. Modeled Water Levels



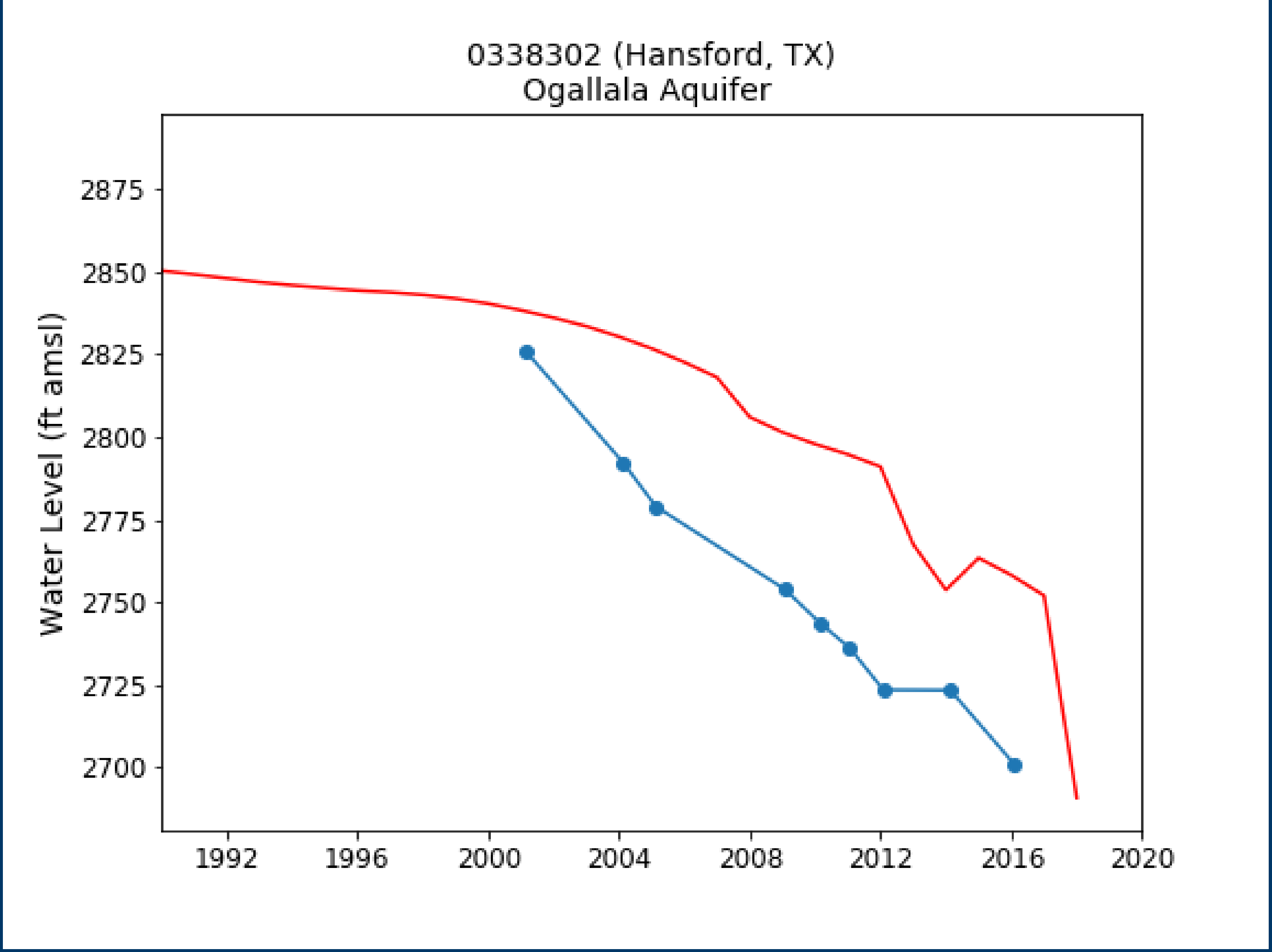
Measured vs. Modeled Water Levels



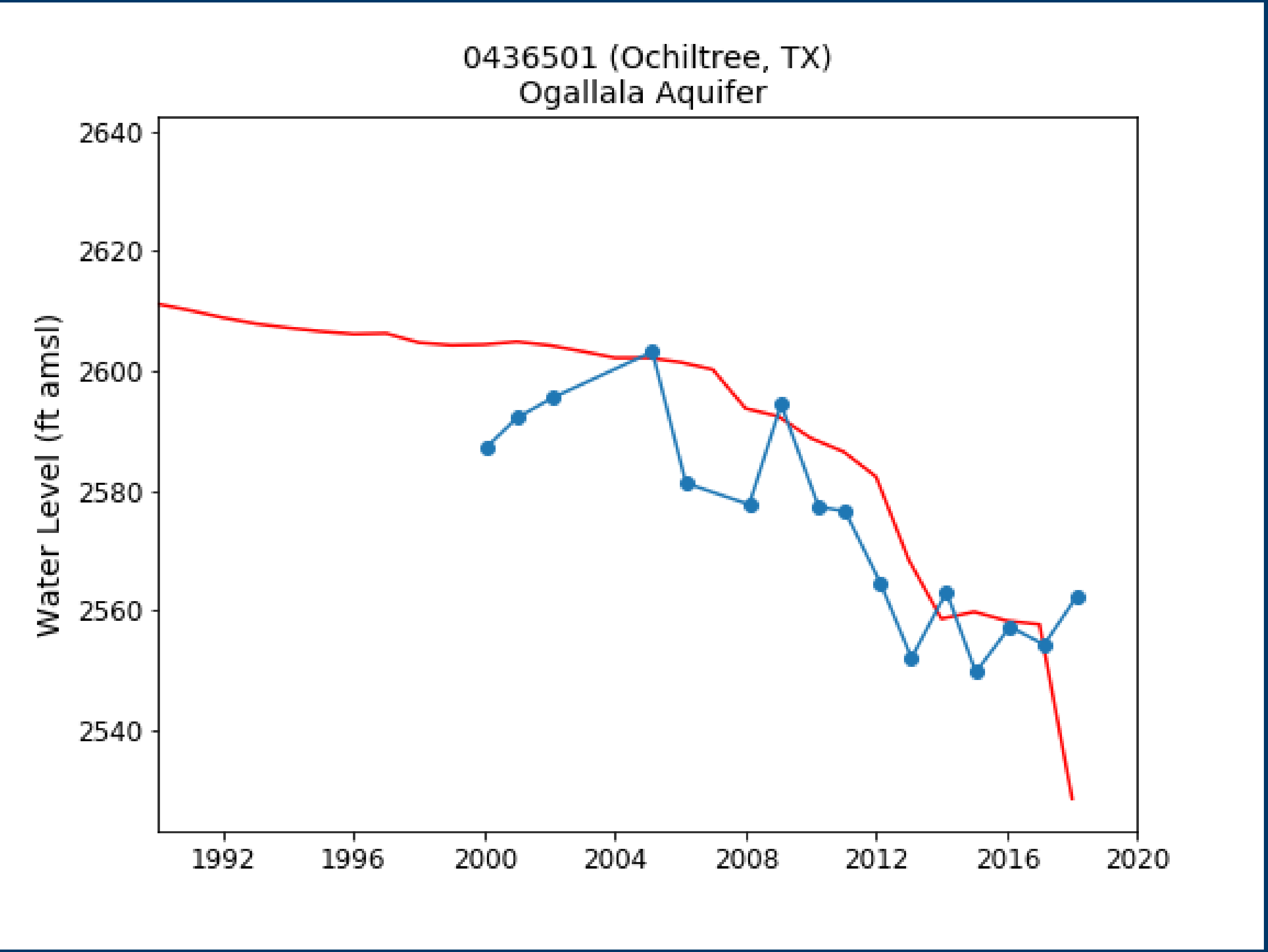
Measured vs. Modeled Water Levels



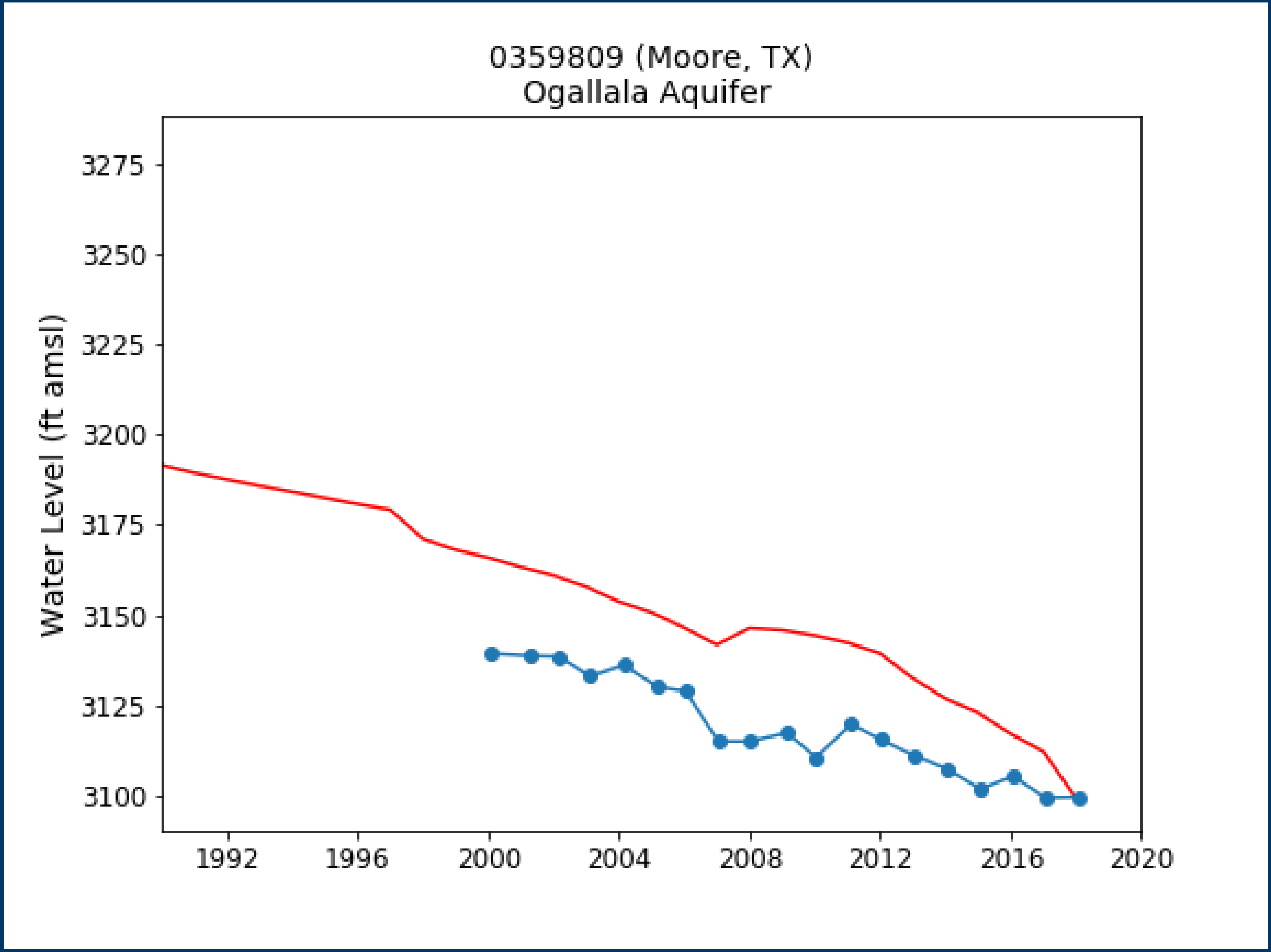
Measured vs. Modeled Water Levels



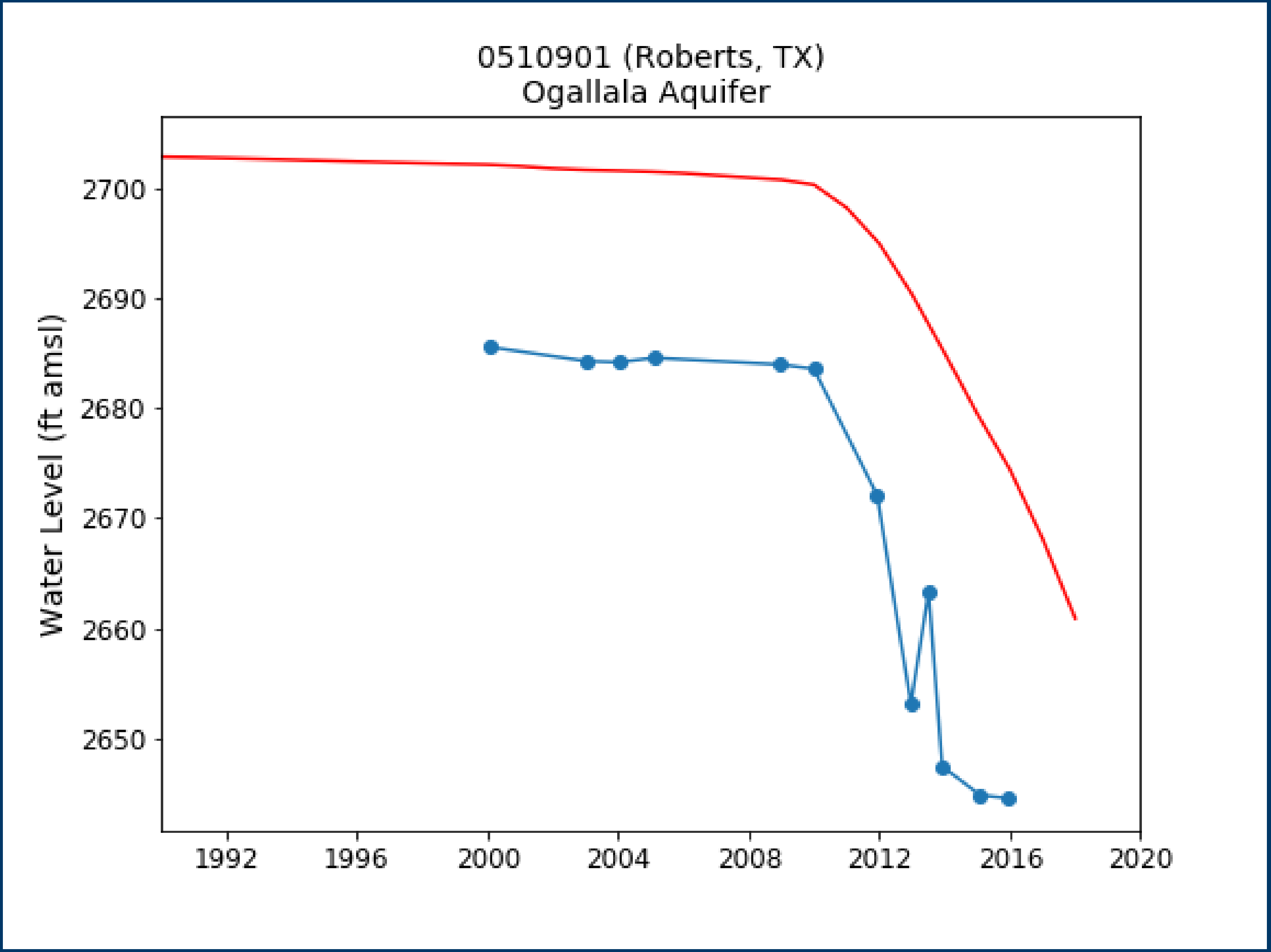
Measured vs. Modeled Water Levels



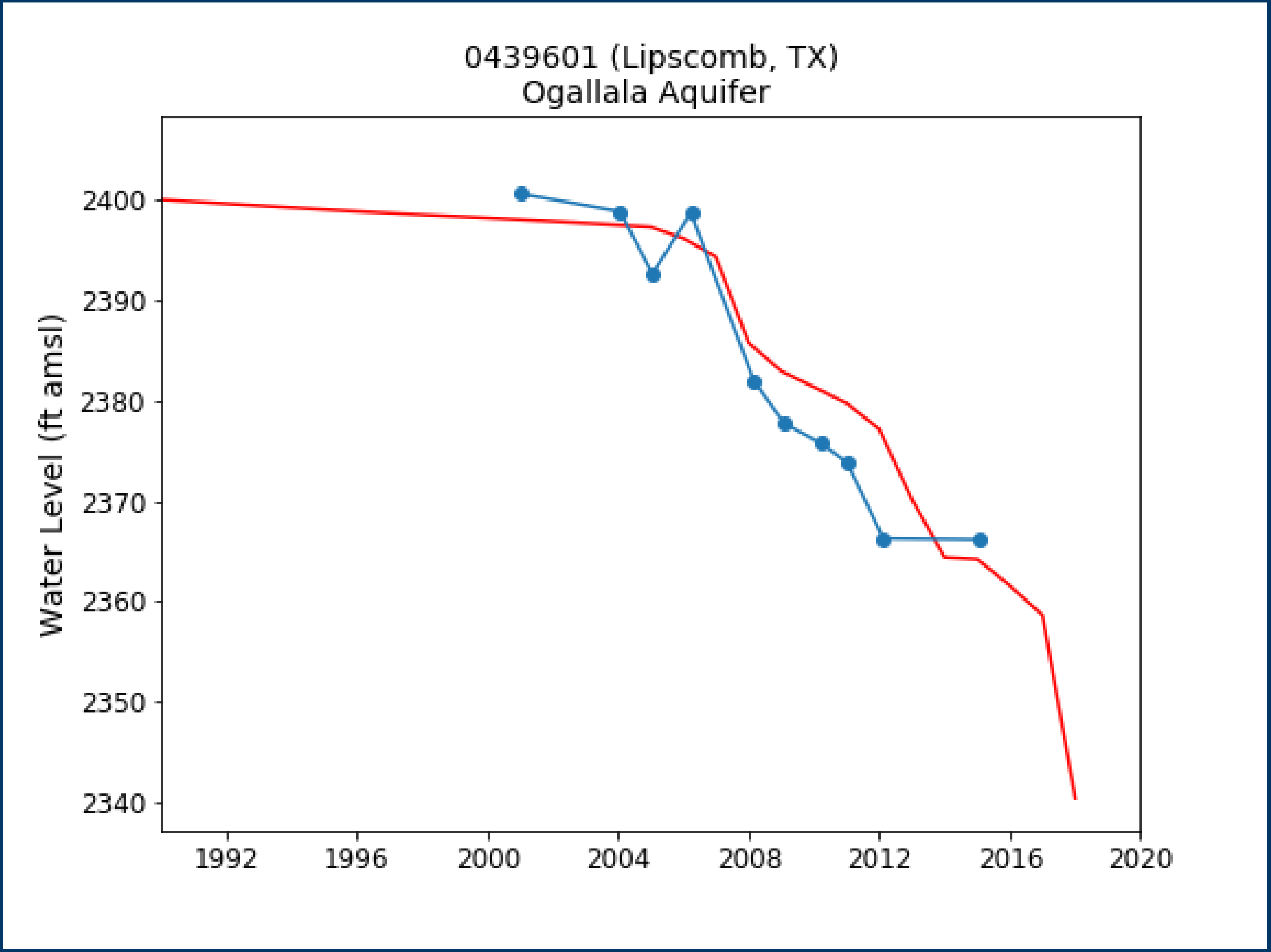
Measured vs. Modeled Water Levels



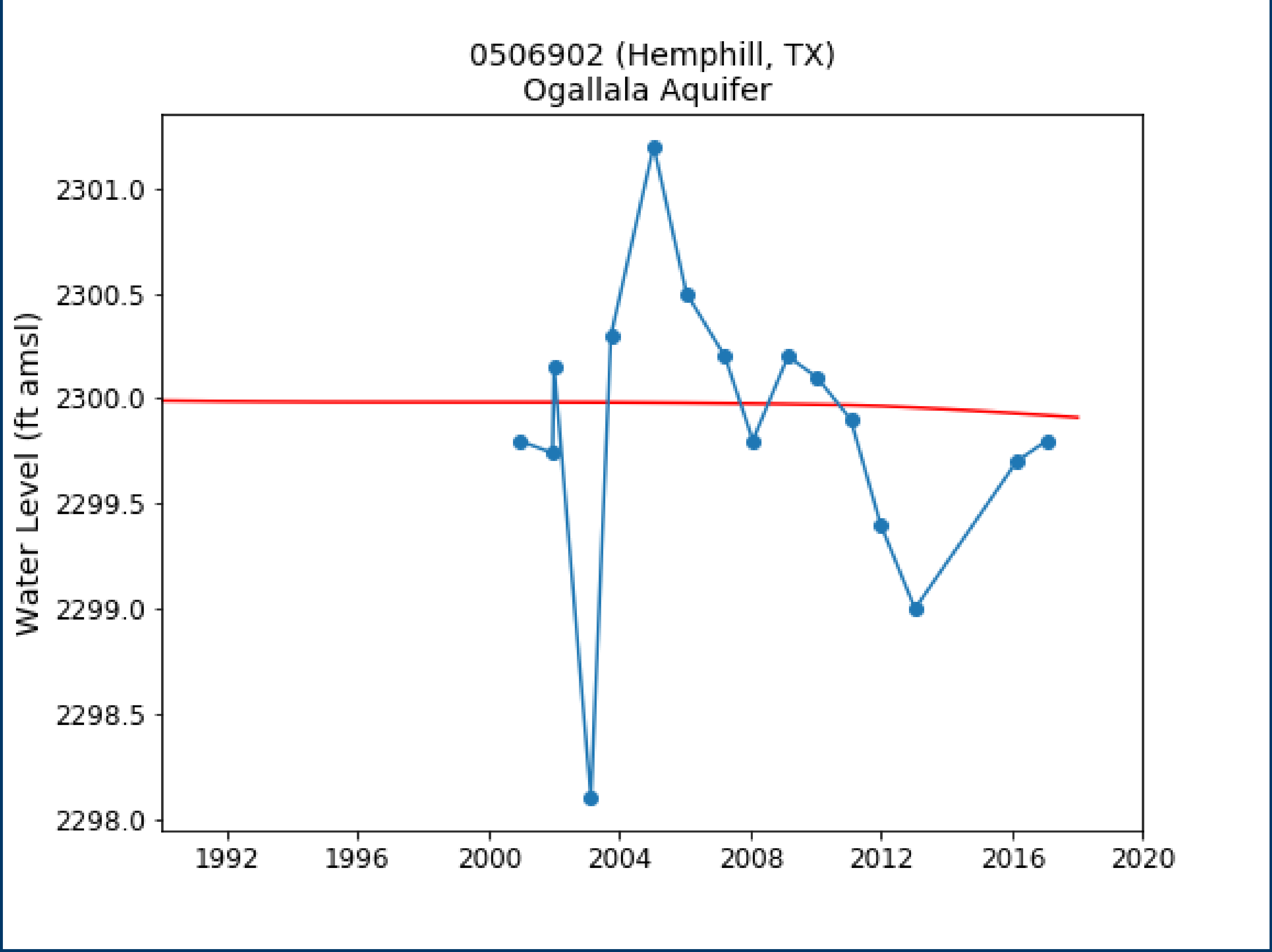
Measured vs. Modeled Water Levels



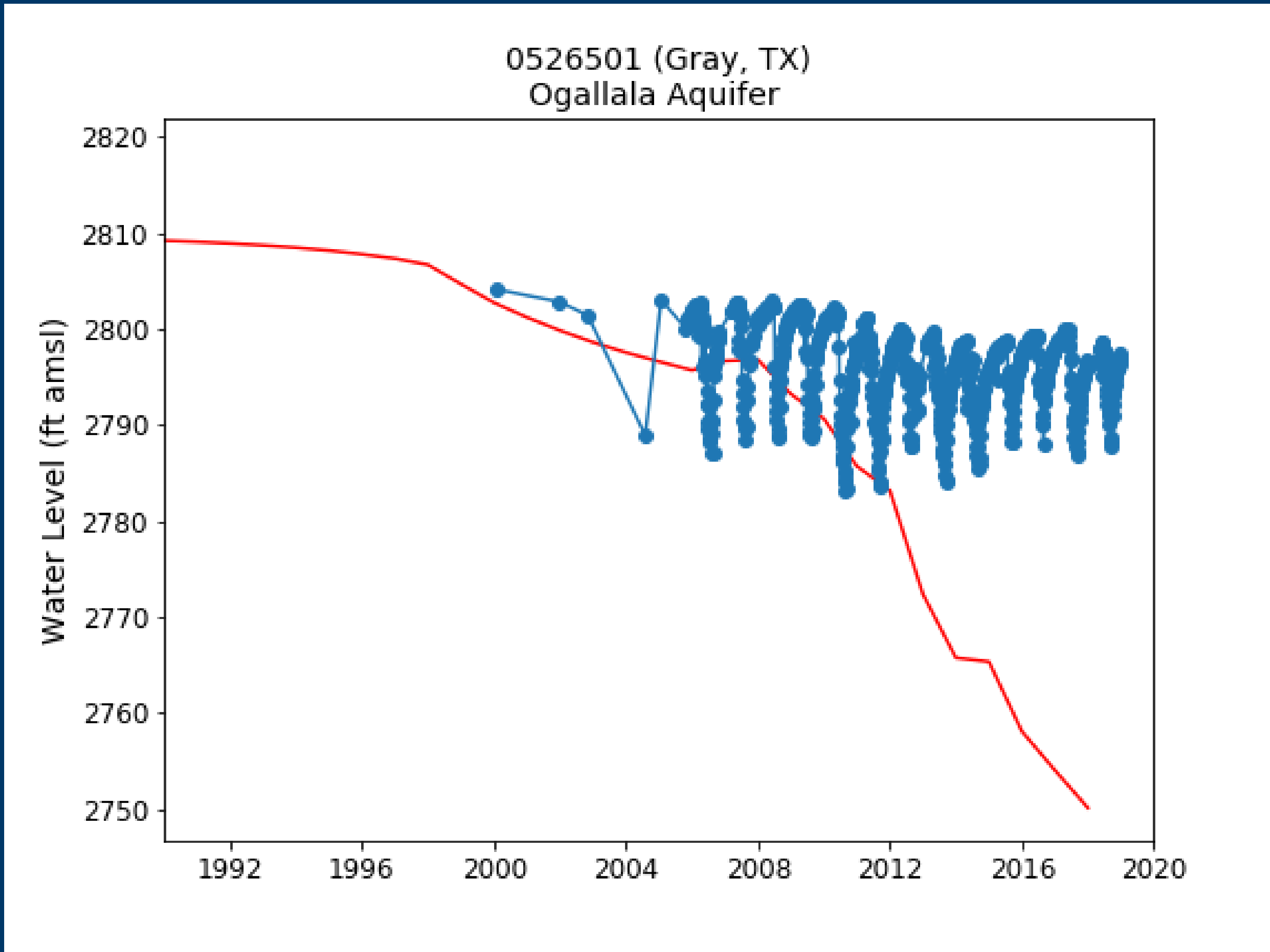
Measured vs. Modeled Water Levels



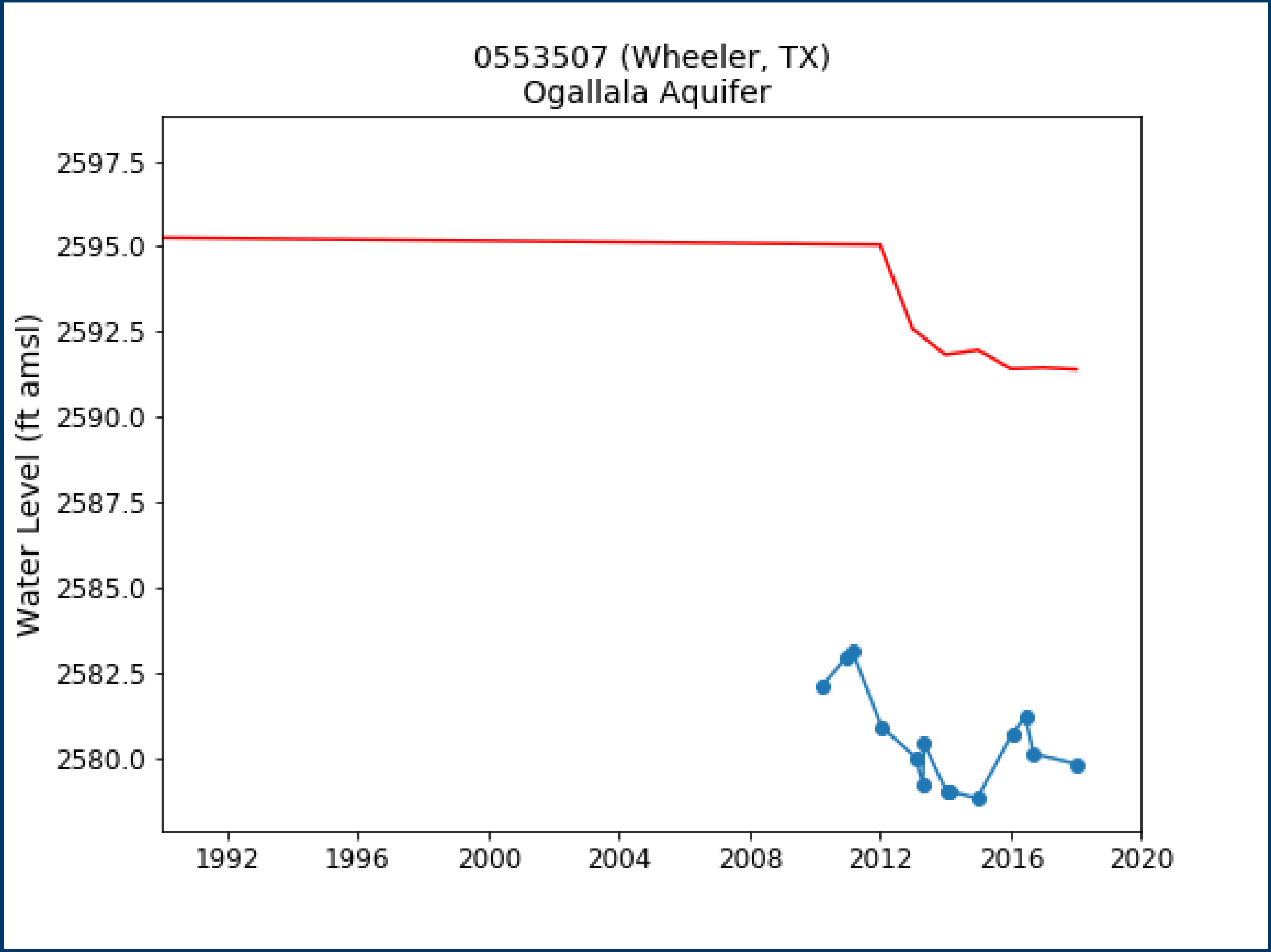
Measured vs. Modeled Water Levels



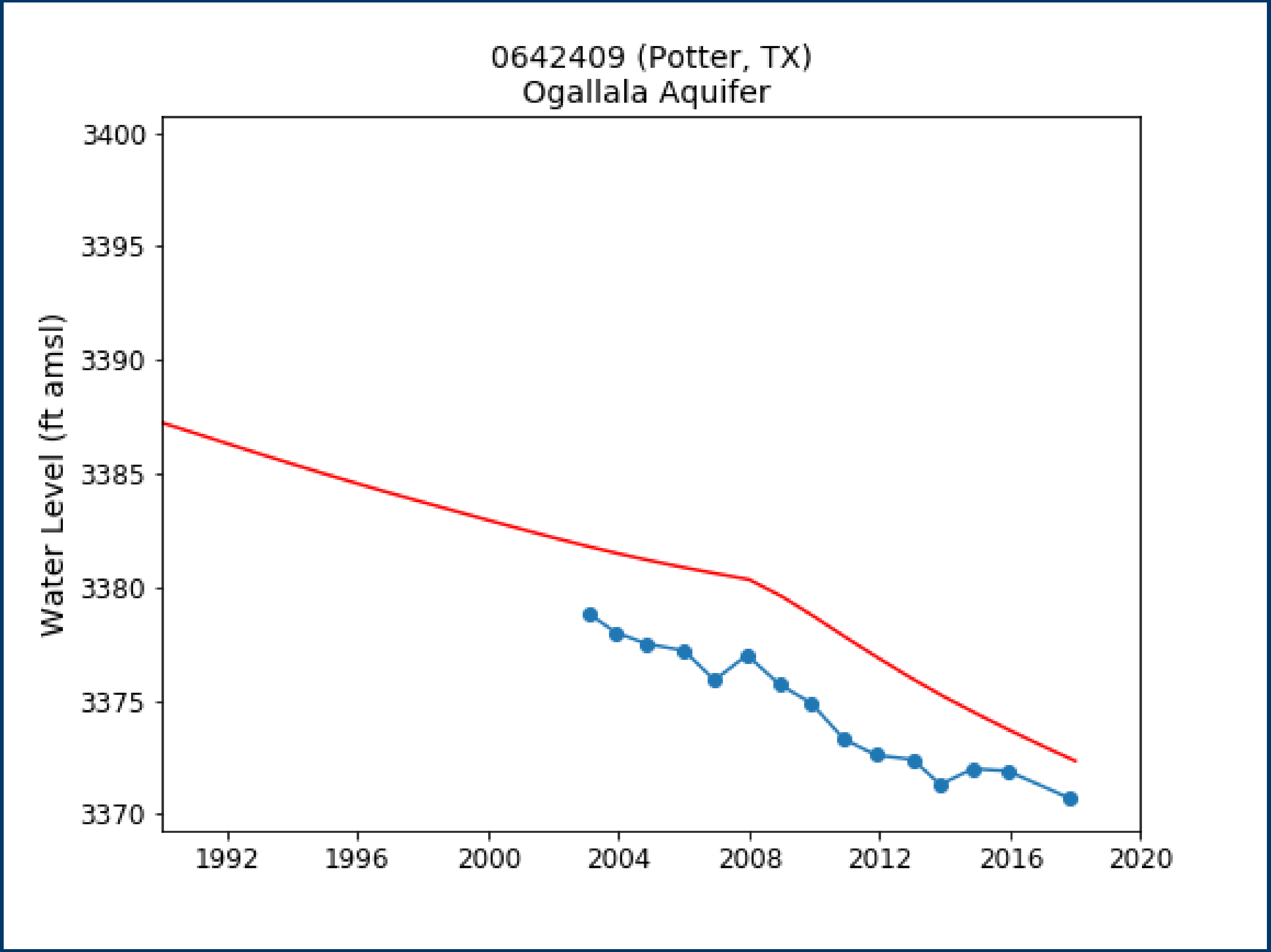
Measured vs. Modeled Water Levels



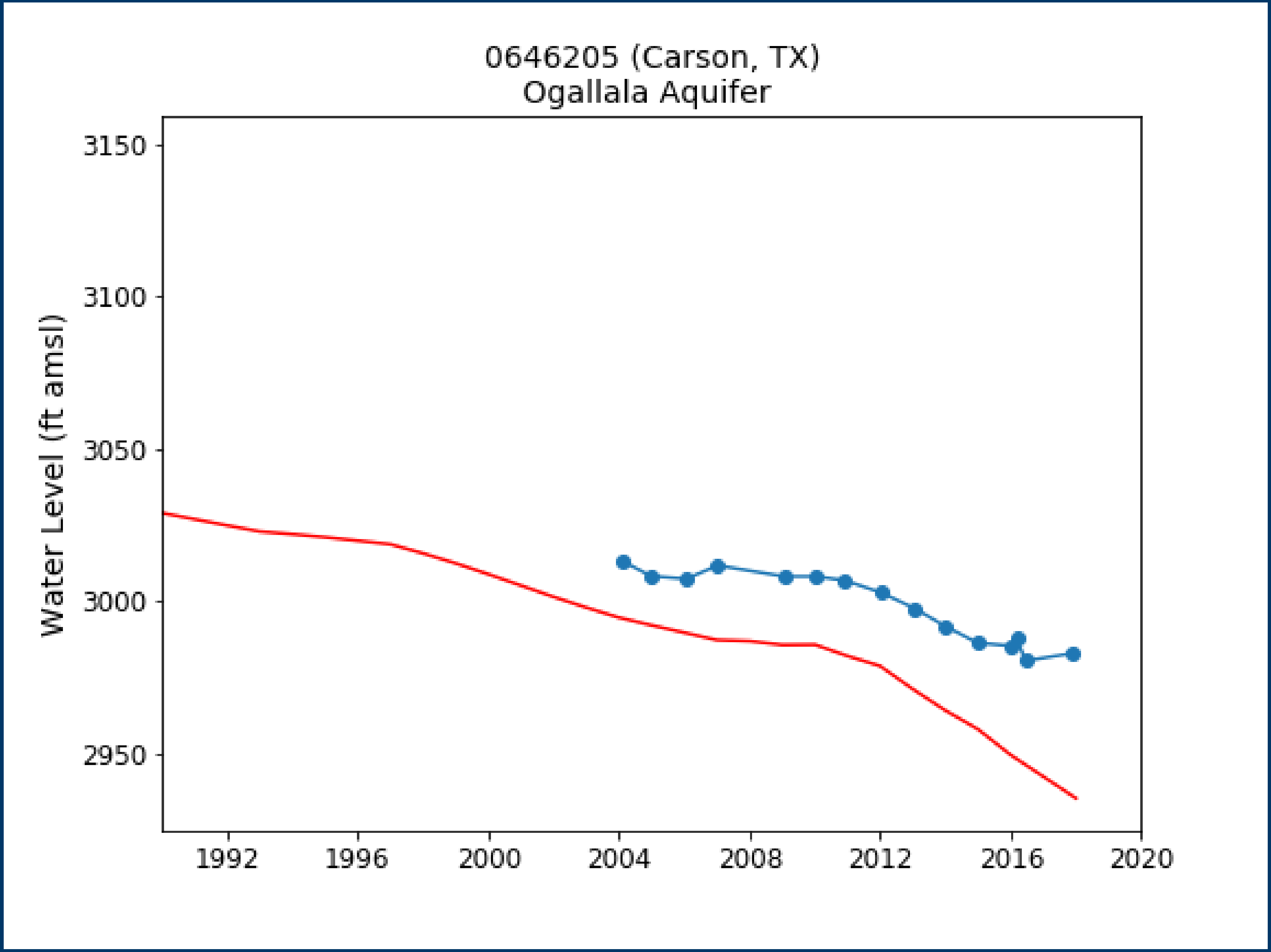
Measured vs. Modeled Water Levels



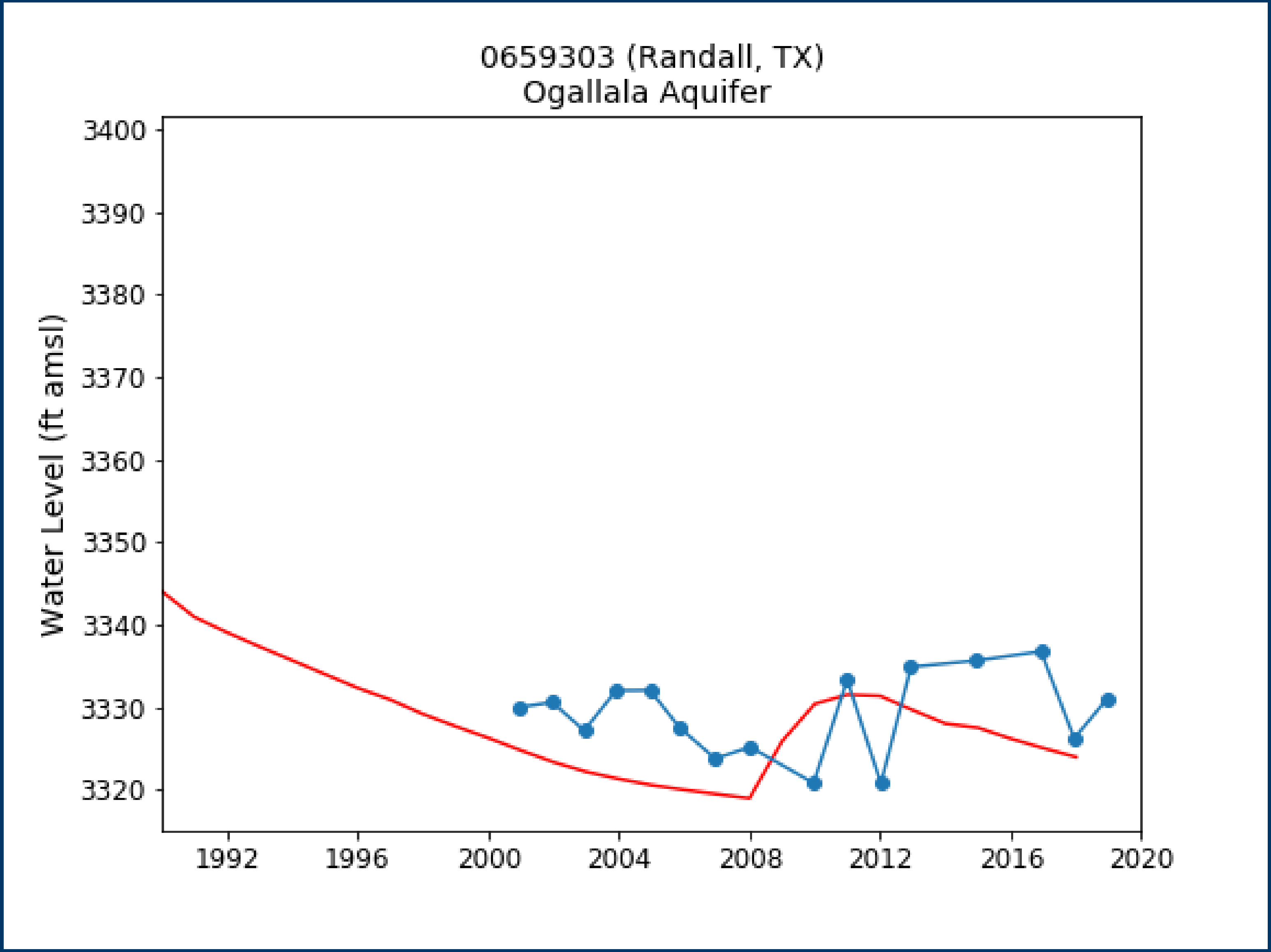
Measured vs. Modeled Water Levels



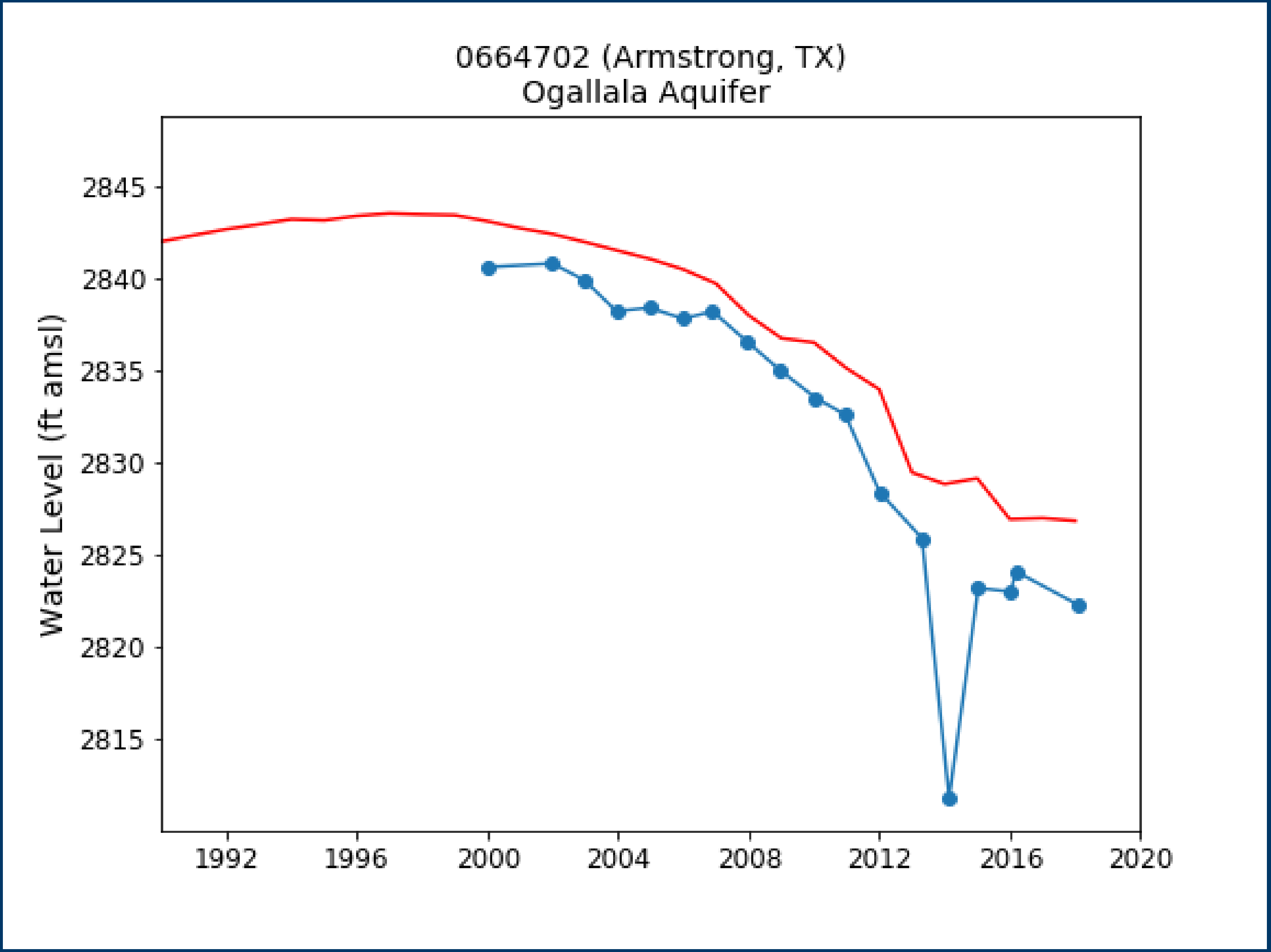
Measured vs. Modeled Water Levels



Measured vs. Modeled Water Levels



Measured vs. Modeled Water Levels



Takeaways from Pumping Update

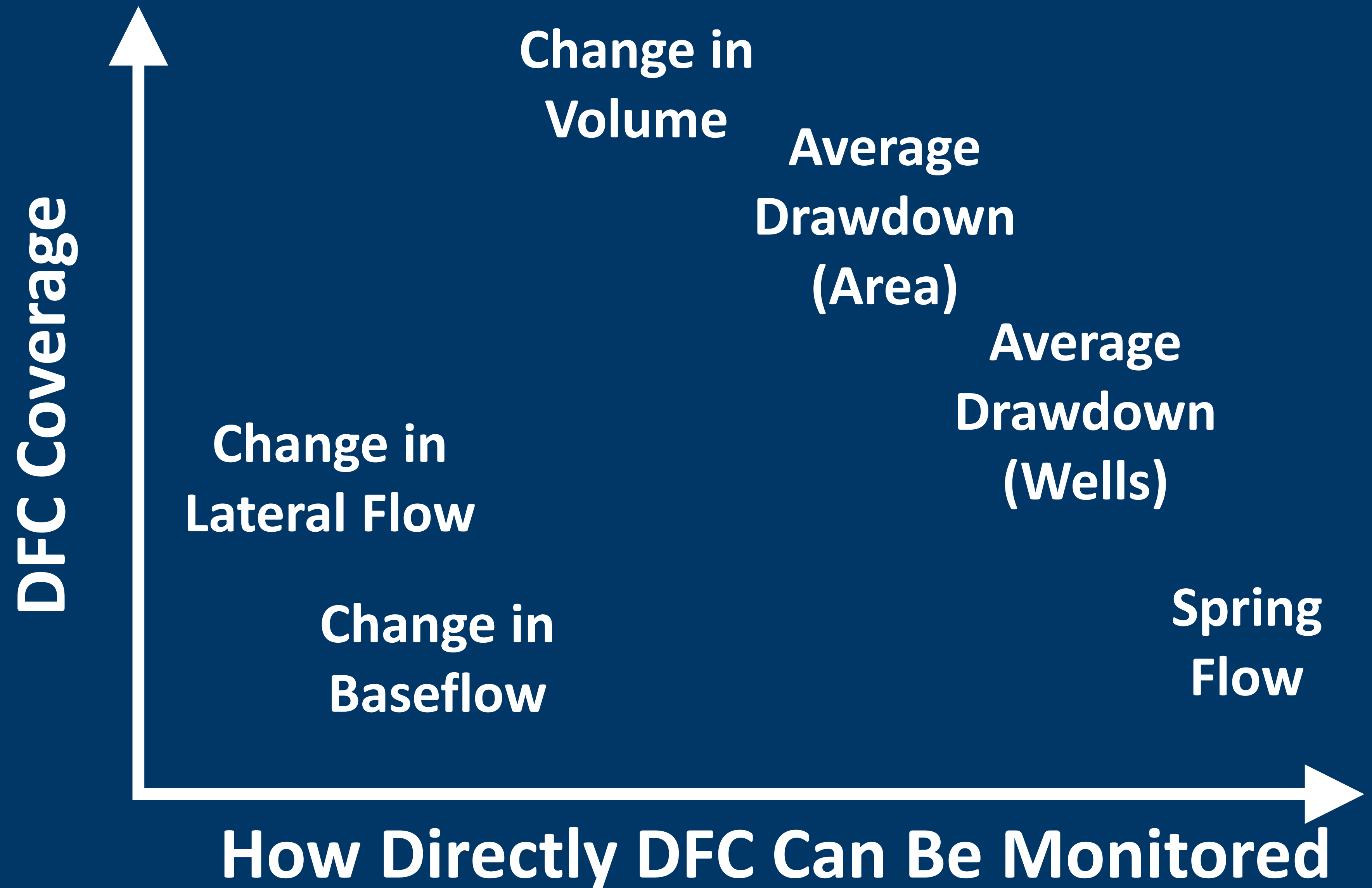
- Reasonably matches water level trends
- Still meets calibration standards
- Ready to use

Agenda Item 8

Selection of model runs scenario(s) and metric(s) for evaluations during the joint planning process

Takeaways from Pumping Update

- Does it capture the limiting factor on groundwater availability? ⟵ **Metric**
- How robust is the dataset for the base year? ⟵ **Time Period**
- Do I have the necessary access to monitor? Or do I need to rely on access and assistance outside the District? ⟵ **Scale**
- How directly can the DFC be monitored? ⟵ **Objectivity**


DFC Coverage
Change in Volume
Average Drawdown (Area)
Average Drawdown (Wells)
Change in Lateral Flow
Change in Baseflow
Spring Flow
How Directly DFC Can Be Monitored

Current DFCs

County	Aquifer	Desired Future Condition (DFC)	Date DFC Adopted
Dallam Hartley Moore Sherman	Ogallala and Rita Blanca	At least 40 percent of volume in storage remaining in 50 years, for the period 2012-2062 collectively in Dallam, Hartley, Moore, and Sherman counties.	11/2/2016
Hansford Lipscomb Ochiltree Hutchinson (partial)	Ogallala and Rita Blanca	At least 50 percent of volume in storage remaining in 50 years, for the period 2012-2062 collectively in Hansford, Lipscomb, and Ochiltree counties and that portion of Hutchinson County within North Plains GCD.	11/2/2016
Carson Donley Gray Hutchinson Oldham Roberts Wheeler Armstrong (partial) Potter (partial)	Ogallala and Rita Blanca	At least 50 percent of volume in storage remaining in 50 years, for the period 2012-2062 in Carson, Donley, Gray, Hutchinson, Oldham, Roberts, and Wheeler counties; and portions of Armstrong and Potter counties within the Panhandle GCD.	11/2/2016
Hemphill	Ogallala and Rita Blanca	At least 80 percent of volume in storage remaining in 50 years for the period 2012-2062, within the Hemphill County.	11/2/2016
Randall Armstrong (partial) Potter (partial)	Ogallala and Rita Blanca	Approximately 20 feet of total average drawdown in 50 years for the period 2012-2062, collectively in Randall County and in Armstrong and Potter counties within the High Plains UWCD.	11/2/2016

Current DFCs

County	Aquifer	Desired Future Condition (DFC)	Date DFC Adopted
Dallam Hartley Moore Sherman	Dockum	At least 40 percent of the available drawdown remaining in 50 years for the period 2012-2062 collectively for Dallam, Hartley, Moore, and Sherman counties.	11/2/2016
Carson Oldham Armstrong (partial) Potter (partial)	Dockum	No more than 30 feet average decline in water levels in 50 years for the period 2012-2062 collectively in Carson and Oldham counties and in Armstrong and Potter counties within the Panhandle GCD.	11/2/2016
Randall Armstrong (partial) Potter (partial)	Dockum	The total average drawdown is approximately 40 feet in 50 years for the period 2012-2062, collectively in Randall county, and in Armstrong and Potter counties within the High Plains UWCD.	11/2/2016

Total Estimated Recoverable Storage – The estimated amount of groundwater within an aquifer that accounts for recovery scenarios that range between 25% and 75% of the porosity-adjusted aquifer volume

Texas Administrative Code Sec. 356.10

Depletion from Pre-Development

	Pre-Development (acre-feet)	2012 (TERS Report)	2018 (Pumping Update)	2012 Remaining from Pre-Development	2018 Remaining from Pre-Development
Armstrong	5,299,690	4,588,232	4,487,224	87%	85%
Carson	21,082,662	14,900,640	13,609,118	71%	65%
Dallam	28,434,183	14,675,683	11,851,670	52%	42%
Donley	5,002,631	4,374,067	4,094,426	87%	82%
Gray	15,098,100	13,723,363	13,265,959	91%	88%
Hansford	31,316,920	24,114,692	21,701,535	77%	69%
Hartley	28,892,108	17,017,453	13,190,837	59%	46%
Hemphill	15,670,373	15,435,360	15,318,250	99%	98%
Hutchinson	14,746,579	11,098,053	10,096,362	75%	68%
Lipscomb	18,899,169	17,979,129	17,384,032	95%	92%
Moore	19,282,780	10,023,770	7,520,454	52%	39%
Ochiltree	24,295,050	20,598,632	19,460,775	85%	80%
Oldham	2,996,146	2,032,524	1,982,429	68%	66%
Potter	3,058,894	1,940,371	1,843,316	63%	60%
Randall	8,719,558	4,837,328	4,567,300	55%	52%
Roberts	30,988,005	29,922,236	29,038,083	97%	94%
Sherman	31,205,594	17,983,746	13,998,307	58%	45%
Wheeler	7,237,931	7,044,147	6,898,596	97%	95%
Hemphill County UWCD	15,670,373	15,435,360	15,318,250	99%	98%
High Plains UWCD No.1	6,218,637	3,073,831	2,893,016	49%	47%
North Plains GCD	189,564,049	127,275,644	109,261,256	67%	58%
Panhandle GCD	87,669,476	76,866,570	73,617,313	88%	84%
GMA1 Total	312,226,373	232,289,425	210,308,673	74%	67%

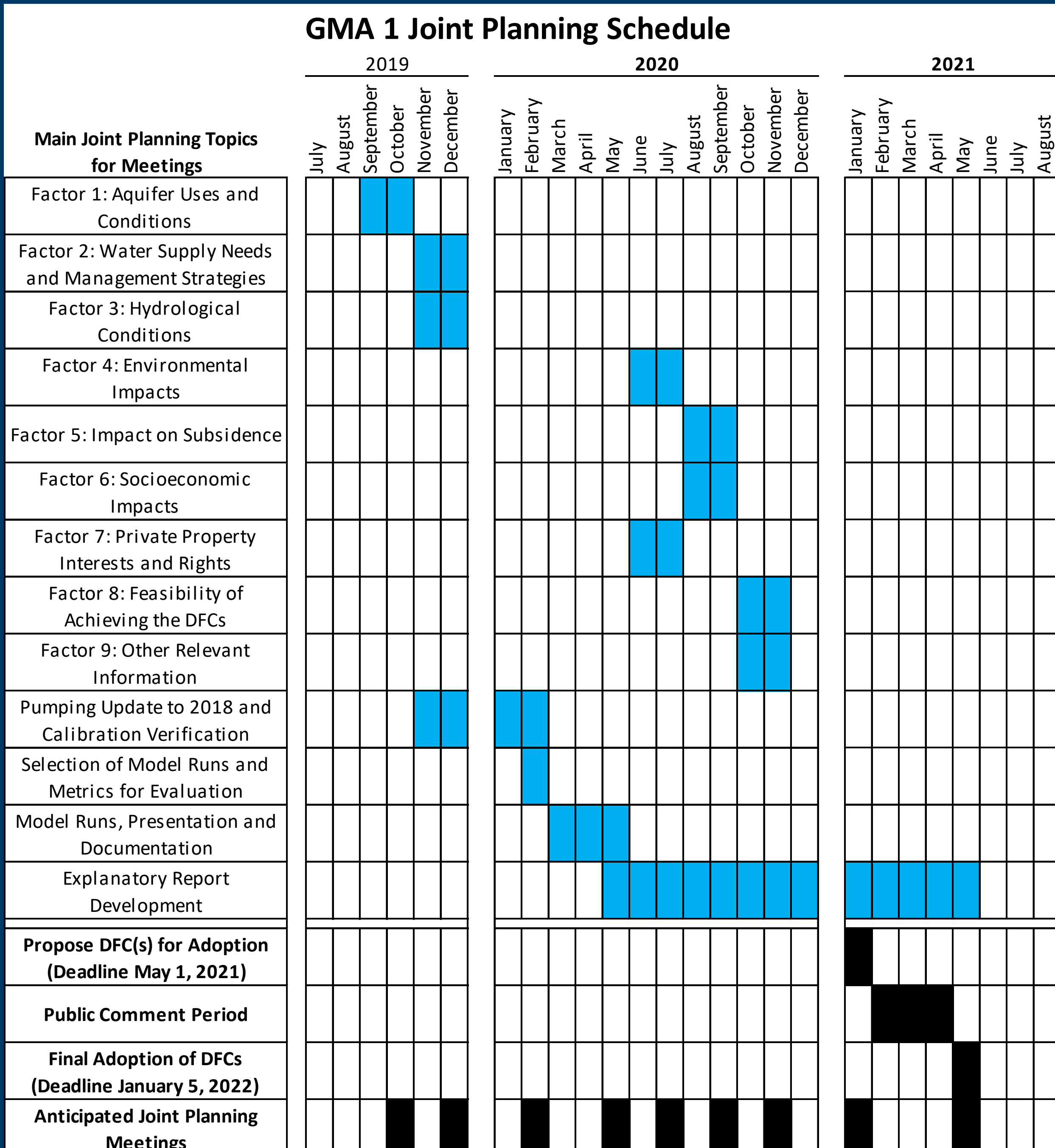
Depletion from Pre-Development

	Pre-Development (acre-feet)	2012 Remaining from Pre-Development	2018 Remaining from Pre-Development
Hemphill County UWCD	15,670,373	99%	98%
High Plains UWCD No.1	6,218,637	49%	47%
North Plains GCD	189,564,049	67%	58%
Panhandle GCD	87,669,476	88%	84%
GMA1 Total	312,226,373	74%	67%

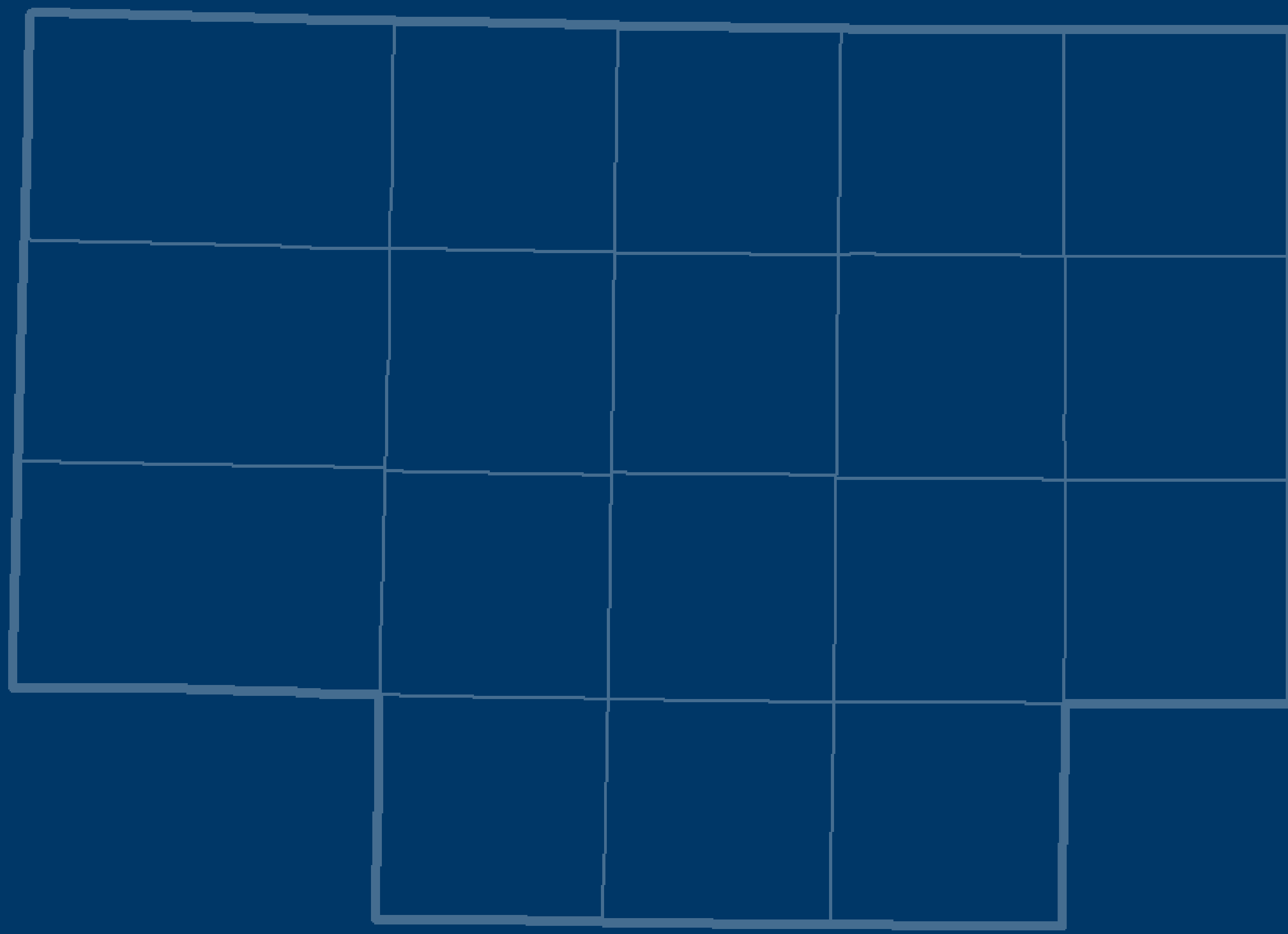
Discussion on Selecting Model Run Scenarios

- Current budget includes evaluation of 2 scenarios
- Potential Paths Forward
  - Go back to boards and discuss run options for next meeting
  - Propose one model run to evaluate and discuss at next meeting – then propose another, if necessary, based on board feedback and model results
  - Propose two model runs to evaluate and discuss at next meeting

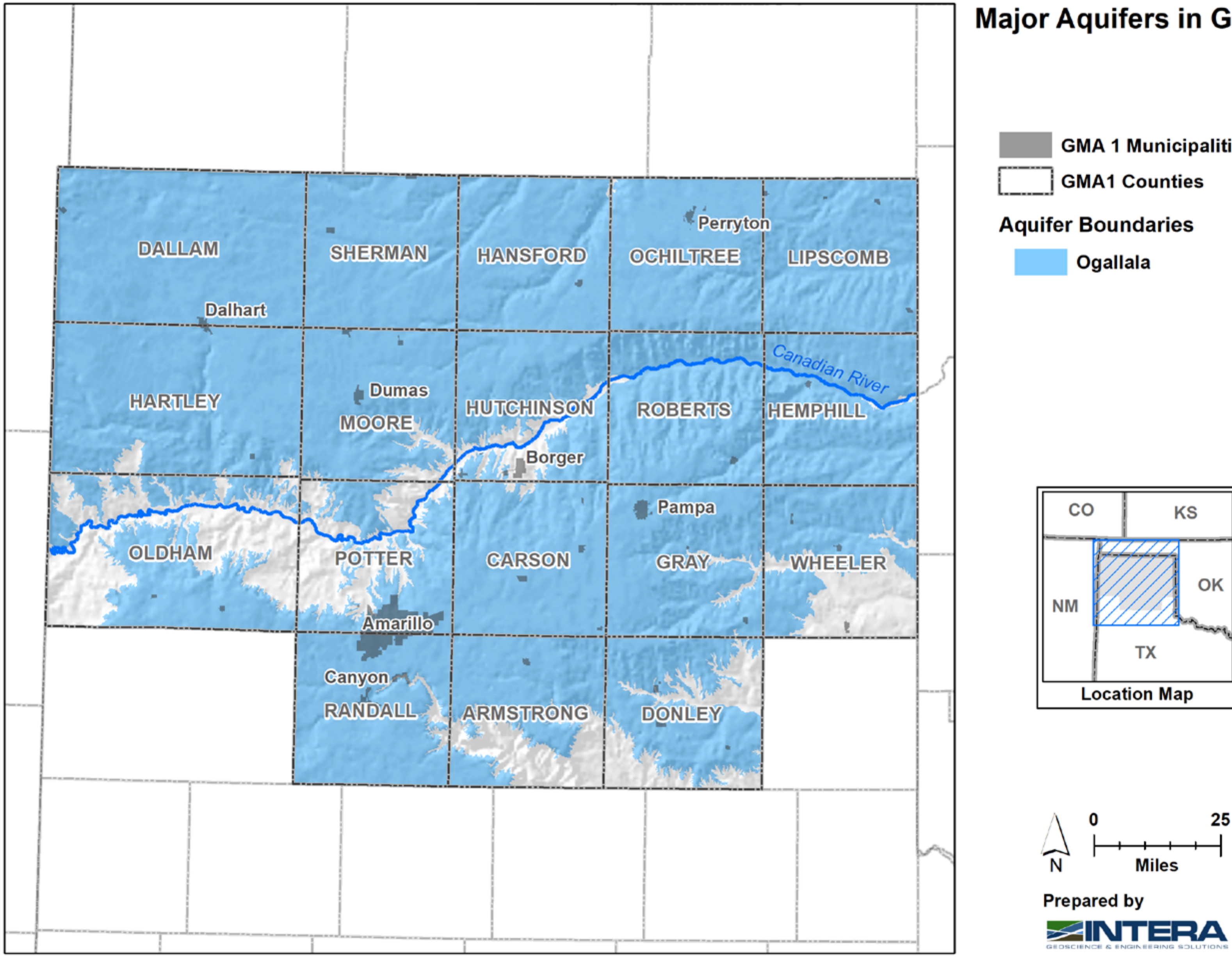
Current Schedule



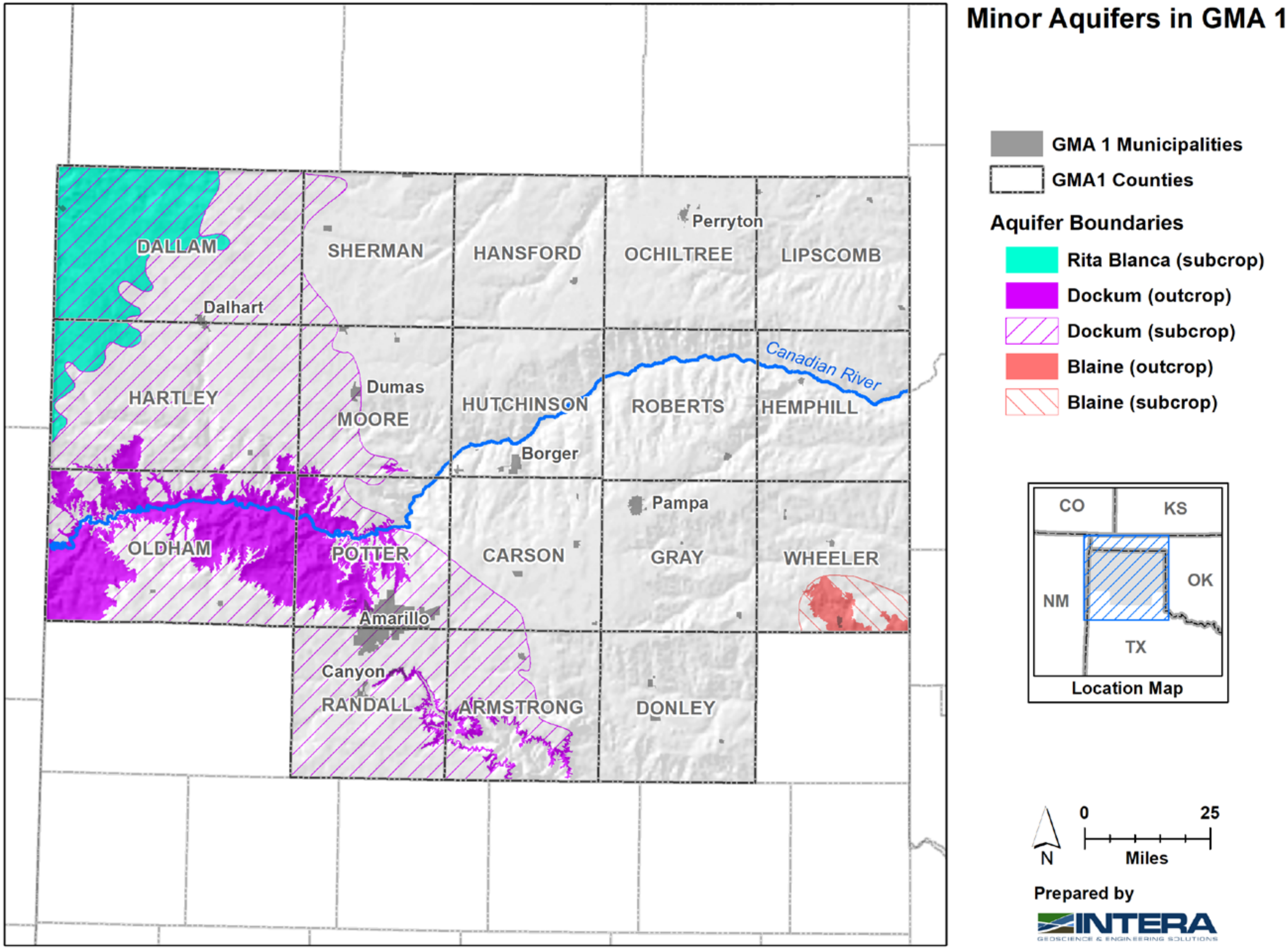
Aquifer Reference Slides



Major Aquifers in GMA 1



Minor Aquifers in GMA 1



High Plains Aquifer System GAM Scenario Results

A Presentation to GMA 1
Joint Planning Group

June 25, 2020

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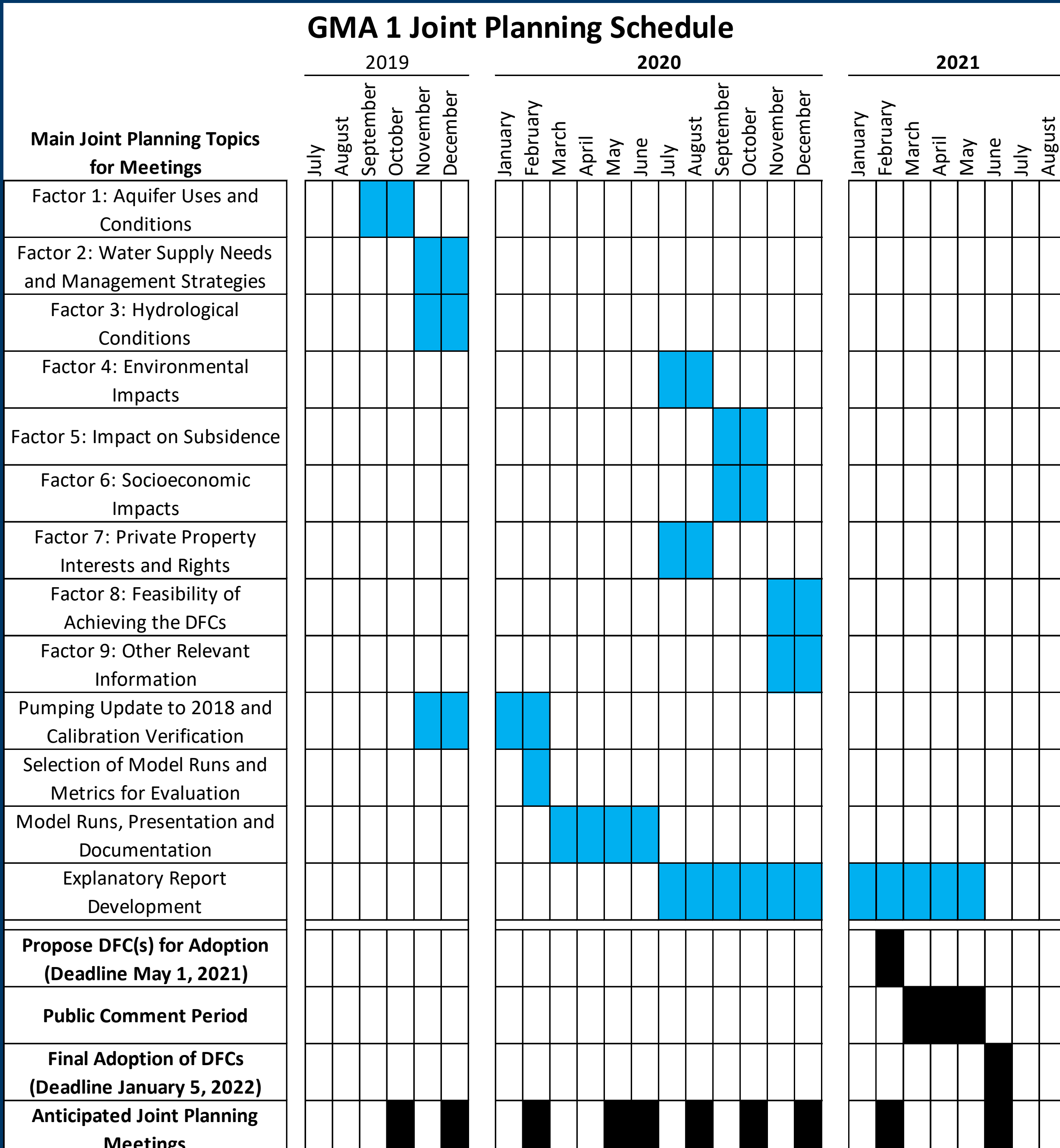
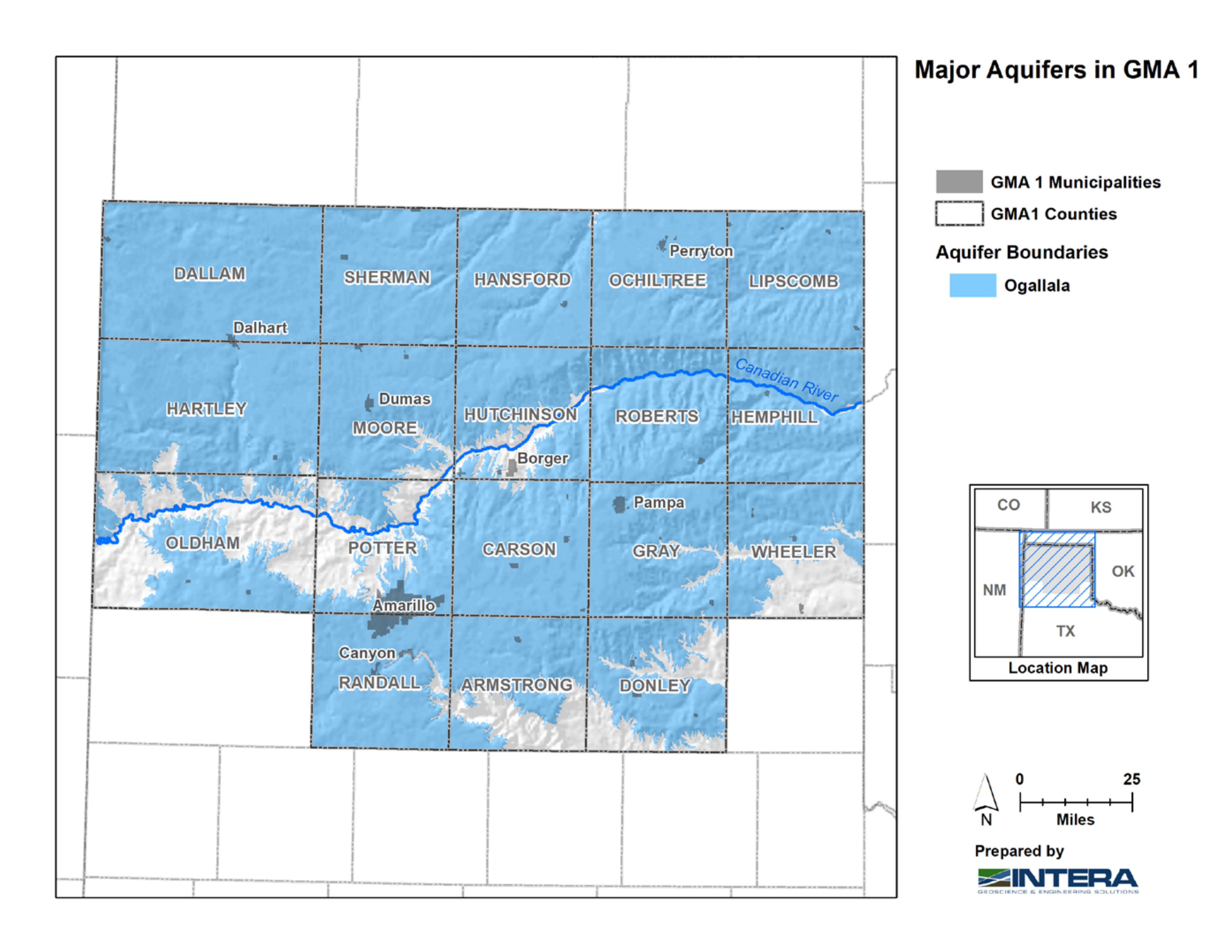


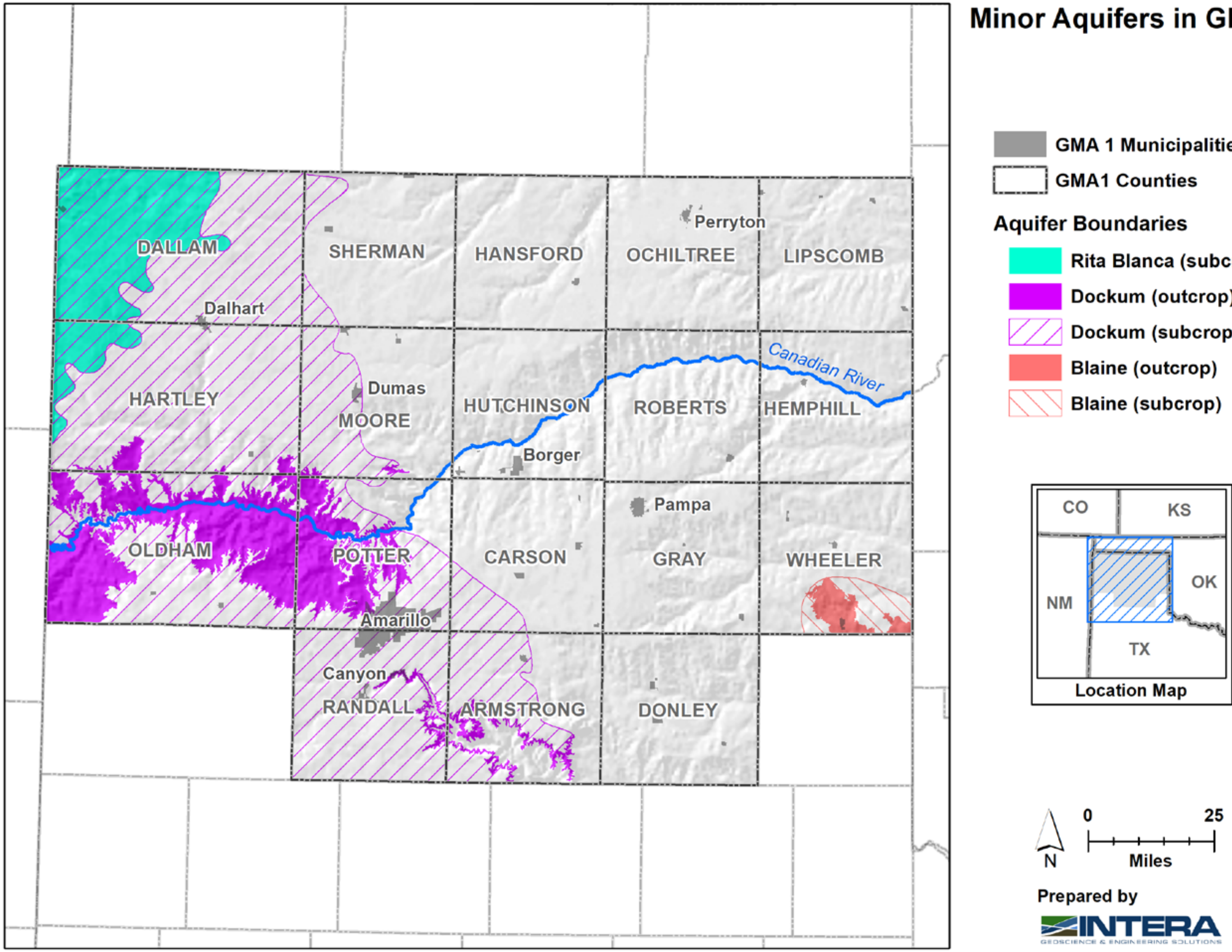
Updated Schedule

- Can adjust schedule for additional run
- Has buffer prior to May 1, 2021 deadline for proposing DFC(s)
- Can consolidate remaining factors into 2 meetings instead of 3
- TWDB RWP request relates to final adoption of DFC(s) (Deadline 1/5/2022)



Major Aquifers in GMA 1
GMA 1 Municipalities
GMA1 Counties
Aquifer Boundaries
Ogallala
DALLAM
SHERMAN
HANSFORD
OCHILTREE
LIPSCOMB
Perryton
Dalhart
HARTLEY
Dumas
MOORE
HUTCHINSON
ROBERTS
HEMPHILL
Canadian River
Borger
OLDHAM
POTTER
CARSON
Pampa
GRAY
WHEELER
Amarillo
Canyon
RANDALL
ARMSTRONG
DONLEY
CO
KS
NM
OK
TX
Location Map
N
0
25
Miles
Prepared by
INTERA

Minor Aquifers in GMA 1



Description of Run Request – Ogallala/Rita Blanca Aquifers

- Dallam, Hartley, Moore and Sherman counties
  - At least 40 percent of the volume in storage remaining for each 50 year period between 2018 and 2080
- Hemphill County
  - At least 80 percent of the volume in storage remaining for each 50 year period between 2018 and 2080
- High Plains UWCD No. 1 within GMA 1
  - 20 feet average drawdown for each 50 year period between 2012 and 2080
- All Other Areas
  - At least 50 percent of the volume in storage remaining for each 50 year period between 2018 and 2080

Description of Run Request – Dockum Aquifer

- Dallam, Hartley, Moore and Sherman counties
  - At least 40 percent available drawdown remaining for each 50 year period between 2018 and 2080
- Oldham and PGCD portion of Potter, Carson and Armstrong counties
  - No more than 30 feet average water level decline for each 50 year period between 2018 and 2080
- Randall and HPWD portion of Armstrong and Potter counties
  - No more than 40 feet average water level decline for each 50 year period between 2012 and 2080

Difference Between DFC Structures

$$Volume = Volume\ Target^{\frac{Year - Base\ Year}{Duration}}$$

For example, for a 50 percent remaining over each 50-year interval:

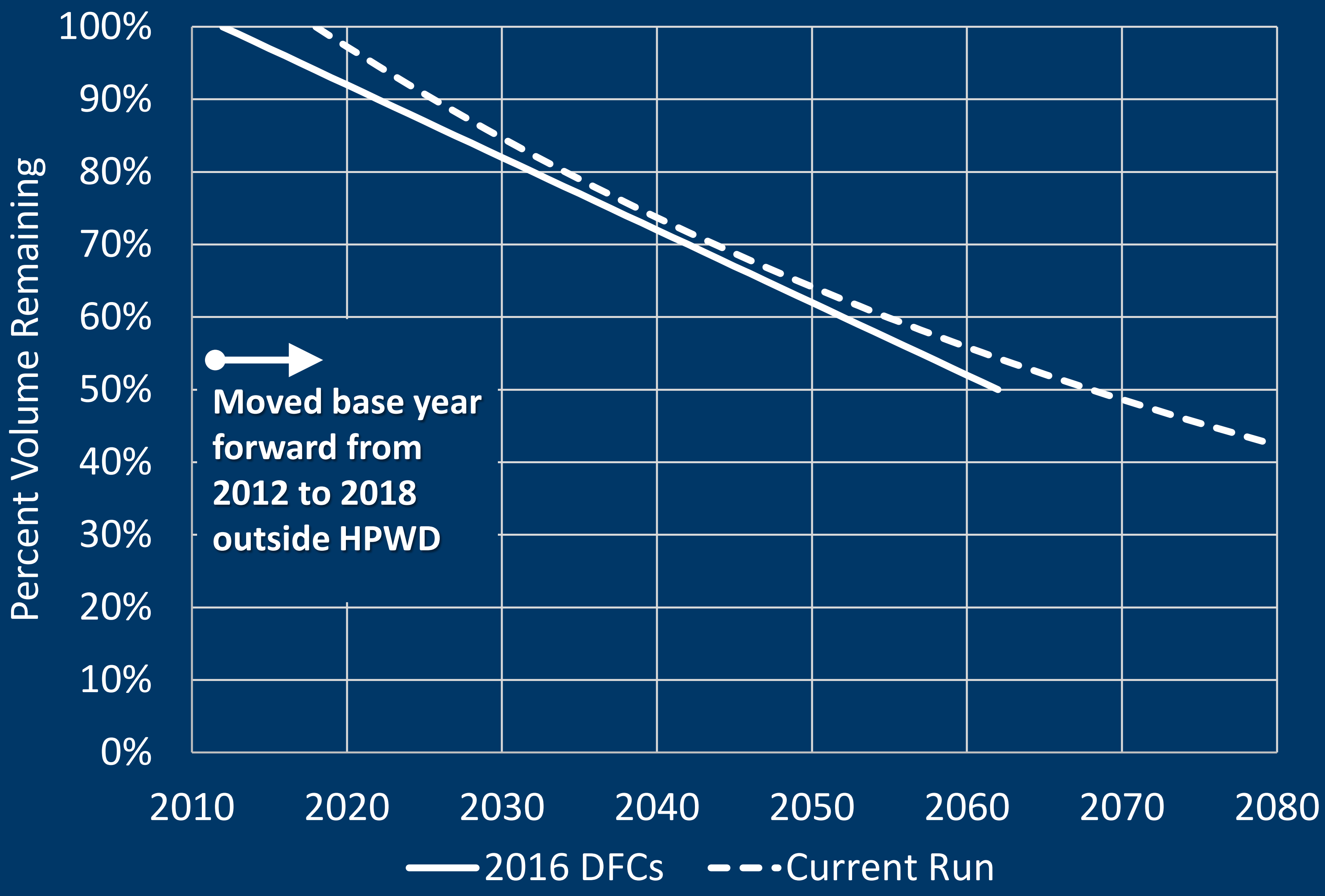
$$Volume = 0.5^{\frac{Year - 2018}{50\ years}}$$

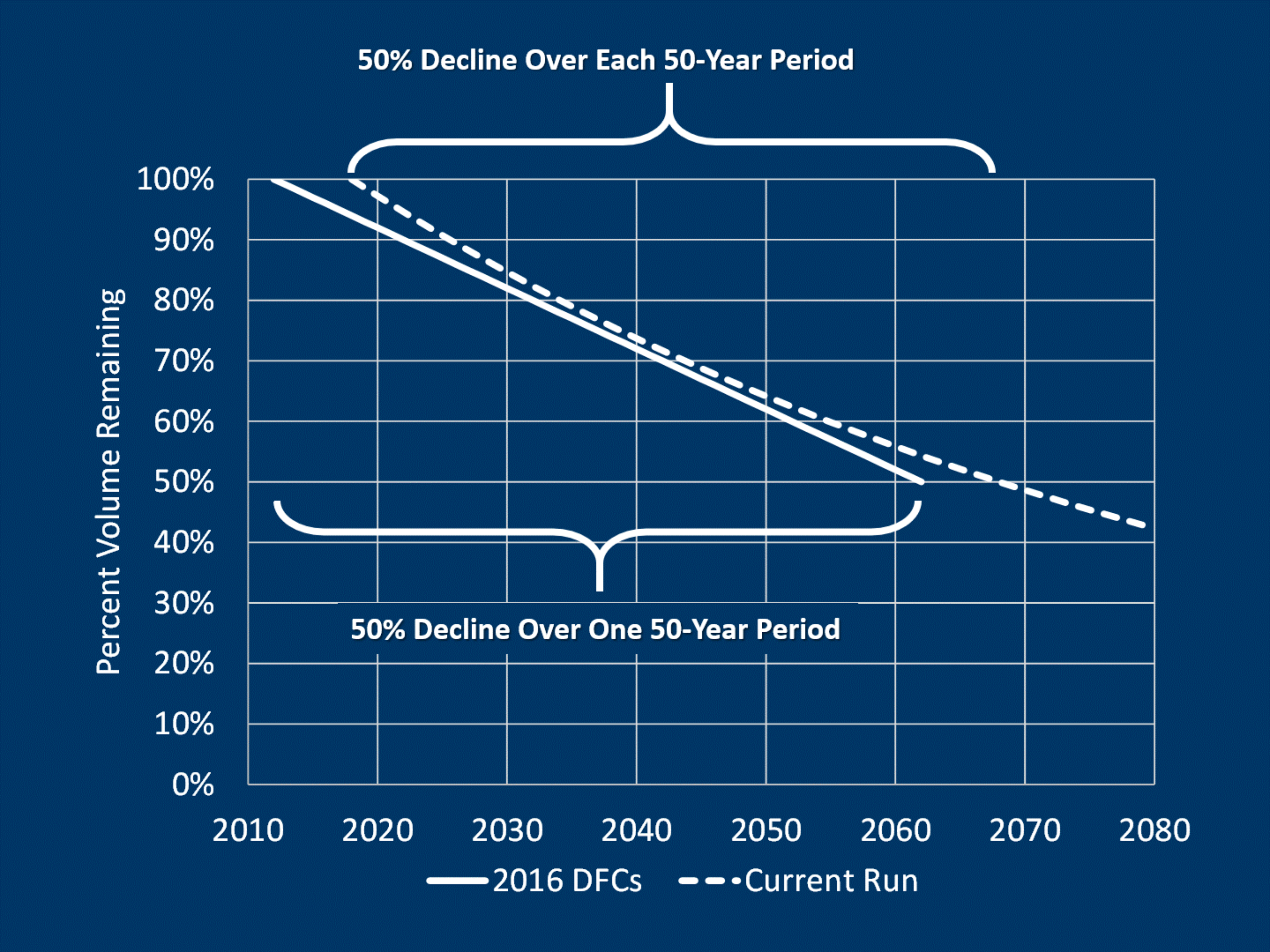
40/50: 1.82% decline each year relative to previous year

50/50: 1.38% decline each year relative to previous year

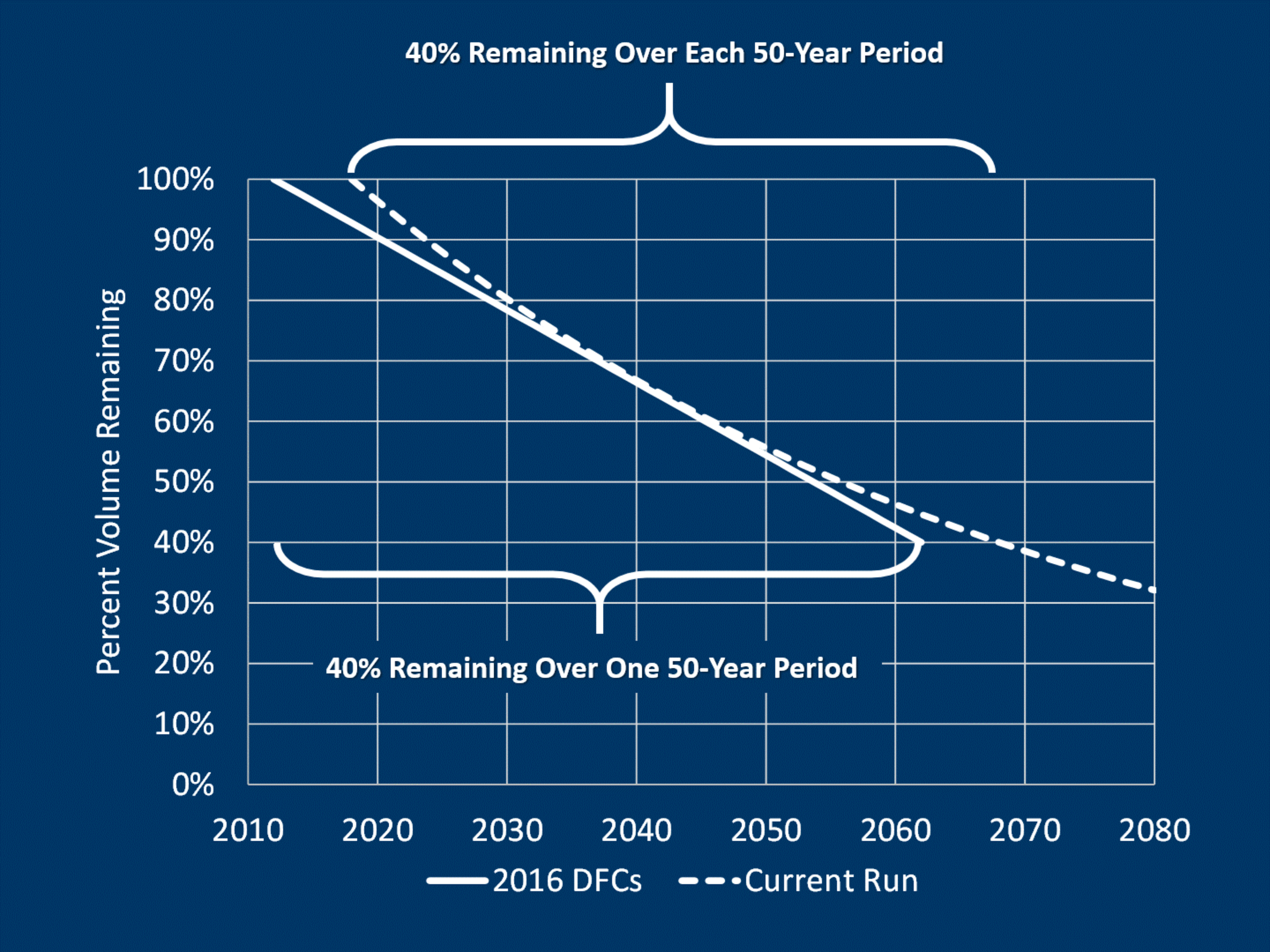
80/50: 0.45% decline each year relative to previous year

Difference Between Runs



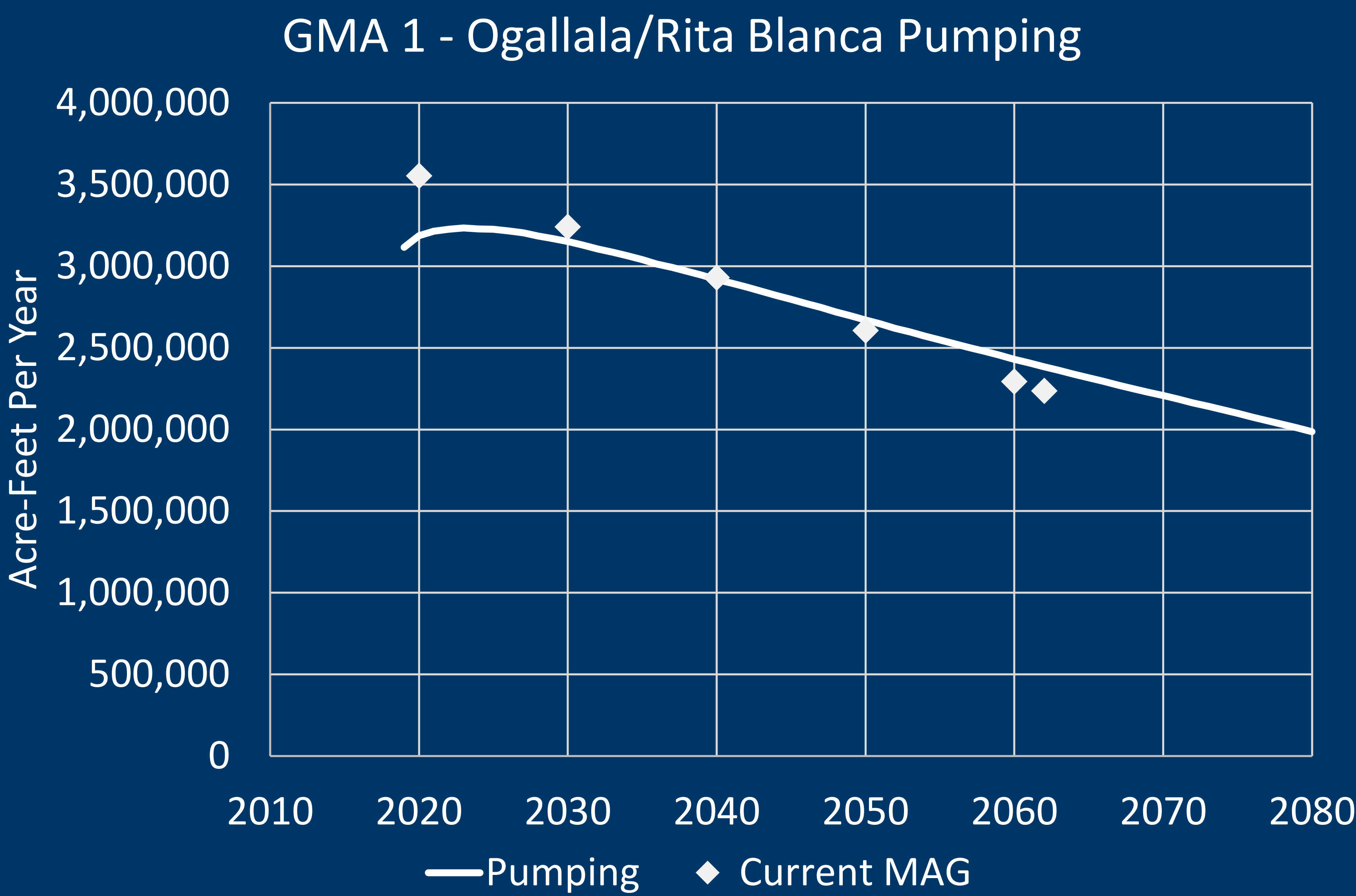


50% Decline Over Each 50-Year Period
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Percent Volume Remaining
50% Decline Over One 50-Year Period
2010
2020
2030
2040
2050
2060
2070
2080
2016 DFCs
Current Run



40% Remaining Over Each 50-Year Period
40% Remaining Over One 50-Year Period
Percent Volume Remaining
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2010
2020
2030
2040
2050
2060
2070
2080
2016 DFCs
Current Run

Model Scenario Results



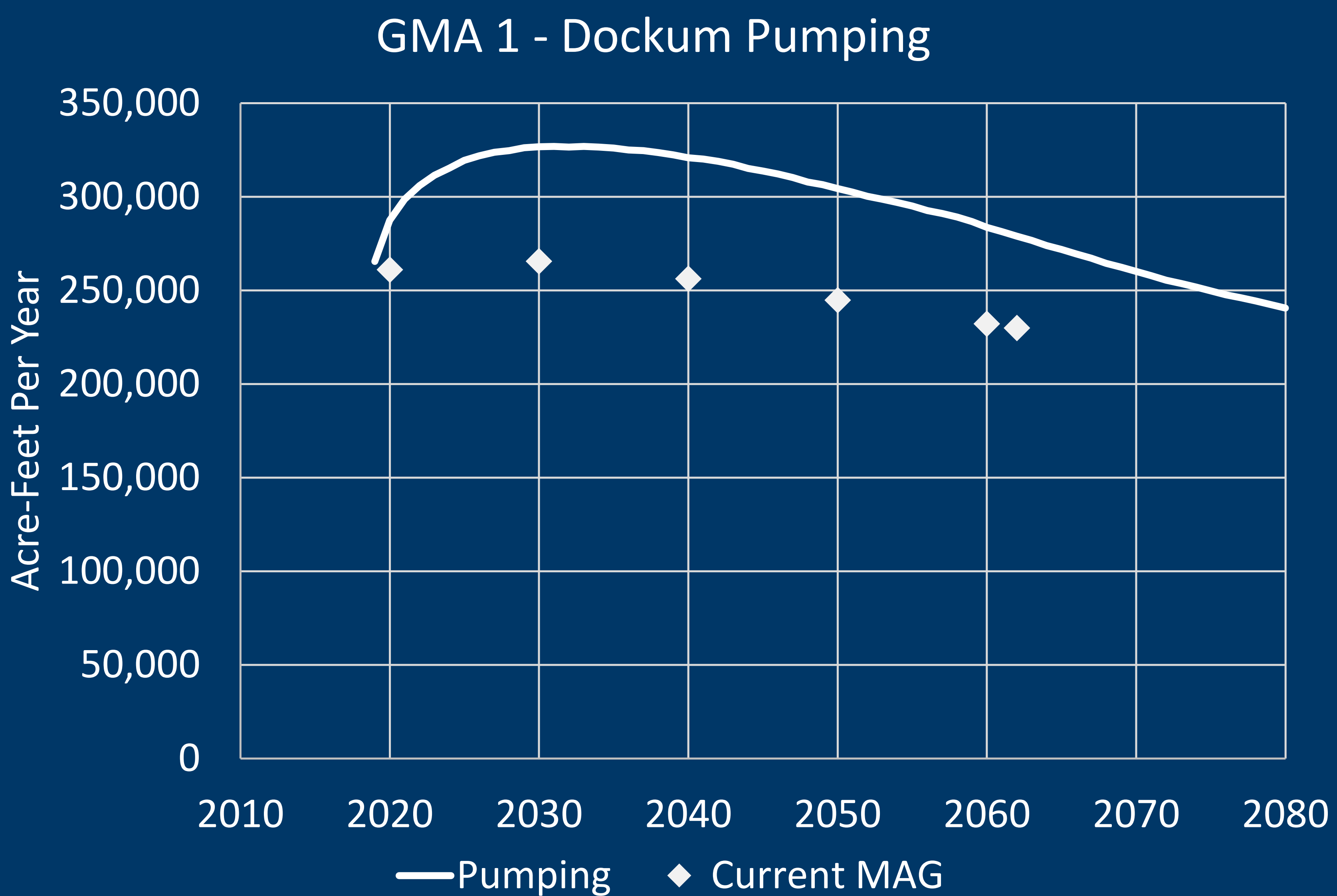
Ogallala/Rita Blanca Aquifer Pumping by Decade (acre-feet per year)

	2020	2030	2040	2050	2060	2070	2080
Hemphill County UWCD	**37,182**	**45,846**	**52,100**	**55,658**	**57,918**	**59,295**	**60,051**
Hemphill	37,182	45,846	52,100	55,658	57,918	59,295	60,051
High Plains UWCD No.1	**44,925**	**41,951**	**35,006**	**28,530**	**23,152**	**19,144**	**16,114**
Armstrong	5,667	4,716	3,001	1,878	1,179	969	784
Potter	2,343	2,539	2,357	2,051	1,631	1,075	801
Randall	36,915	34,697	29,648	24,601	20,343	17,100	14,529
North Plains GCD	**1,988,622**	**1,875,121**	**1,697,404**	**1,533,765**	**1,381,478**	**1,239,976**	**1,111,652**
Dallam	319,323	269,752	228,251	195,016	165,443	144,455	127,992
Hansford	296,868	295,895	281,027	264,464	247,229	229,951	211,025
Hartley	354,907	270,408	207,323	170,002	144,264	124,448	108,128
Hutchinson	77,759	80,242	77,674	74,510	70,462	67,541	63,950
Lipscomb	250,966	270,997	262,931	250,133	235,071	219,119	201,565
Moore	140,116	139,837	132,461	121,696	105,913	88,223	72,976
Ochiltree	259,136	260,144	246,760	231,654	215,169	199,455	180,919
Sherman	289,546	287,846	260,978	226,290	197,926	166,784	145,097

Ogallala/Rita Blanca Aquifer Pumping by Decade (acre-feet per year)

	2020	2030	2040	2050	2060	2070	2080
Panhandle GCD	**979,448**	**1,053,106**	**1,013,268**	**949,684**	**879,583**	**813,865**	**734,607**
Armstrong	56,821	51,760	45,662	40,268	35,017	30,705	27,080
Carson	162,975	166,133	159,424	149,866	140,958	134,453	121,522
Donley	72,596	78,318	76,996	72,649	66,893	60,955	53,227
Gray	177,264	181,767	173,242	160,488	146,740	133,890	121,683
Hutchinson	8,506	10,596	11,774	11,792	11,403	10,782	9,586
Potter	23,972	22,260	19,549	16,487	13,579	10,997	8,803
Roberts	357,959	409,569	394,109	369,578	343,395	317,738	285,999
Wheeler	119,354	132,702	132,512	128,557	121,599	114,345	106,707
Non-District Areas	**136,155**	**134,059**	**120,162**	**103,627**	**87,940**	**74,965**	**64,550**
Hartley	15,523	16,391	15,601	14,319	12,962	11,654	10,413
Hutchinson	33,885	32,988	28,313	24,075	20,934	18,588	17,168
Moore	8,685	9,687	9,395	8,251	7,107	6,202	5,506
Oldham	40,412	39,092	36,116	31,239	25,989	21,407	18,004
Randall	37,650	35,901	30,736	25,742	20,948	17,114	13,460
GMA 1 Total	**3,186,332**	**3,150,084**	**2,917,940**	**2,671,264**	**2,430,072**	**2,207,245**	**1,986,974**

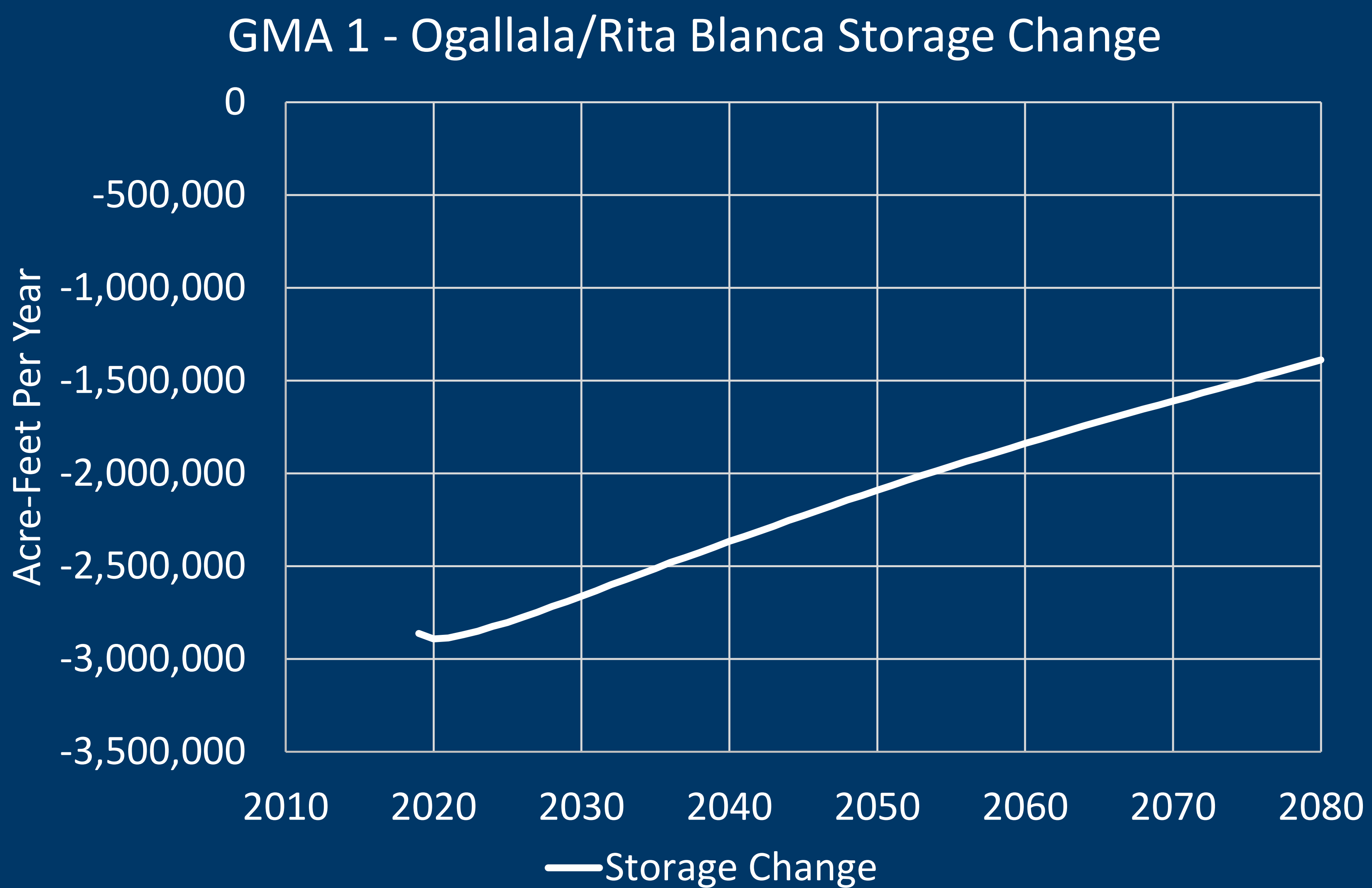
Model Scenario Results



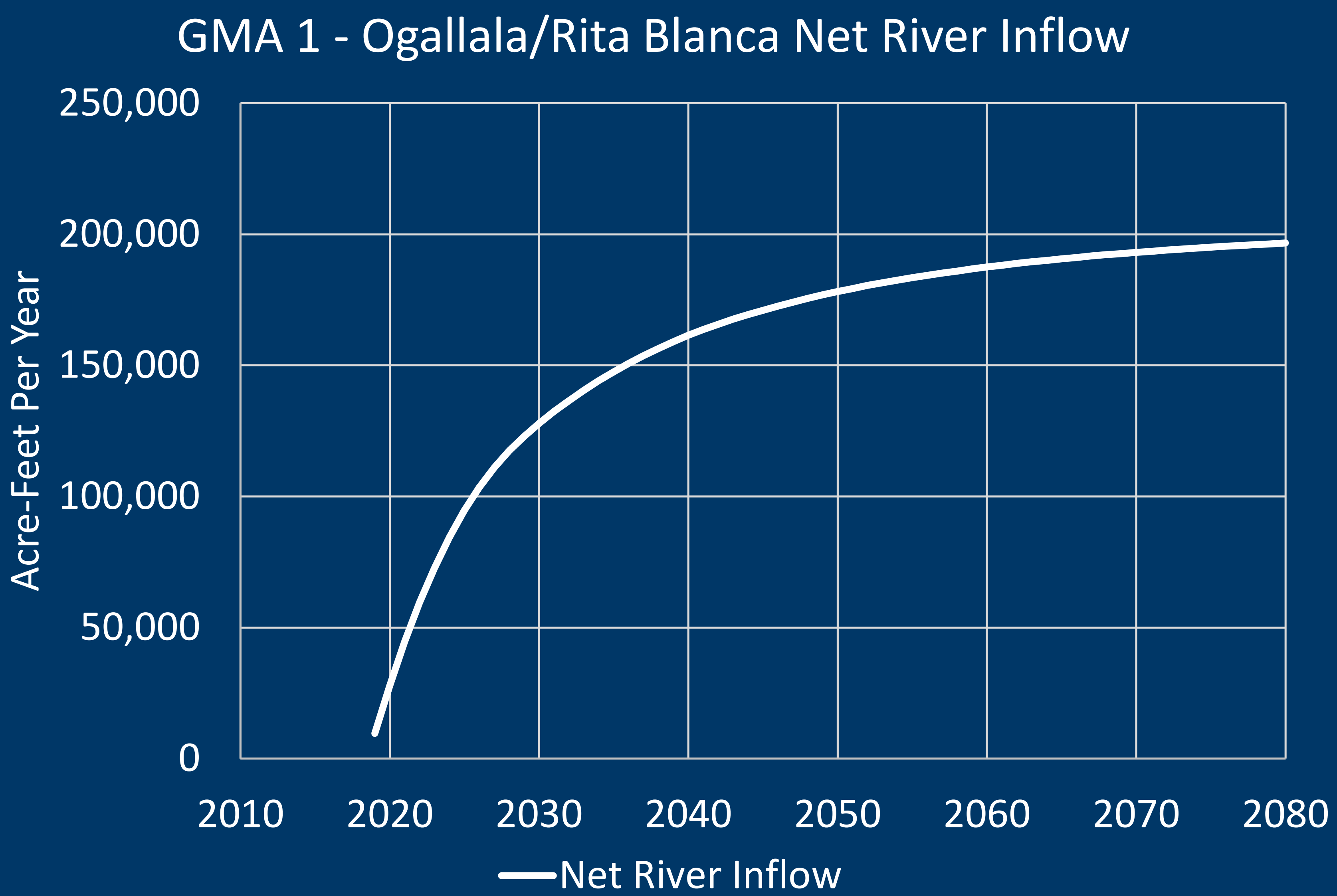
Dockum Aquifer Pumping by Decade (acre-feet per year)

	2020	2030	2040	2050	2060	2070	2080
High Plains UWCD No.1	**11,489**	**12,235**	**12,305**	**10,971**	**10,179**	**10,085**	**10,155**
Armstrong	1,849	835	221	221	221	221	221
Potter	2,658	2,658	2,402	2,316	2,276	2,249	2,168
Randall	6,982	8,742	9,683	8,434	7,682	7,615	7,766
North Plains GCD	**33,262**	**33,170**	**31,424**	**29,745**	**28,304**	**26,928**	**25,715**
Dallam	15,953	15,549	14,687	14,045	13,502	12,920	12,406
Hartley	12,379	11,802	11,031	10,343	9,737	9,242	8,815
Moore	4,487	5,402	5,398	5,068	4,773	4,477	4,204
Sherman	444	416	309	289	293	288	290
Panhandle GCD	**35,405**	**44,836**	**45,885**	**45,599**	**44,643**	**43,623**	**42,403**
Armstrong	5,302	7,107	8,105	8,607	8,830	8,909	8,895
Carson	6	6	6	6	6	6	6
Potter	30,097	37,723	37,774	36,987	35,806	34,707	33,501
Non-District Areas	**207,317**	**236,532**	**231,191**	**218,086**	**200,544**	**179,456**	**162,332**
Hartley	44,168	52,833	52,986	50,465	46,810	43,002	39,229
Moore	241	560	593	617	641	645	624
Oldham	143,936	153,889	145,622	135,482	124,602	114,645	105,122
Randall	18,974	29,250	31,990	31,523	28,491	21,163	17,357
GMA 1 Total	**287,474**	**326,773**	**320,806**	**304,402**	**283,670**	**260,092**	**240,605**

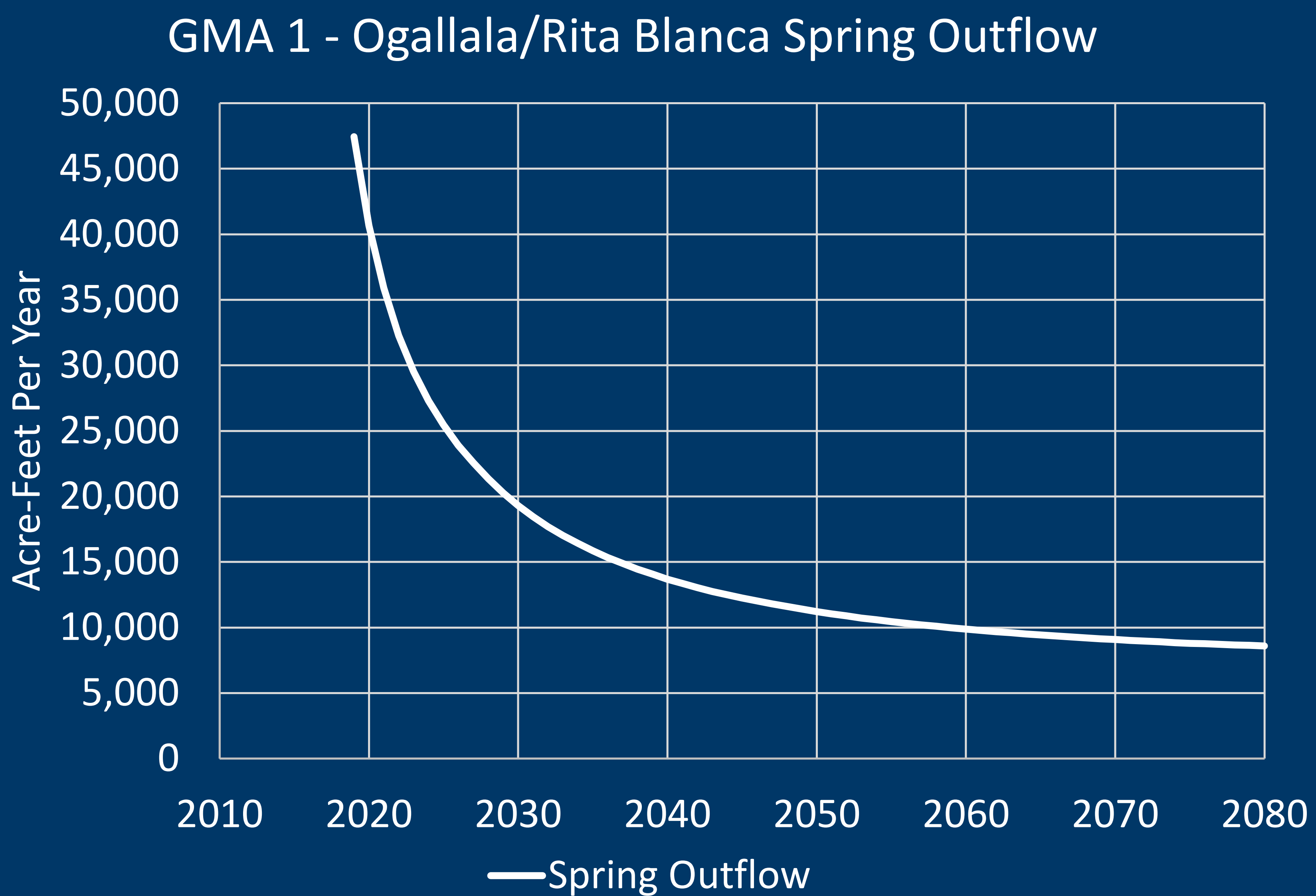
Model Scenario Results



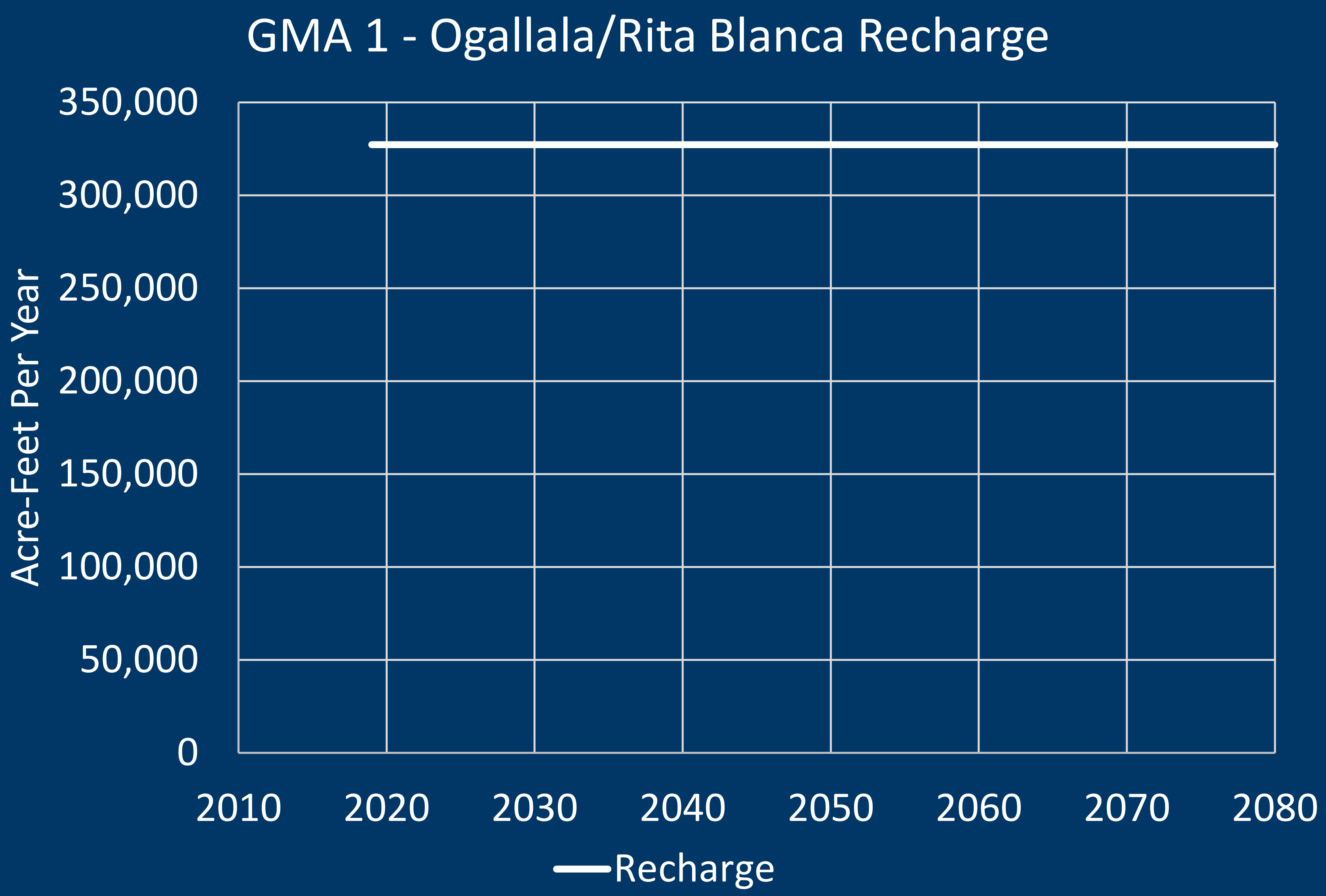
Model Scenario Results



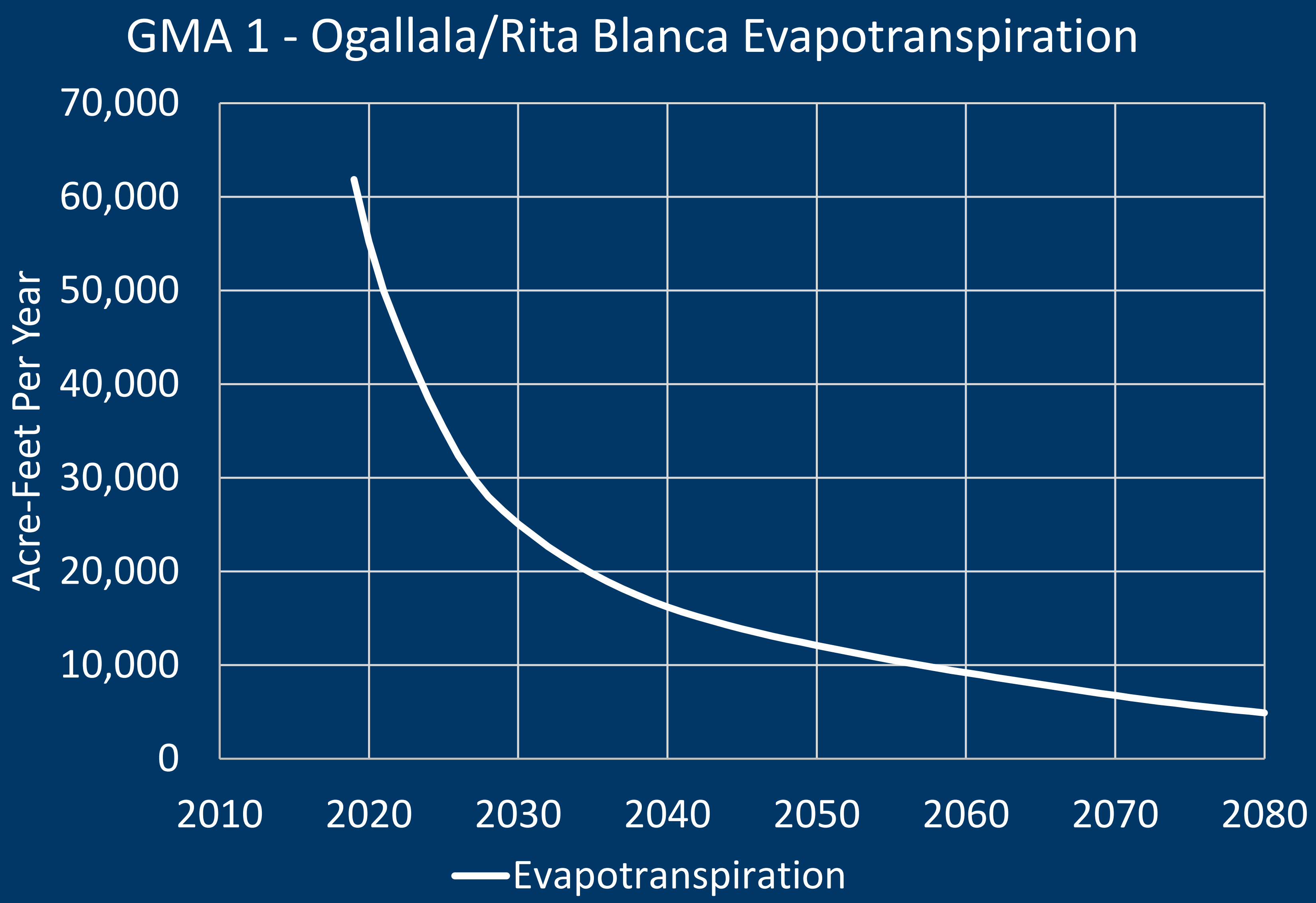
Model Scenario Results



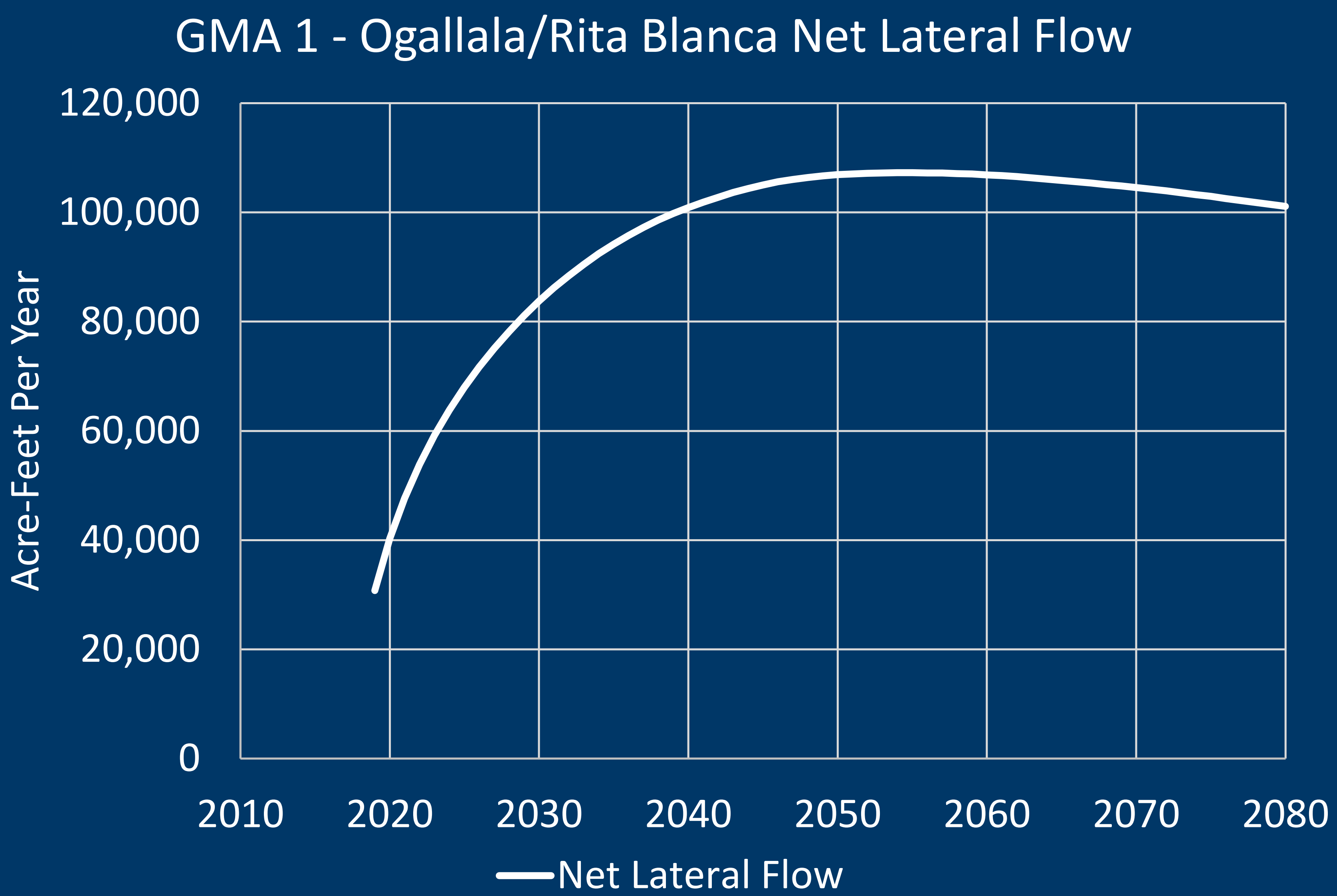
Model Scenario Results



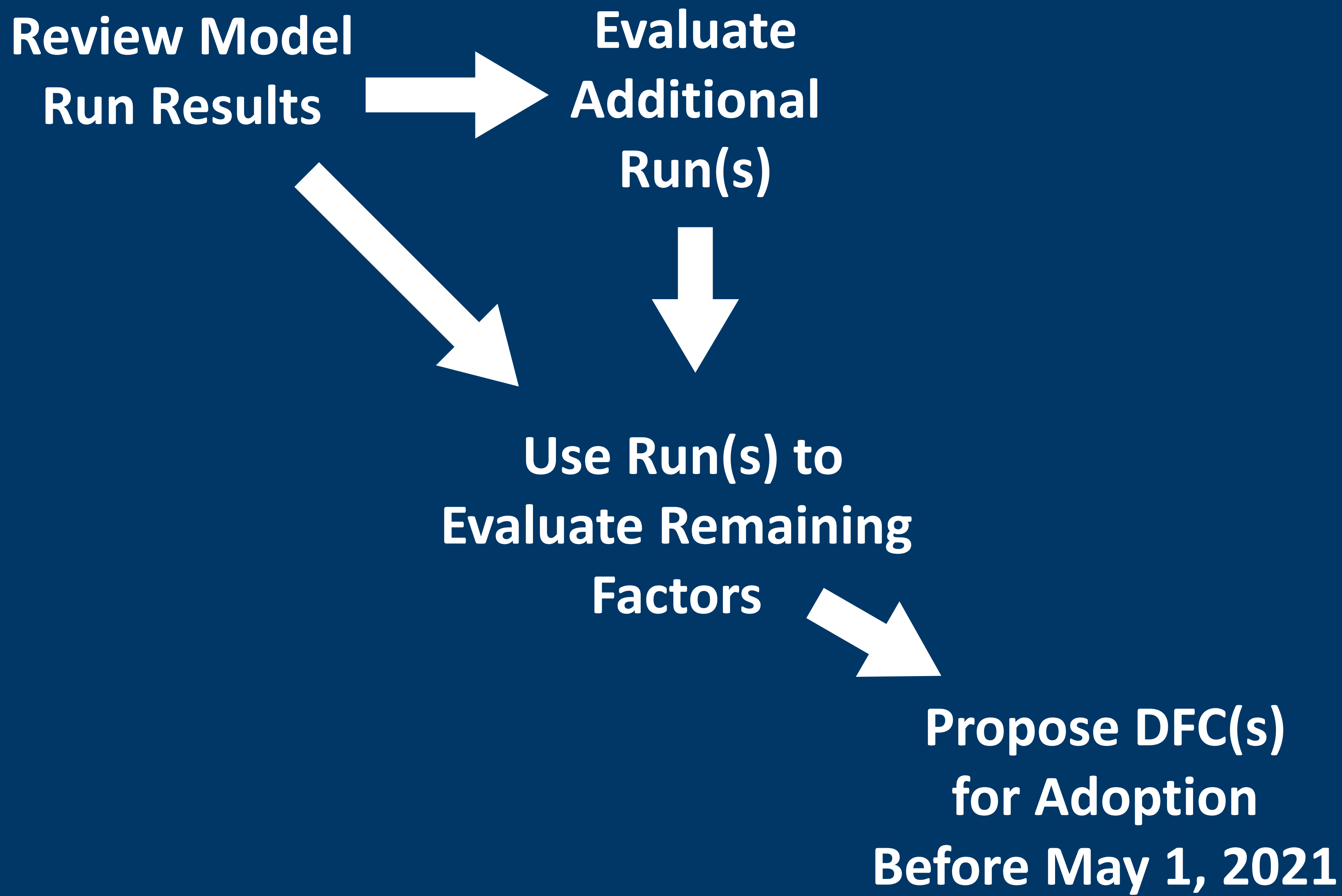
Model Scenario Results

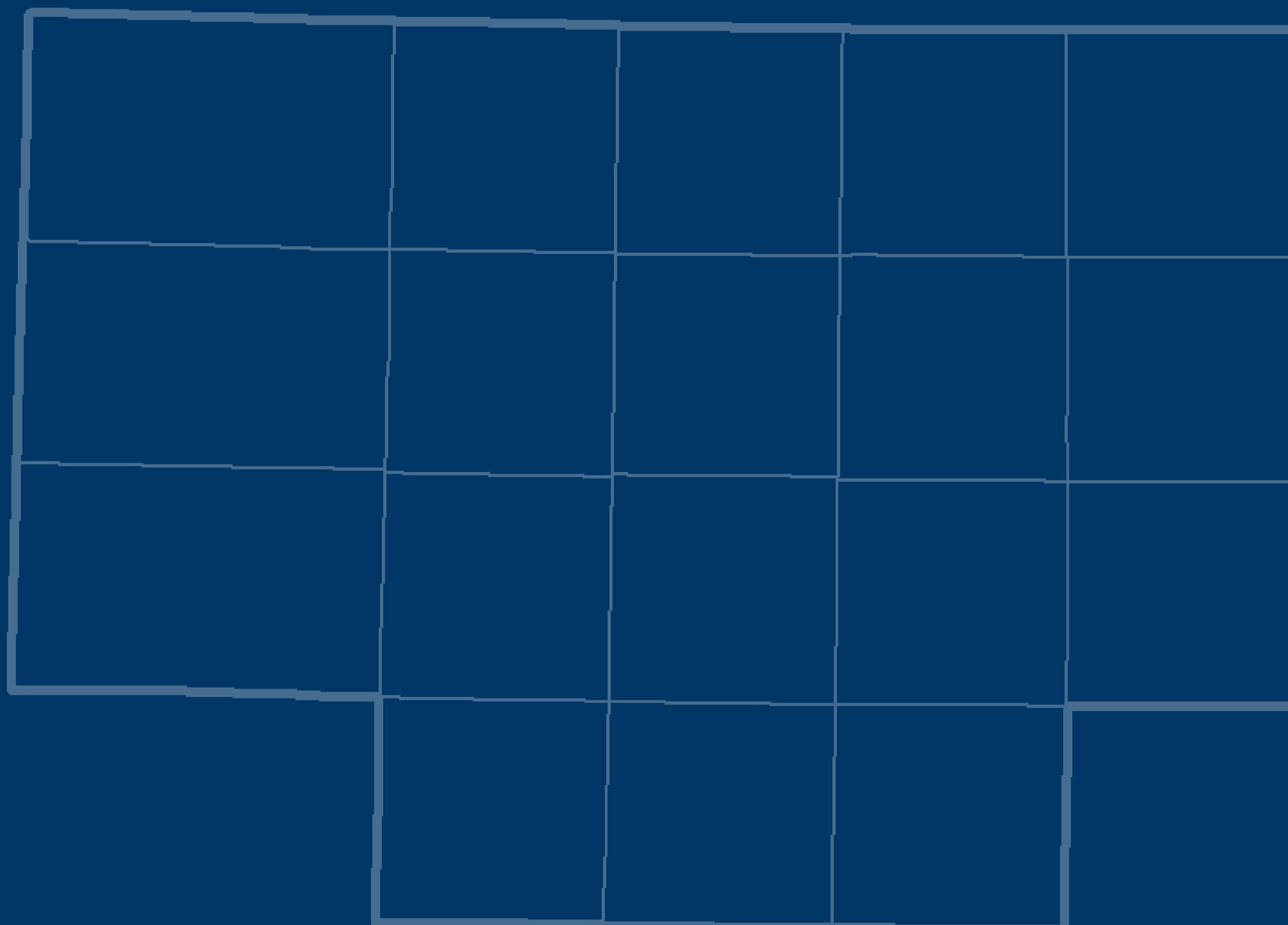


Model Scenario Results



Potential Paths Forward





Consideration of Environmental Impacts and Private Property Rights

A Presentation to GMA 1
Joint Planning Group

September 24, 2020

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The "9 Factors" to Consider

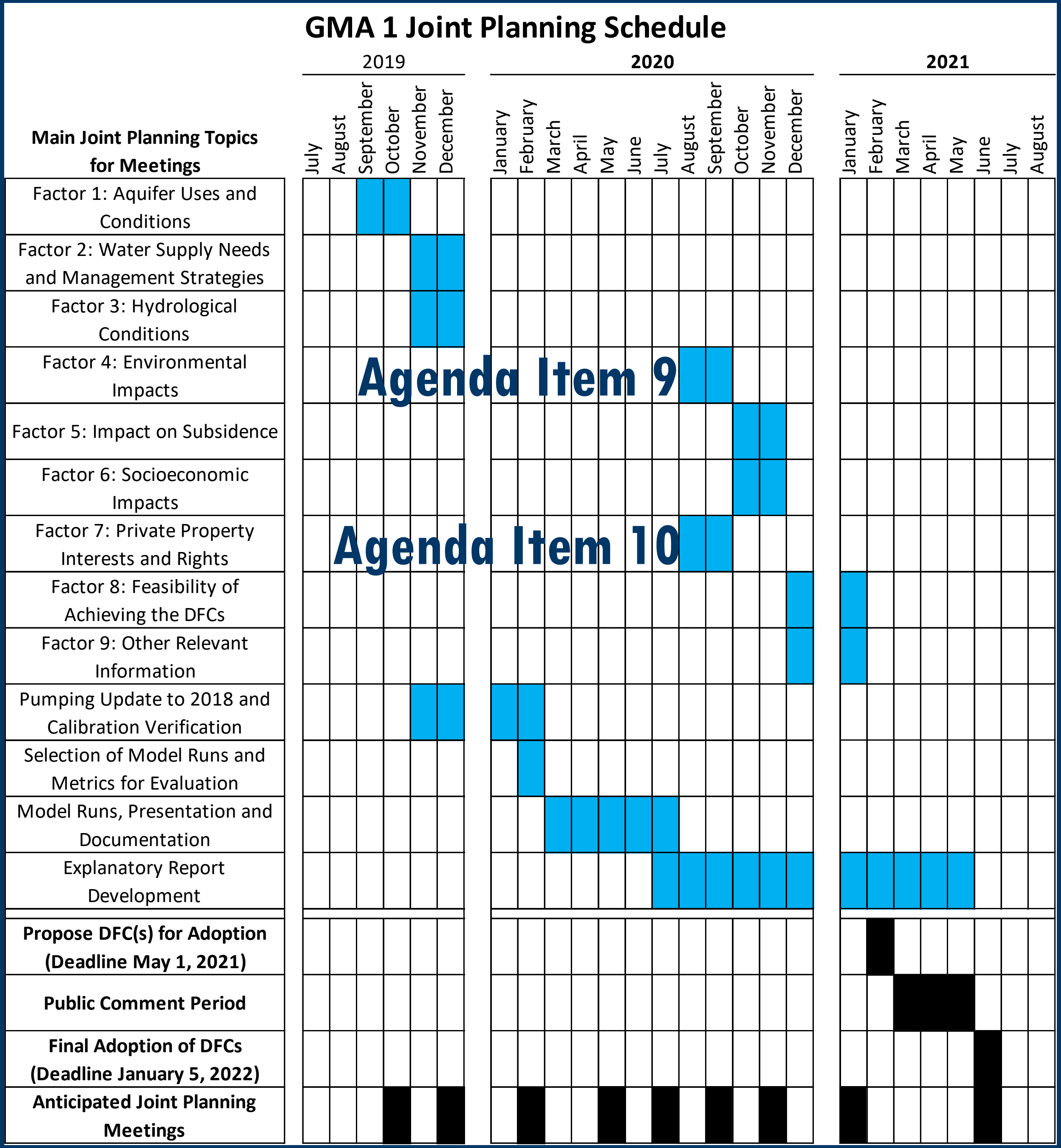
- Aquifer uses or conditions (10/28/2019)
- Water supply needs and management strategies (12/12/2019)
- Hydrological conditions (12/12/2019)
- <u>Other environmental impacts</u>
- Impact on subsidence (next meeting)
- Socioeconomic impacts (next meeting)
- <u>Impact on private property rights</u>
- Feasibility of achieving the DFC
- Any other relevant information

The Balancing Test

Desired Future Conditions must provide:

“a balance between the highest practicable level of groundwater production and the conservation, preservation, protection, recharging, and prevention of waste of groundwater and control of subsidence in the management area” (TWC Ch. 36)

Current Schedule



DFCs Being Considered – Ogallala/Rita Blanca

- Dallam, Hartley, Moore and Sherman counties
  - At least 40 percent of the volume in storage remaining for each 50 year period between 2018 and 2080
- Hemphill County
  - At least 80 percent of the volume in storage remaining for each 50 year period between 2018 and 2080
- High Plains UWCD No. 1 within GMA 1
  - 20 feet average drawdown for each 50 year period between 2012 and 2080
- All Other Areas
  - At least 50 percent of the volume in storage remaining for each 50 year period between 2018 and 2080

DFCs Being Considered – Dockum Aquifer

- Dallam, Hartley, Moore and Sherman counties
  - –At least 40 percent available drawdown remaining for each 50 year period between 2018 and 2080
- Oldham and PGCD portion of Potter, Carson and Armstrong counties
  - –No more than 30 feet average water level decline for each 50 year period between 2018 and 2080
- Randall and HPWD portion of Armstrong and Potter counties
  - –No more than 40 feet average water level decline for each 50 year period between 2012 and 2080

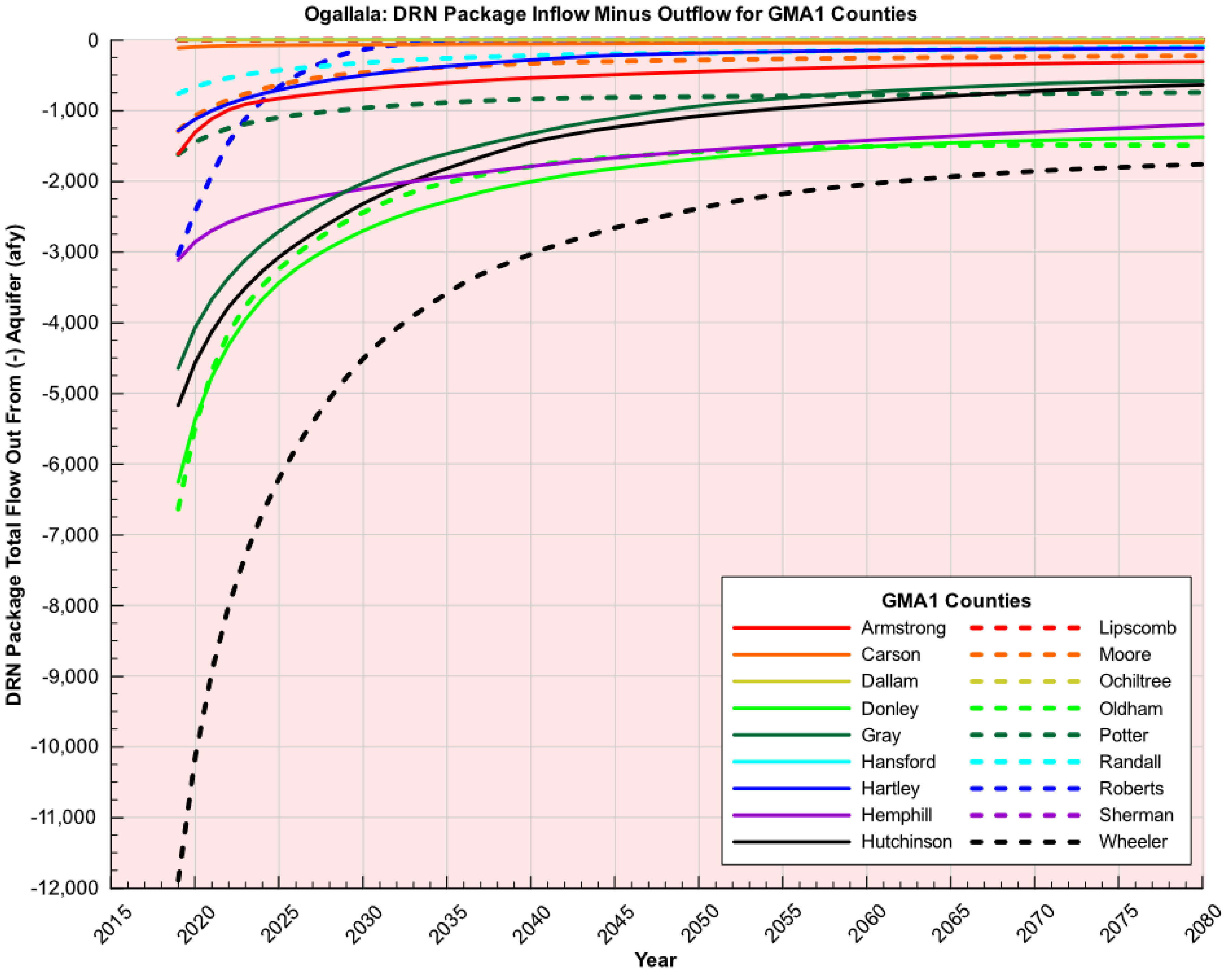
Agenda Item 9
Consideration of Environmental Impacts

Other Environmental Impacts in TWC Ch 36

“other environmental impacts, including impacts on spring flow and other interactions between groundwater and surface water;”

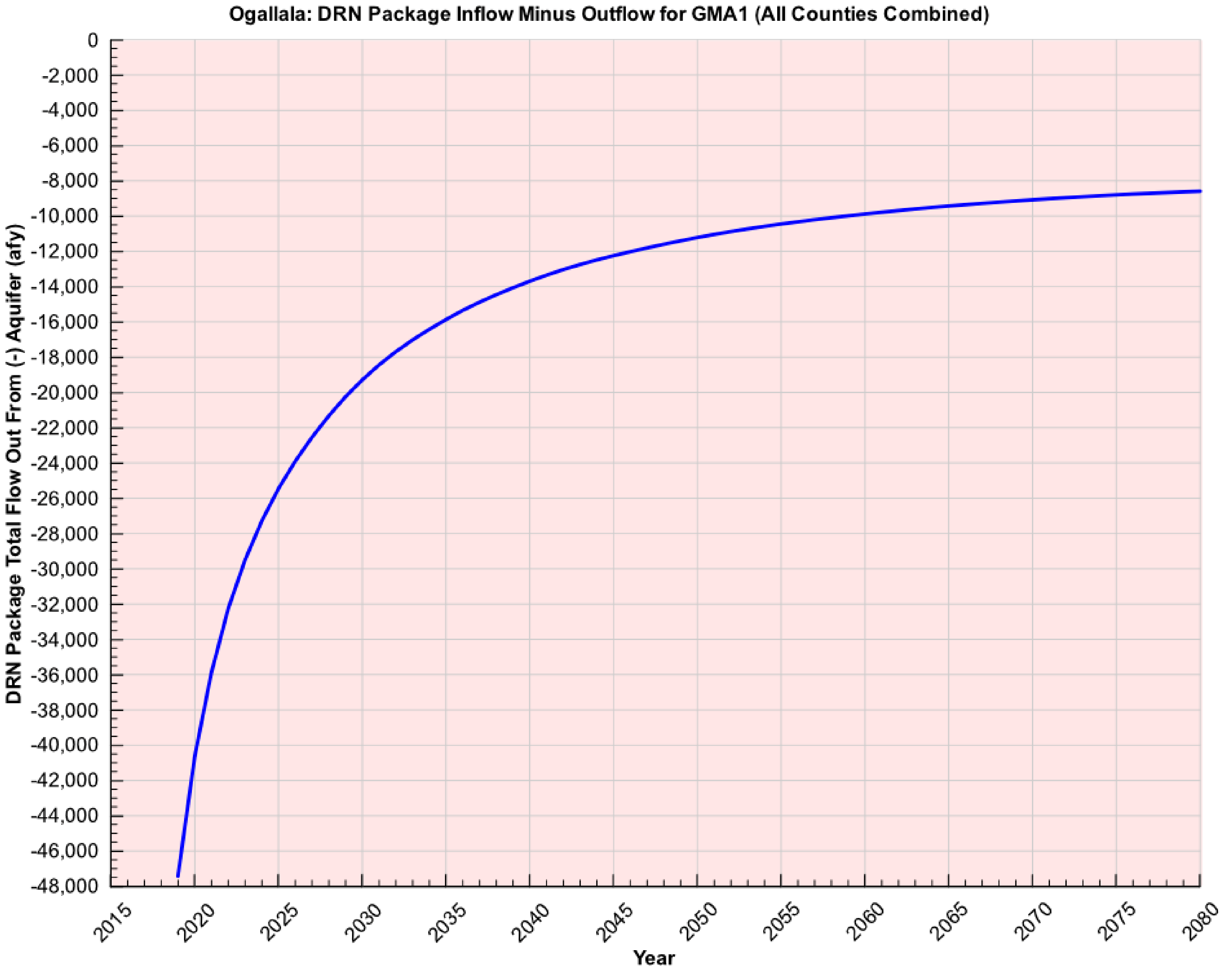
Ogallala

Drain outflows representing springs, seeps and draws



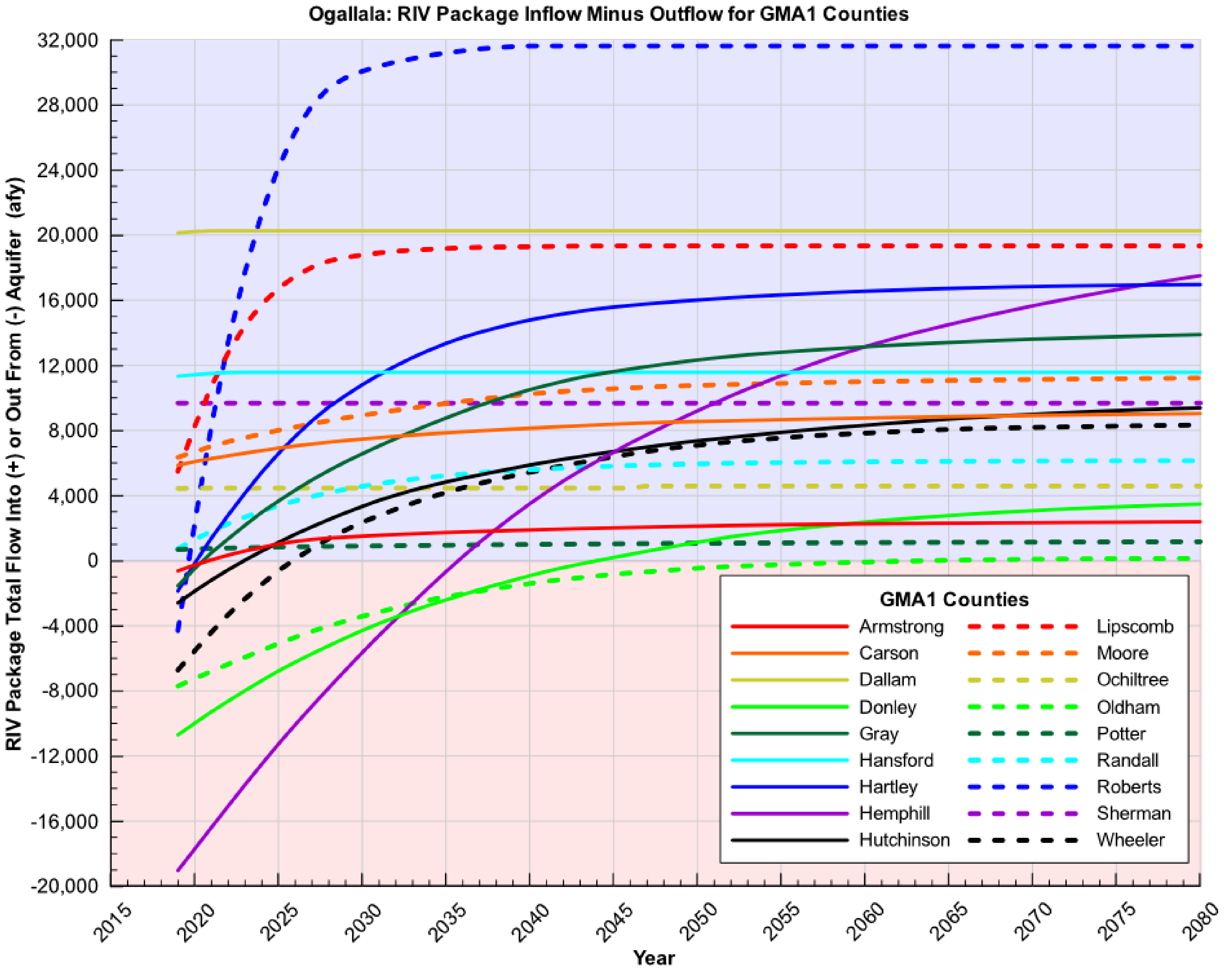
Ogallala

Drain outflows representing springs, seeps and draws



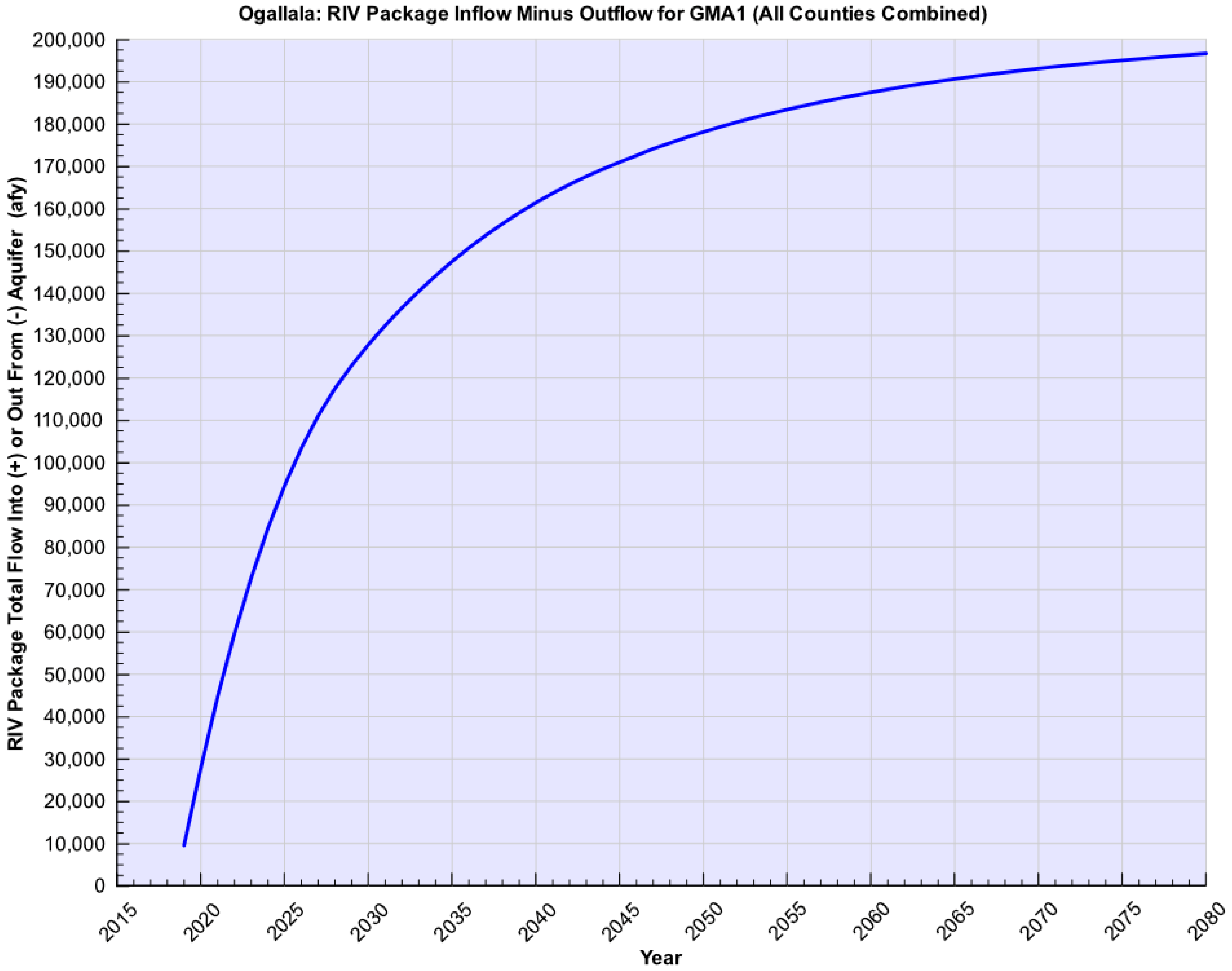
Ogallala

Net interaction between groundwater and rivers



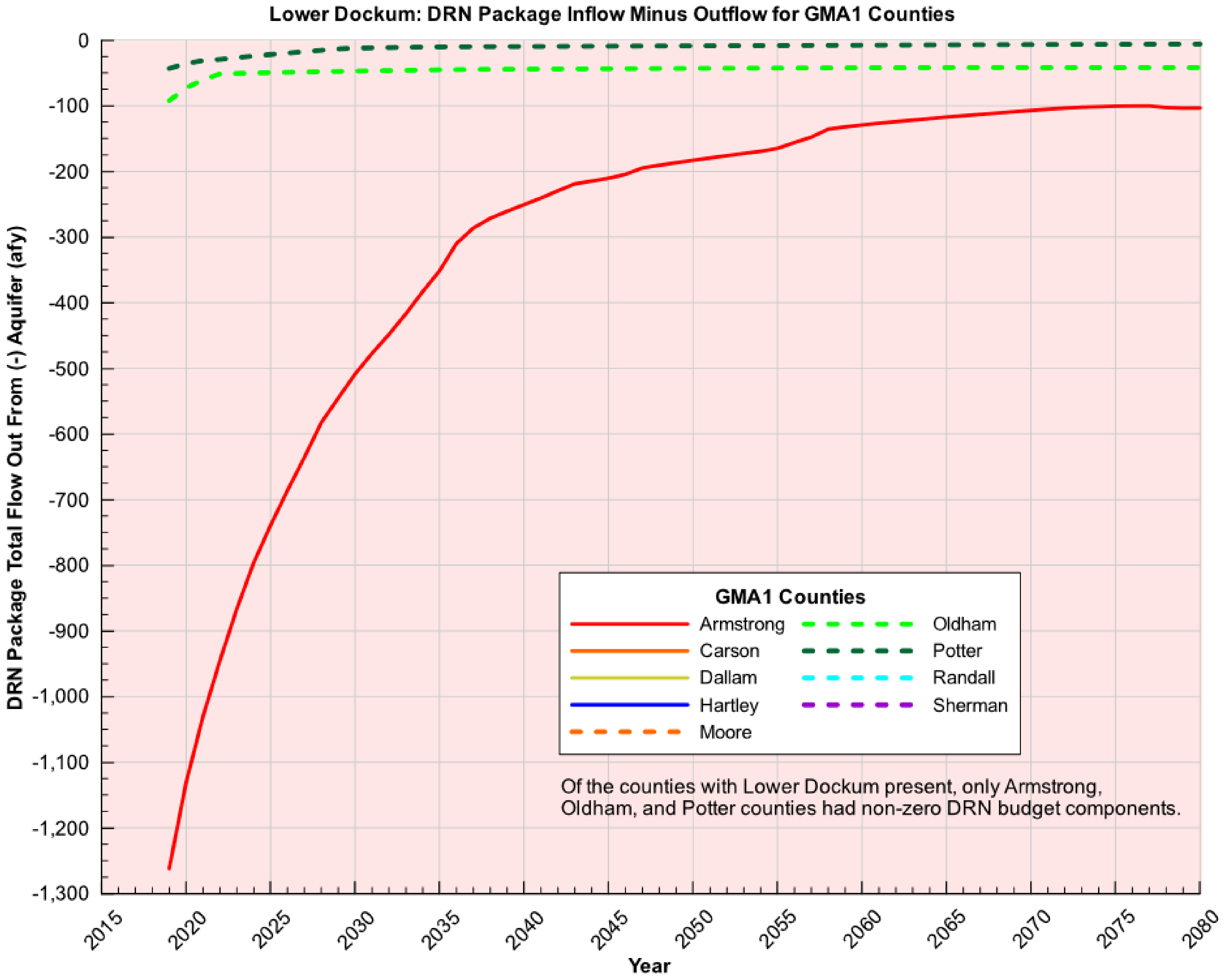
Ogallala

Net interaction between groundwater and rivers



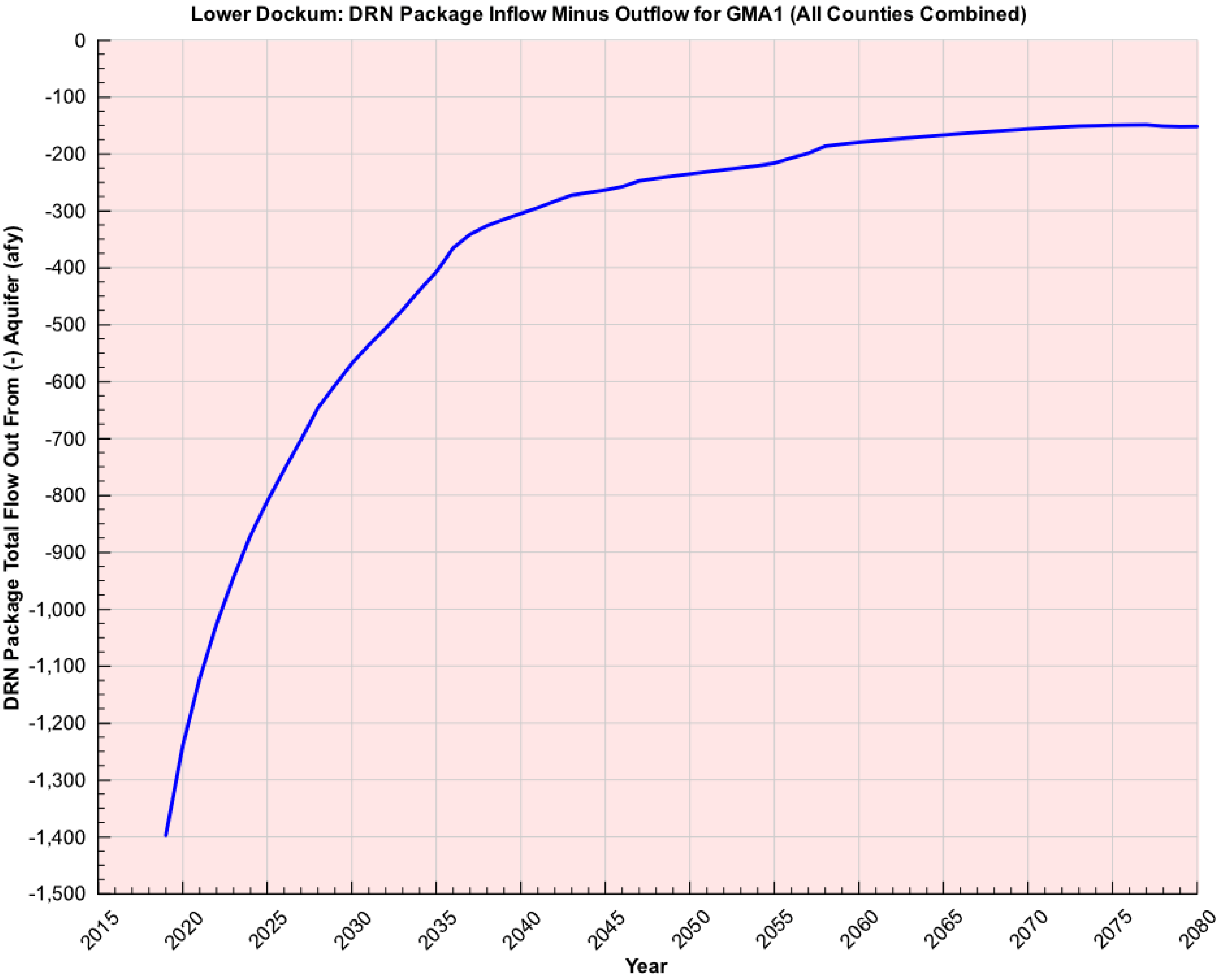
Lower Dockum

Drain outflows representing springs, seeps and draws



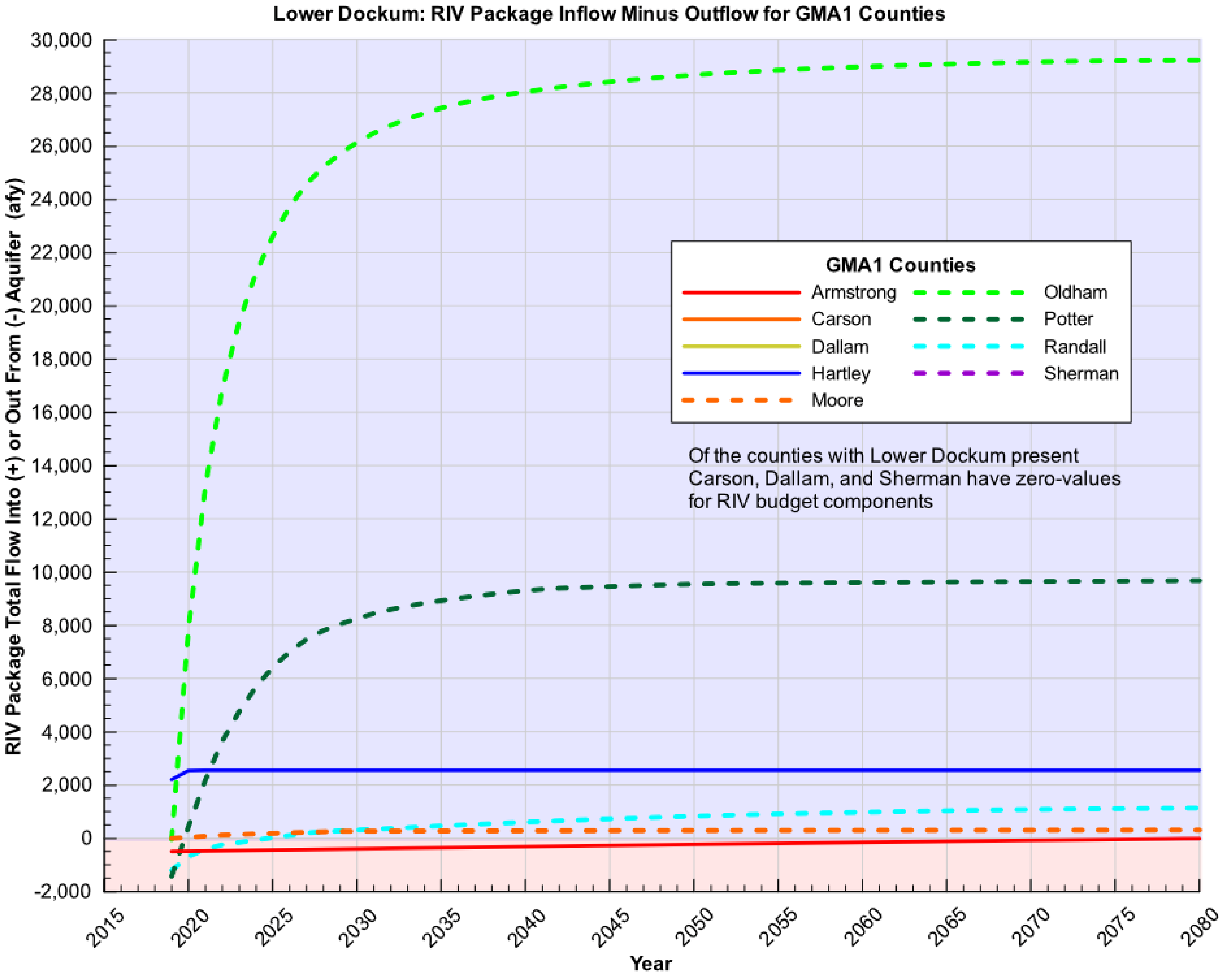
Lower Dockum

Drain outflows representing springs, seeps and draws



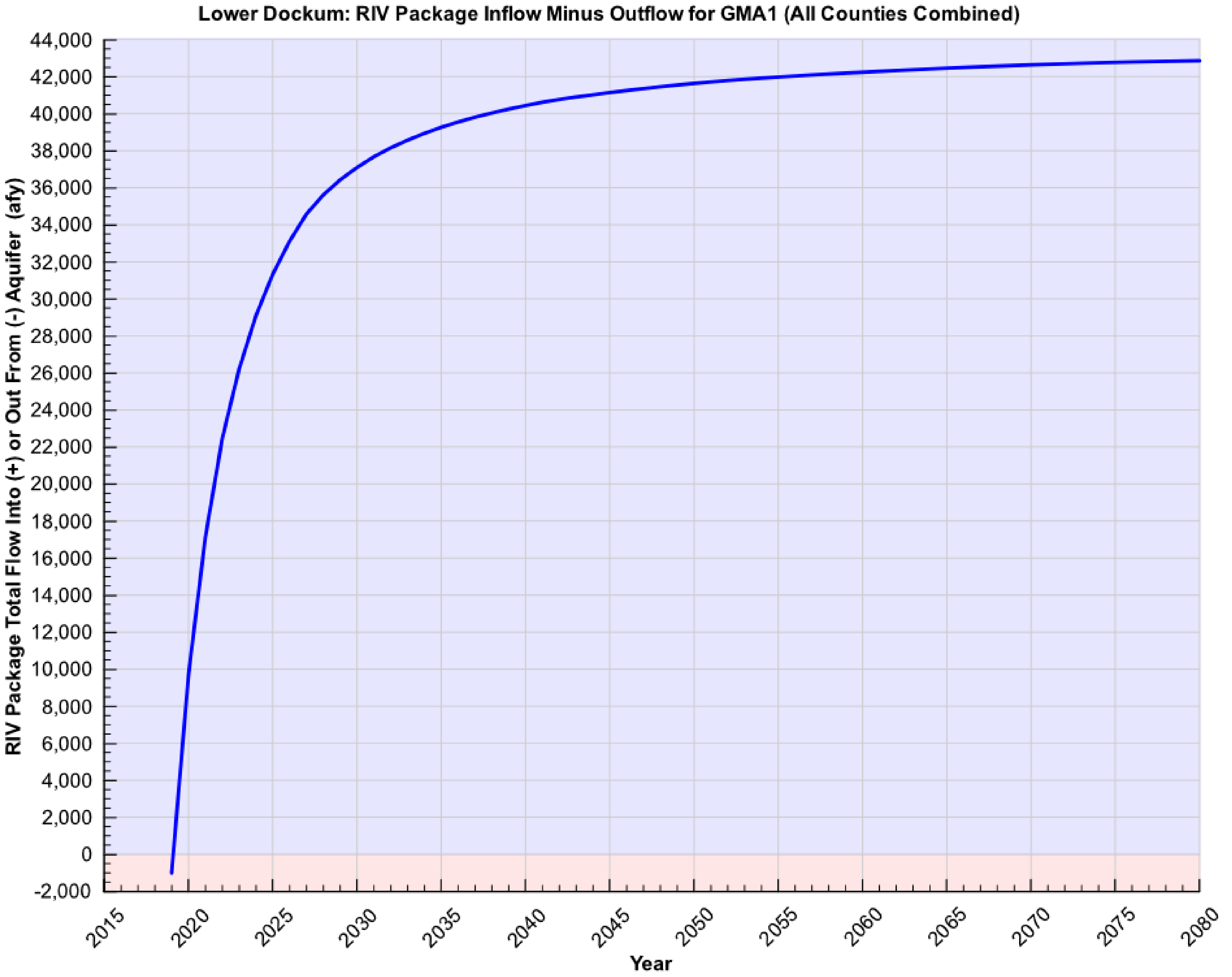
Lower Dockum

Net interaction between groundwater and rivers



Lower Dockum

Net interaction between groundwater and rivers



Additional Resources

- **Groundwater availability model runs in District management plans use historical average interaction between groundwater and surface water**
- **District management plan GAM runs can be found on the TWDB website here:**
  https://www.twdb.texas.gov/groundwater/management_areas/gma1.asp

Agenda Item 10
Consideration of Private Property Rights

Private Property Impacts in TWC Ch 36

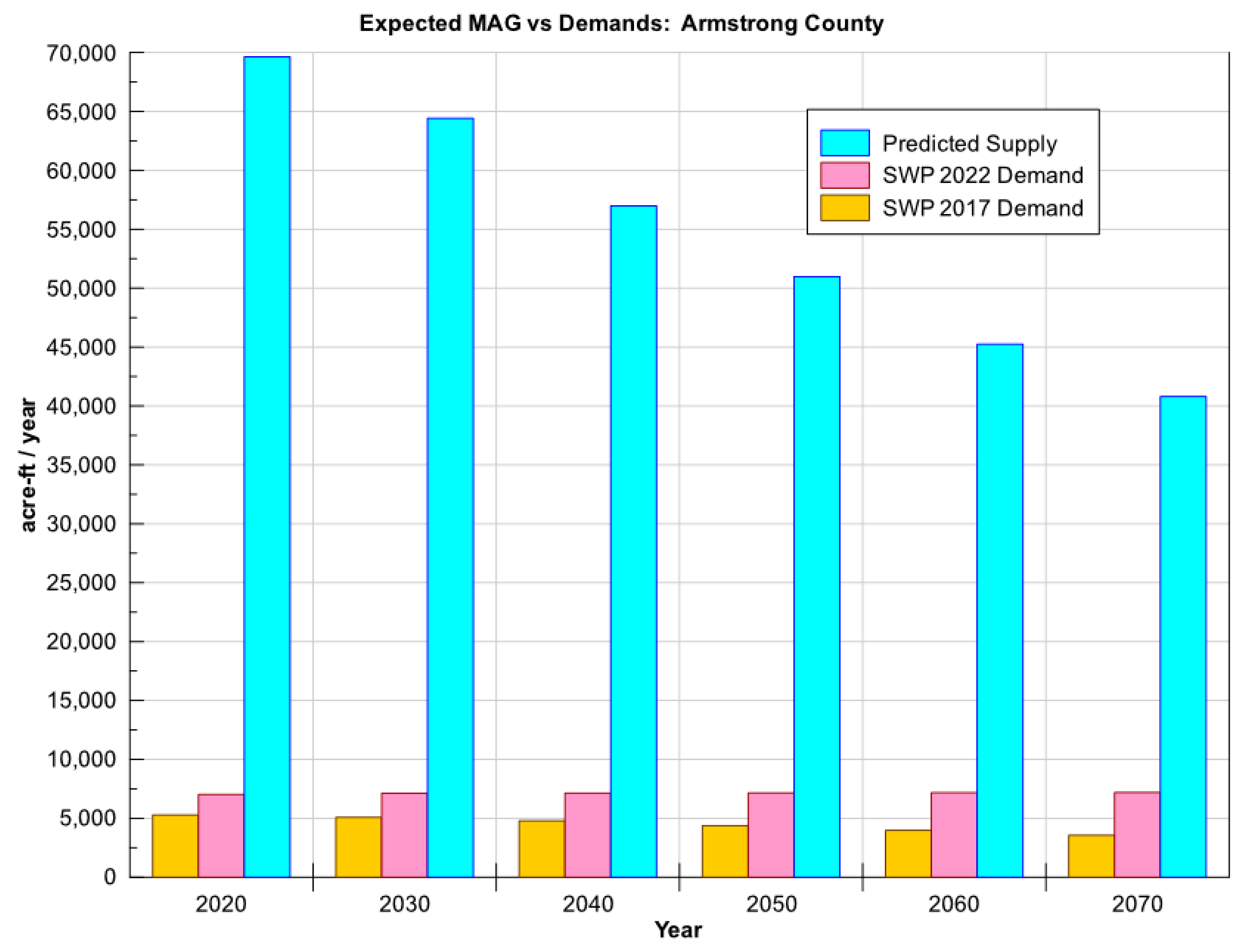
“the impact on the interests and rights in private property, including ownership and the rights of management area landowners and their lessees and assigns in groundwater as recognized under Section 36.002;”

Private Property Rights and Impacts

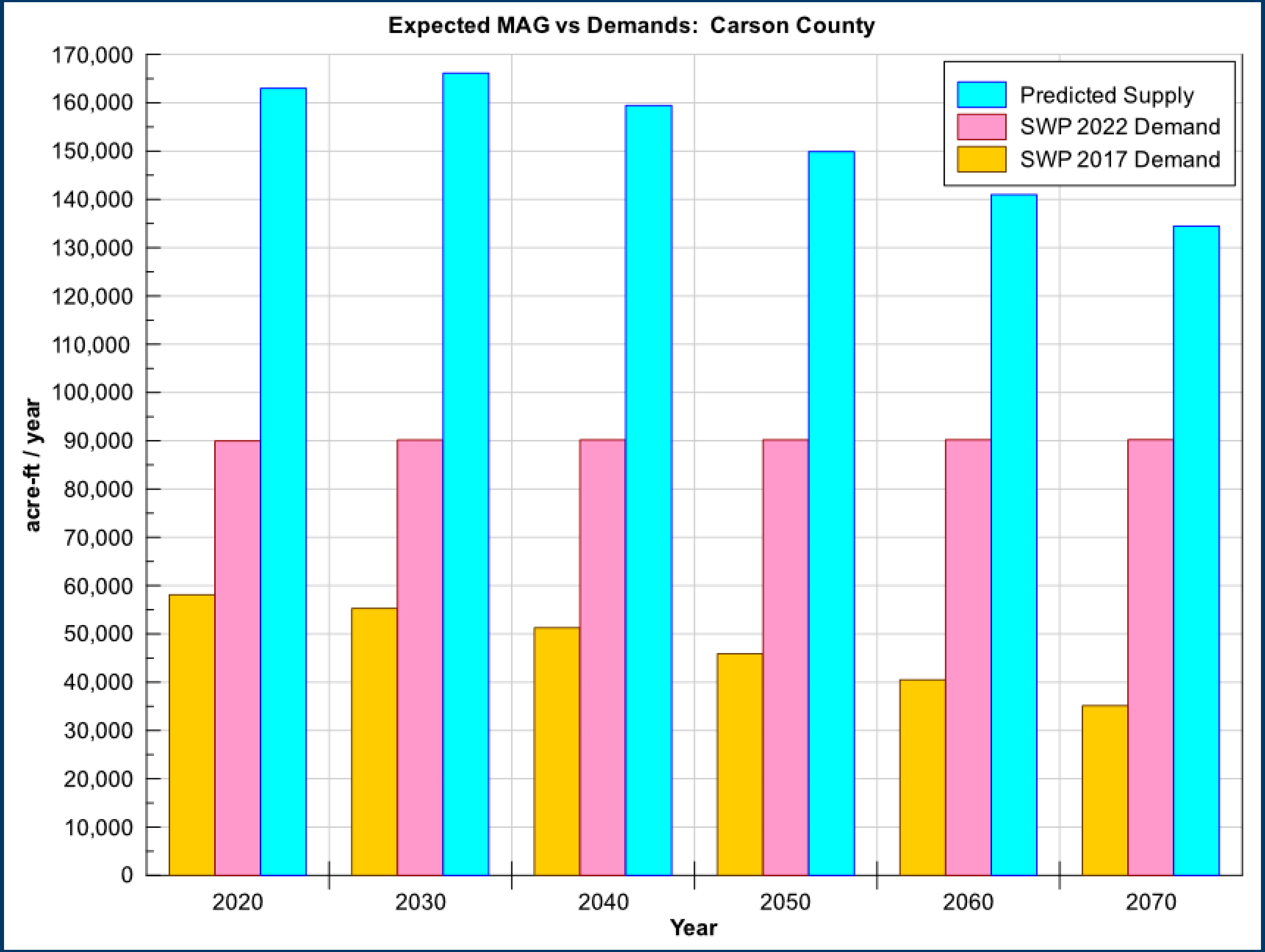
- **State is empowered to regulate groundwater production**
- **Regulation is essential to groundwater conservation and use**
- **Each landowner "owns separately, distinctly, and exclusively all the water under his land."**
- **Rules adopted by a District to achieve a DFC may have a potential impact on private property rights**
- **Impacts may be viewed as both restricting and benefiting property rights**

Source: EAA vs Day case as summarized by Keith Good's presentation to GMA 1 in 2015

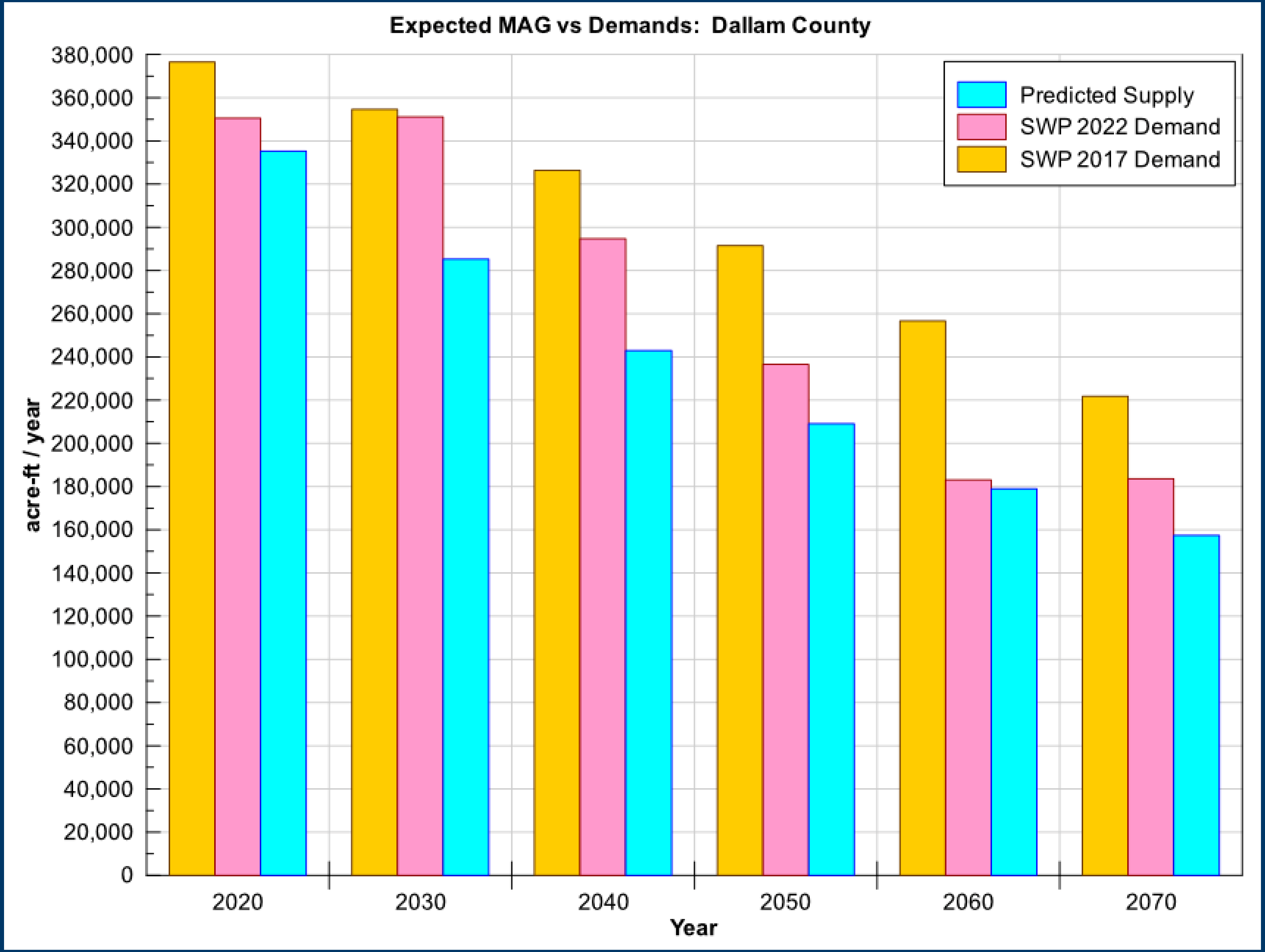
Expected MAG vs Demand



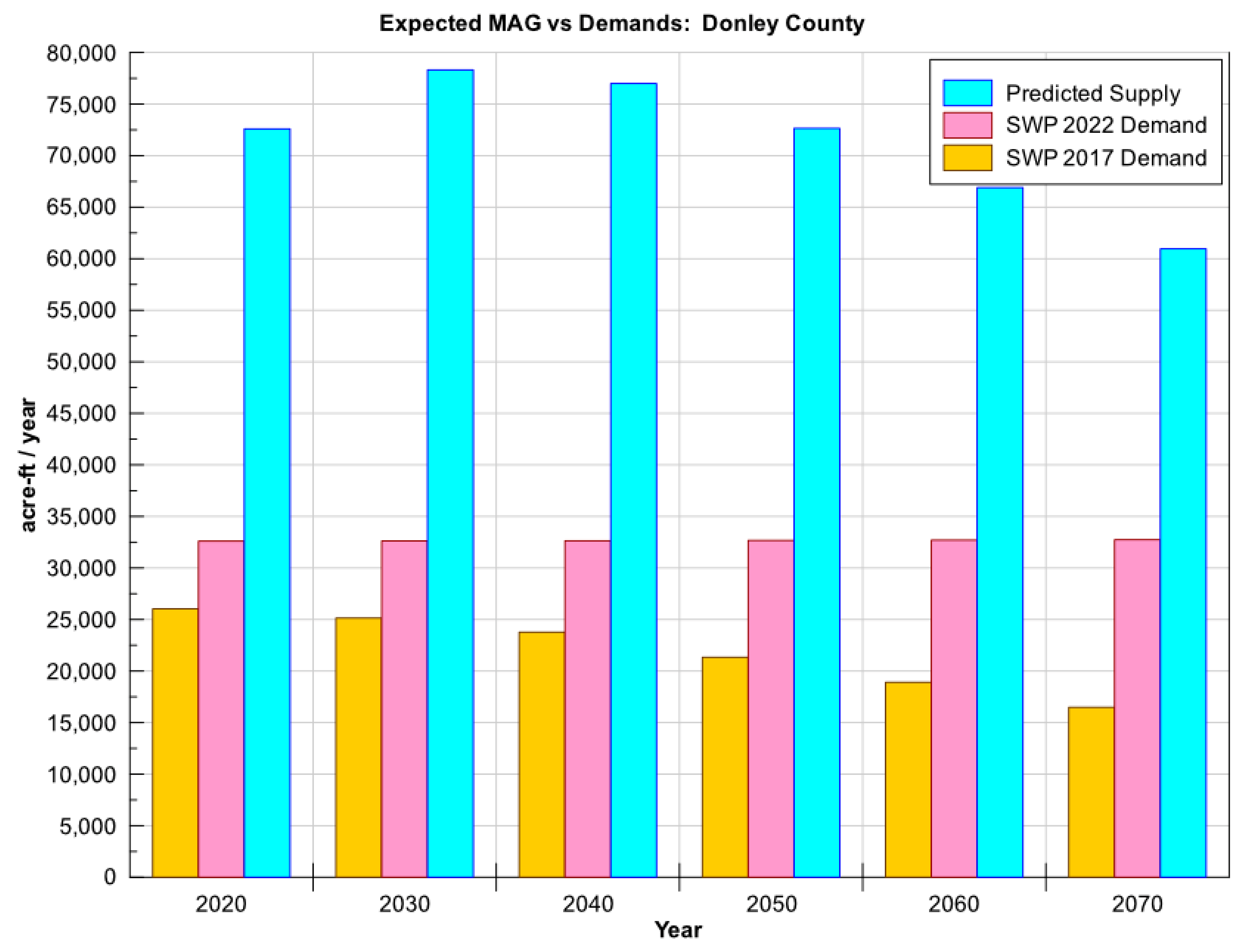
Expected MAG vs Demand



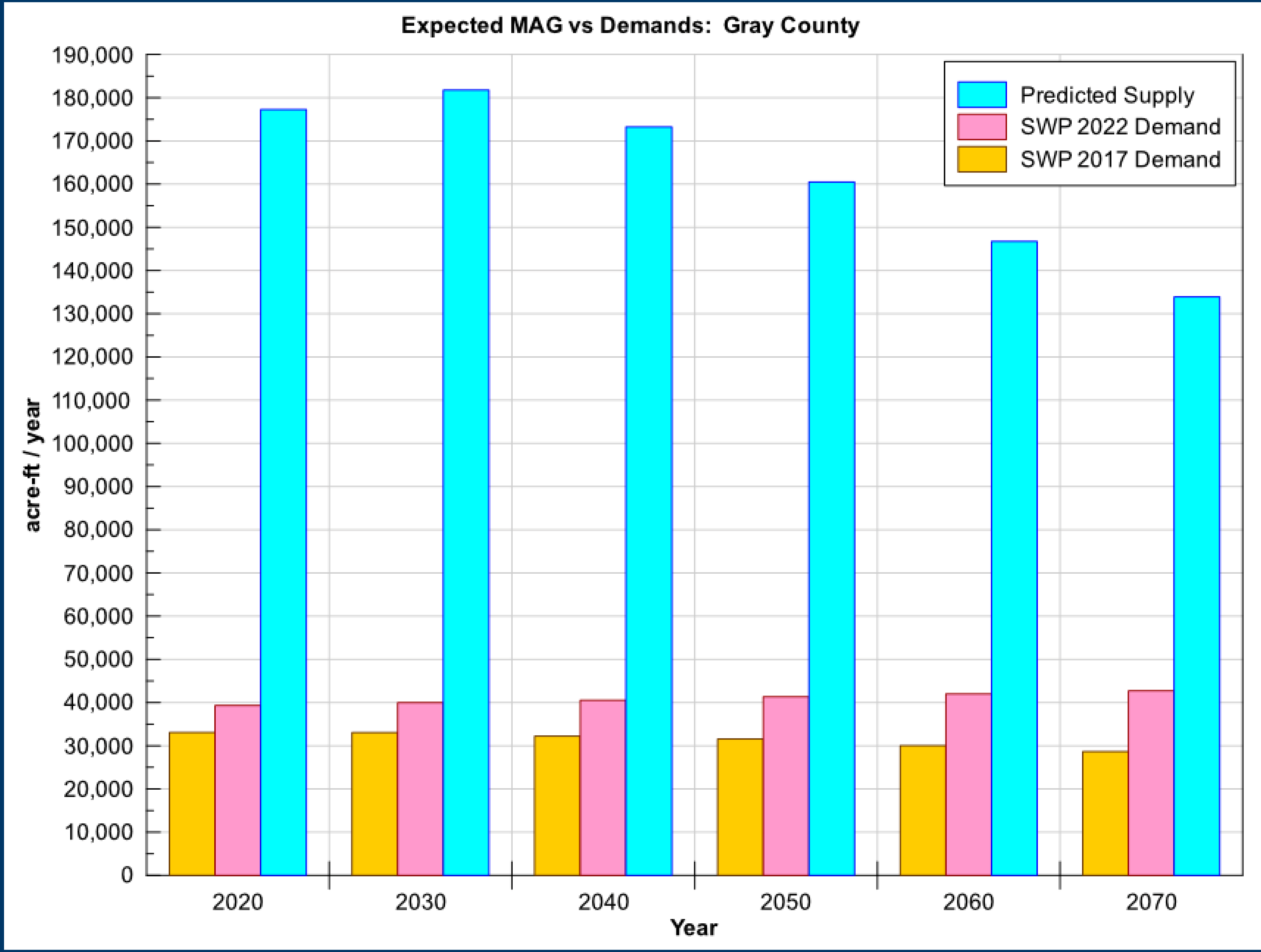
Expected MAG vs Demand



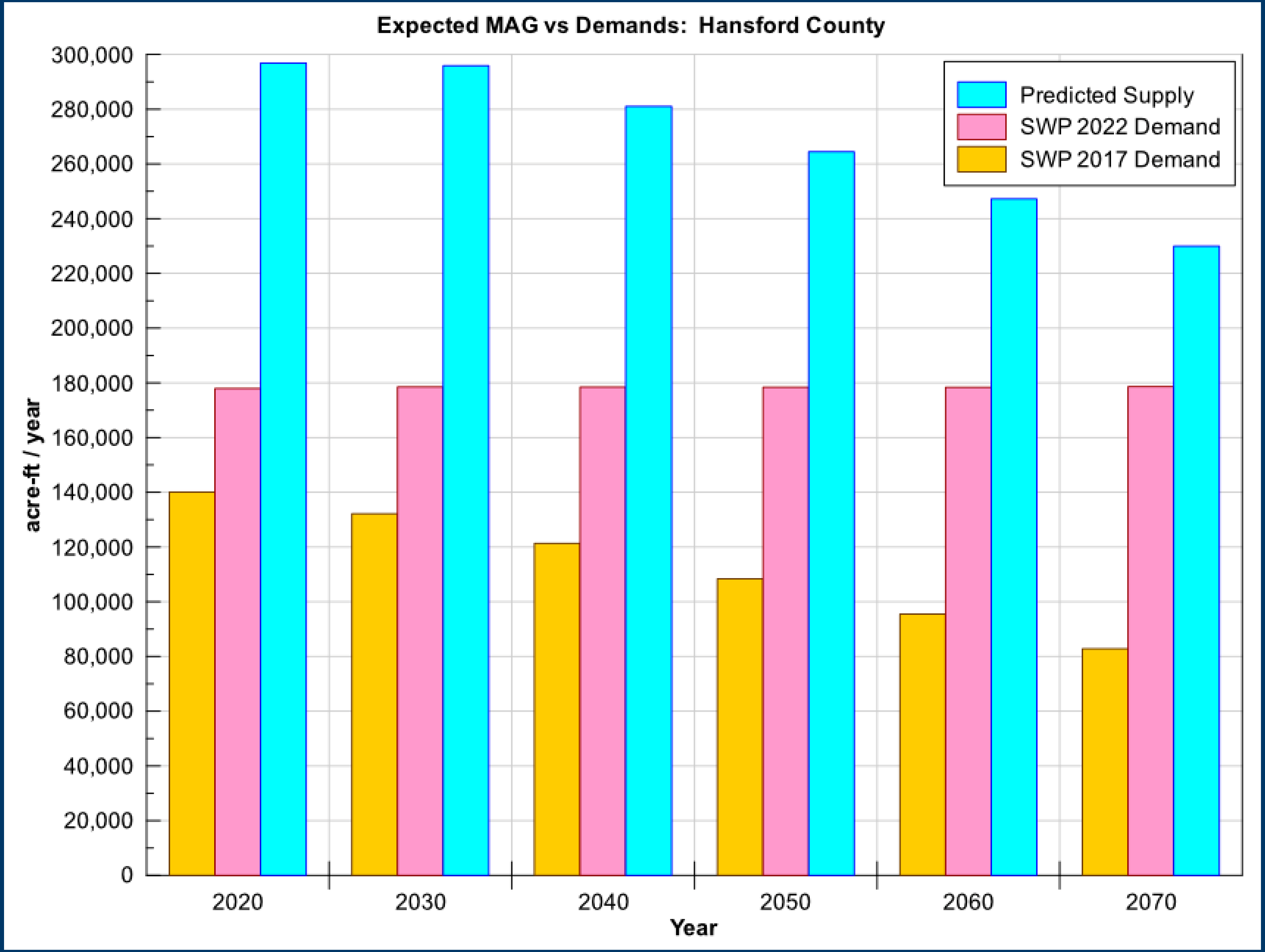
Expected MAG vs Demand



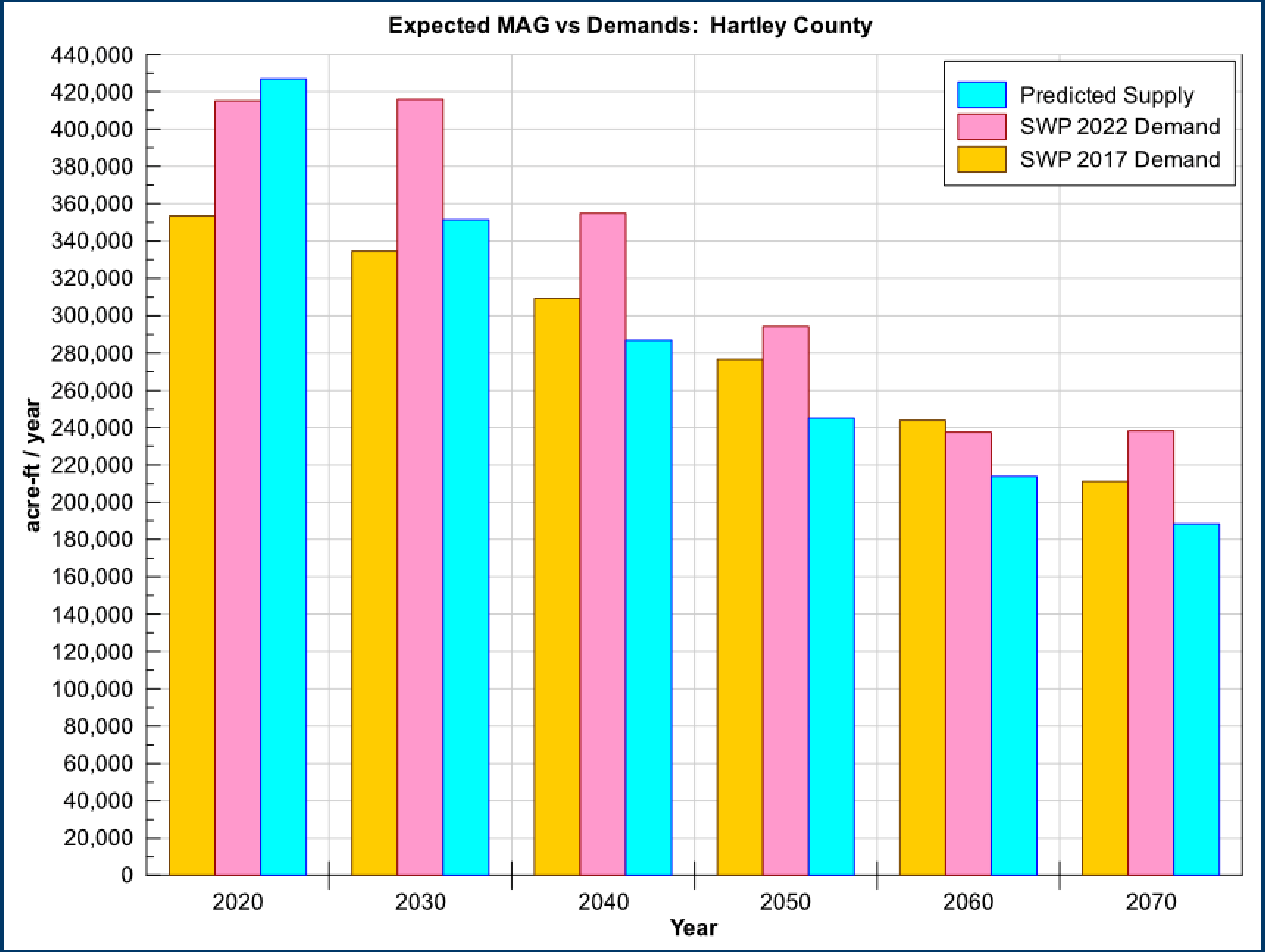
Expected MAG vs Demand



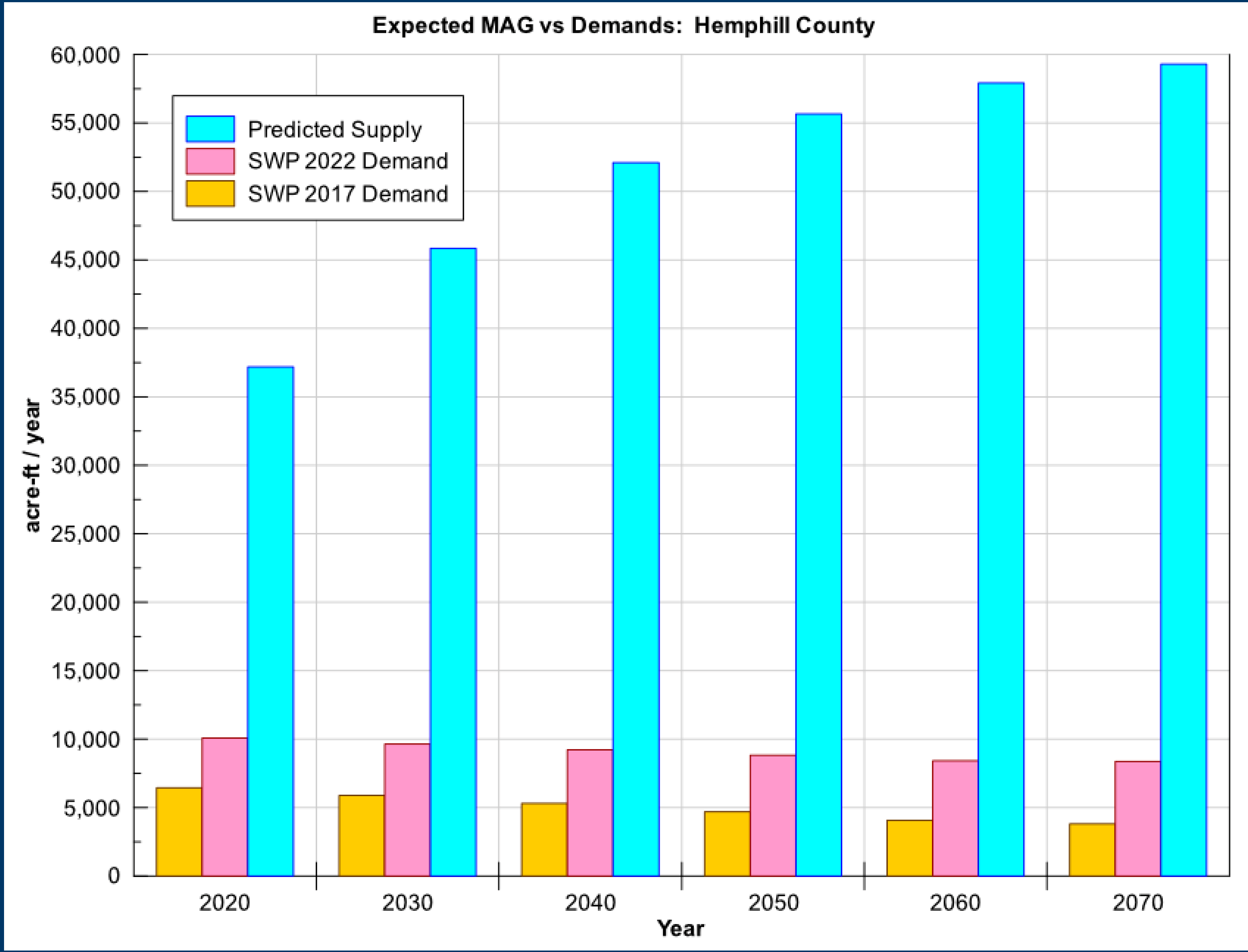
Expected MAG vs Demand



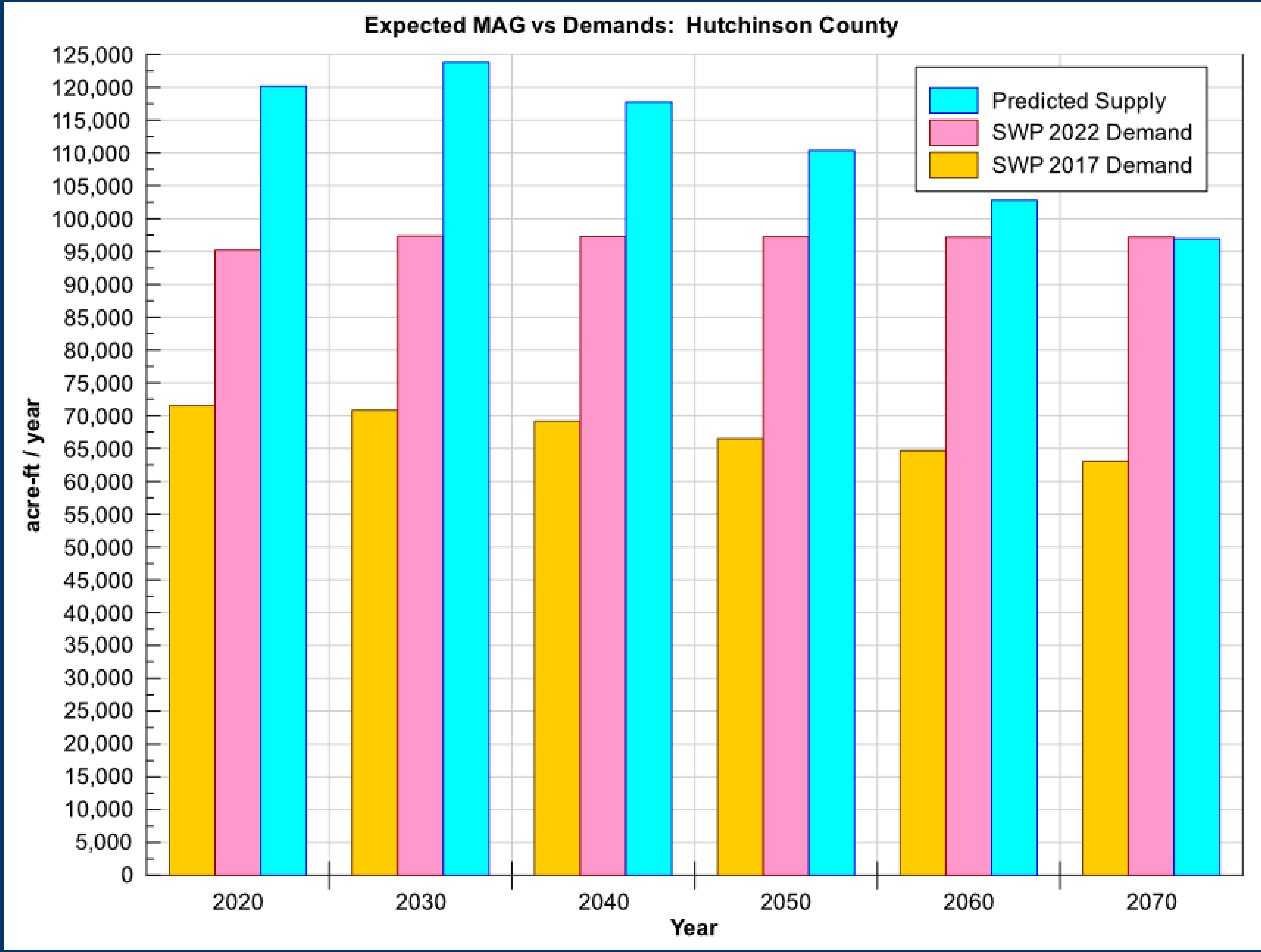
Expected MAG vs Demand



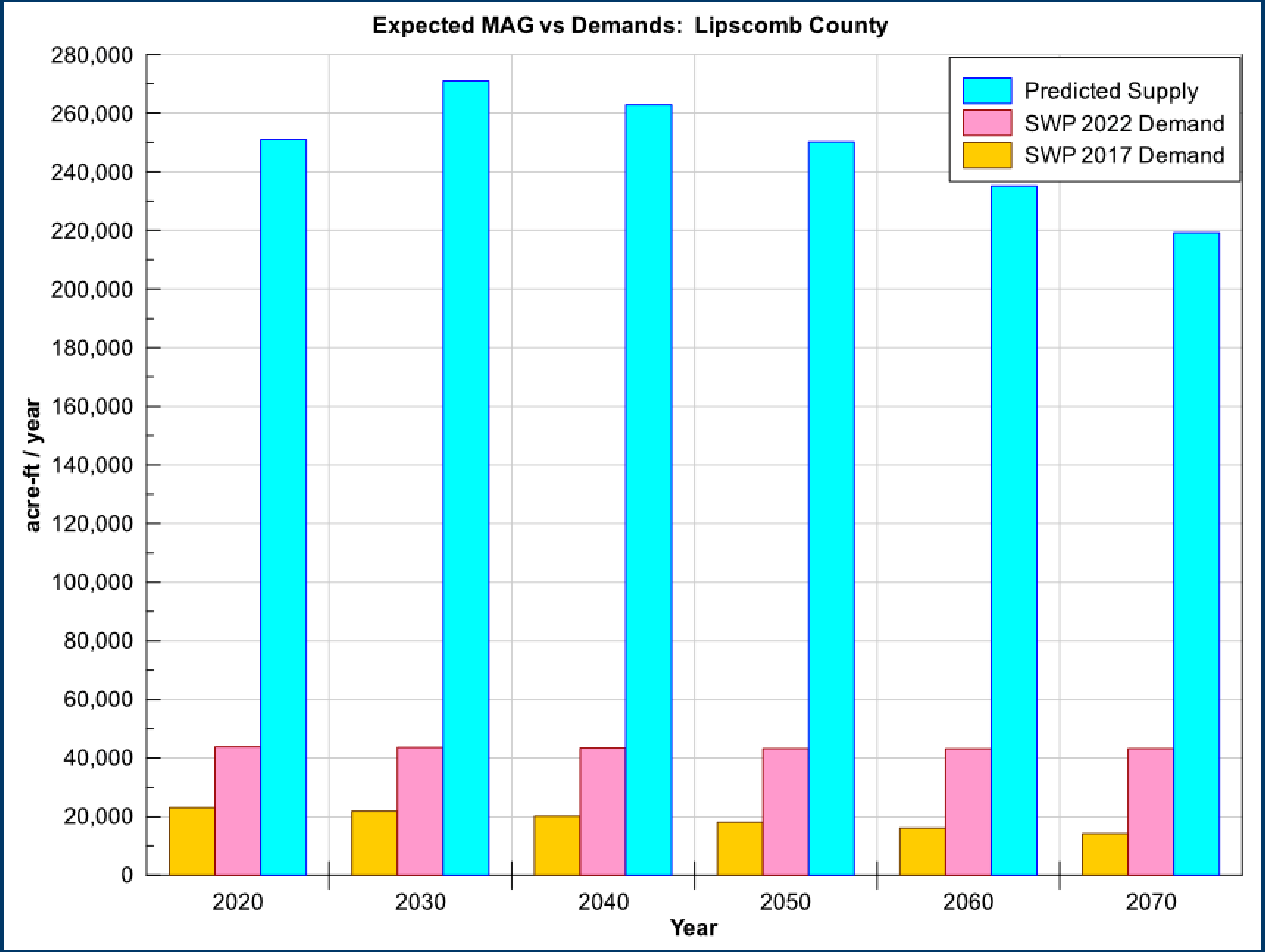
Expected MAG vs Demand



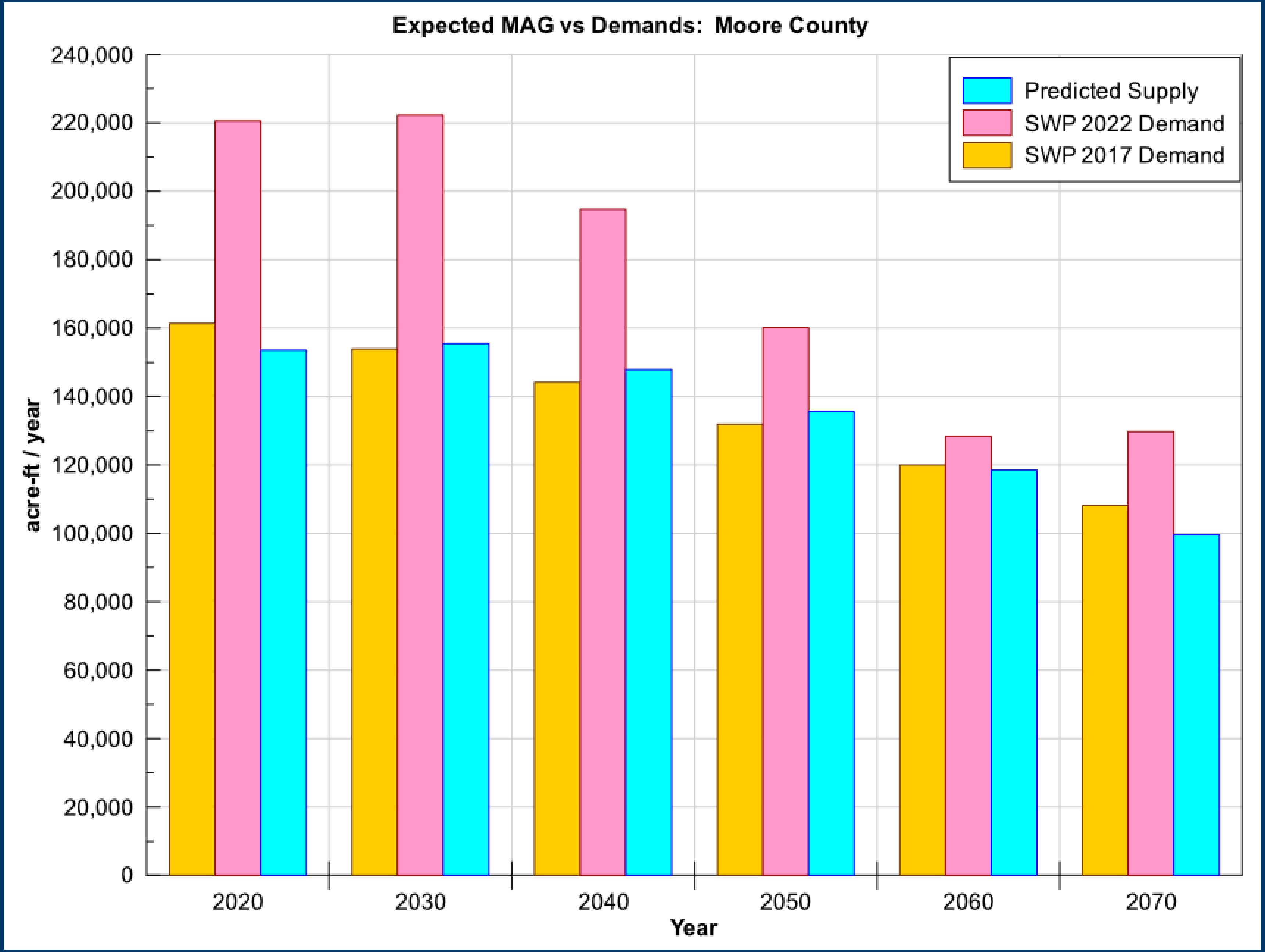
Expected MAG vs Demand



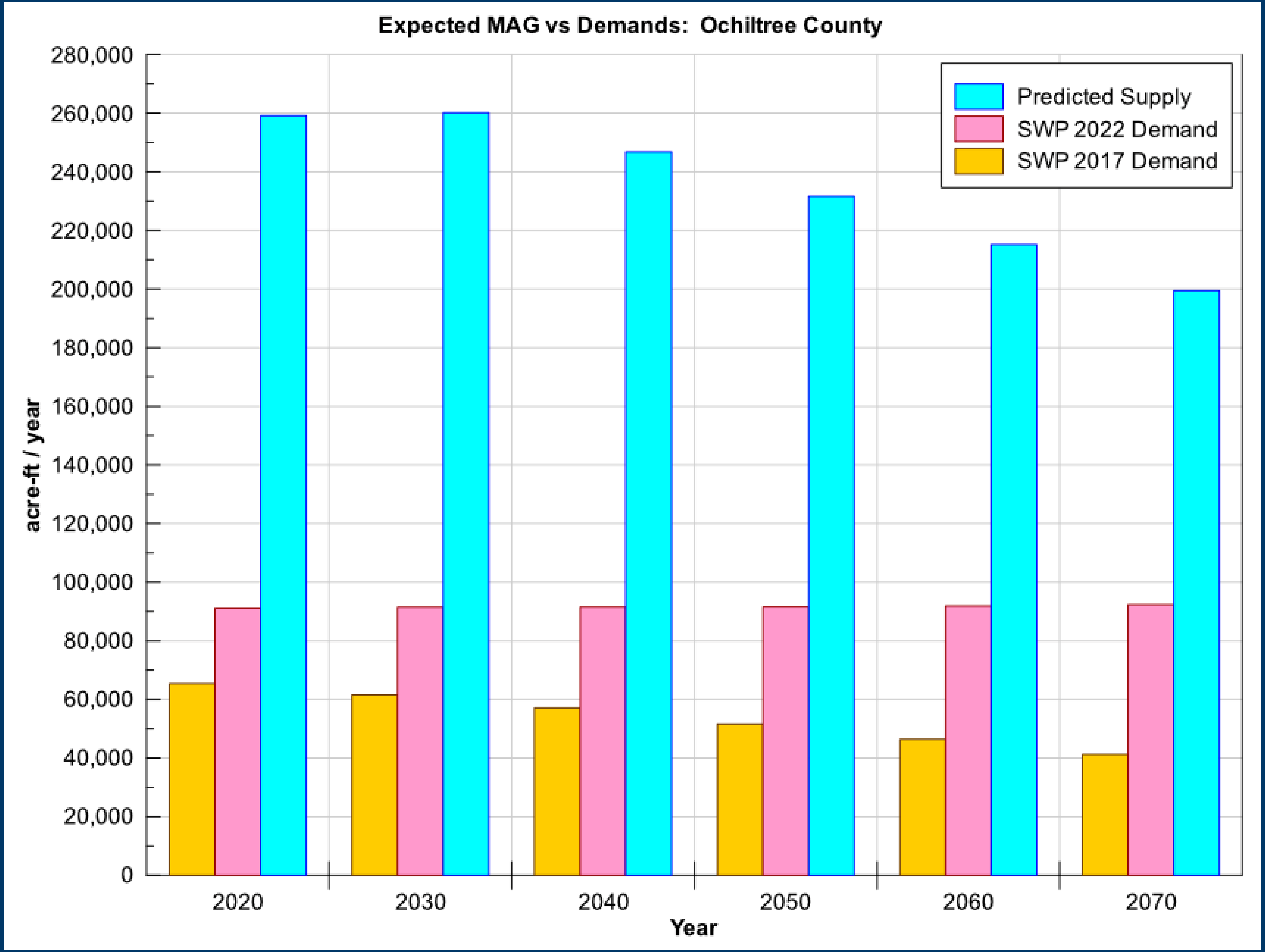
Expected MAG vs Demand



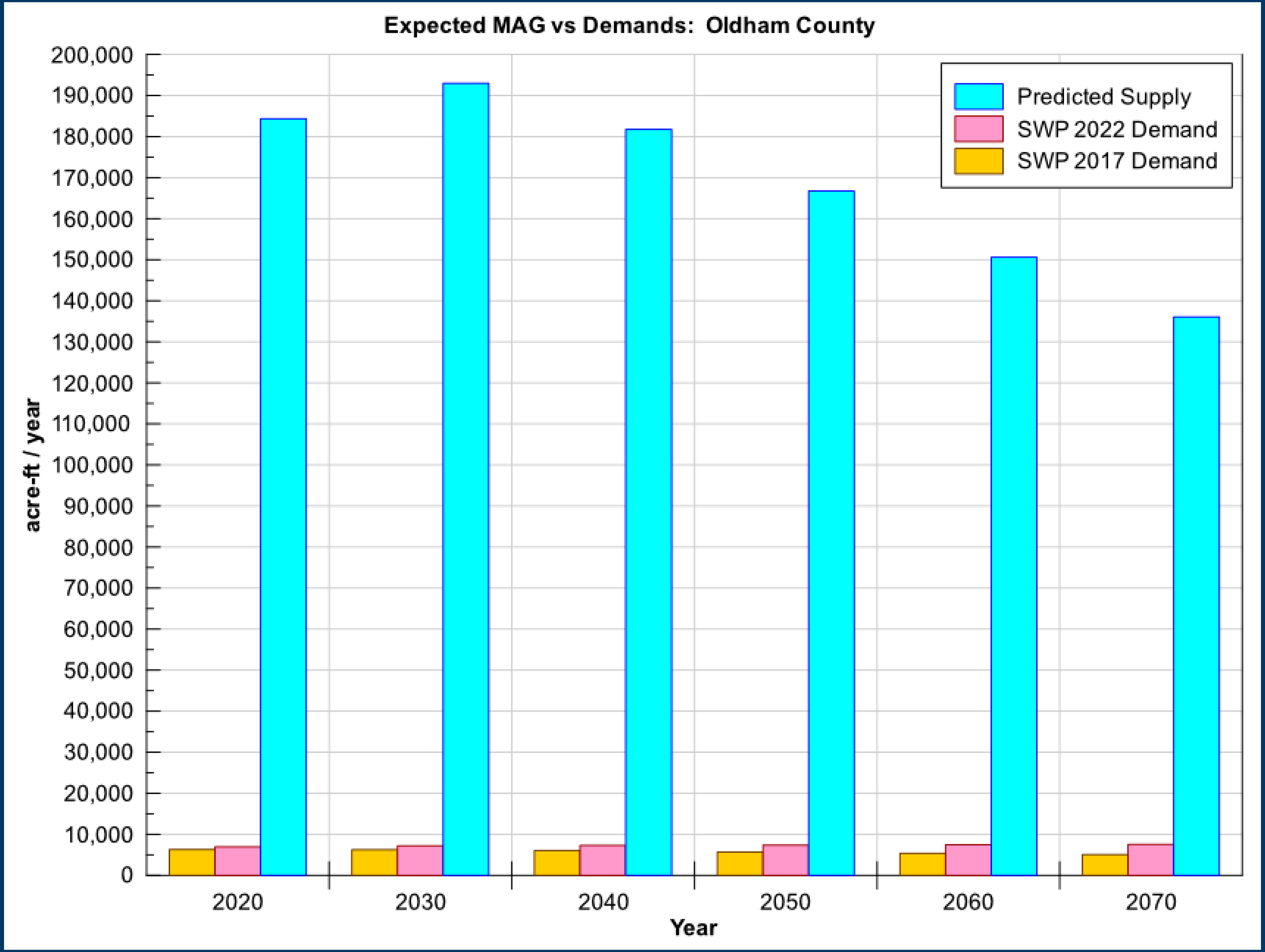
Expected MAG vs Demand



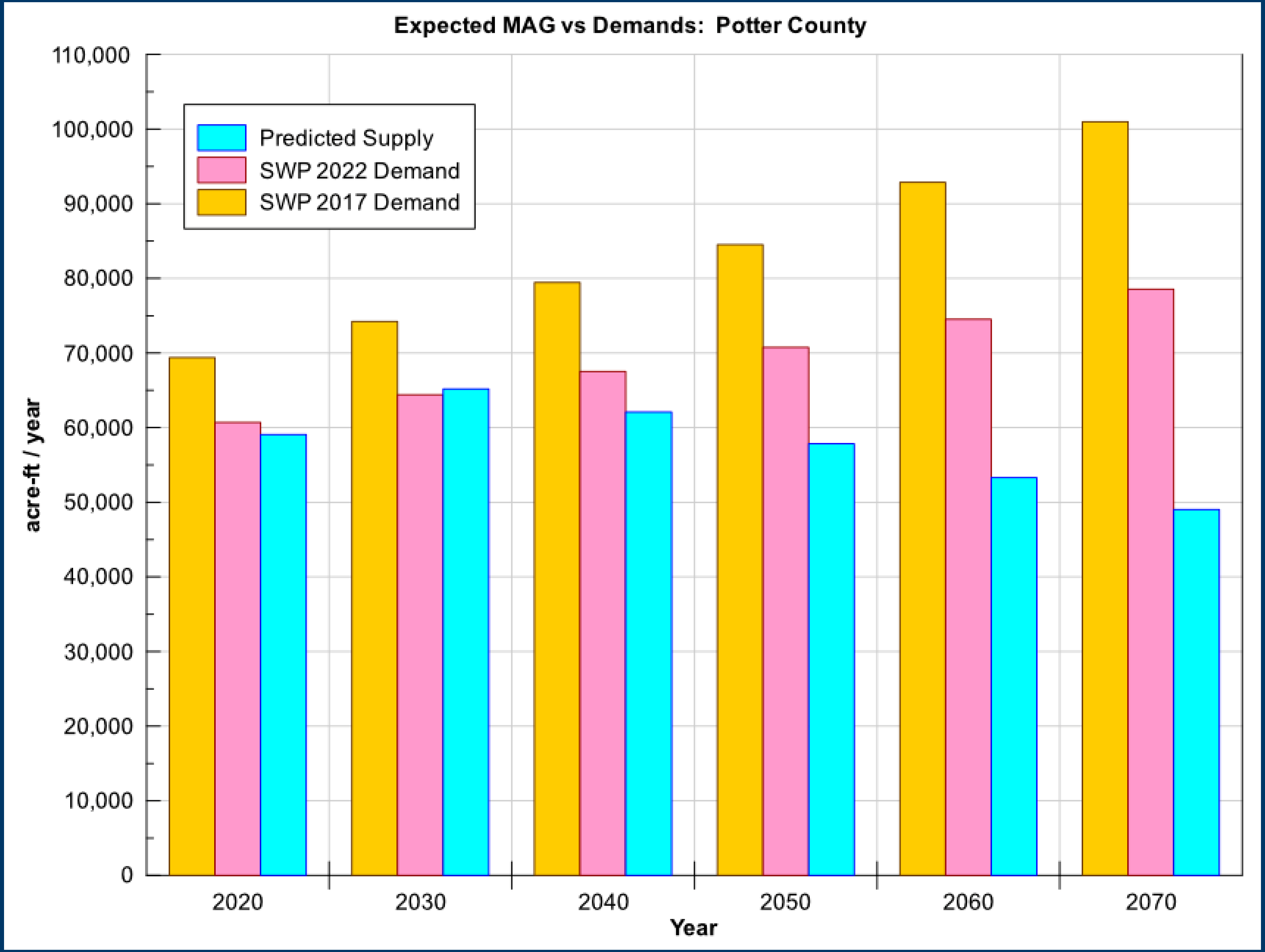
Expected MAG vs Demand



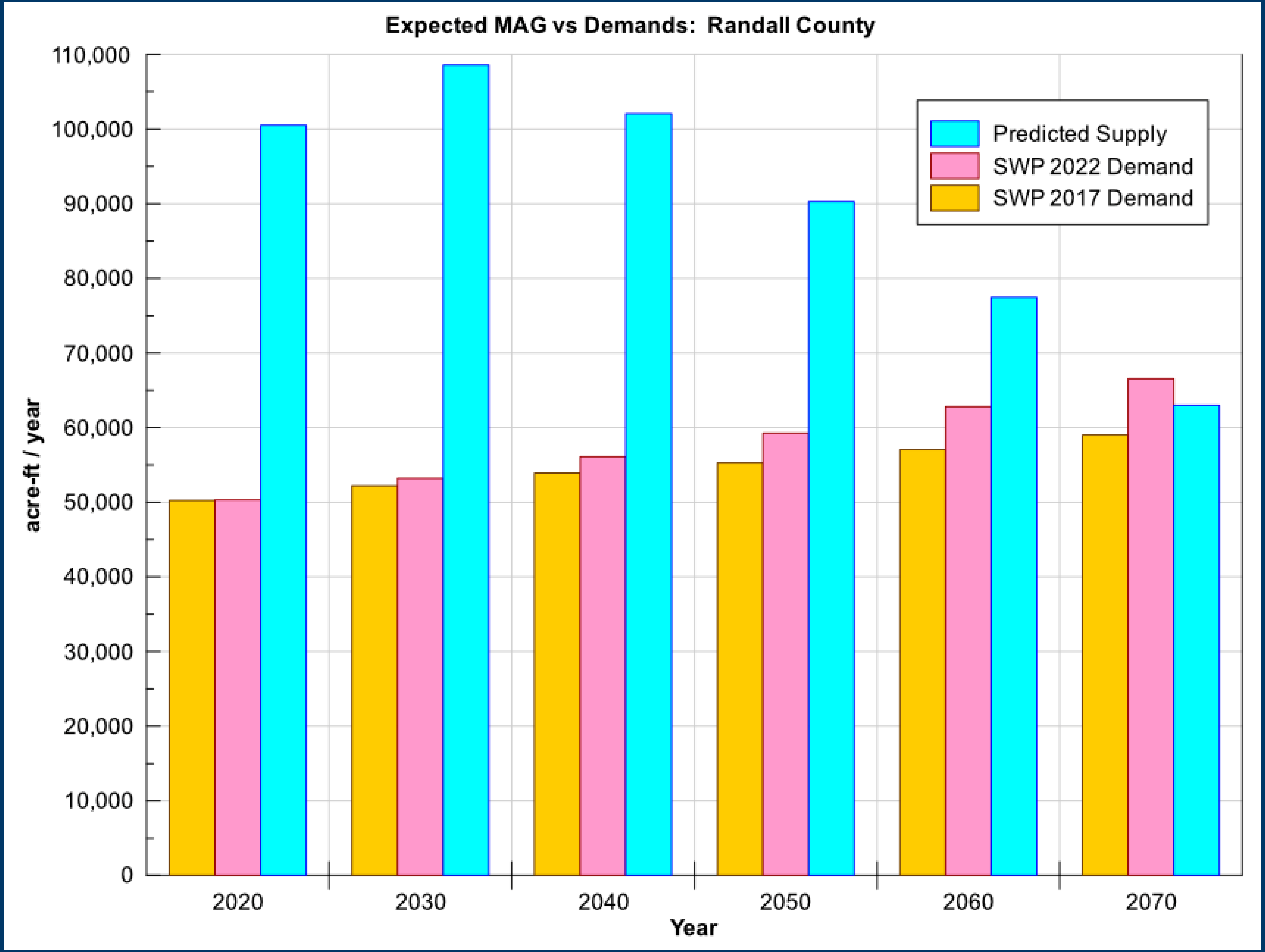
Expected MAG vs Demand



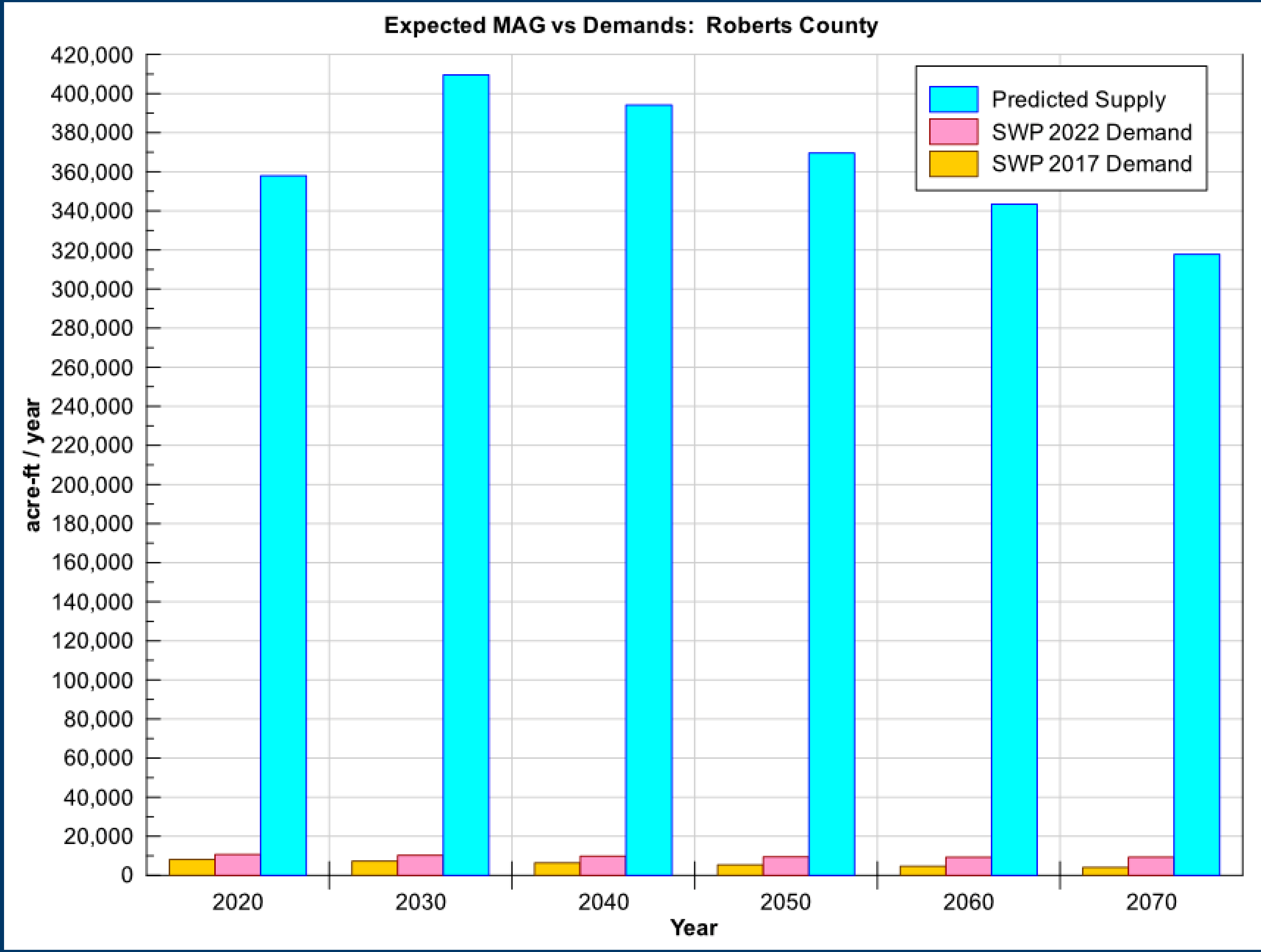
Expected MAG vs Demand



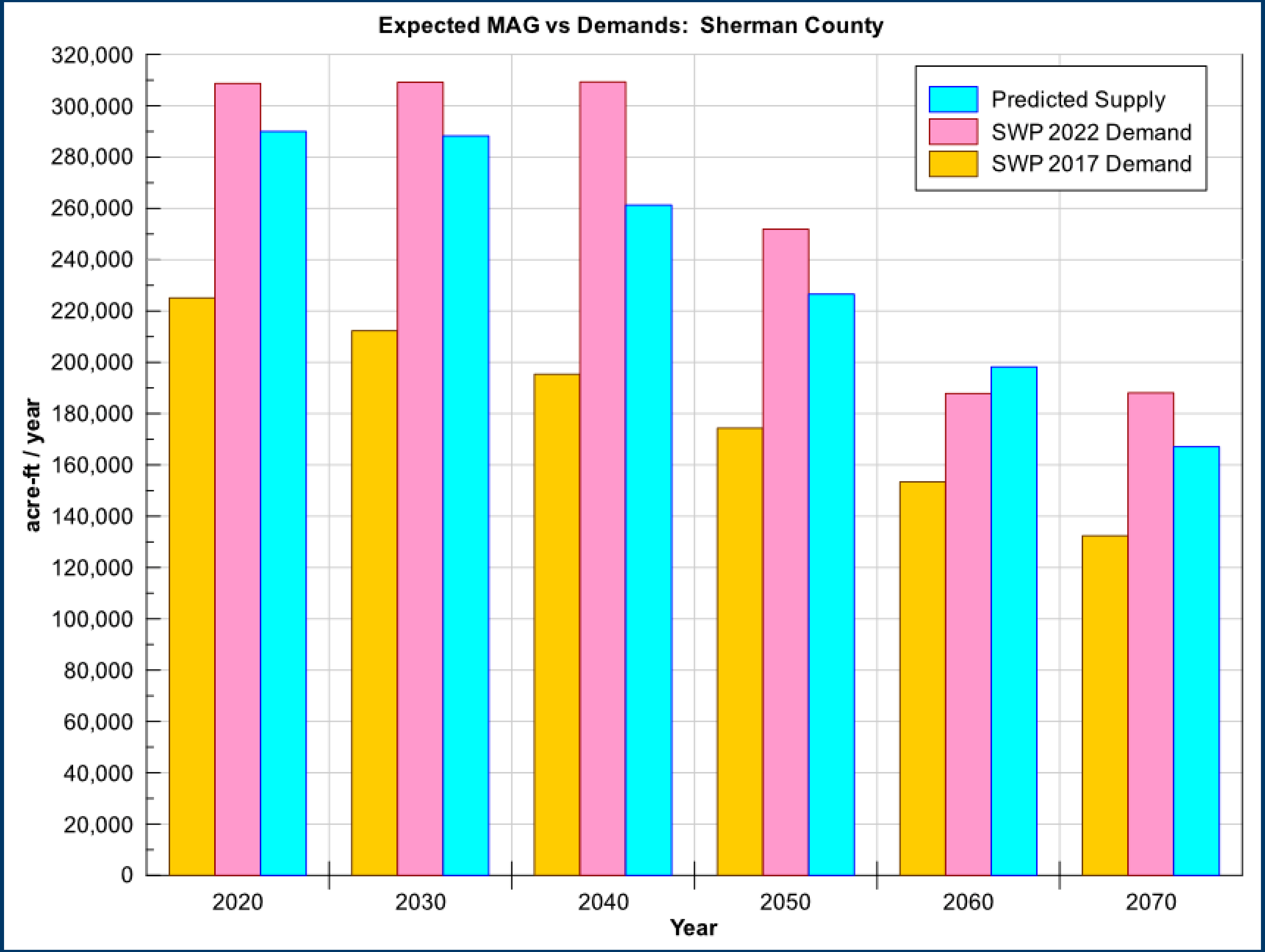
Expected MAG vs Demand



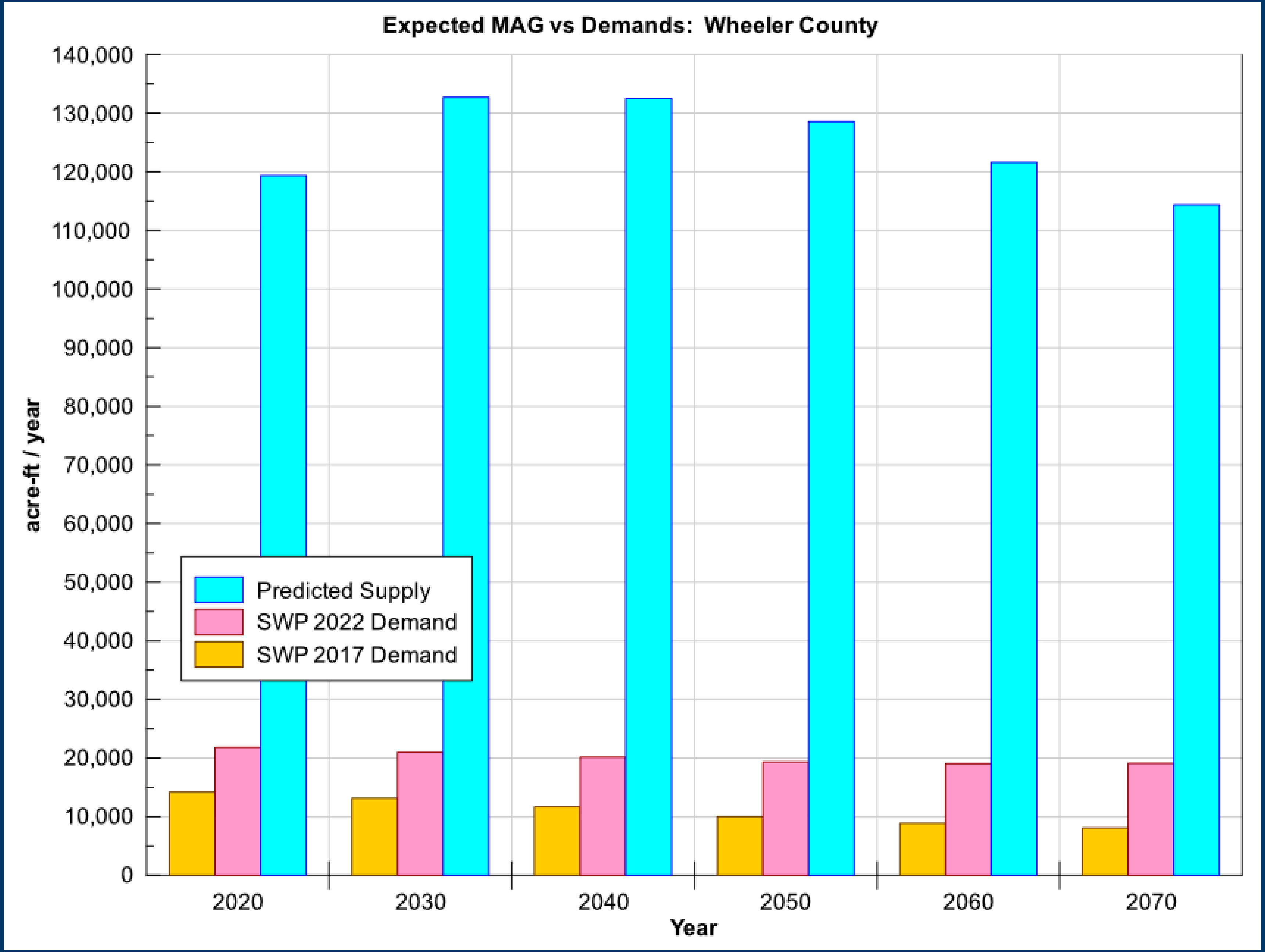
Expected MAG vs Demand



Expected MAG vs Demand



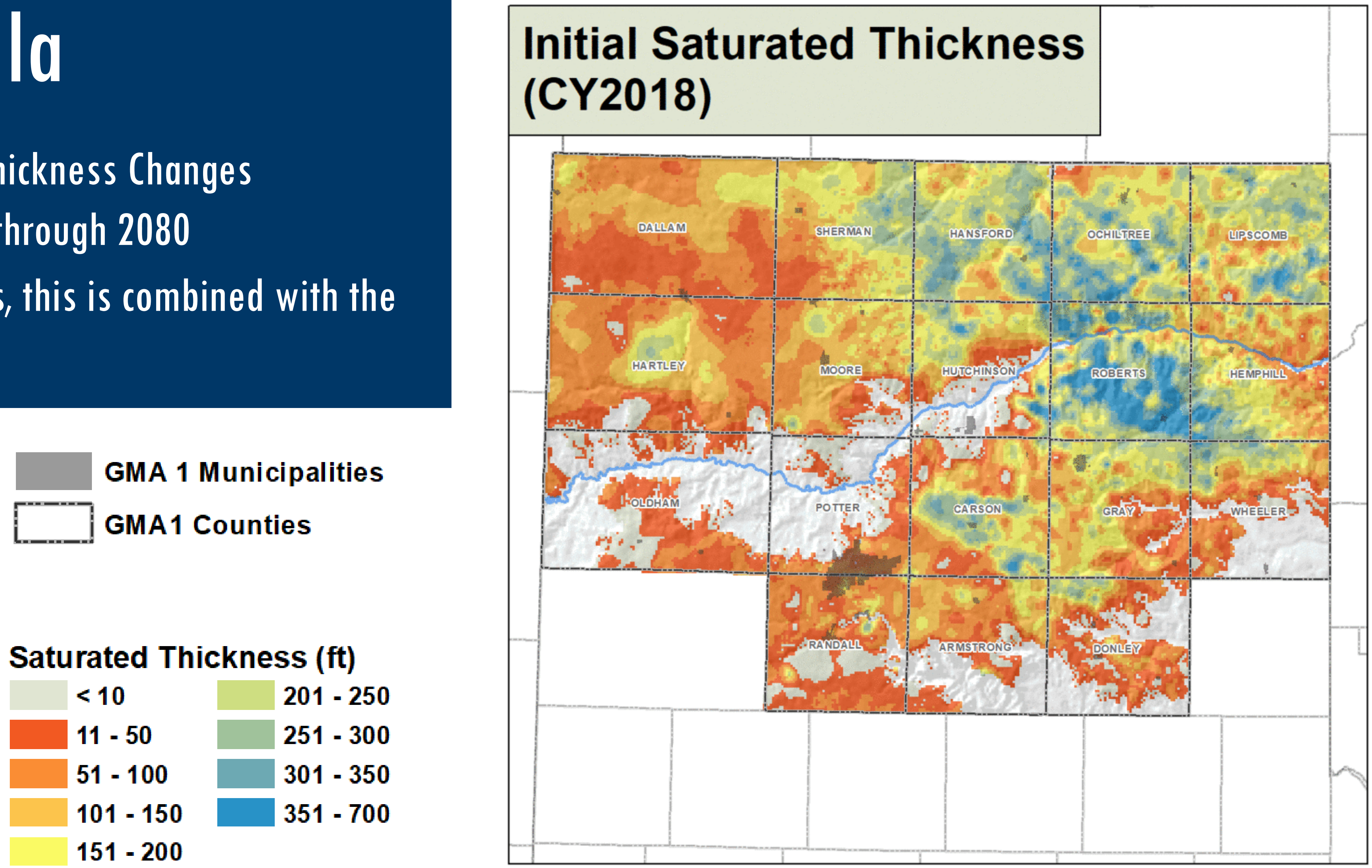
Expected MAG vs Demand



Ogallala

Saturated Thickness Changes
from 2018 through 2080

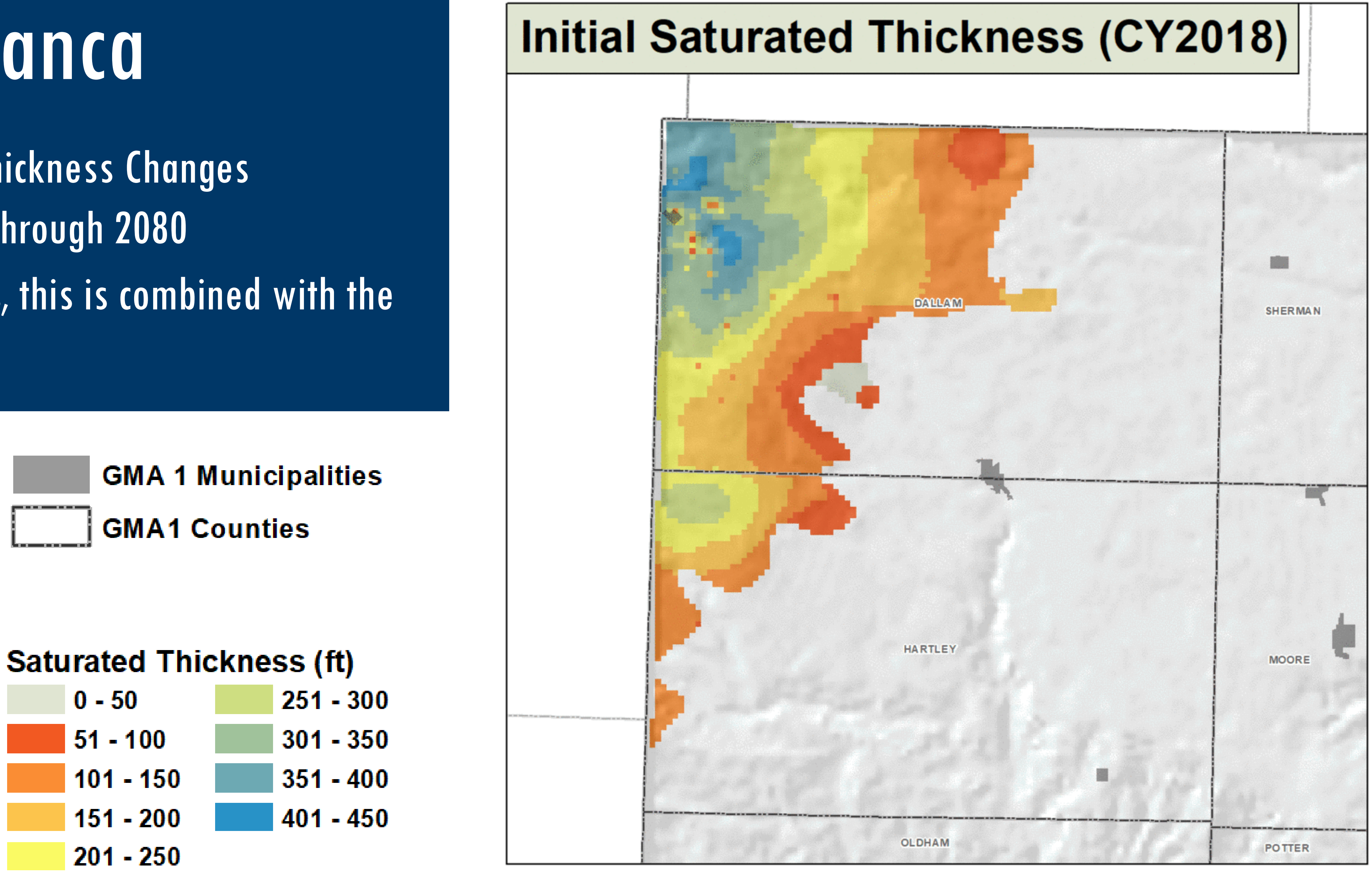
For the DFCs, this is combined with the Rita Blanca



Rita Blanca

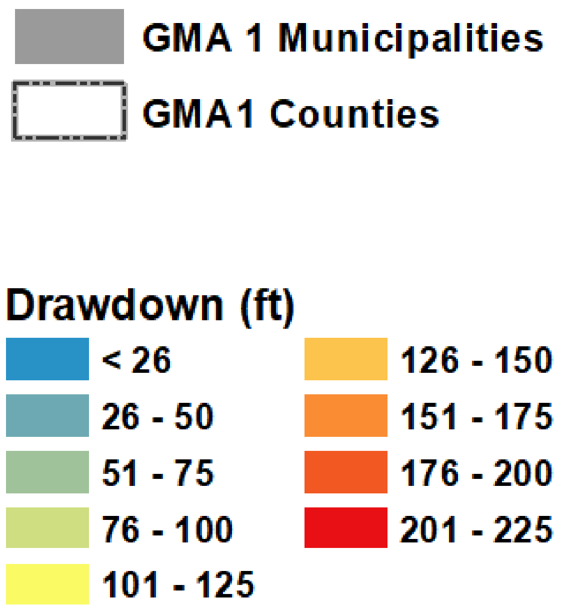
Saturated Thickness Changes from 2018 through 2080

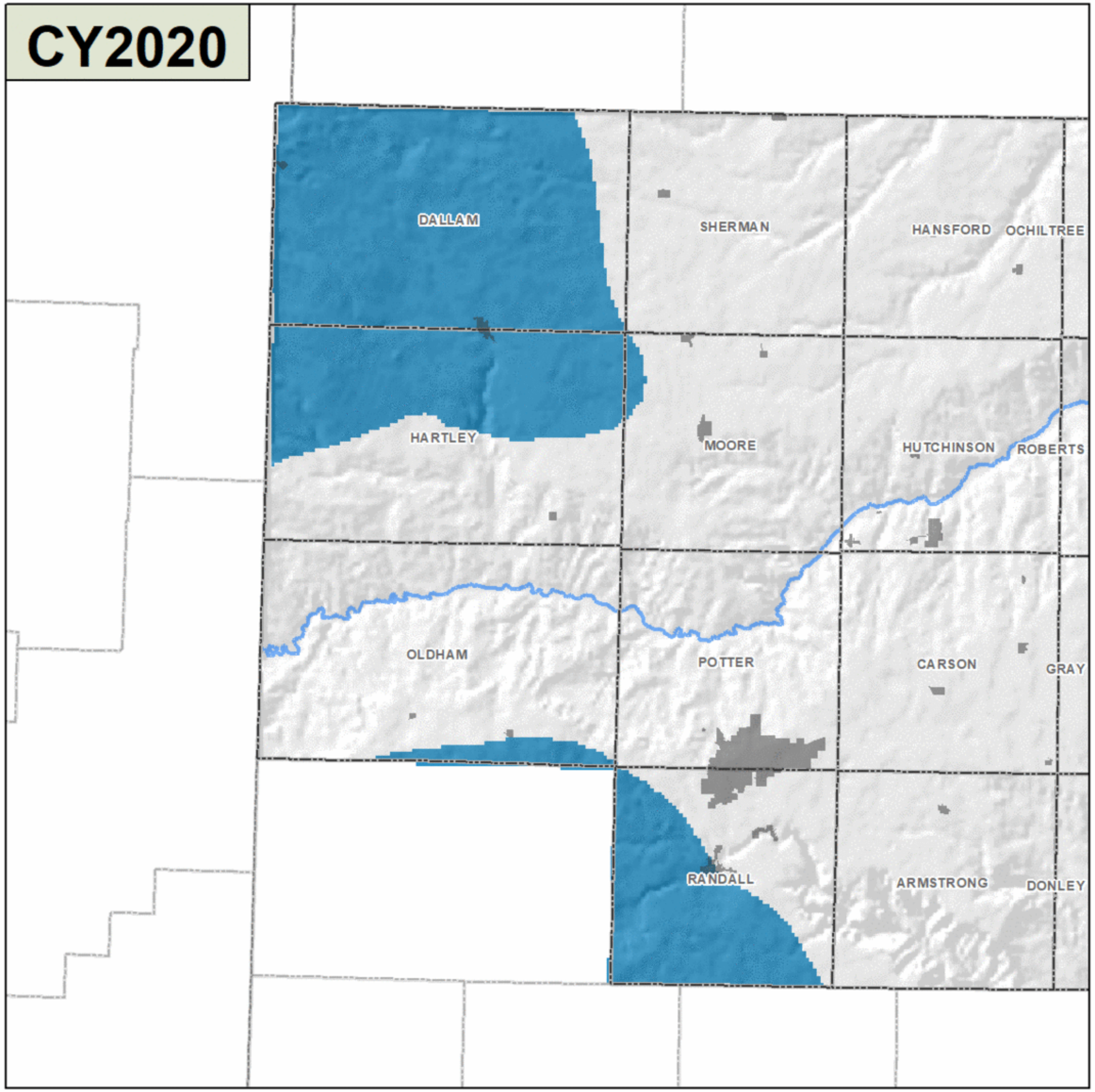
For the DFCs, this is combined with the Ogallala



Upper Dockum

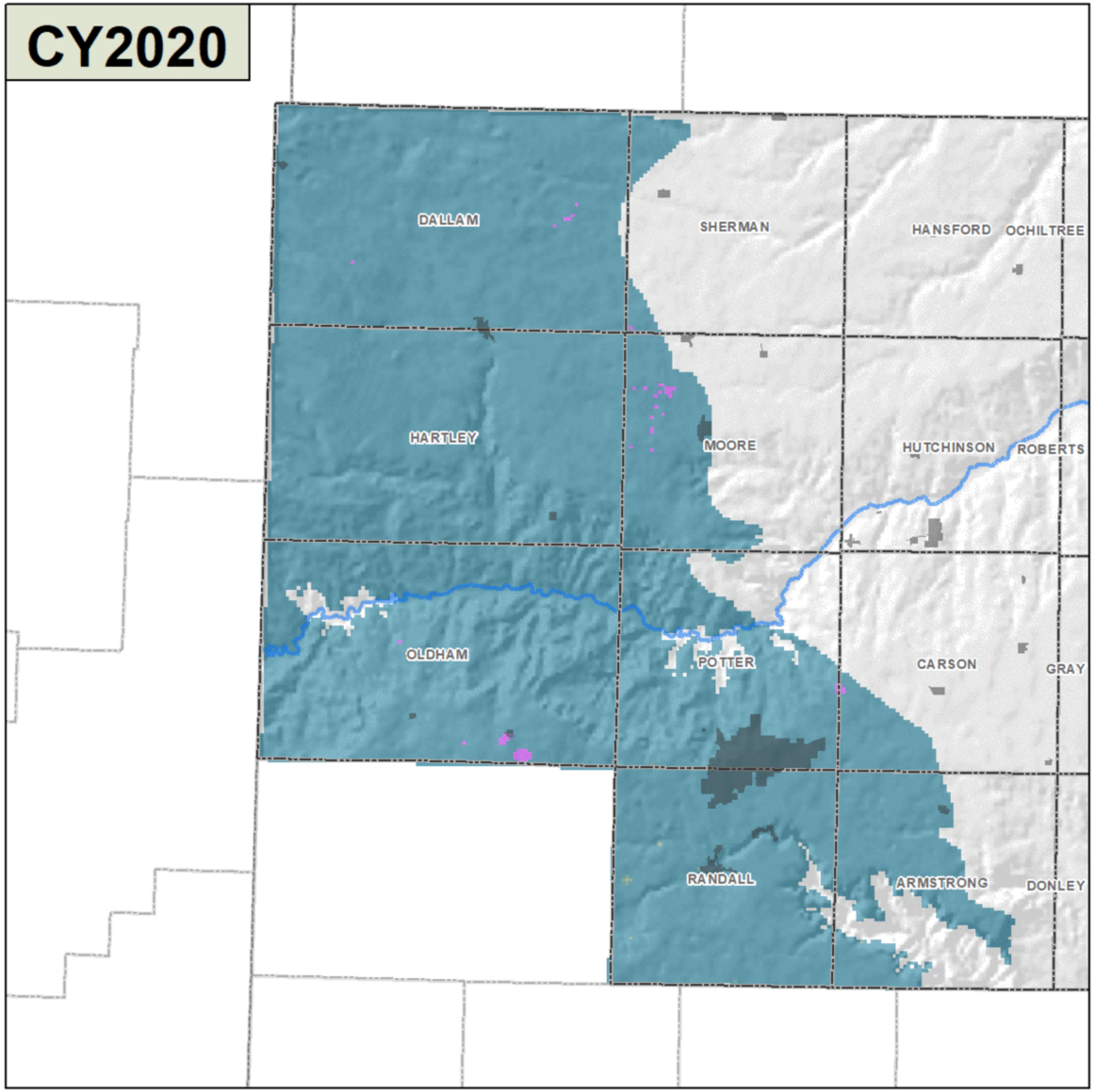
Drawdown from 2018 through 2080





Lower Dockum

Drawdown from 2018 through 2080



GMA 1 Municipalities

GMA1 Counties

Drawdown (ft)

< 0	251 - 300
0 - 50	301 - 350
51 - 100	351 - 400
101 - 150	401 - 450
151 - 200	451 - 500
201 - 250	501 - 550

Balancing Private Property Rights

"Lenient" DFCs

Allow existing users to produce more groundwater on existing acreage

Poses risks to water supply and needs of future users

Increased drainage from neighboring landowners

"Conservation" DFCs

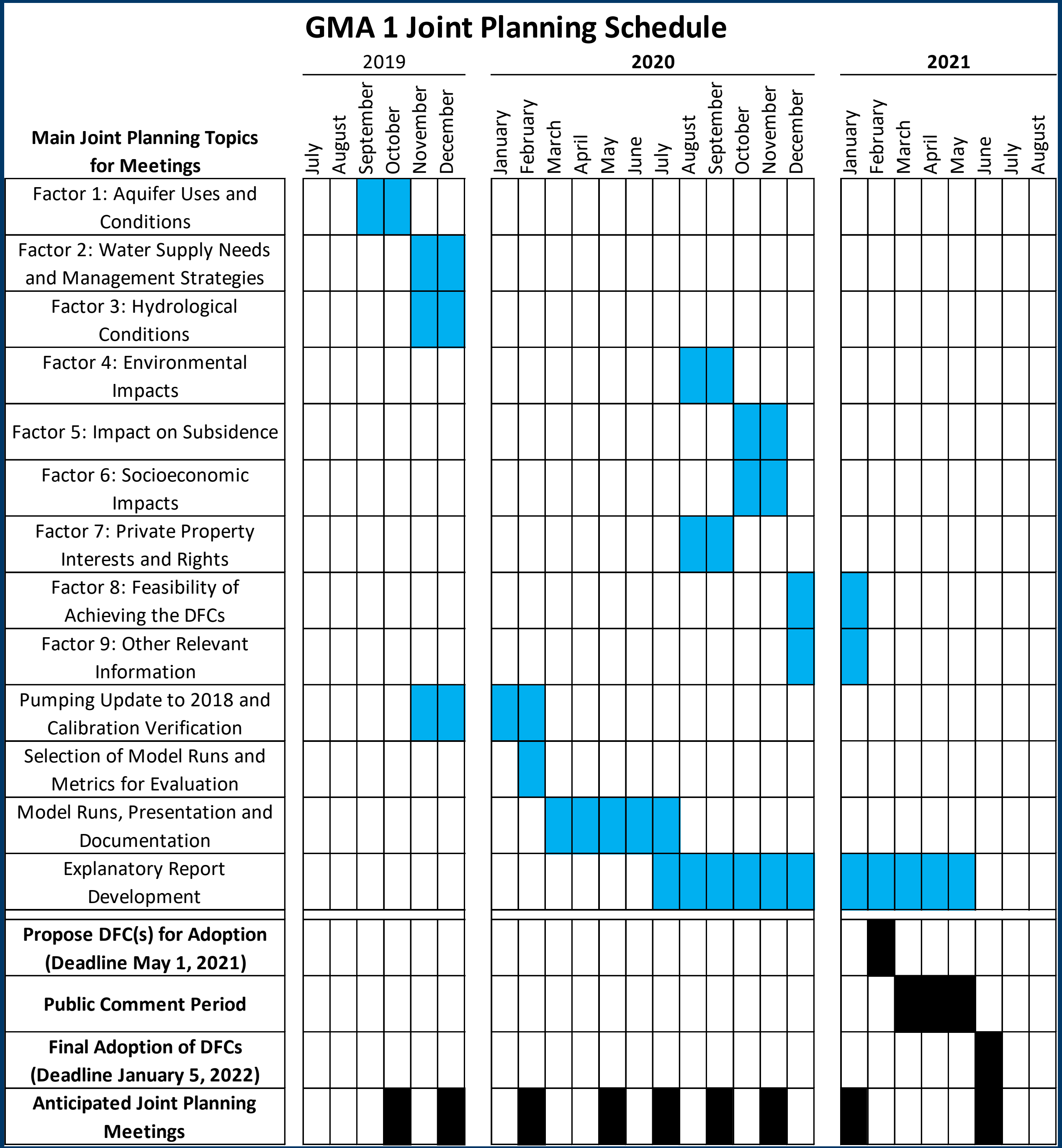
May require some users to reduce production or acquire more groundwater rights

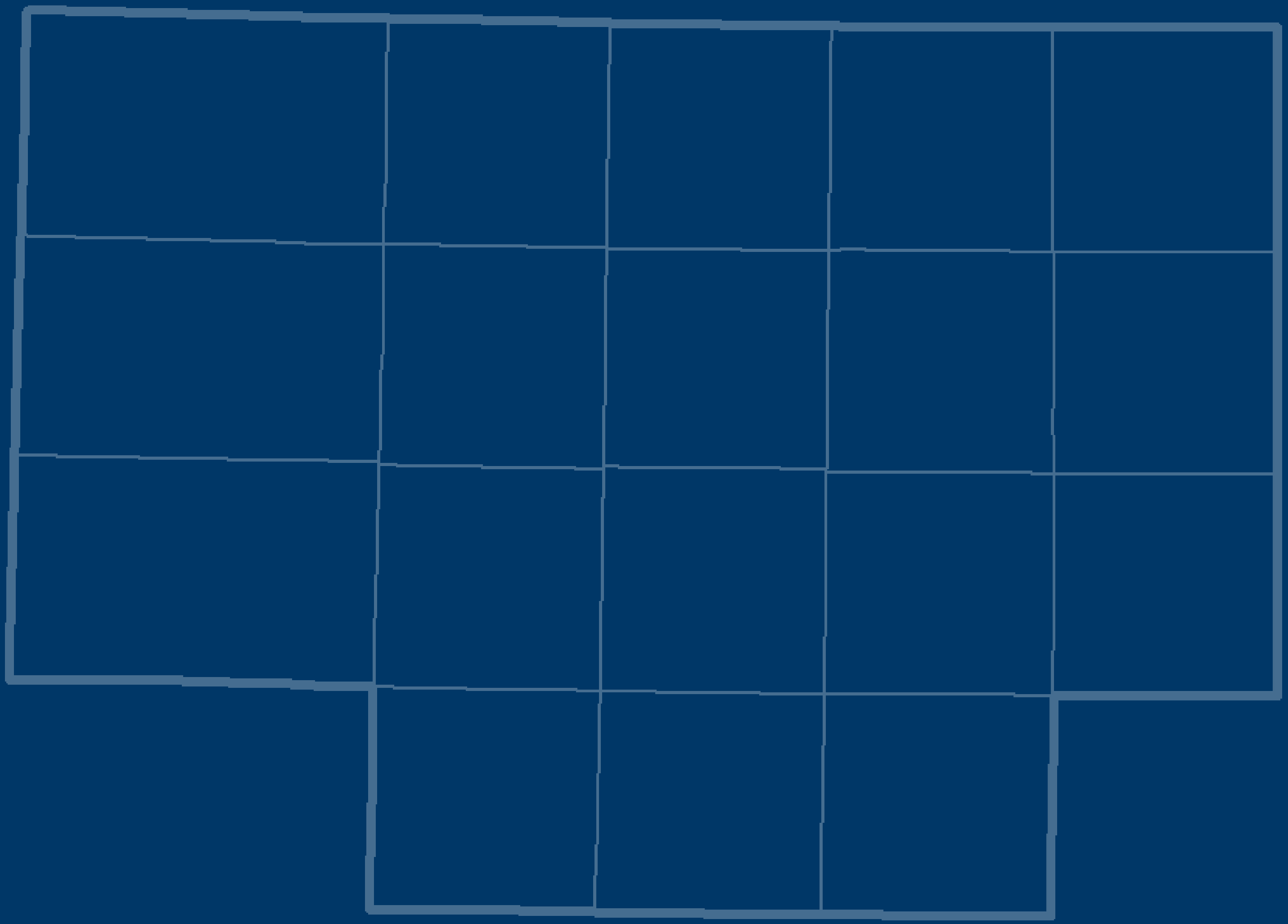
May extend groundwater supply and levels to meet future needs

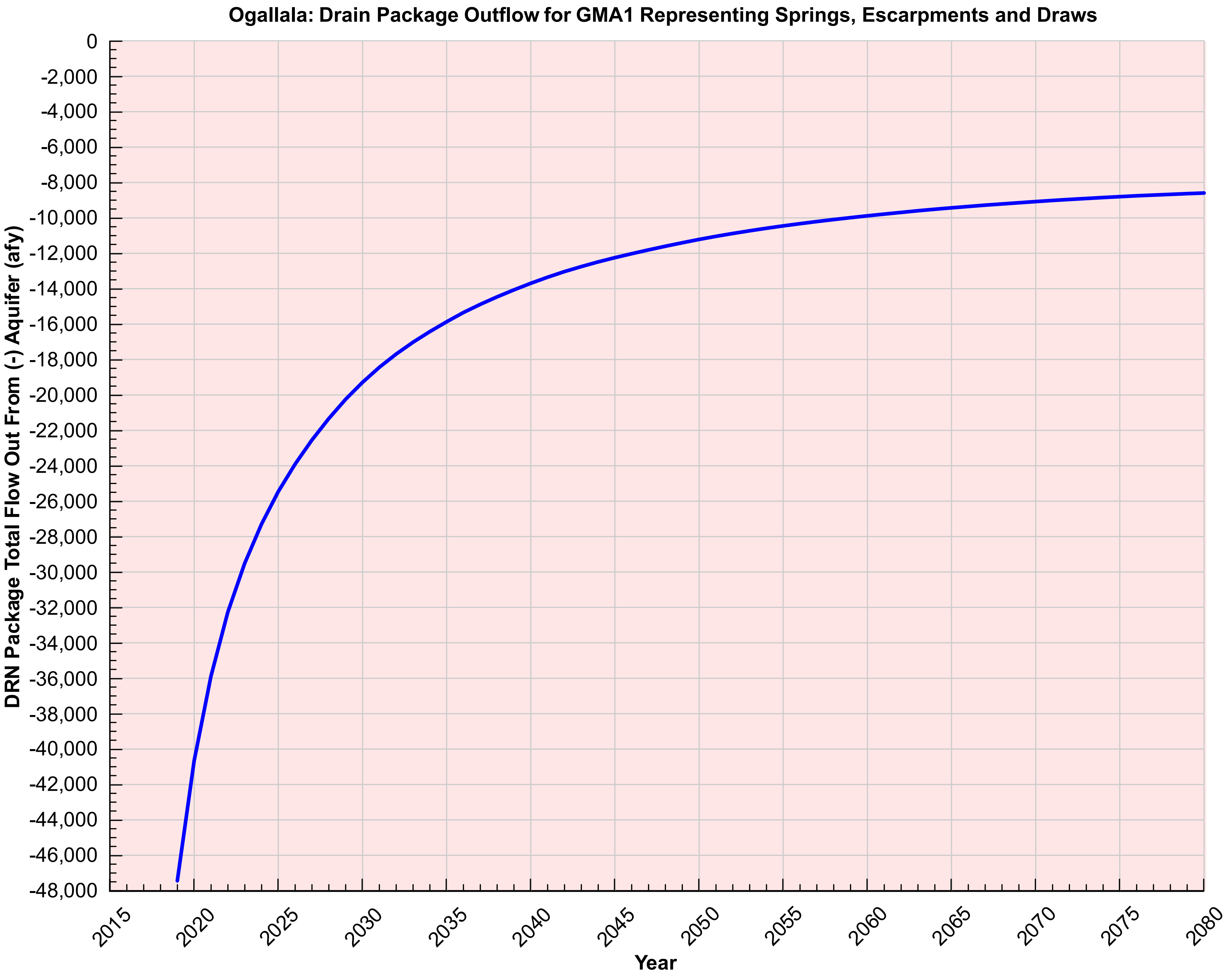
Minimizes well interference and induced groundwater drainage between property owners

Source: Evaluation of private property rights described in 2016 GMA 1 Explanatory Report

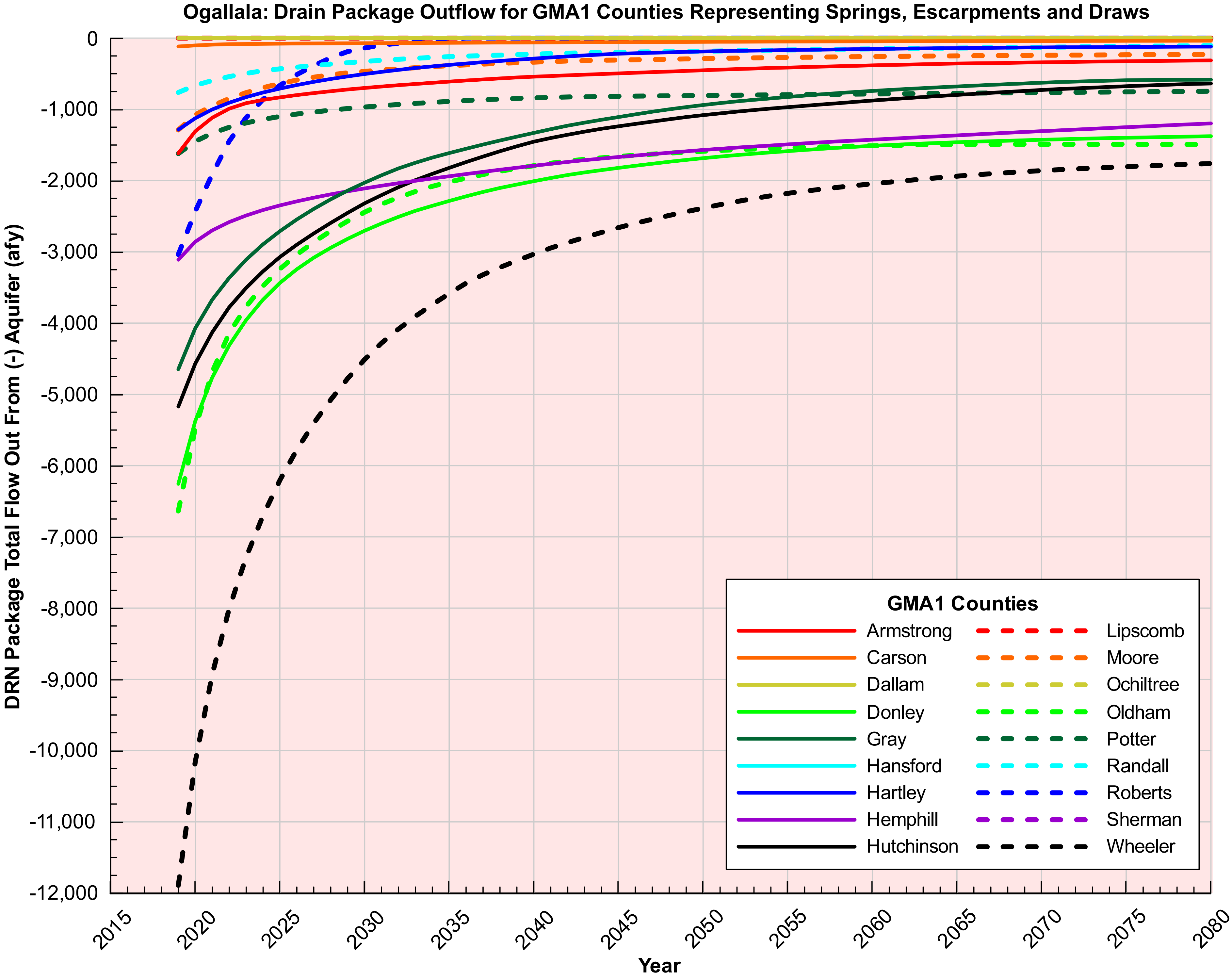
Next Steps


GMA 1 Joint Planning Schedule
2019
2020
2021
Main Joint Planning Topics for Meetings
July
August
September
October
November
December
January
February
March
April
May
June
July
August
September
October
November
December
January
February
March
April
May
June
July
August
Factor 1: Aquifer Uses and Conditions
Factor 2: Water Supply Needs and Management Strategies
Factor 3: Hydrological Conditions
Factor 4: Environmental Impacts
Factor 5: Impact on Subsidence
Factor 6: Socioeconomic Impacts
Factor 7: Private Property Interests and Rights
Factor 8: Feasibility of Achieving the DFCs
Factor 9: Other Relevant Information
Pumping Update to 2018 and Calibration Verification
Selection of Model Runs and Metrics for Evaluation
Model Runs, Presentation and Documentation
Explanatory Report Development
Propose DFC(s) for Adoption (Deadline May 1, 2021)
Public Comment Period
Final Adoption of DFCs (Deadline January 5, 2022)
Anticipated Joint Planning Meetings

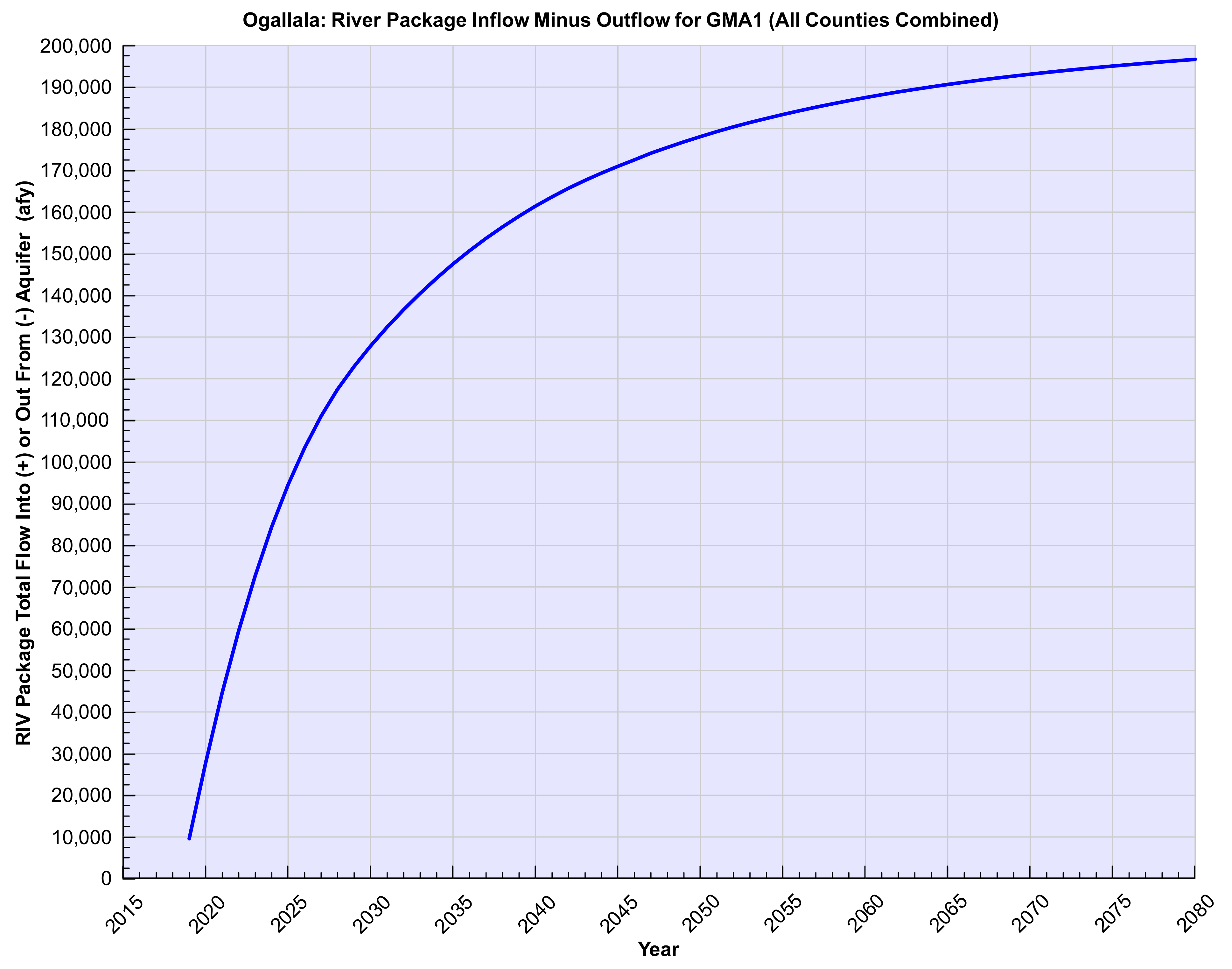




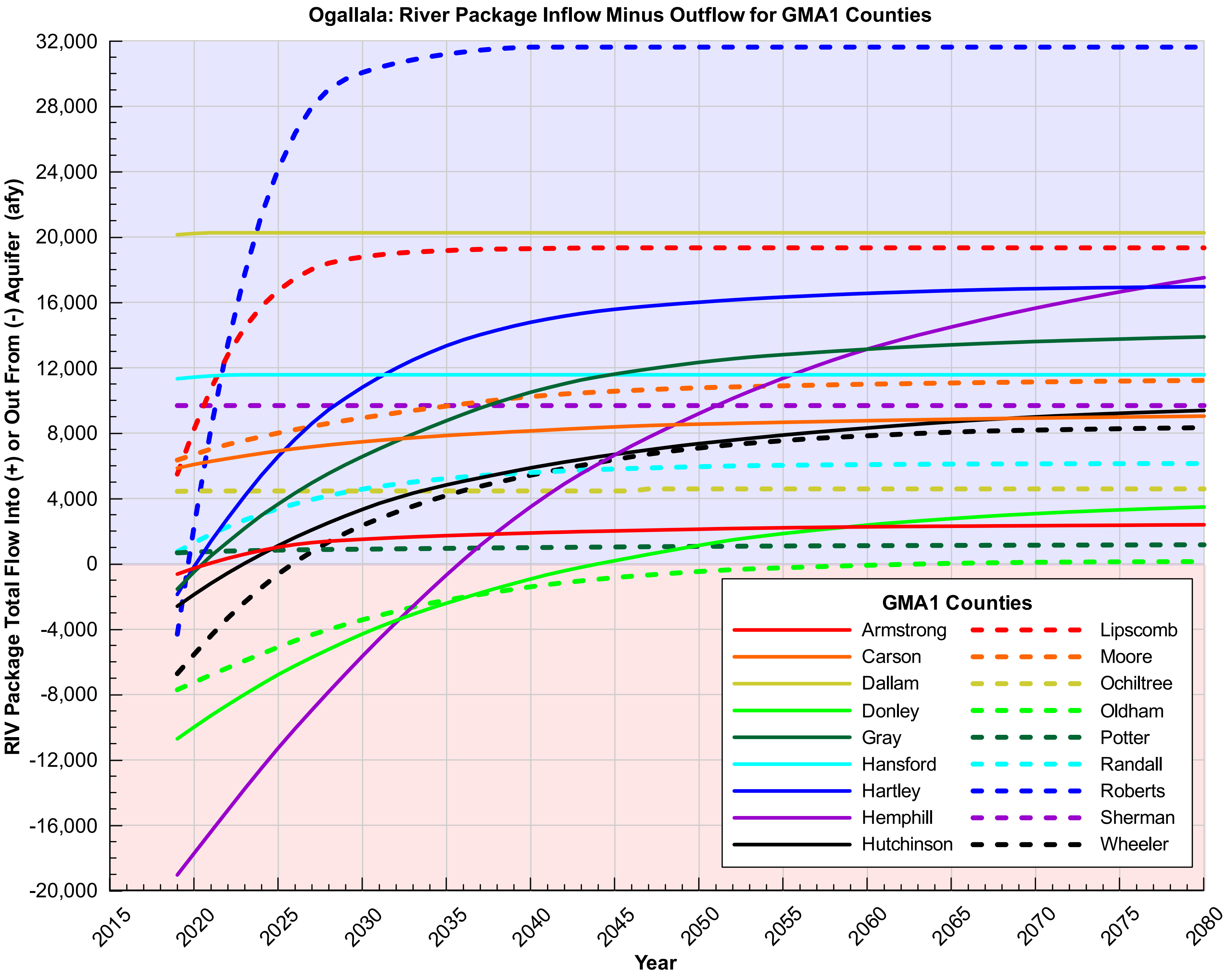
Ogallala: Drain Package Outflow for GMA1 Representing Springs, Escarpments and Draws
DRN Package Total Flow Out From (-) Aquifer (afy)
0
-2,000
-4,000
-6,000
-8,000
-10,000
-12,000
-14,000
-16,000
-18,000
-20,000
-22,000
-24,000
-26,000
-28,000
-30,000
-32,000
-34,000
-36,000
-38,000
-40,000
-42,000
-44,000
-46,000
-48,000
2015
2020
2025
2030
2035
2040
2045
2050
2055
2060
2065
2070
2075
2080
Year



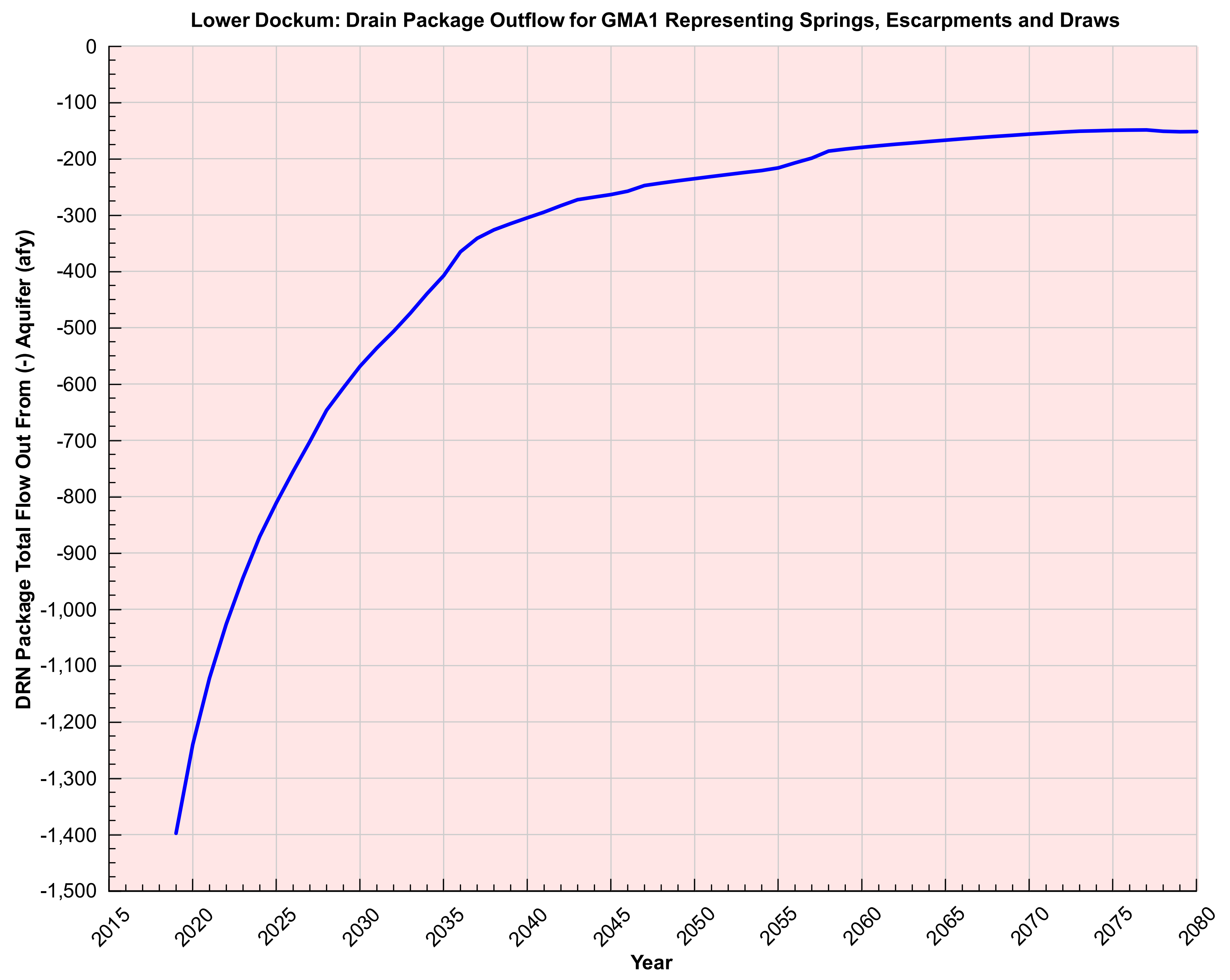
Ogallala: Drain Package Outflow for GMA1 Counties Representing Springs, Escarpments and Draws
DRN Package Total Flow Out From (-) Aquifer (afy)
0
-1,000
-2,000
-3,000
-4,000
-5,000
-6,000
-7,000
-8,000
-9,000
-10,000
-11,000
-12,000
2015
2020
2025
2030
2035
2040
2045
2050
2055
2060
2065
2070
2075
2080
Year
GMA1 Counties
Armstrong
Carson
Dallam
Donley
Gray
Hansford
Hartley
Hemphill
Hutchinson
Lipscomb
Moore
Ochiltree
Oldham
Potter
Randall
Roberts
Sherman
Wheeler

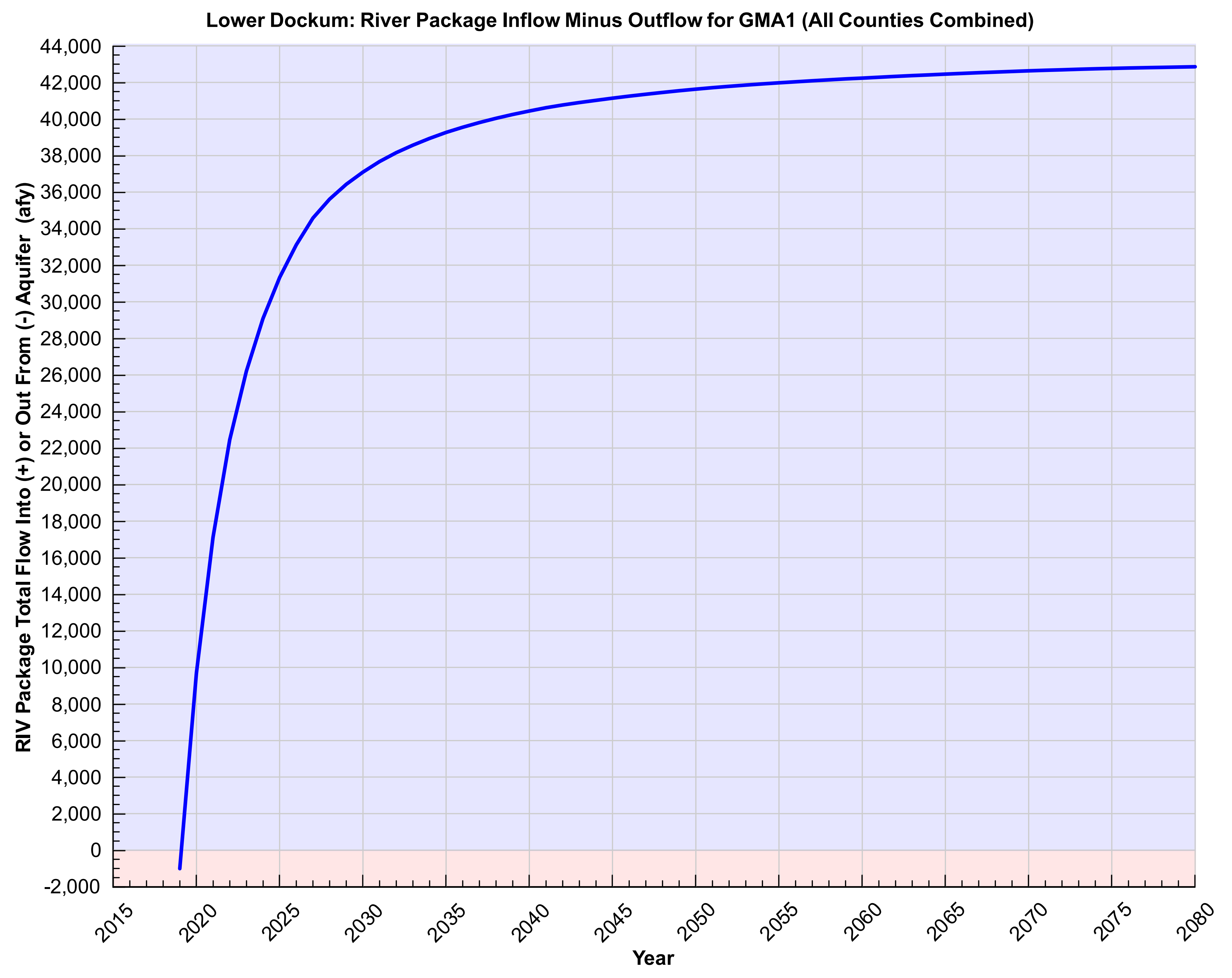


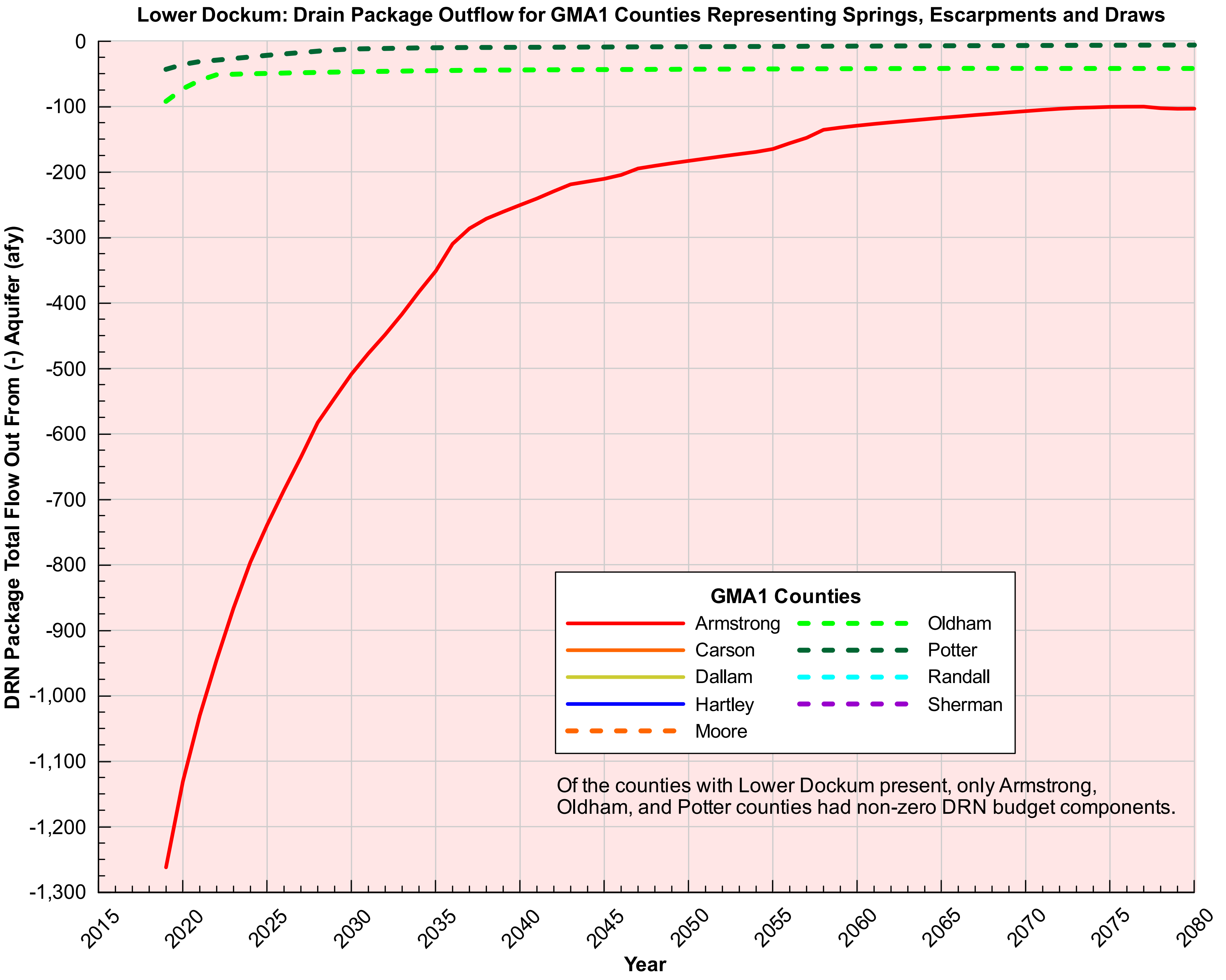
Ogallala: River Package Inflow Minus Outflow for GMA1 (All Counties Combined)
RIV Package Total Flow Into (+) or Out From (-) Aquifer (afy)
200,000
190,000
180,000
170,000
160,000
150,000
140,000
130,000
120,000
110,000
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
2015
2020
2025
2030
2035
2040
2045
2050
2055
2060
2065
2070
2075
2080
Year



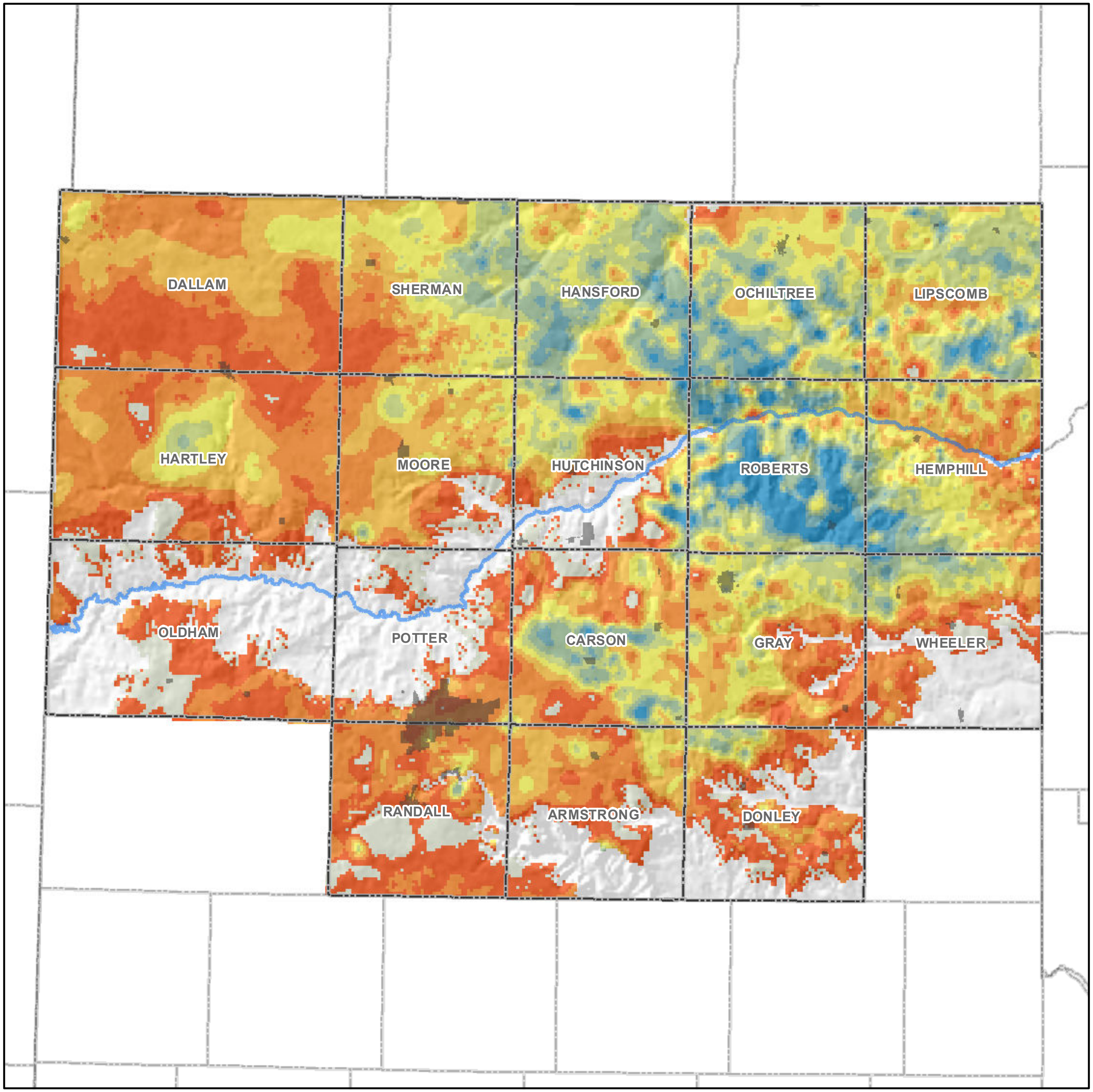
Ogallala: River Package Inflow Minus Outflow for GMA1 Counties
RIV Package Total Flow Into (+) or Out From (-) Aquifer (afy)
32,000
28,000
24,000
20,000
16,000
12,000
8,000
4,000
0
-4,000
-8,000
-12,000
-16,000
-20,000
2015
2020
2025
2030
2035
2040
2045
2050
2055
2060
2065
2070
2075
2080
Year
GMA1 Counties
Armstrong
Carson
Dallam
Donley
Gray
Hansford
Hartley
Hemphill
Hutchinson
Lipscomb
Moore
Ochiltree
Oldham
Potter
Randall
Roberts
Sherman
Wheeler

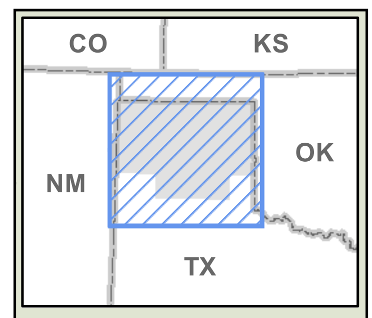

Lower Dockum: Drain Package Outflow for GMA1 Representing Springs, Escarpments and Draws
DRN Package Total Flow Out From (-) Aquifer (afy)
0
-100
-200
-300
-400
-500
-600
-700
-800
-900
-1,000
-1,100
-1,200
-1,300
-1,400
-1,500
2015
2020
2025
2030
2035
2040
2045
2050
2055
2060
2065
2070
2075
2080
Year


Lower Dockum: River Package Inflow Minus Outflow for GMA1 (All Counties Combined)
RIV Package Total Flow Into (+) or Out From (-) Aquifer (afy)
44,000
42,000
40,000
38,000
36,000
34,000
32,000
30,000
28,000
26,000
24,000
22,000
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
-2,000
2015
2020
2025
2030
2035
2040
2045
2050
2055
2060
2065
2070
2075
2080
Year


Lower Dockum: Drain Package Outflow for GMA1 Counties Representing Springs, Escarpments and Draws
DRN Package Total Flow Out From (-) Aquifer (afy)
0
-100
-200
-300
-400
-500
-600
-700
-800
-900
-1,000
-1,100
-1,200
-1,300
2015
2020
2025
2030
2035
2040
2045
2050
2055
2060
2065
2070
2075
2080
Year
GMA1 Counties
Armstrong
Carson
Dallam
Hartley
Moore
Oldham
Potter
Randall
Sherman
Of the counties with Lower Dockum present, only Armstrong, Oldham, and Potter counties had non-zero DRN budget components.

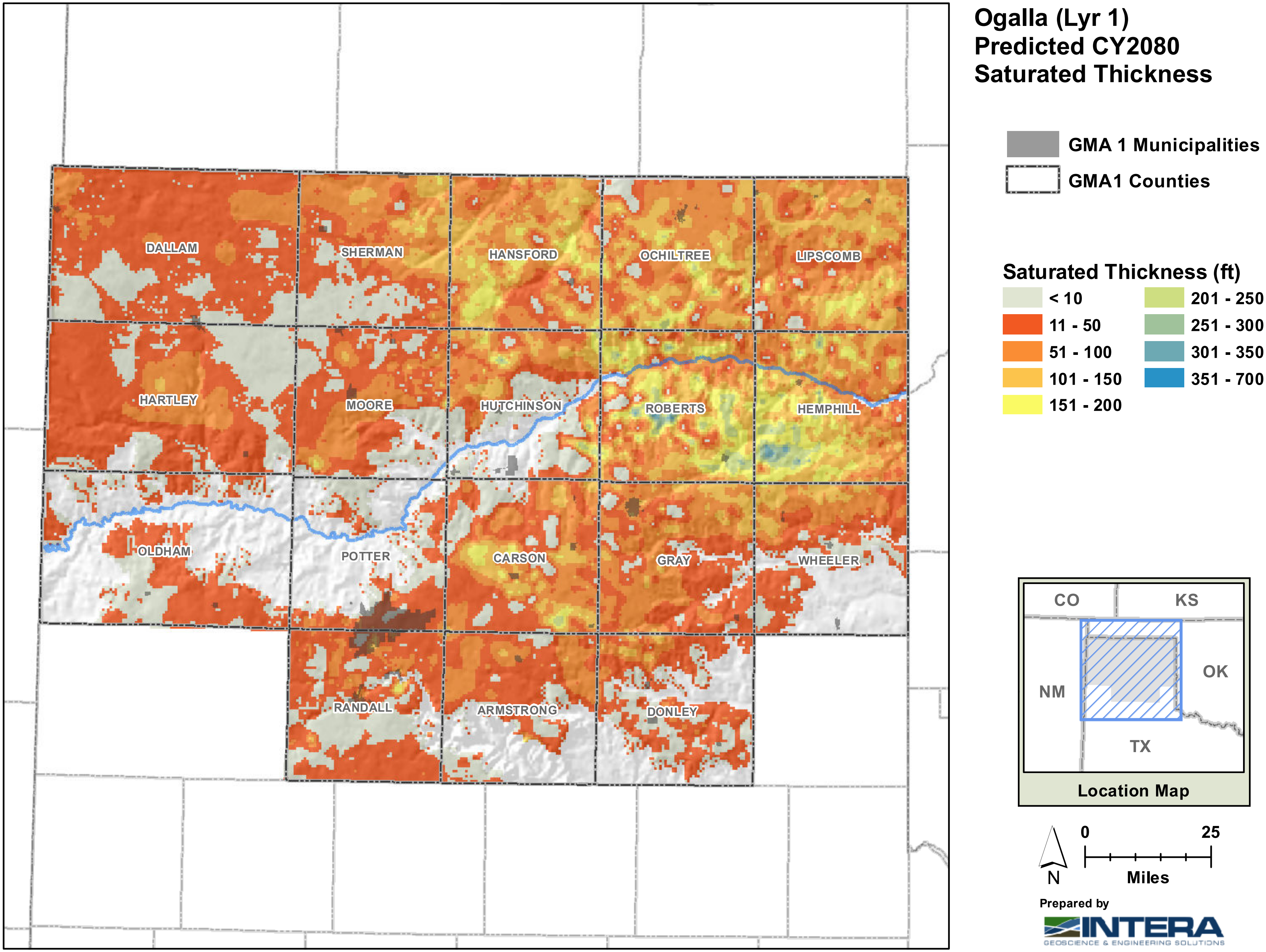
Ogalla (Lyr 1)
Initial Saturated Thickness
(CY2018)





Location Map

Prepared by
INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS


Ogalla (Lyr 1)
Predicted CY2080
Saturated Thickness
GMA 1 Municipalities
GMA1 Counties
Saturated Thickness (ft)
< 10
11 - 50
51 - 100
101 - 150
151 - 200
201 - 250
251 - 300
301 - 350
351 - 700
DALLAM
SHERMAN
HANSFORD
OCHILTREE
LIPSCOMB
HARTLEY
MOORE
HUTCHINSON
ROBERTS
HEMPHILL
OLDHAM
POTTER
CARSON
GRAY
WHEELER
RANDALL
ARMSTRONG
DONLEY
CO
KS
OK
NM
TX
Location Map
0
25
N
Miles
Prepared by
INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS

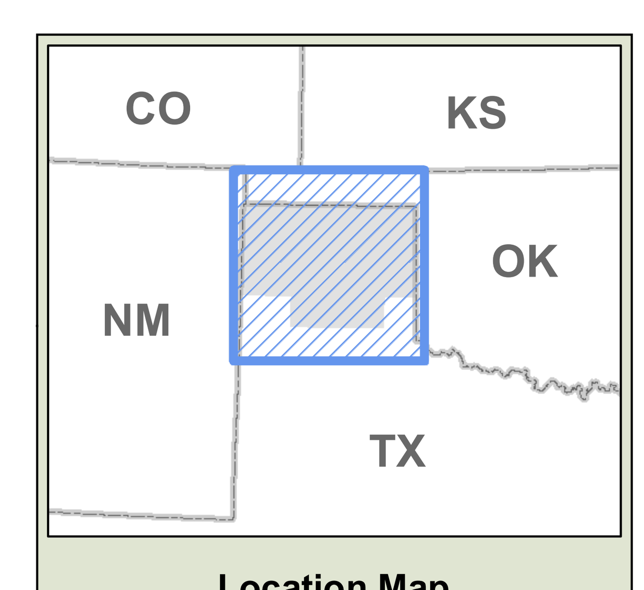
Ogallala (Layer 1)
Predicted Saturated Thickness,
Years 2020 through 2080

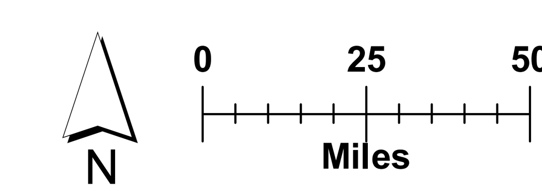
GMA 1 Municipalities

GMA1 Counties

Saturated Thickness (ft)

- < 10
- 11 - 50
- 51 - 100
- 101 - 150
- 151 - 200
- 201 - 250
- 251 - 300
- 301 - 350
- 351 - 700





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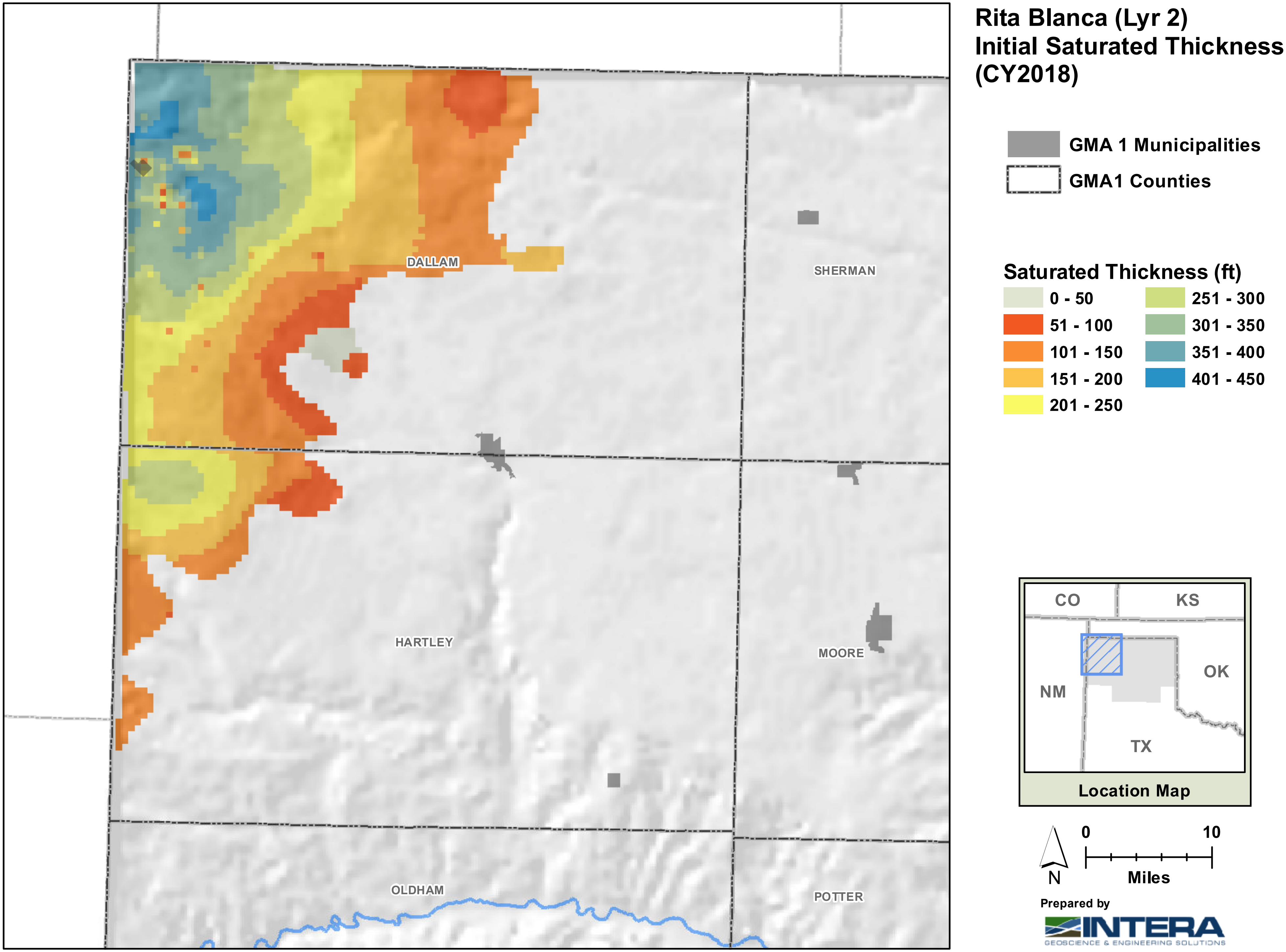
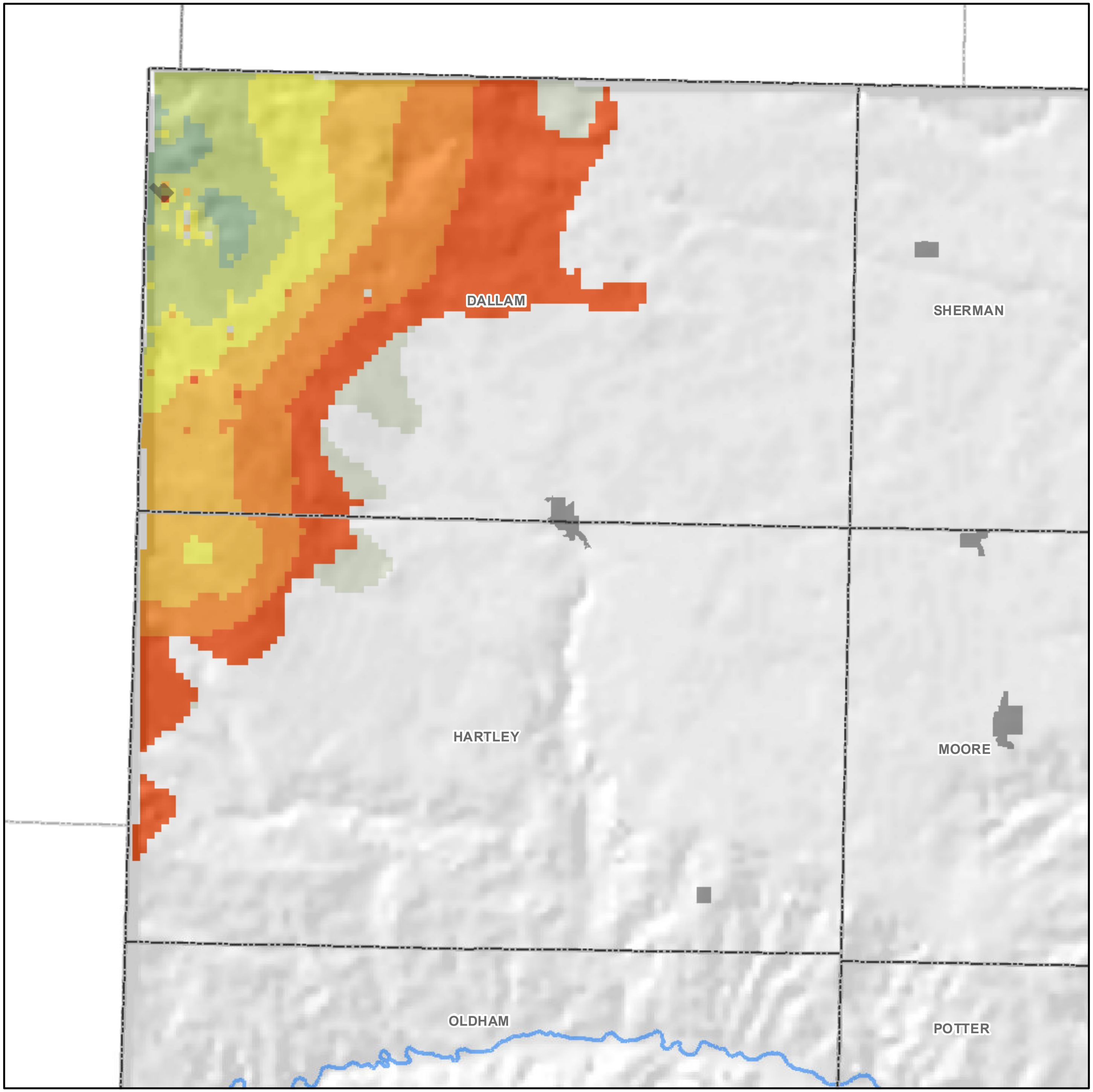


Rita Blanca (Lyr 2)
Initial Saturated Thickness
(CY2018)
GMA 1 Municipalities
GMA1 Counties
Saturated Thickness (ft)
0 - 50
51 - 100
101 - 150
151 - 200
201 - 250
251 - 300
301 - 350
351 - 400
401 - 450
DALLAM
SHERMAN
HARTLEY
MOORE
OLDHAM
POTTER
CO
KS
NM
OK
TX
Location Map
N
0
10
Miles
Prepared by
INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS

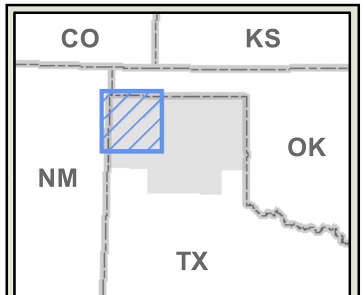


Rita Blanca (Lyr 2) Predicted CY2080 Saturated Thickness

GMA 1 Municipalities
GMA1 Counties

Saturated Thickness (ft)

0 - 50
51 - 100
101 - 150
151 - 200
201 - 250
251 - 300
301 - 350
351 - 400
401 - 450



Location Map

0 10
N
Miles

Prepared by
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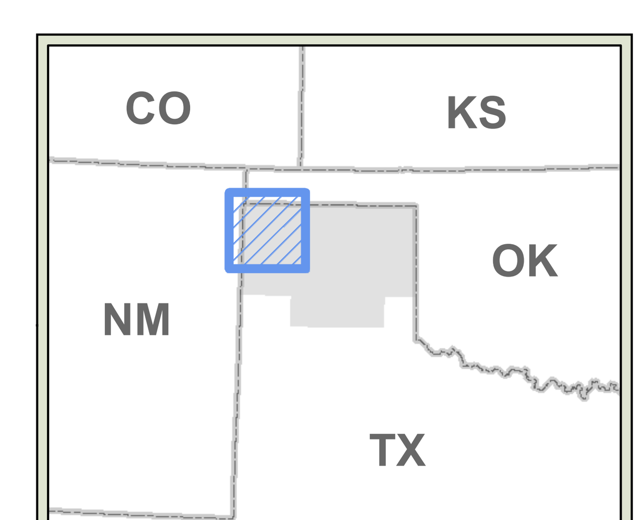
Rita Blanca (Layer 2) Predicted Saturated Thickness, Years 2020 through 2080

GMA 1 Municipalities

GMA1 Counties

Saturated Thickness (ft)

0 - 50	251 - 300
51 - 100	301 - 350
101 - 150	351 - 400
151 - 200	401 - 450
201 - 250	



Location Map

N

0 10 20

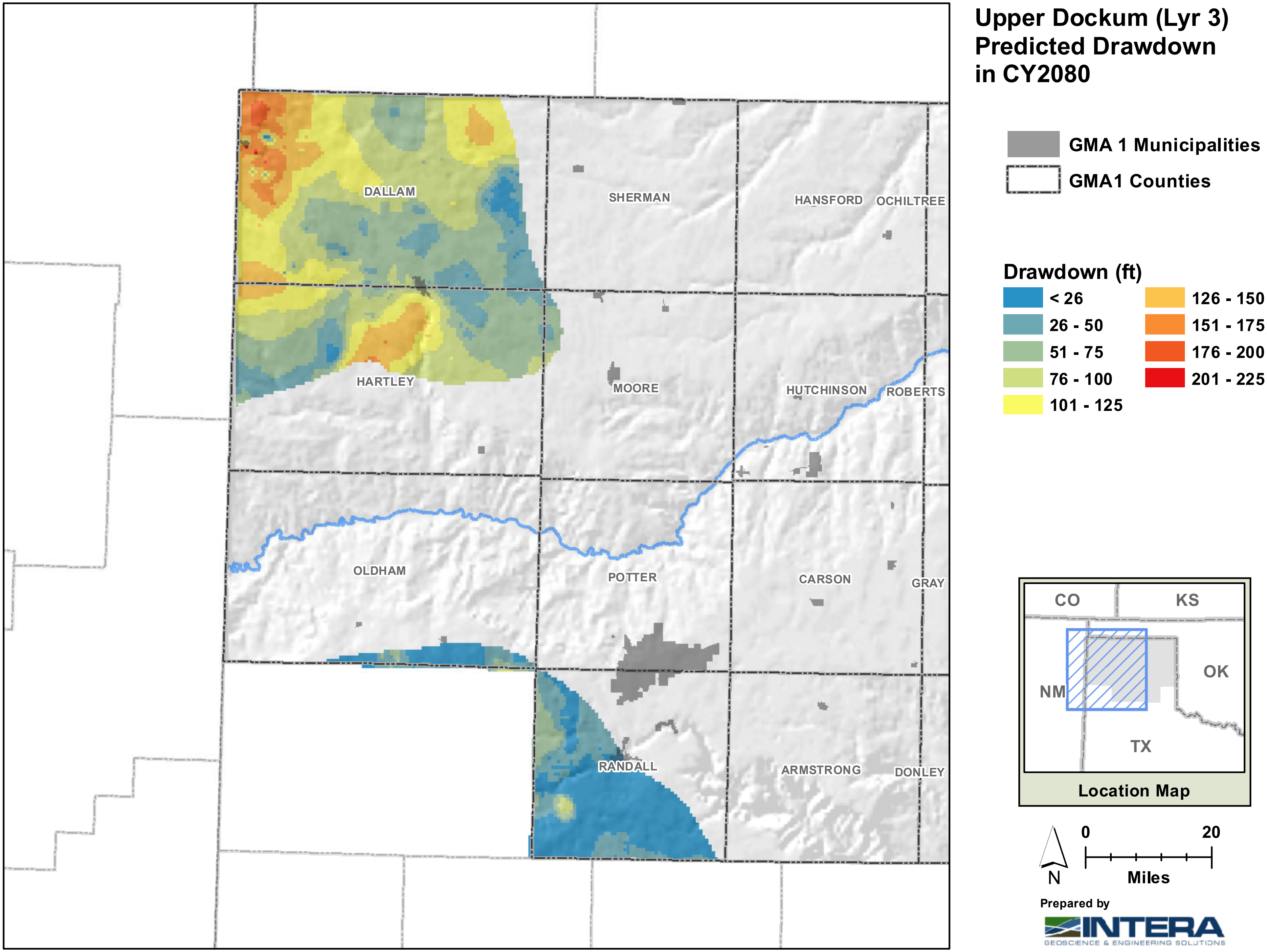
Miles

Prepared by

INTERA

GEOSCIENCE & ENGINEERING SOLUTIONS

Upper Dockum (Lyr 3) Predicted Drawdown in CY2080



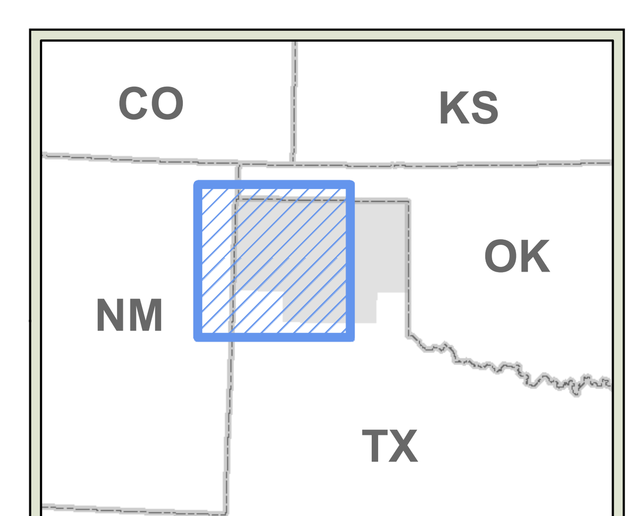
Upper Dockum (Layer 3) Predicted Drawdown, Years 2020 through 2080

GMA 1 Municipalities

GMA1 Counties

Drawdown (ft)

- < 26
- 26 - 50
- 51 - 75
- 76 - 100
- 101 - 125
- 126 - 150
- 151 - 175
- 176 - 200
- 201 - 225

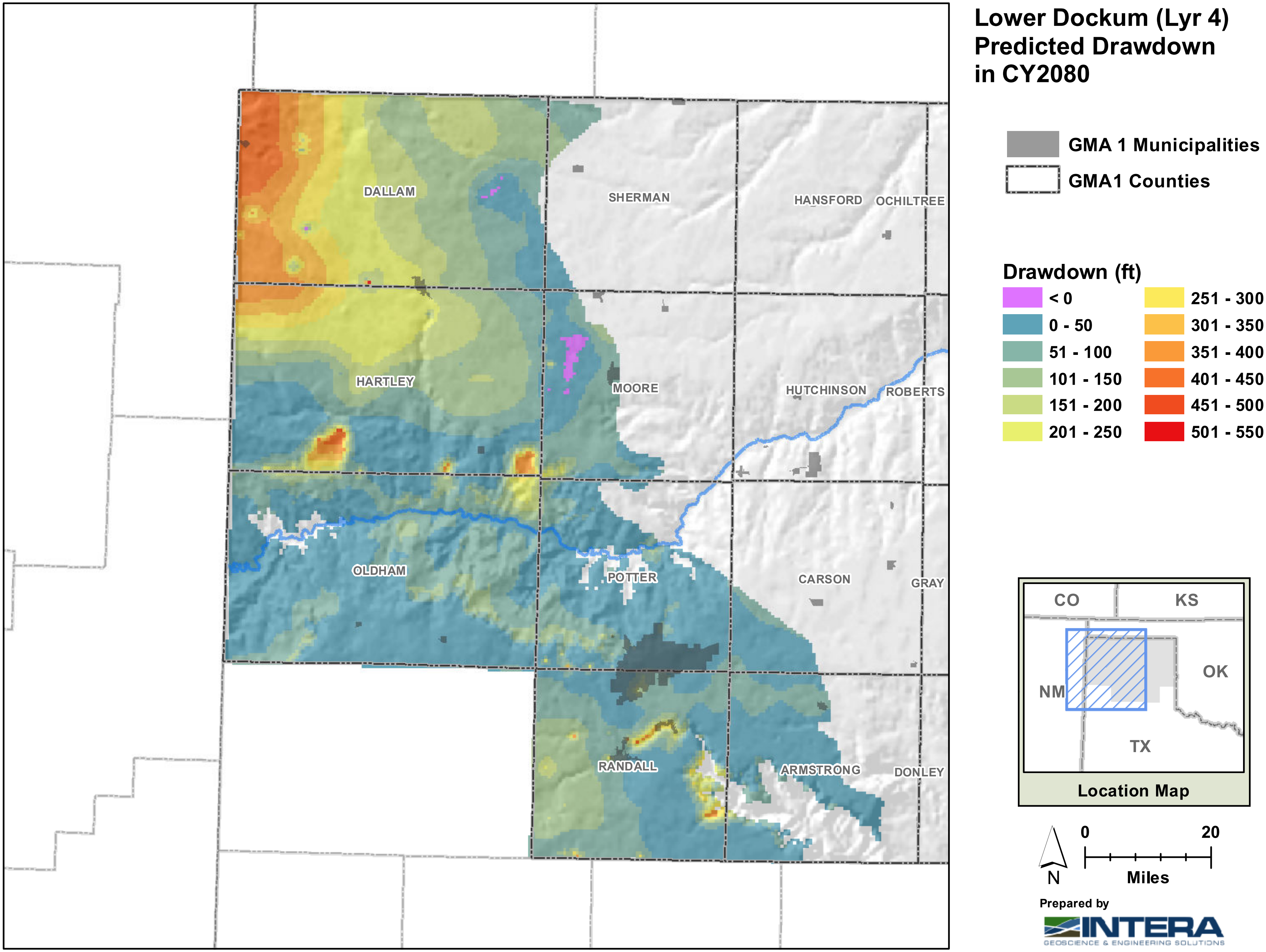


Location Map

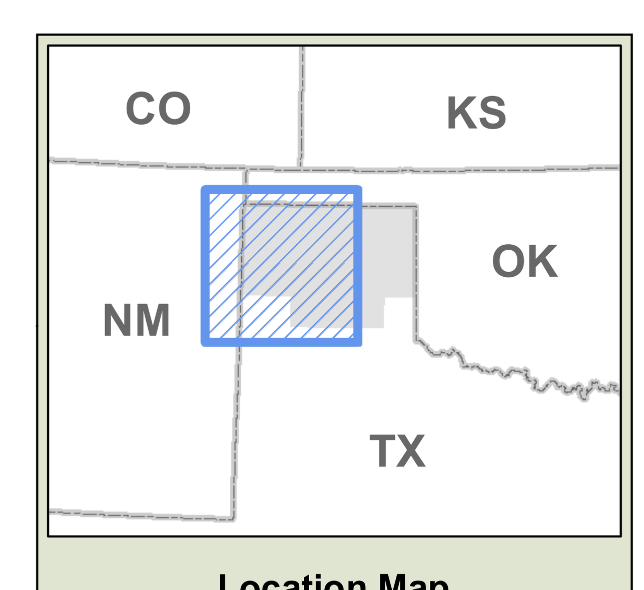
N 0 20 40 Miles

Prepared by INTERA GEOSCIENCE & ENGINEERING SOLUTIONS

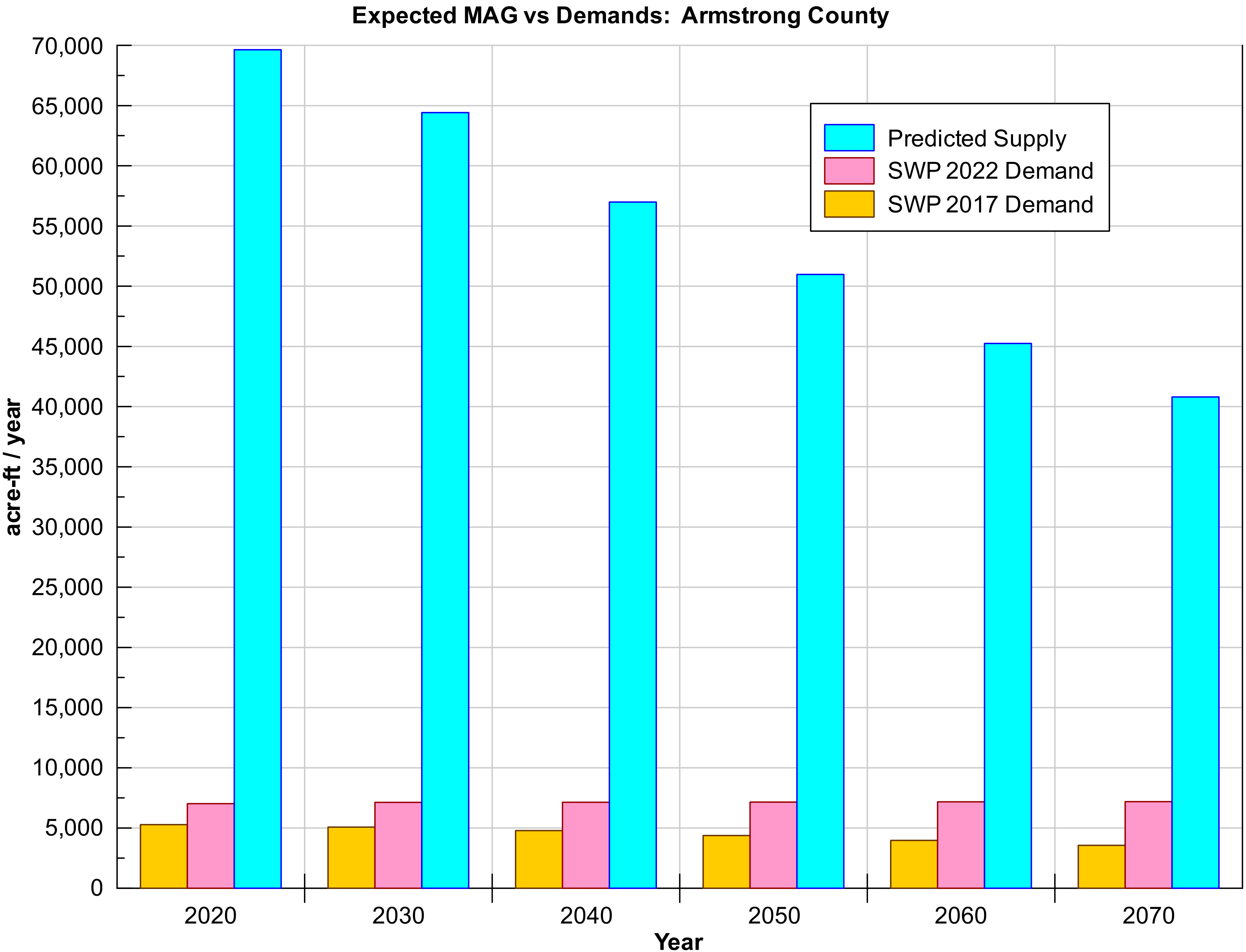
Lower Dockum (Lyr 4) Predicted Drawdown in CY2080



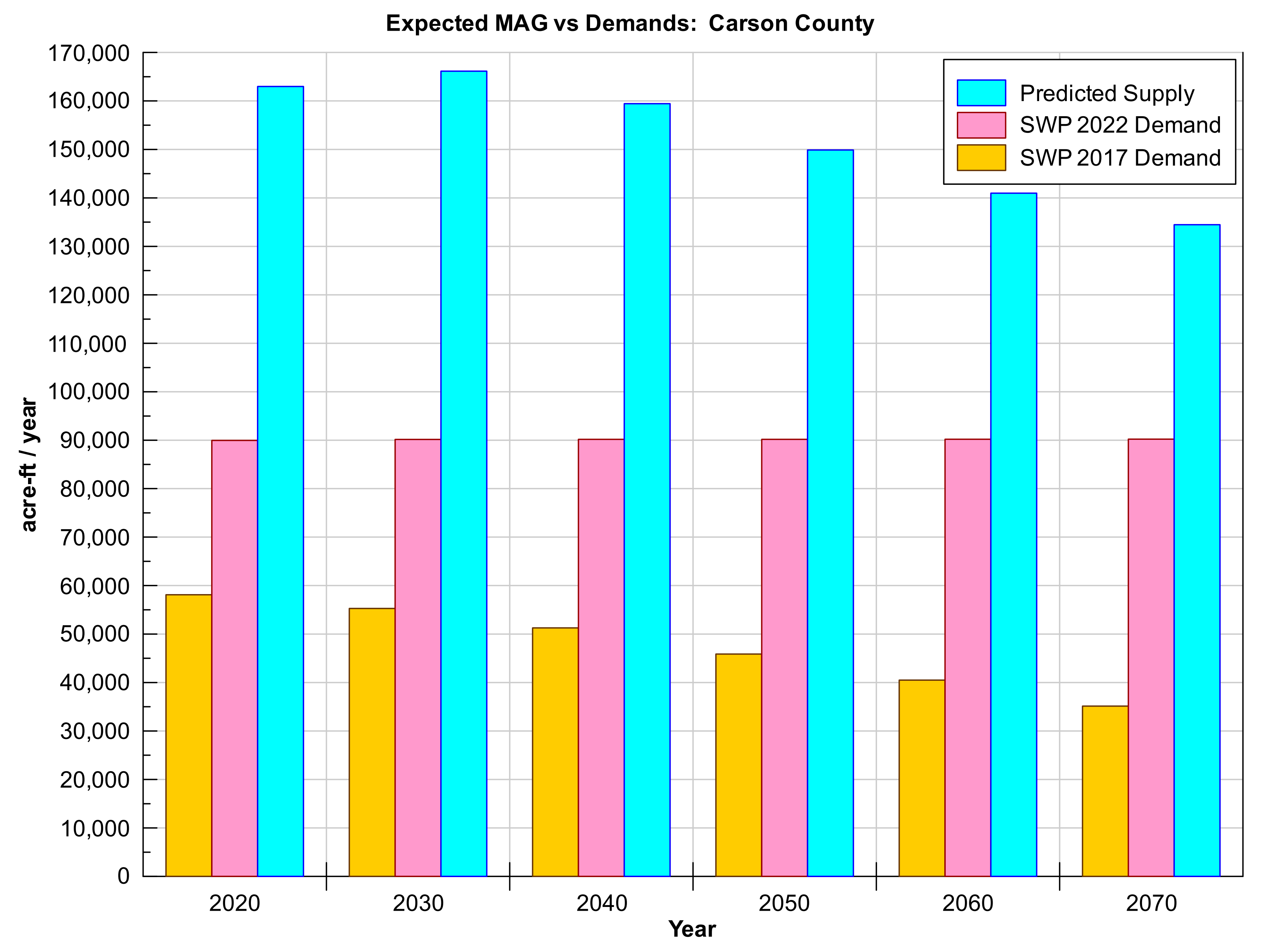
Lower Dockum (Layer 4)
Predicted Drawdown,
Years 2020 through 2080

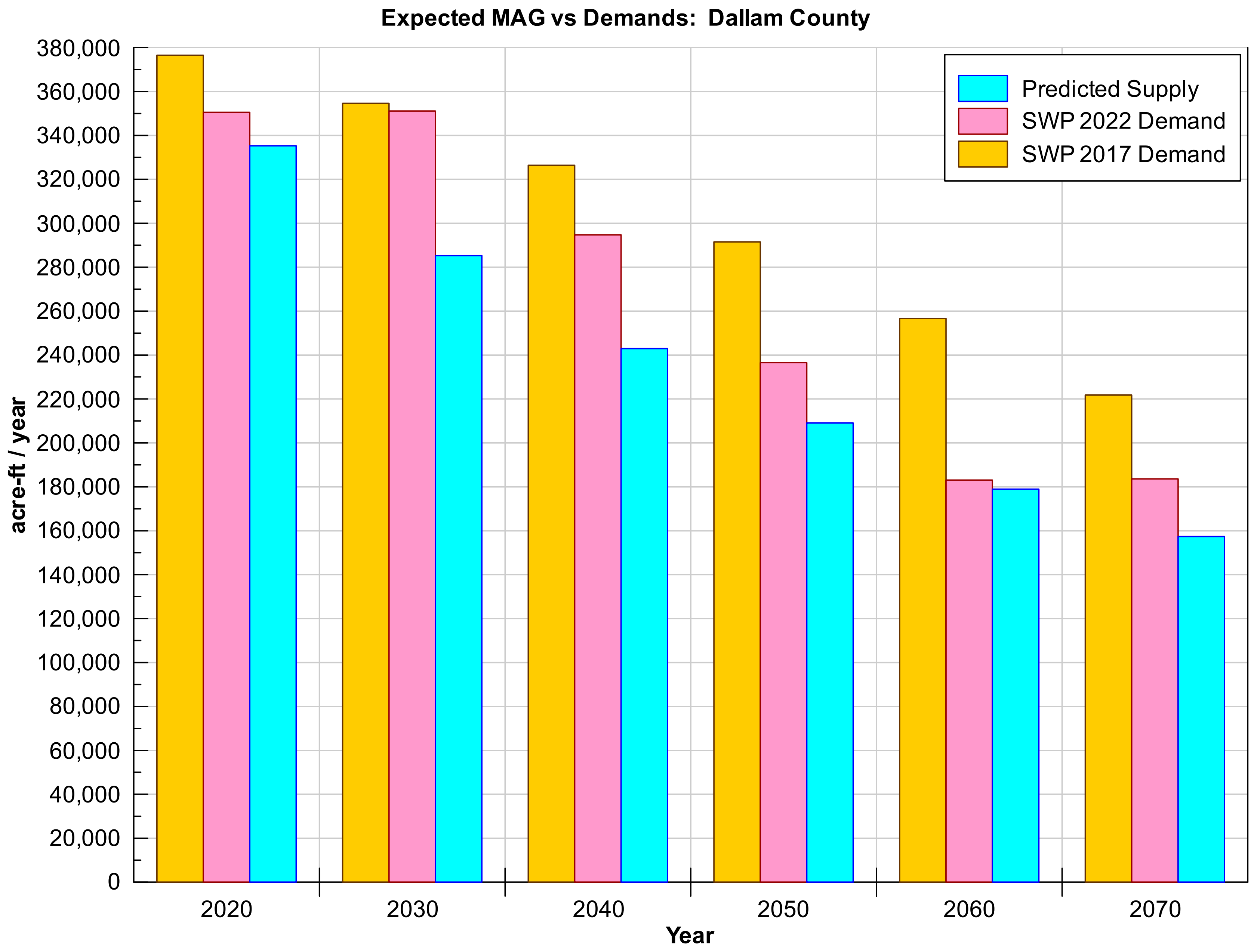


Prepared by INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS

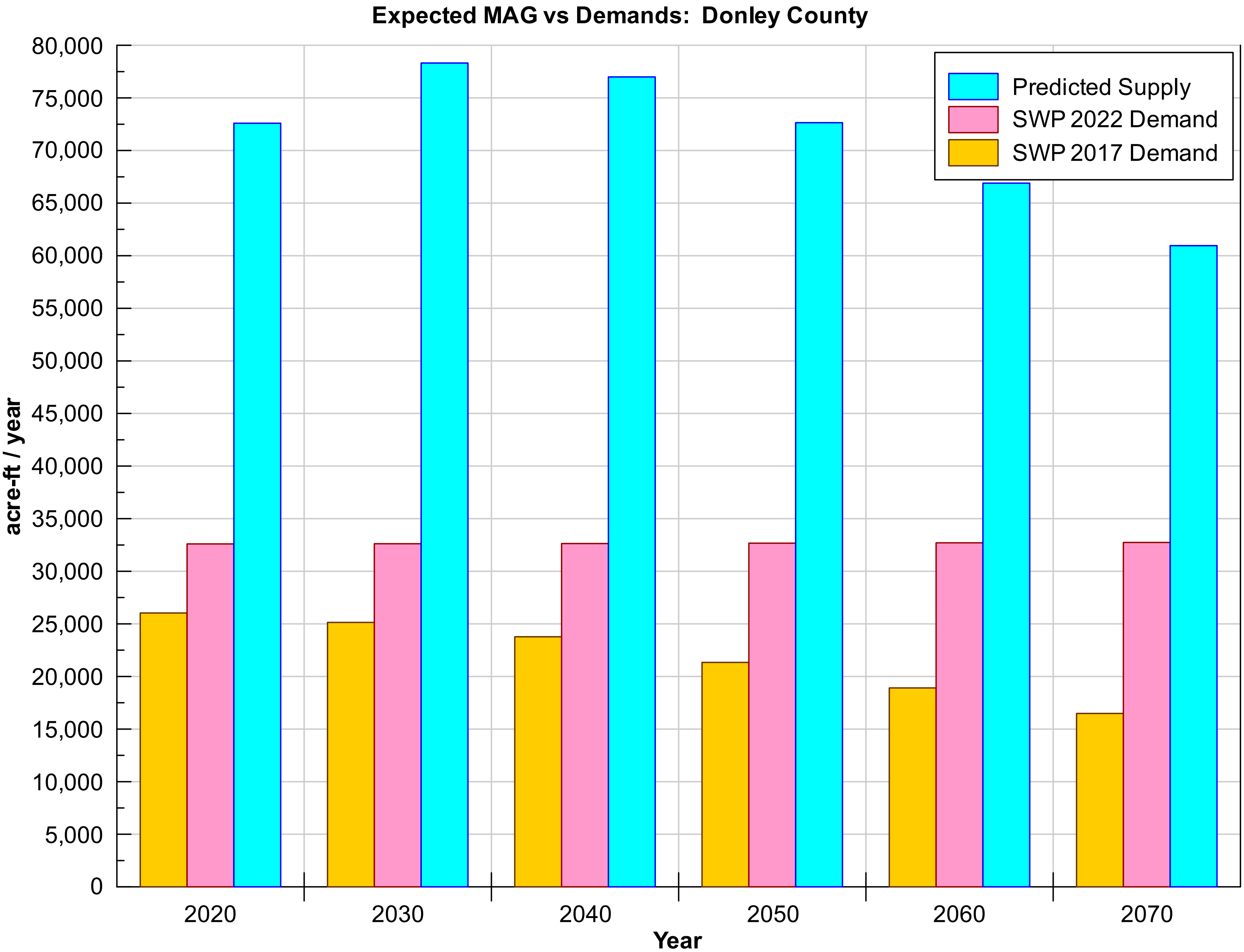


Expected MAG vs Demands: Armstrong County
acre-ft / year
70,000
65,000
60,000
55,000
50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
2020
2030
2040
2050
2060
2070
Year
Predicted Supply
SWP 2022 Demand
SWP 2017 Demand

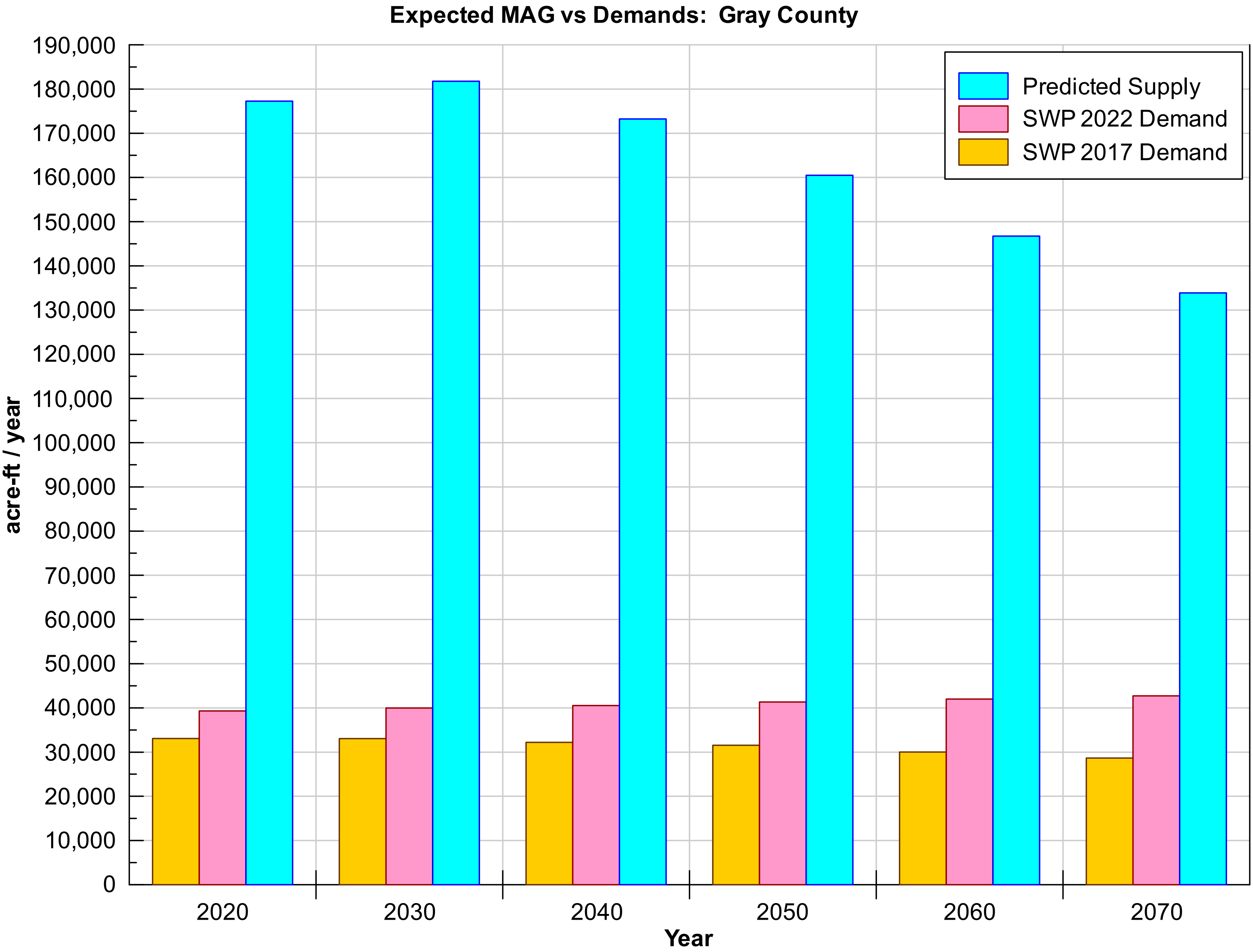

Expected MAG vs Demands: Carson County
170,000
160,000
150,000
140,000
130,000
120,000
110,000
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
acre-ft / year
Predicted Supply
SWP 2022 Demand
SWP 2017 Demand
2020
2030
2040
2050
2060
2070
Year

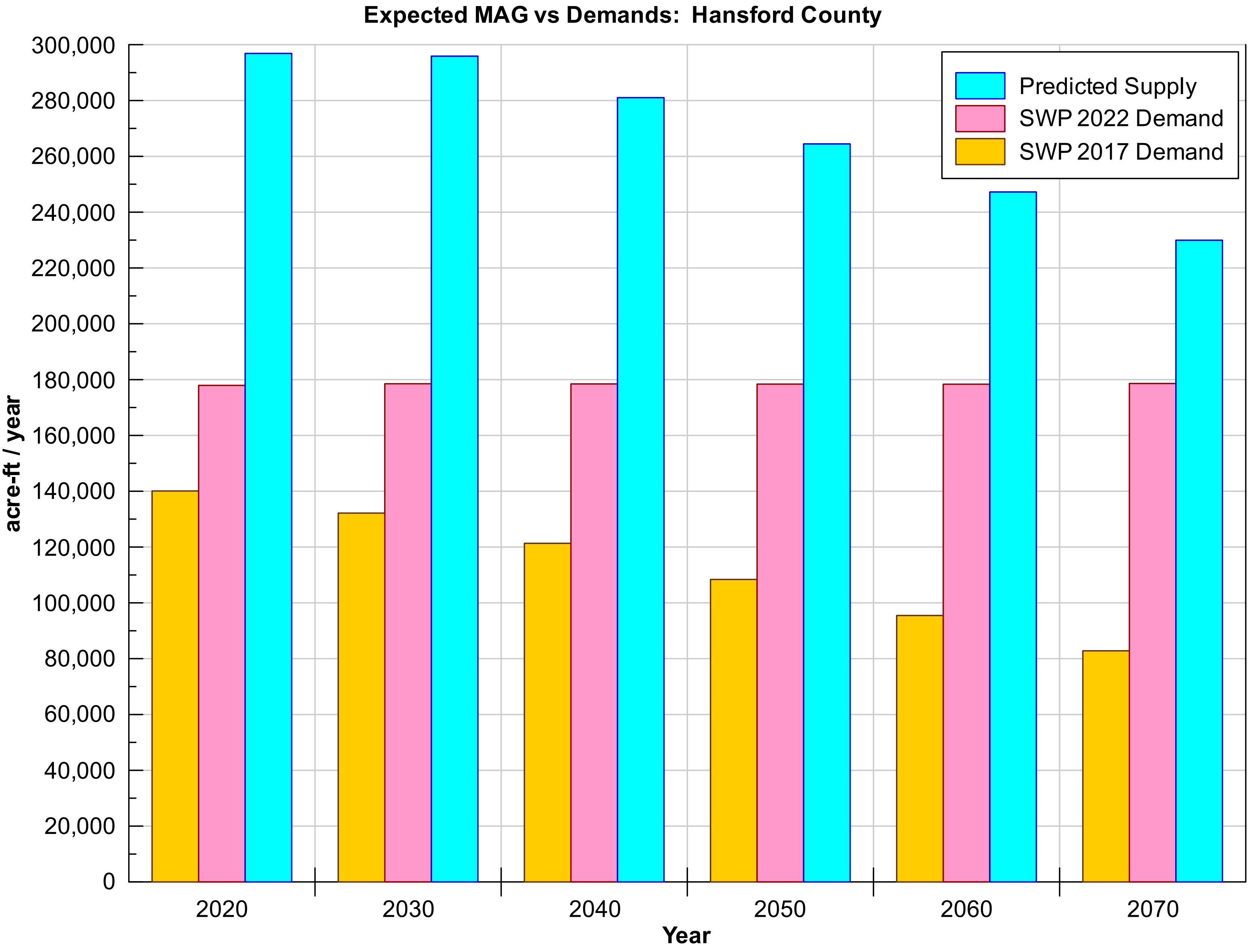


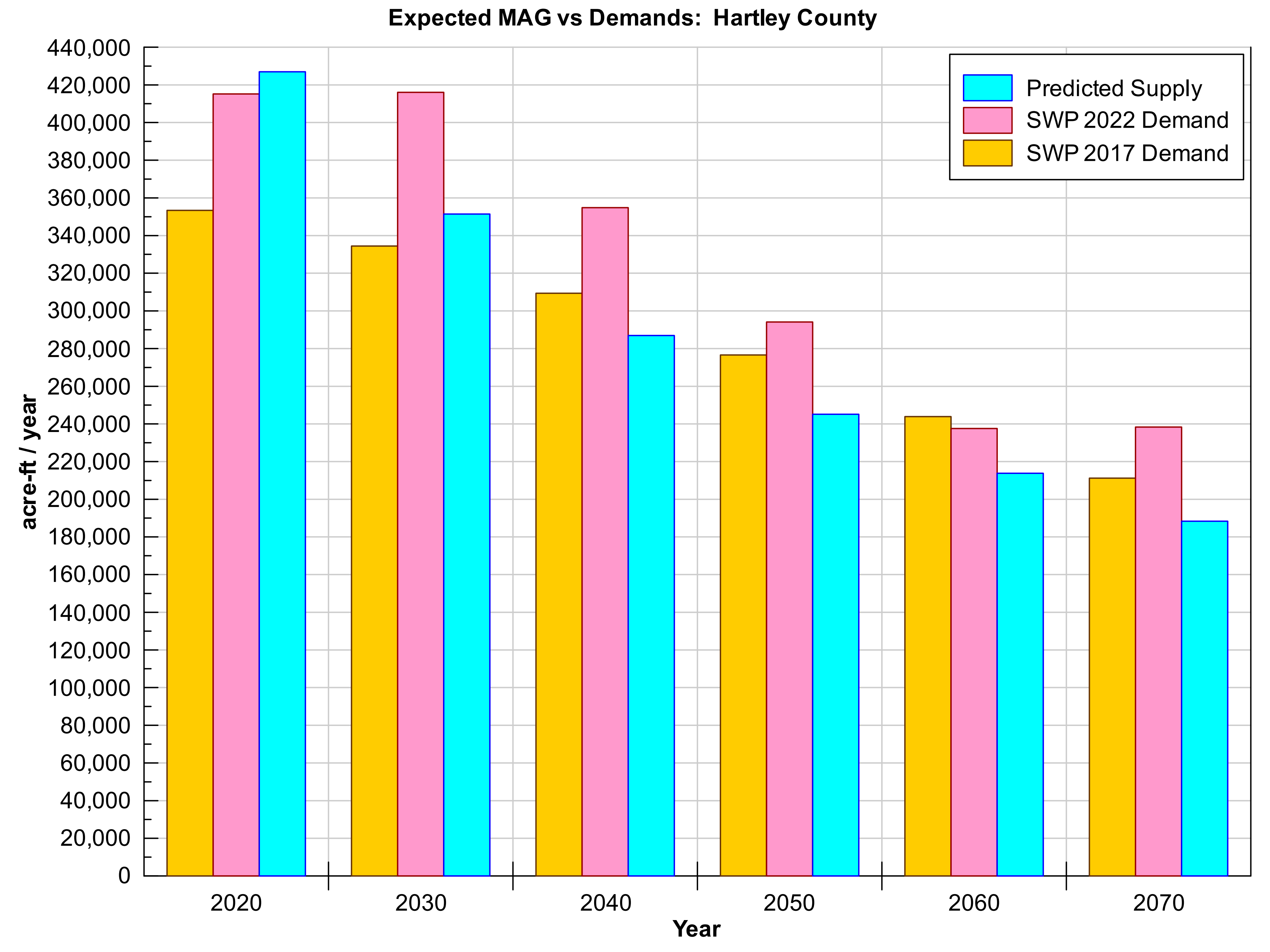
Expected MAG vs Demands: Dallam County
acre-ft / year
380,000
360,000
340,000
320,000
300,000
280,000
260,000
240,000
220,000
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
2020
2030
2040
2050
2060
2070
Year
Predicted Supply
SWP 2022 Demand
SWP 2017 Demand



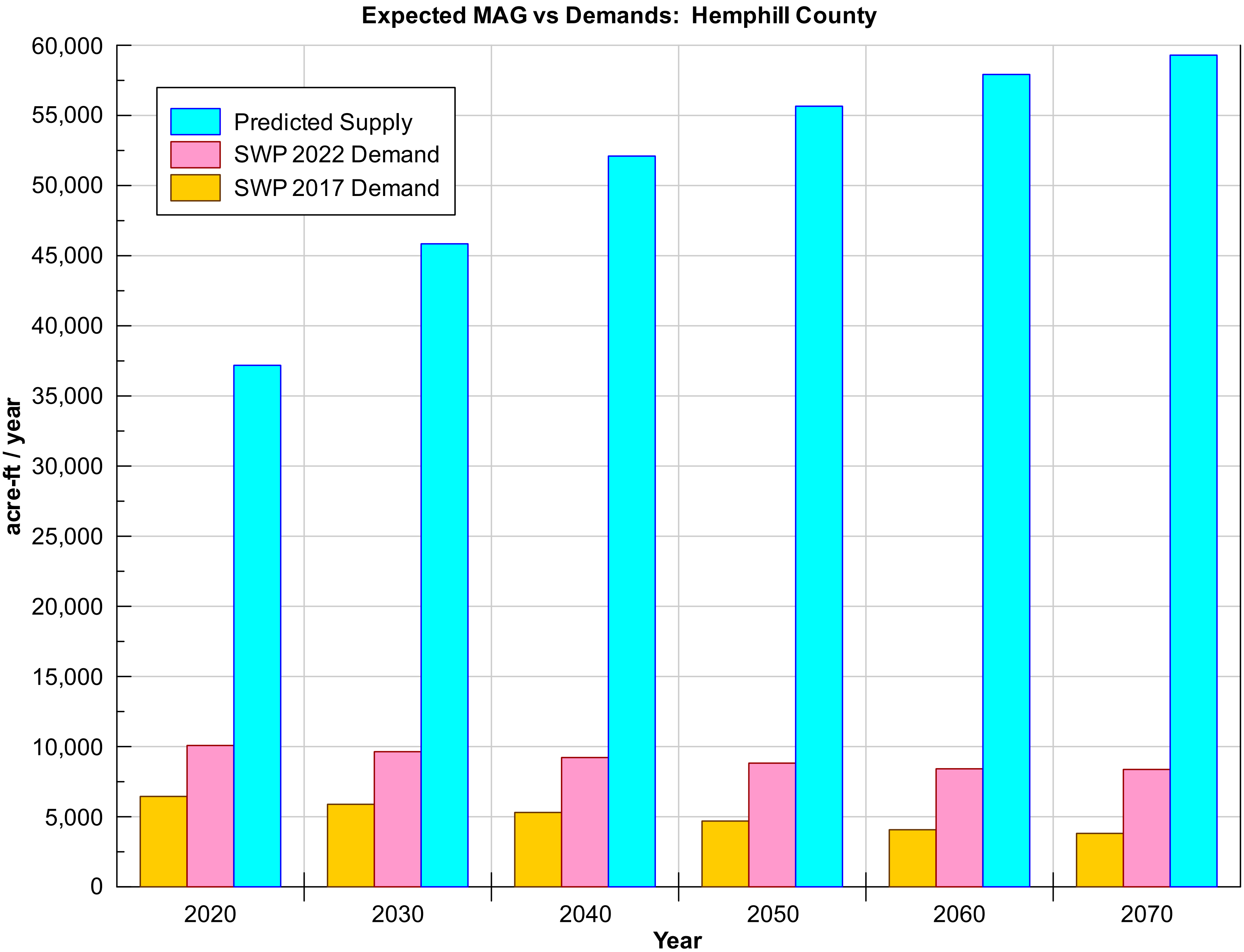
Expected MAG vs Demands: Donley County
80,000
75,000
70,000
65,000
60,000
55,000
50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
acre-ft / year
2020
2030
2040
2050
2060
2070
Year
Predicted Supply
SWP 2022 Demand
SWP 2017 Demand

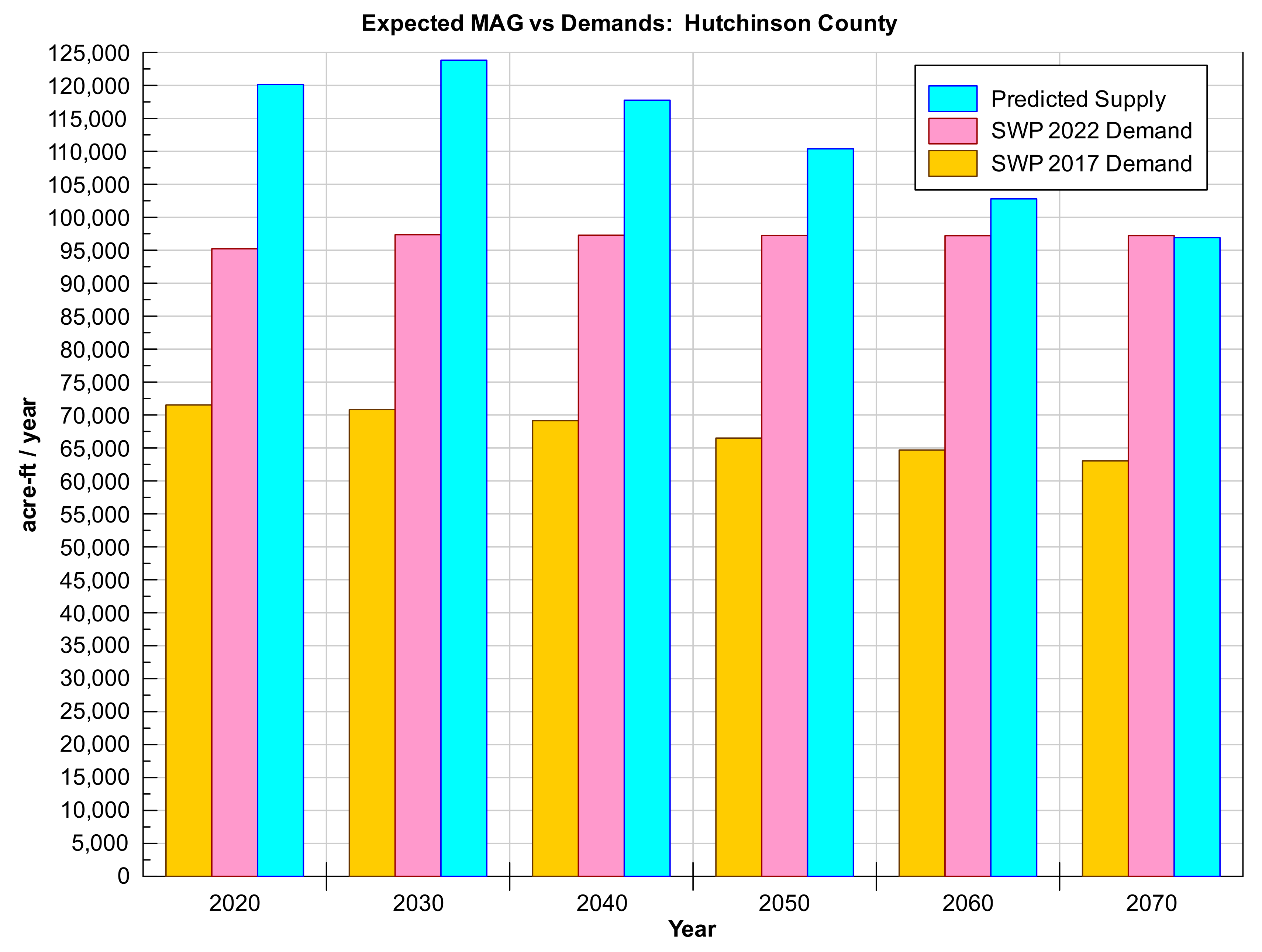

Expected MAG vs Demands: Gray County
acre-ft / year
190,000
180,000
170,000
160,000
150,000
140,000
130,000
120,000
110,000
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
2020
2030
2040
2050
2060
2070
Year
Predicted Supply
SWP 2022 Demand
SWP 2017 Demand


Expected MAG vs Demands: Hansford County
acre-ft / year
300,000
280,000
260,000
240,000
220,000
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
2020
2030
2040
2050
2060
2070
Year
Predicted Supply
SWP 2022 Demand
SWP 2017 Demand



Expected MAG vs Demands: Hartley County
Predicted Supply
SWP 2022 Demand
SWP 2017 Demand
acre-ft / year
440,000
420,000
400,000
380,000
360,000
340,000
320,000
300,000
280,000
260,000
240,000
220,000
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
2020
2030
2040
2050
2060
2070
Year


Expected MAG vs Demands: Hemphill County
Predicted Supply
SWP 2022 Demand
SWP 2017 Demand
acre-ft / year
60,000
55,000
50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
2020
2030
2040
2050
2060
2070
Year



Expected MAG vs Demands: Hutchinson County
Predicted Supply
SWP 2022 Demand
SWP 2017 Demand
acre-ft / year
0
5,000
10,000
15,000
20,000
25,000
30,000
35,000
40,000
45,000
50,000
55,000
60,000
65,000
70,000
75,000
80,000
85,000
90,000
95,000
100,000
105,000
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125,000
2020
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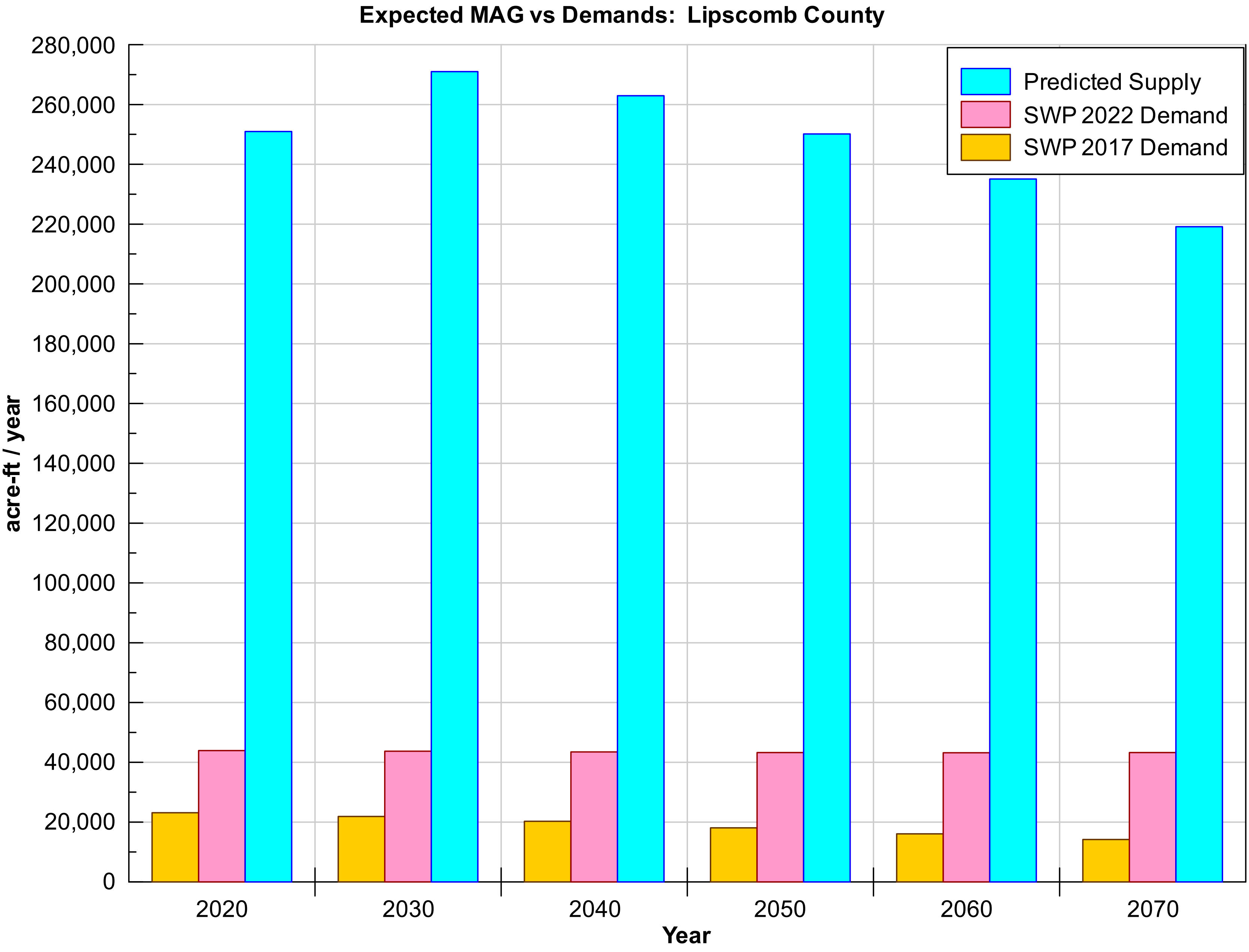
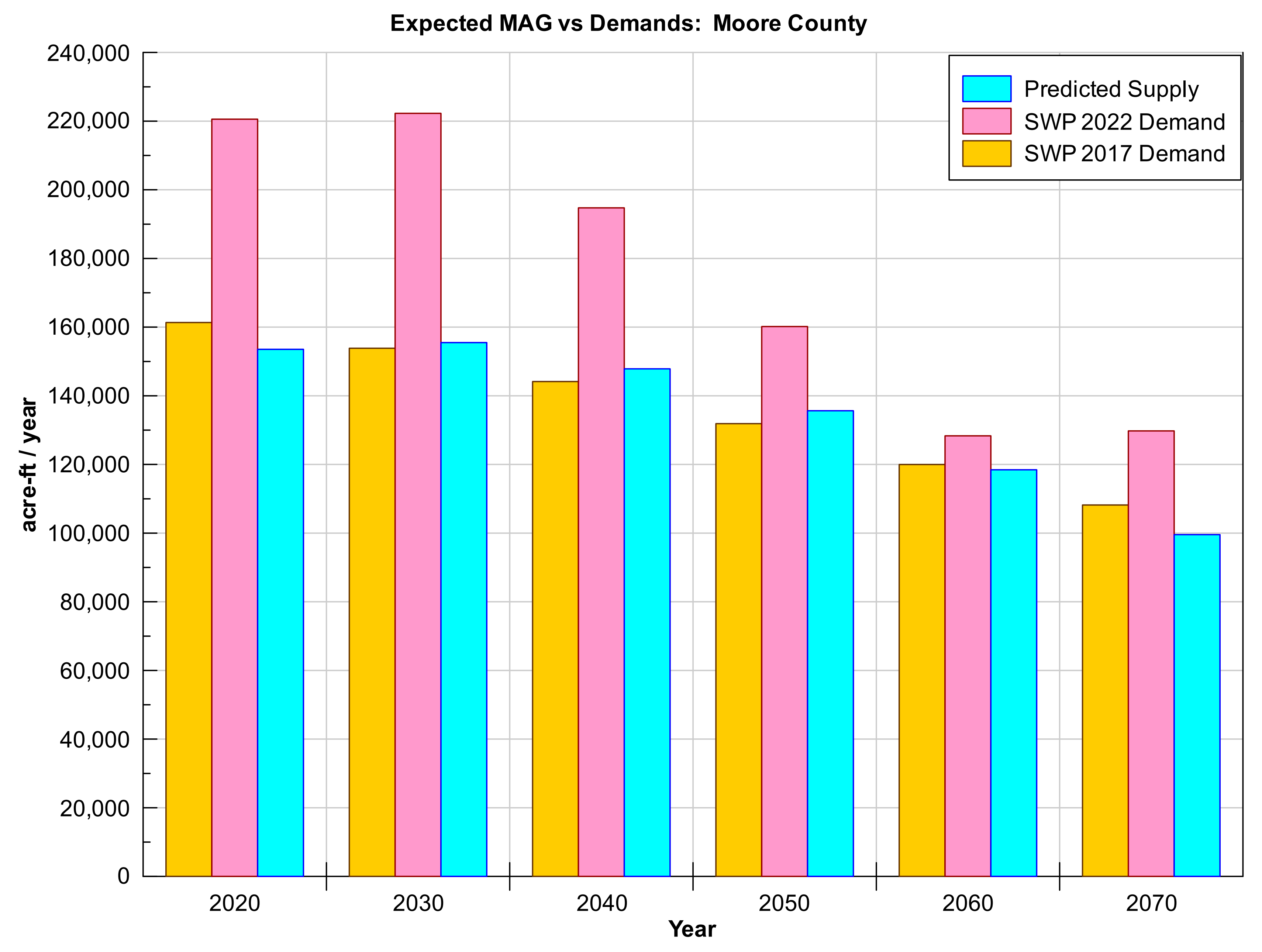
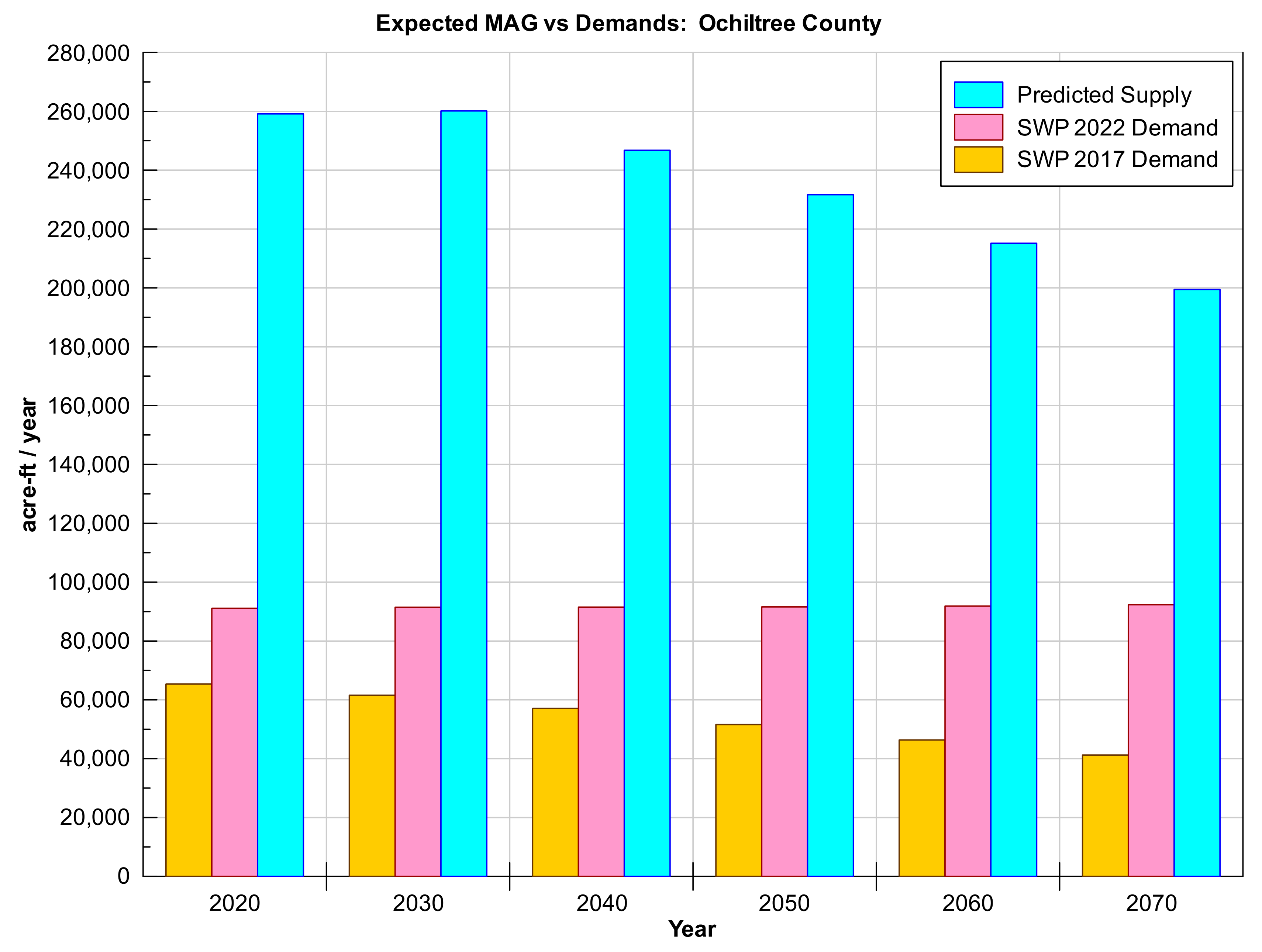
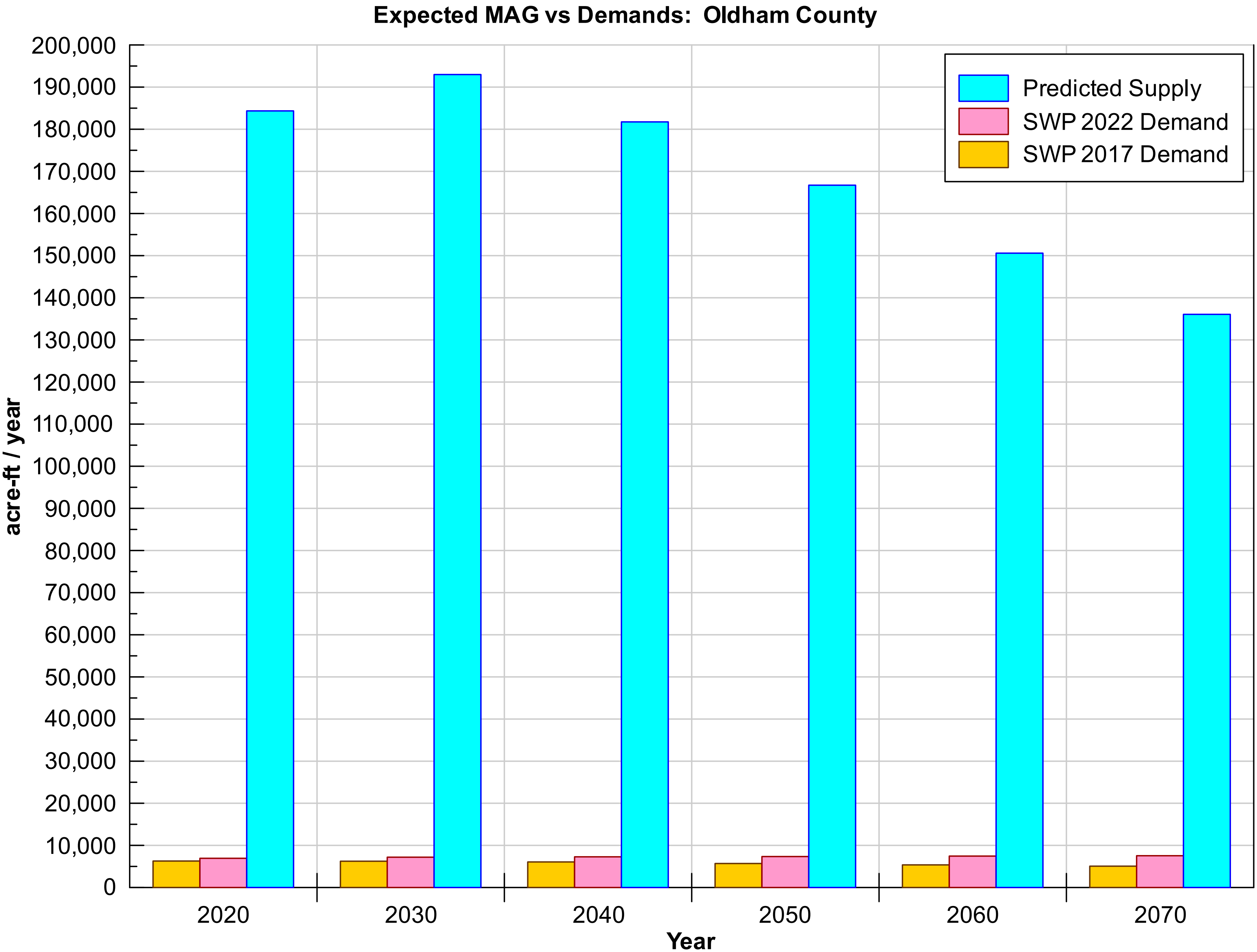
2050
2060
2070
Year


Expected MAG vs Demands: Lipscomb County
280,000
260,000
240,000
220,000
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
acre-ft / year
2020
2030
2040
2050
2060
2070
Year
Predicted Supply
SWP 2022 Demand
SWP 2017 Demand


Expected MAG vs Demands: Moore County
Predicted Supply
SWP 2022 Demand
SWP 2017 Demand
acre-ft / year
240,000
220,000
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
2020
2030
2040
2050
2060
2070
Year



Expected MAG vs Demands: Ochiltree County
280,000
260,000
240,000
220,000
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
acre-ft / year
2020
2030
2040
2050
2060
2070
Year
Predicted Supply
SWP 2022 Demand
SWP 2017 Demand



Expected MAG vs Demands: Oldham County
Predicted Supply
SWP 2022 Demand
SWP 2017 Demand
acre-ft / year
200,000
190,000
180,000
170,000
160,000
150,000
140,000
130,000
120,000
110,000
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
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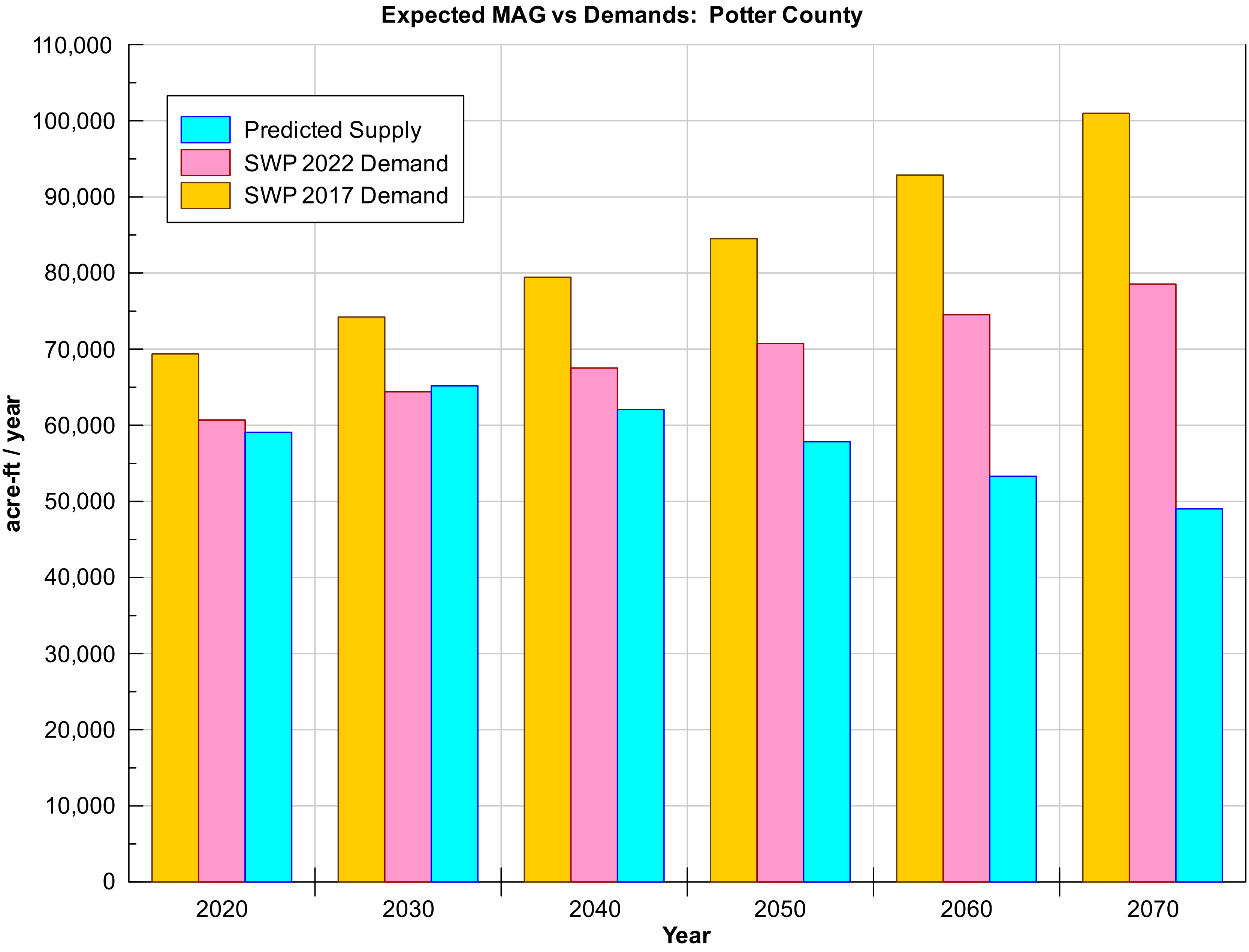
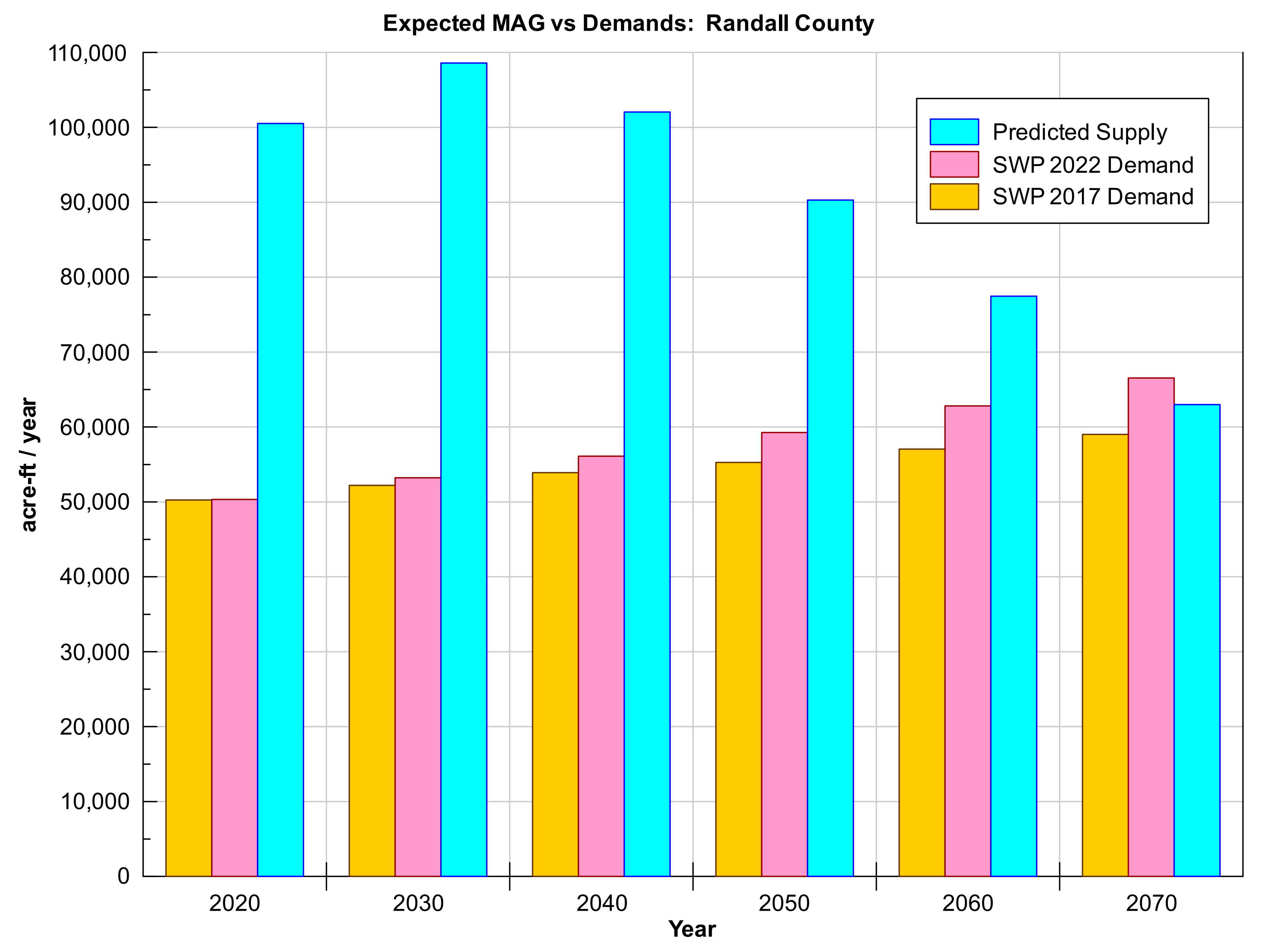
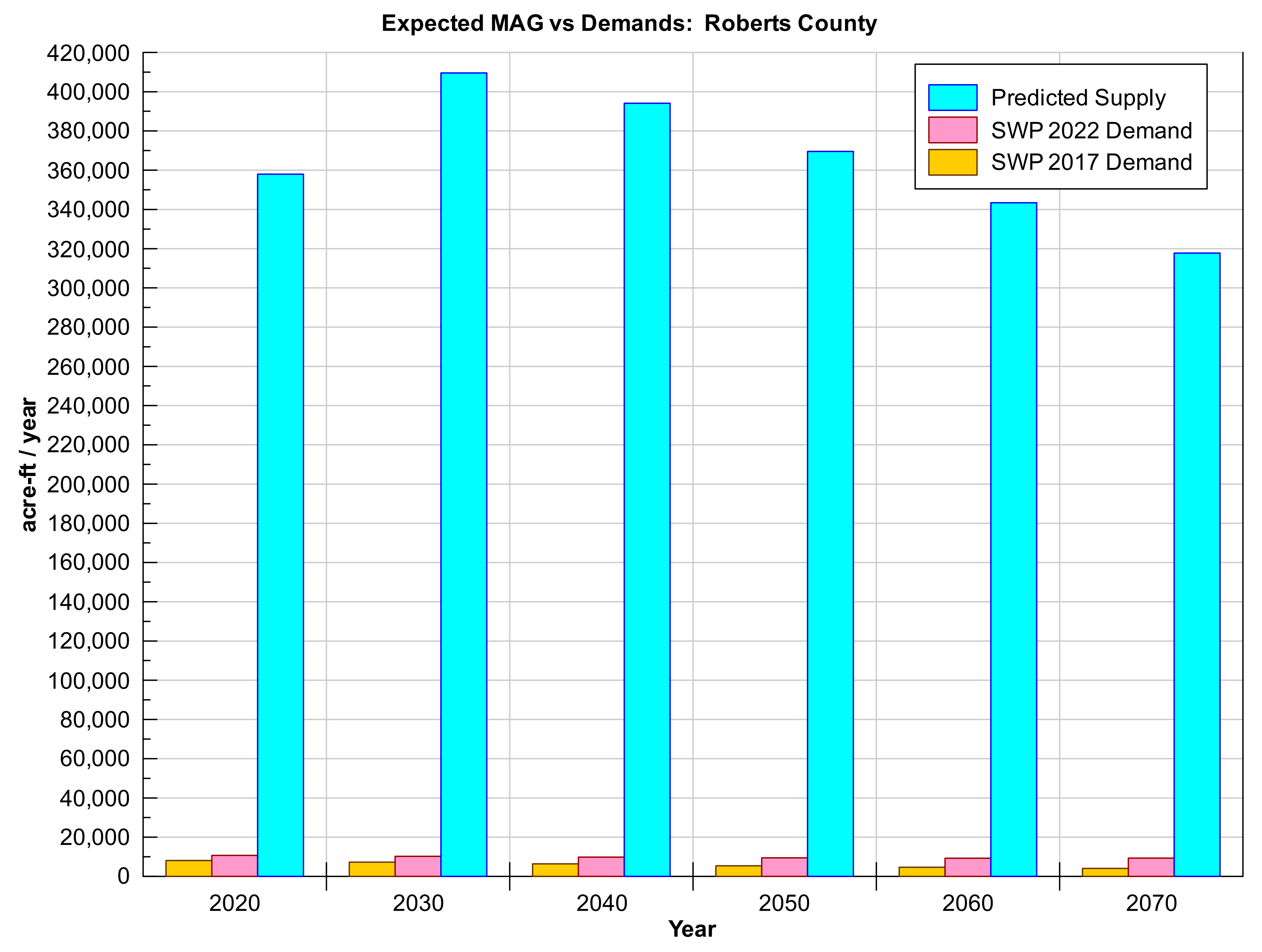
2030
2040
2050
2060
2070
Year



Expected MAG vs Demands: Potter County
Predicted Supply
SWP 2022 Demand
SWP 2017 Demand
acre-ft / year
110,000
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
2020
2030
2040
2050
2060
2070
Year


Expected MAG vs Demands: Randall County
110,000
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
acre-ft / year
Predicted Supply
SWP 2022 Demand
SWP 2017 Demand
2020
2030
2040
2050
2060
2070
Year



Expected MAG vs Demands: Roberts County
Predicted Supply
SWP 2022 Demand
SWP 2017 Demand
acre-ft / year
420,000
400,000
380,000
360,000
340,000
320,000
300,000
280,000
260,000
240,000
220,000
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
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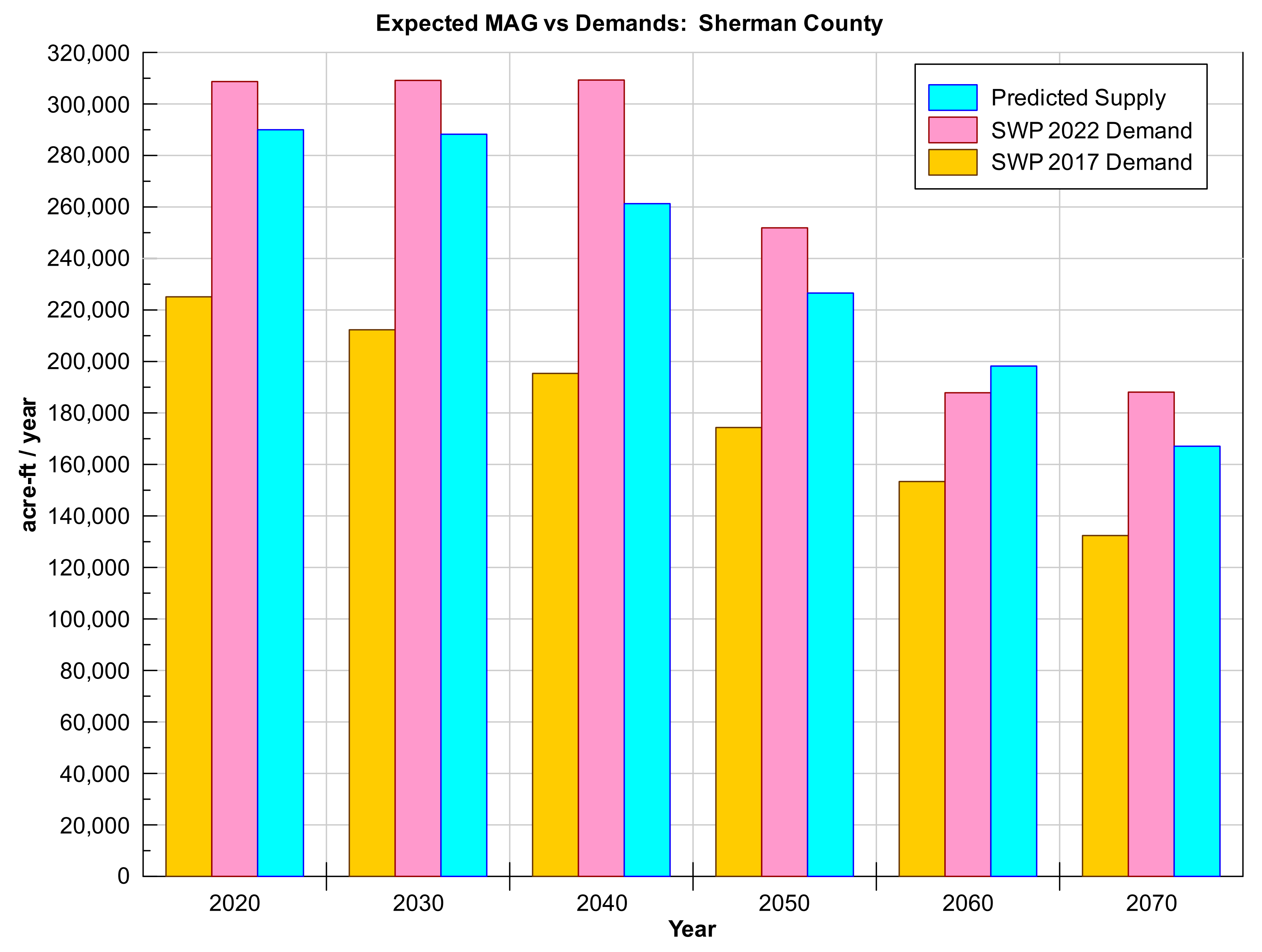
2020
2030
2040
2050
2060
2070
Year



Expected MAG vs Demands: Sherman County
Predicted Supply
SWP 2022 Demand
SWP 2017 Demand
acre-ft / year
Year
0
20,000
40,000
60,000
80,000
100,000
120,000
140,000
160,000
180,000
200,000
220,000
240,000
260,000
280,000
300,000
320,000
2020
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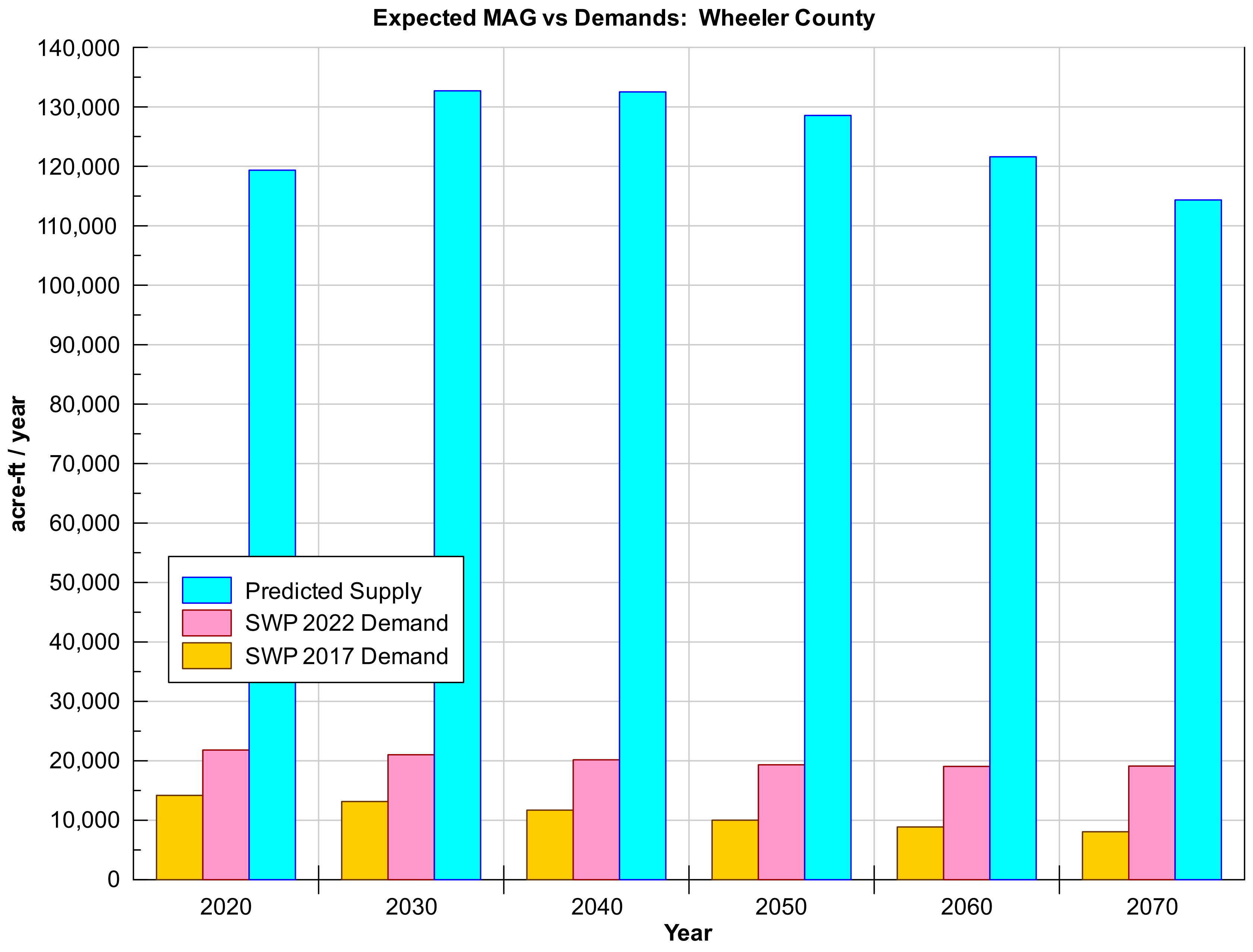
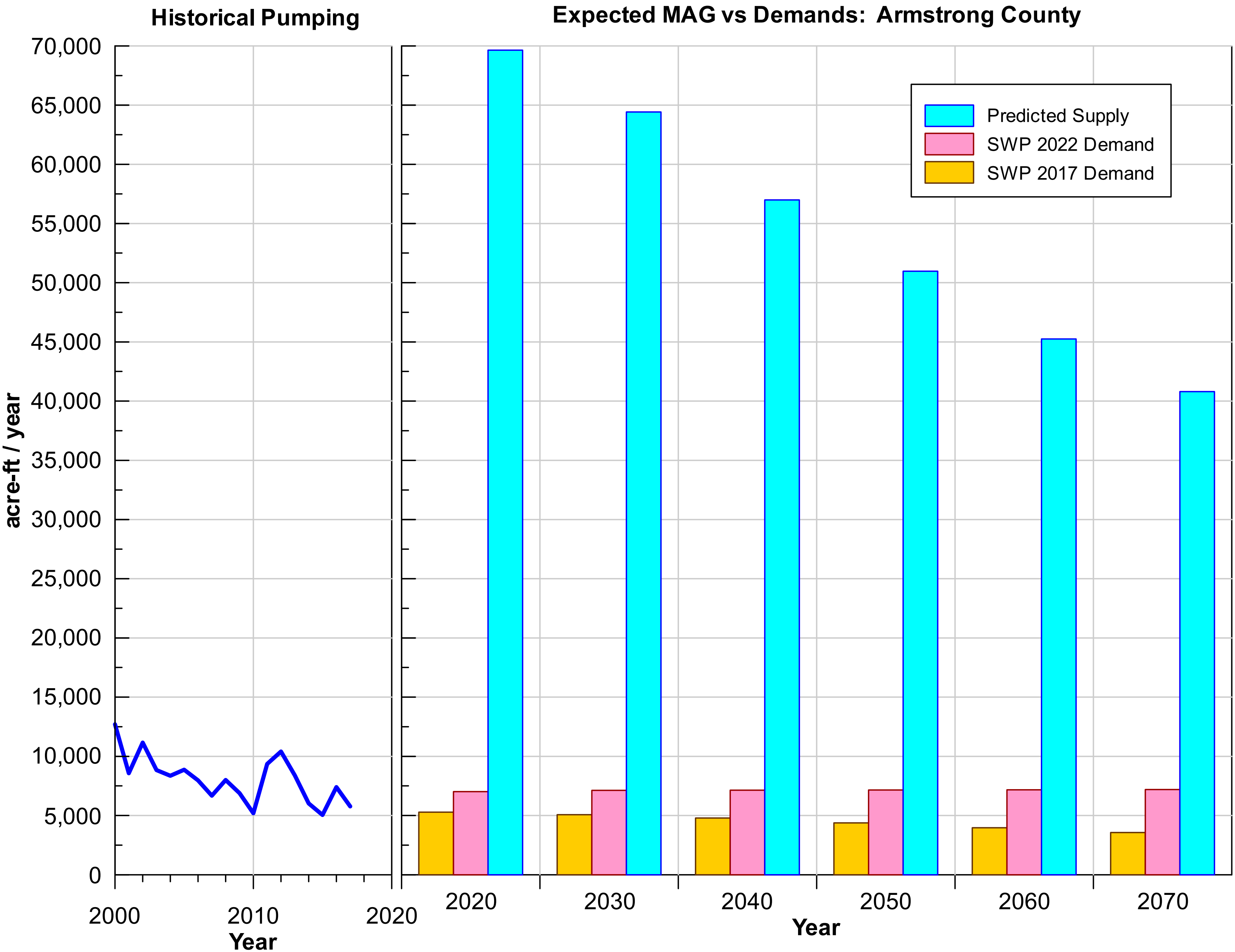
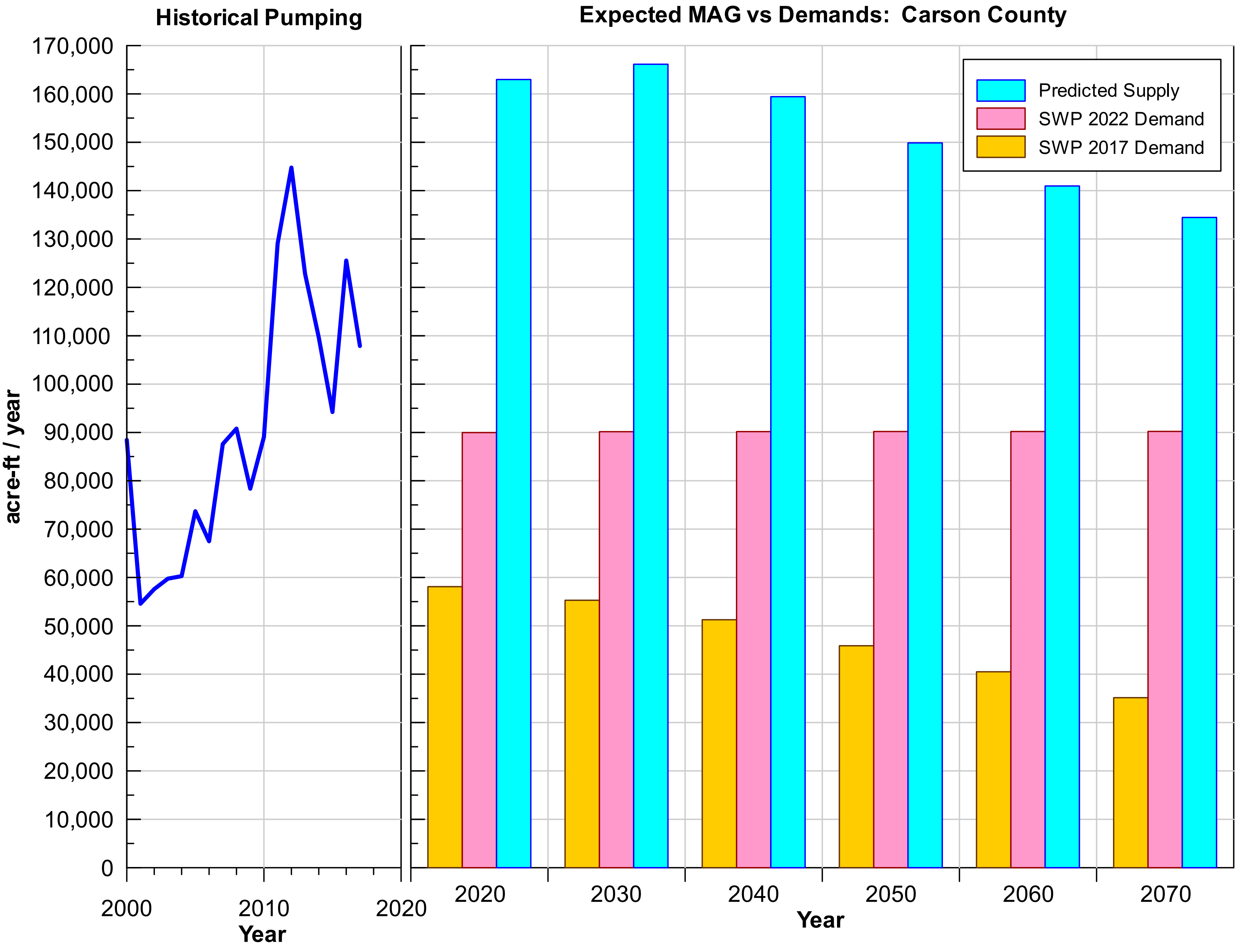
2040
2050
2060
2070



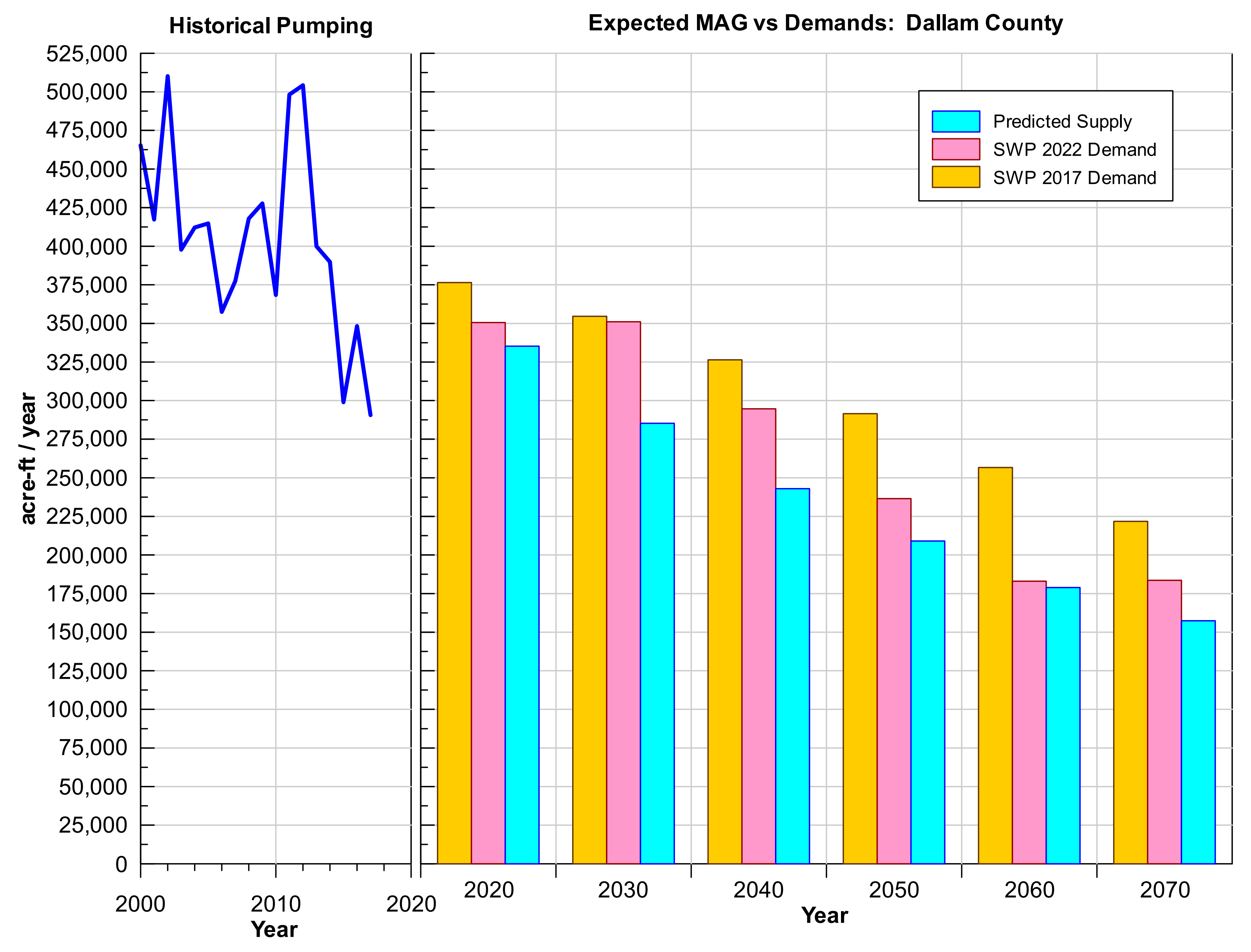
Expected MAG vs Demands: Wheeler County
acre-ft / year
140,000
130,000
120,000
110,000
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
2020
2030
2040
2050
2060
2070
Year
Predicted Supply
SWP 2022 Demand
SWP 2017 Demand



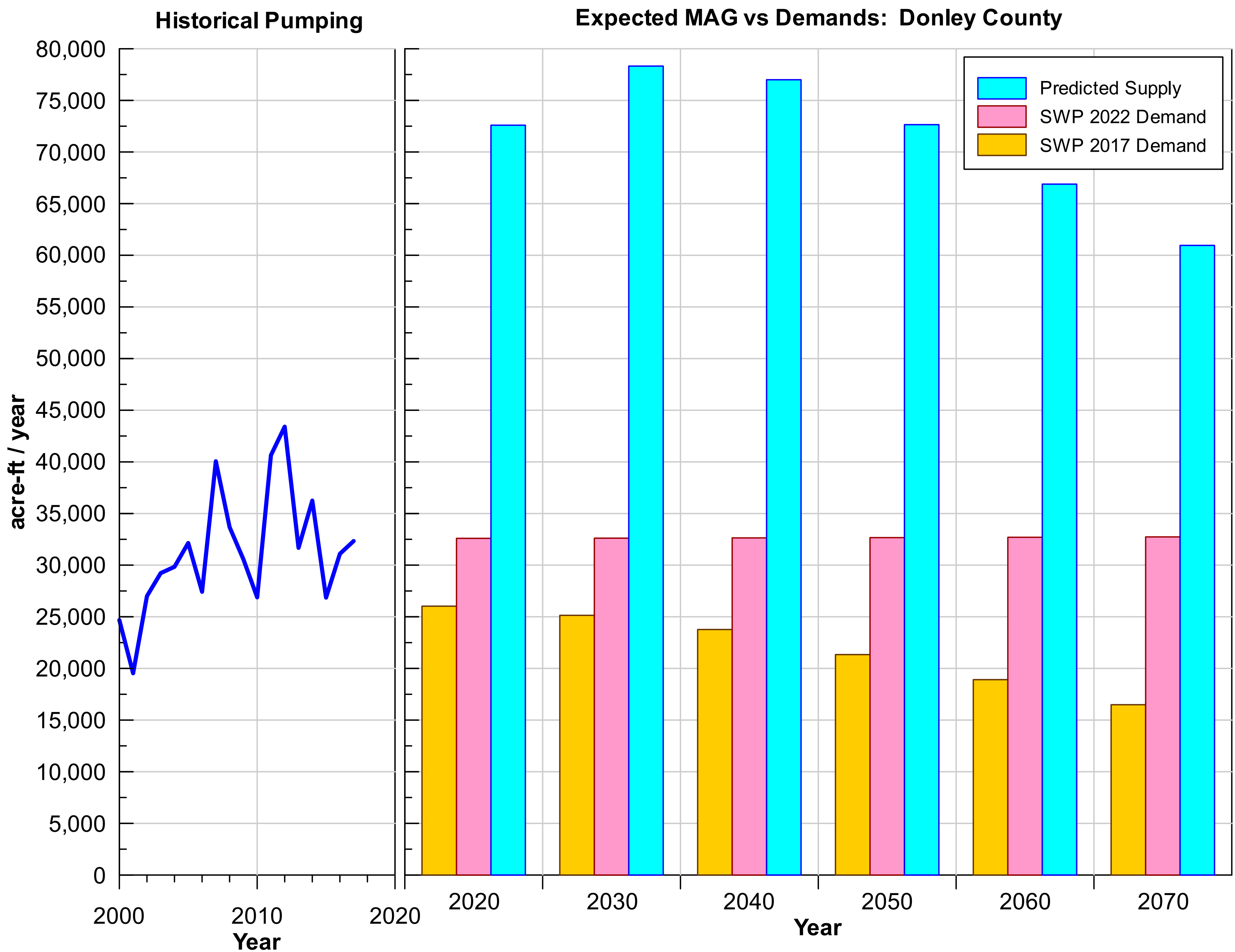
Historical Pumping
Expected MAG vs Demands: Armstrong County
acre-ft / year
70,000
65,000
60,000
55,000
50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
2000
2010
2020
Year
Predicted Supply
SWP 2022 Demand
SWP 2017 Demand
2020
2030
2040
2050
2060
2070
Year



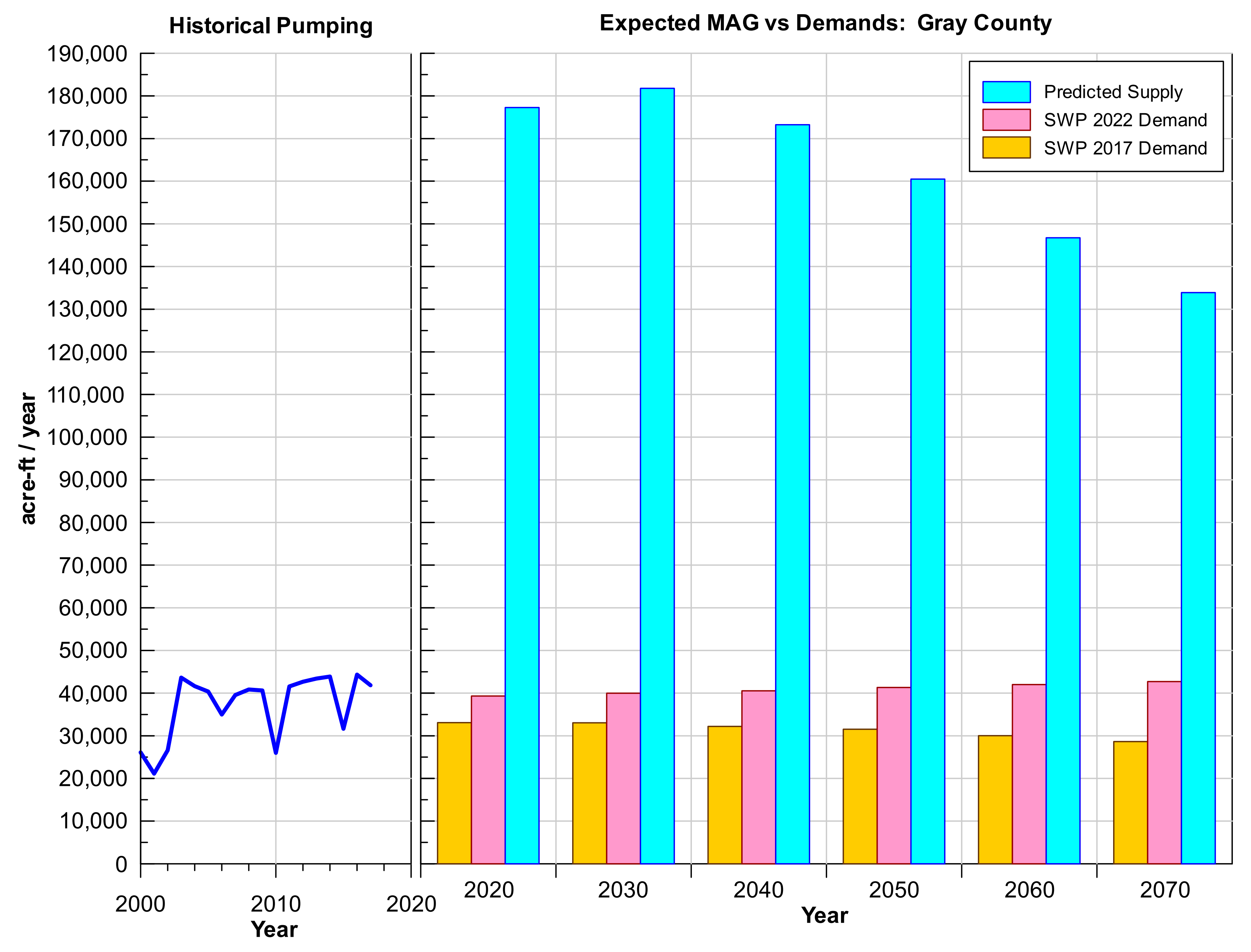
Historical Pumping
Expected MAG vs Demands: Carson County
acre-ft / year
170,000
160,000
150,000
140,000
130,000
120,000
110,000
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
2000
2010
2020
Year
Predicted Supply
SWP 2022 Demand
SWP 2017 Demand
2020
2030
2040
2050
2060
2070
Year



Historical Pumping
Expected MAG vs Demands: Dallam County
acre-ft / year
525,000
500,000
475,000
450,000
425,000
400,000
375,000
350,000
325,000
300,000
275,000
250,000
225,000
200,000
175,000
150,000
125,000
100,000
75,000
50,000
25,000
0
2000
2010
2020
Year
Predicted Supply
SWP 2022 Demand
SWP 2017 Demand
2020
2030
2040
2050
2060
2070
Year



Historical Pumping
Expected MAG vs Demands: Donley County
acre-ft / year
80,000
75,000
70,000
65,000
60,000
55,000
50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
2000
2010
2020
Year
2020
2030
2040
2050
2060
2070
Year
Predicted Supply
SWP 2022 Demand
SWP 2017 Demand



Historical Pumping
Expected MAG vs Demands: Gray County
Predicted Supply
SWP 2022 Demand
SWP 2017 Demand
acre-ft / year
190,000
180,000
170,000
160,000
150,000
140,000
130,000
120,000
110,000
100,000
90,000
80,000
70,000
60,000
50,000
40,000
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10,000
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Year
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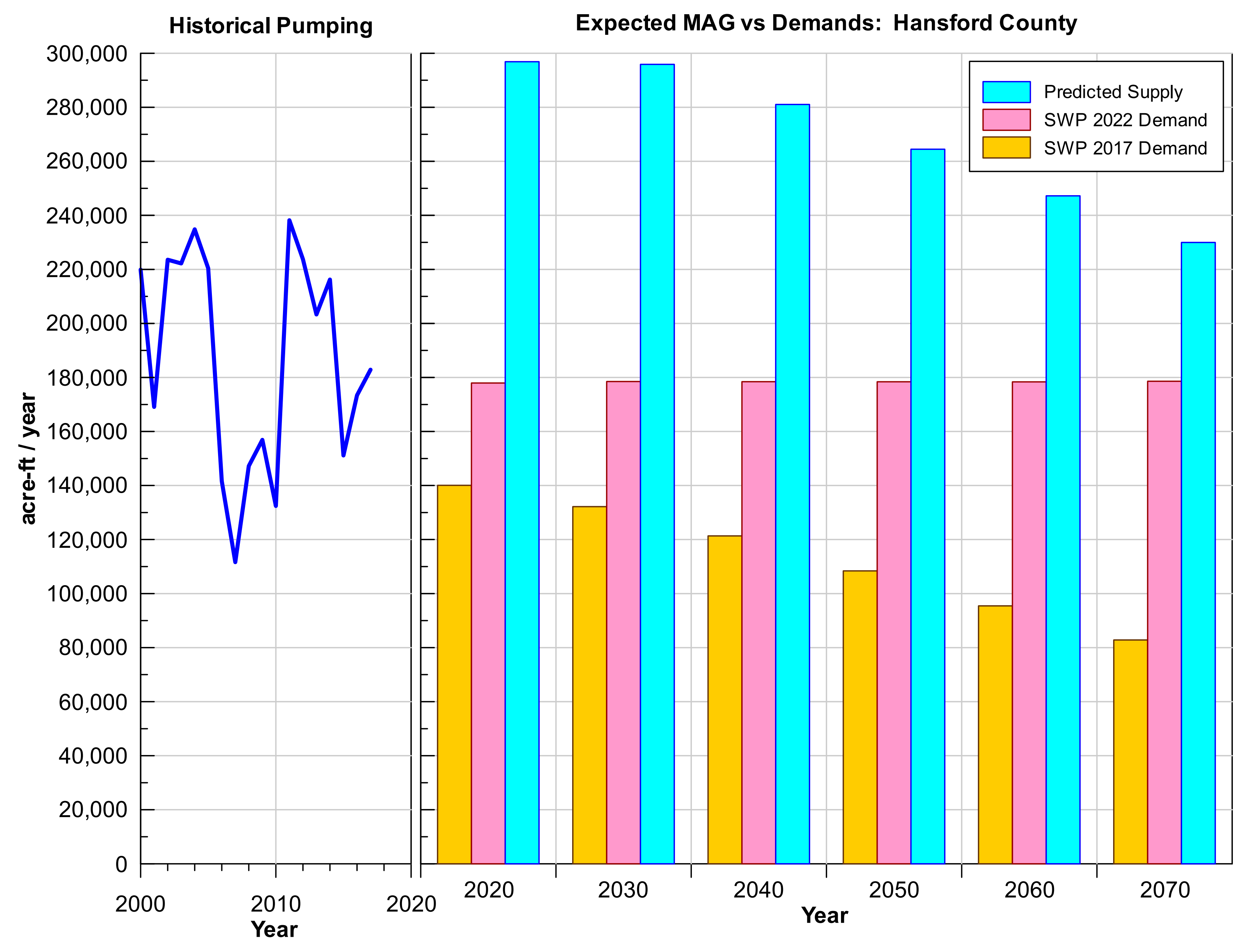
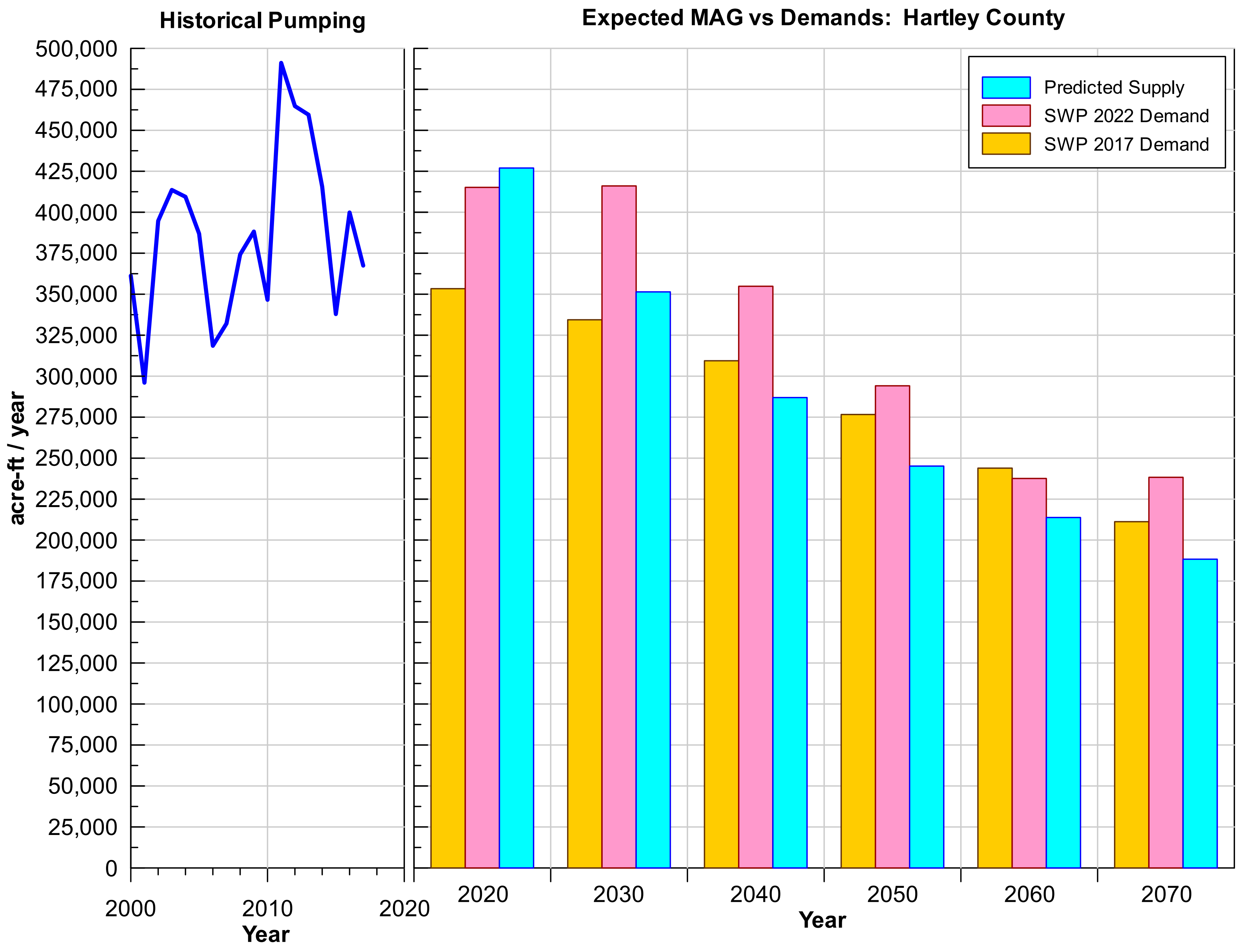
2050
2060
2070
Year



Historical Pumping
Expected MAG vs Demands: Hansford County
acre-ft / year
300,000
280,000
260,000
240,000
220,000
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
2000
2010
2020
Year
2020
2030
2040
2050
2060
2070
Year
Predicted Supply
SWP 2022 Demand
SWP 2017 Demand


Historical Pumping
Expected MAG vs Demands: Hartley County
Predicted Supply
SWP 2022 Demand
SWP 2017 Demand
acre-ft / year
500,000
475,000
450,000
425,000
400,000
375,000
350,000
325,000
300,000
275,000
250,000
225,000
200,000
175,000
150,000
125,000
100,000
75,000
50,000
25,000
0
2000
2010
2020
Year
2020
2030
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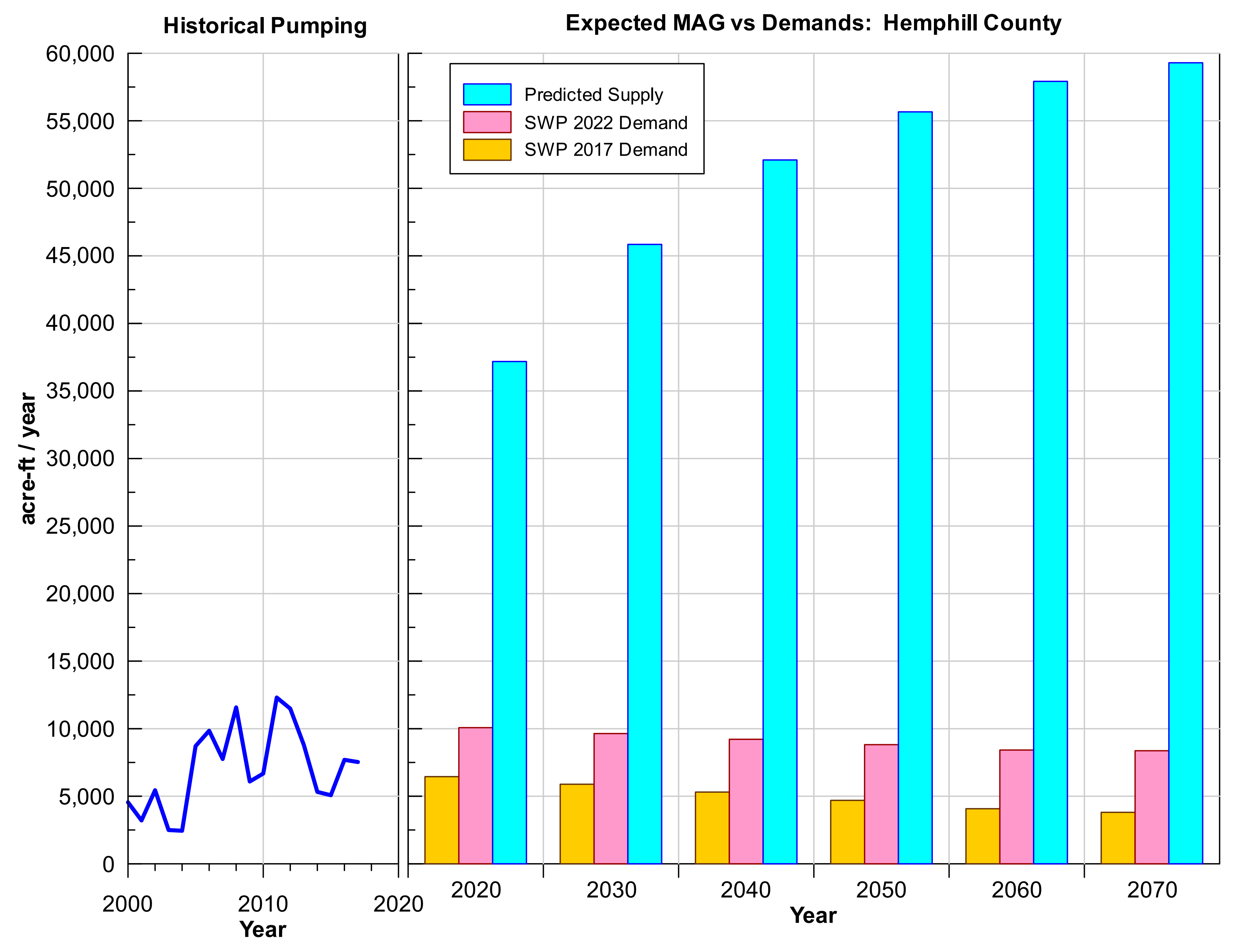
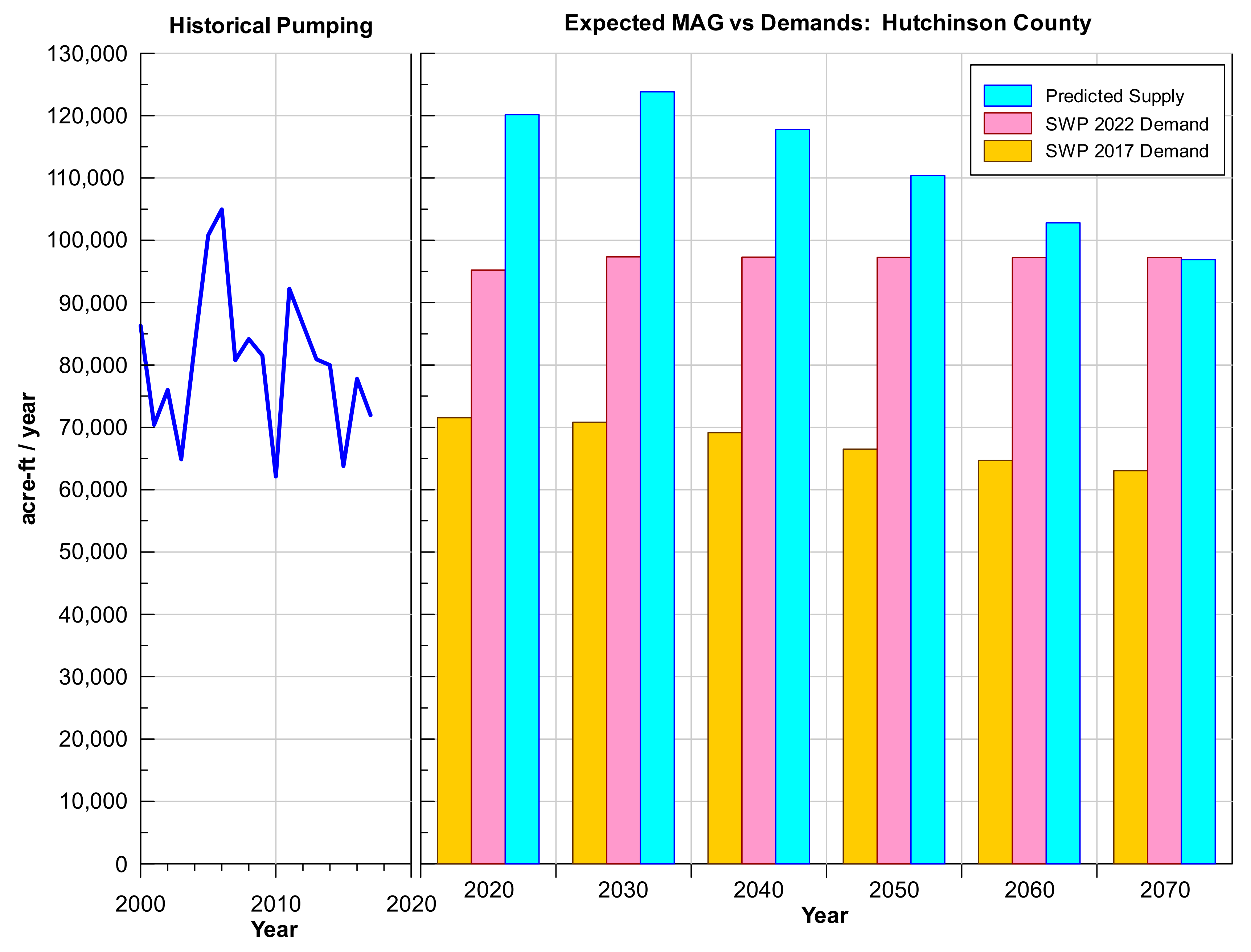
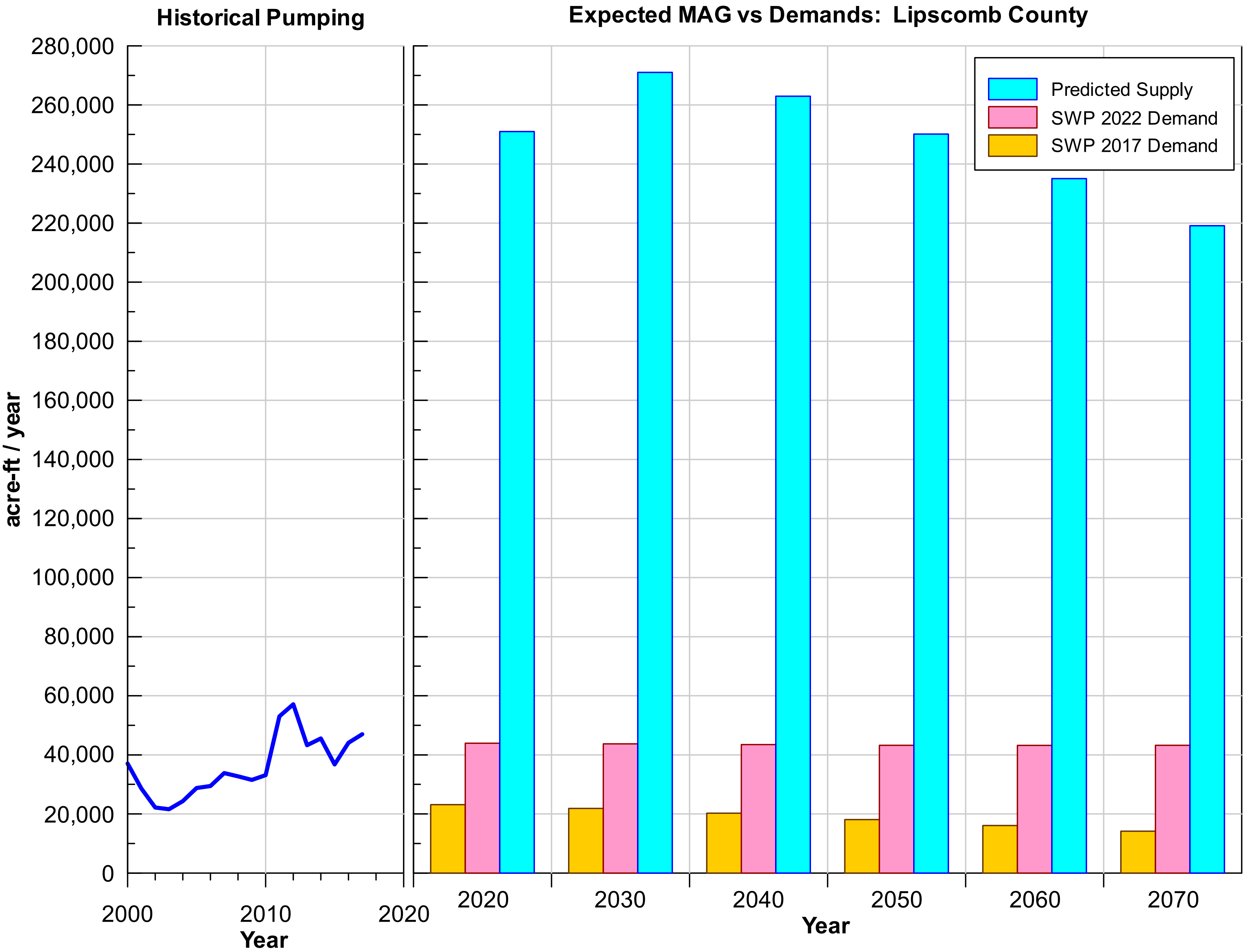
2050
2060
2070
Year



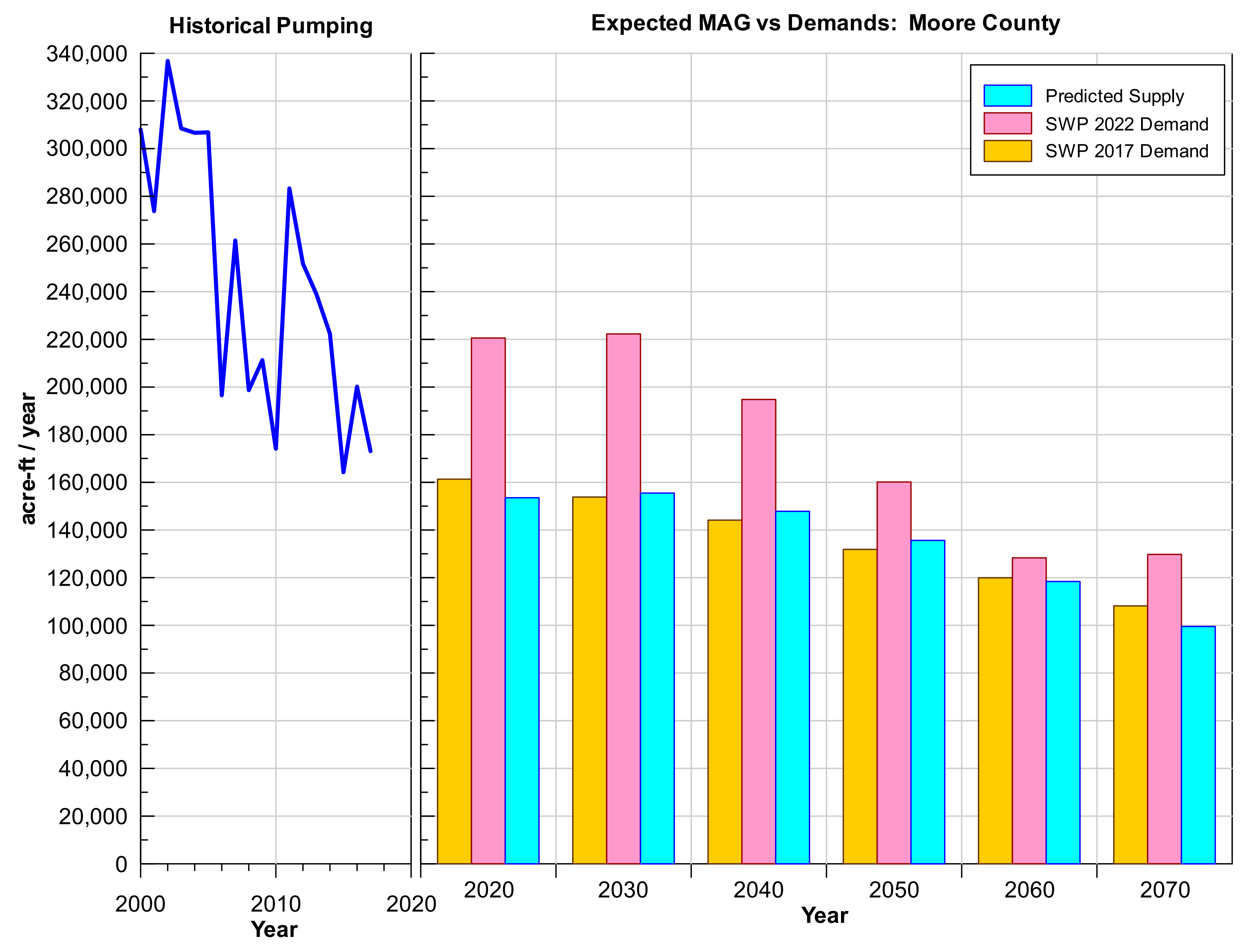
Historical Pumping
Expected MAG vs Demands: Hemphill County
Predicted Supply
SWP 2022 Demand
SWP 2017 Demand
acre-ft / year
60,000
55,000
50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
2000
2010
2020
Year
2020
2030
2040
2050
2060
2070
Year



Historical Pumping
Expected MAG vs Demands: Hutchinson County
Predicted Supply
SWP 2022 Demand
SWP 2017 Demand
acre-ft / year
130,000
120,000
110,000
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
2000
2010
2020
Year
2020
2030
2040
2050
2060
2070
Year



Historical Pumping
Expected MAG vs Demands: Lipscomb County
acre-ft / year
280,000
260,000
240,000
220,000
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
2000
2010
2020
Year
2020
2030
2040
2050
2060
2070
Year
Predicted Supply
SWP 2022 Demand
SWP 2017 Demand



Historical Pumping
Expected MAG vs Demands: Moore County
acre-ft / year
340,000
320,000
300,000
280,000
260,000
240,000
220,000
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
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2000
2010
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Year
2020
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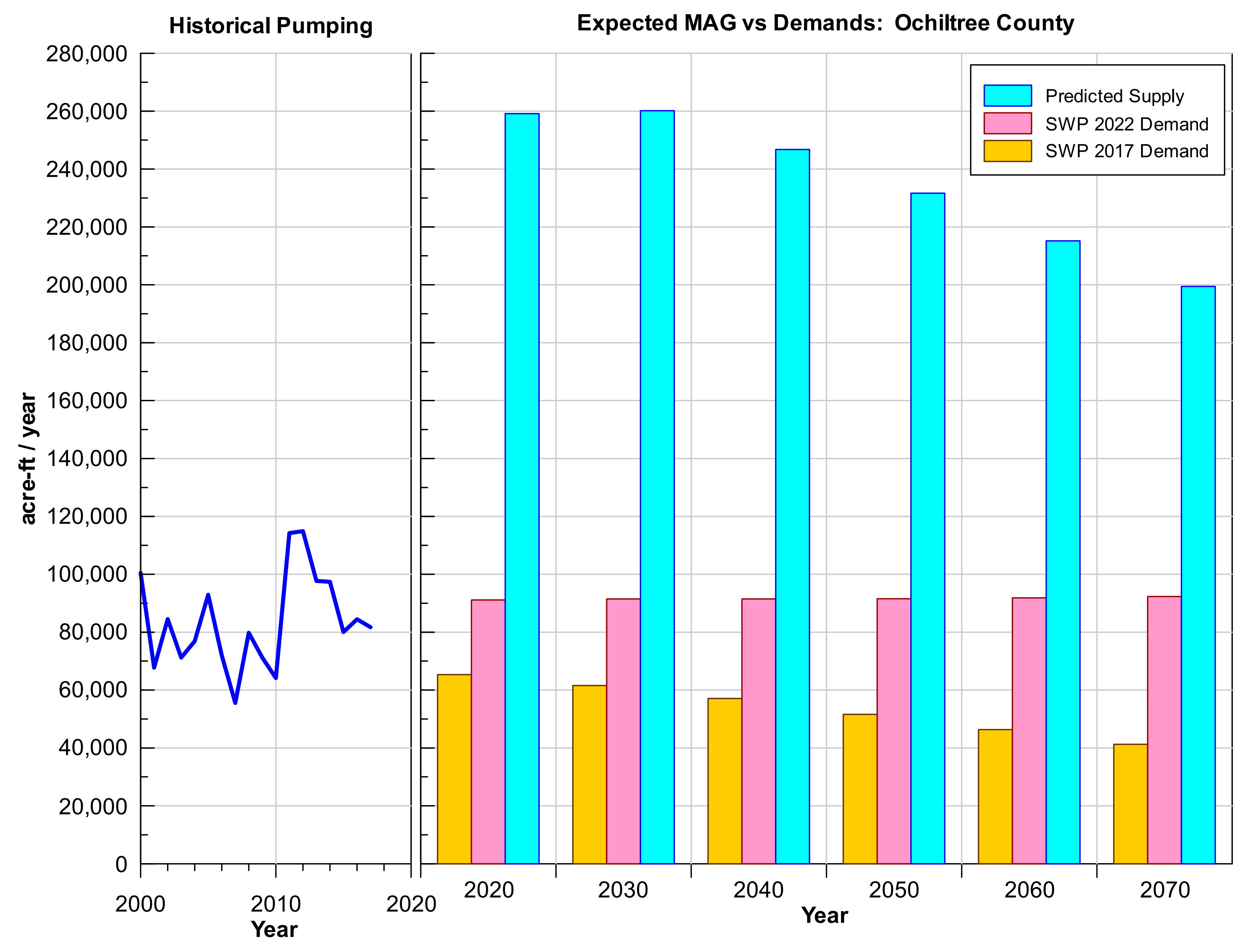
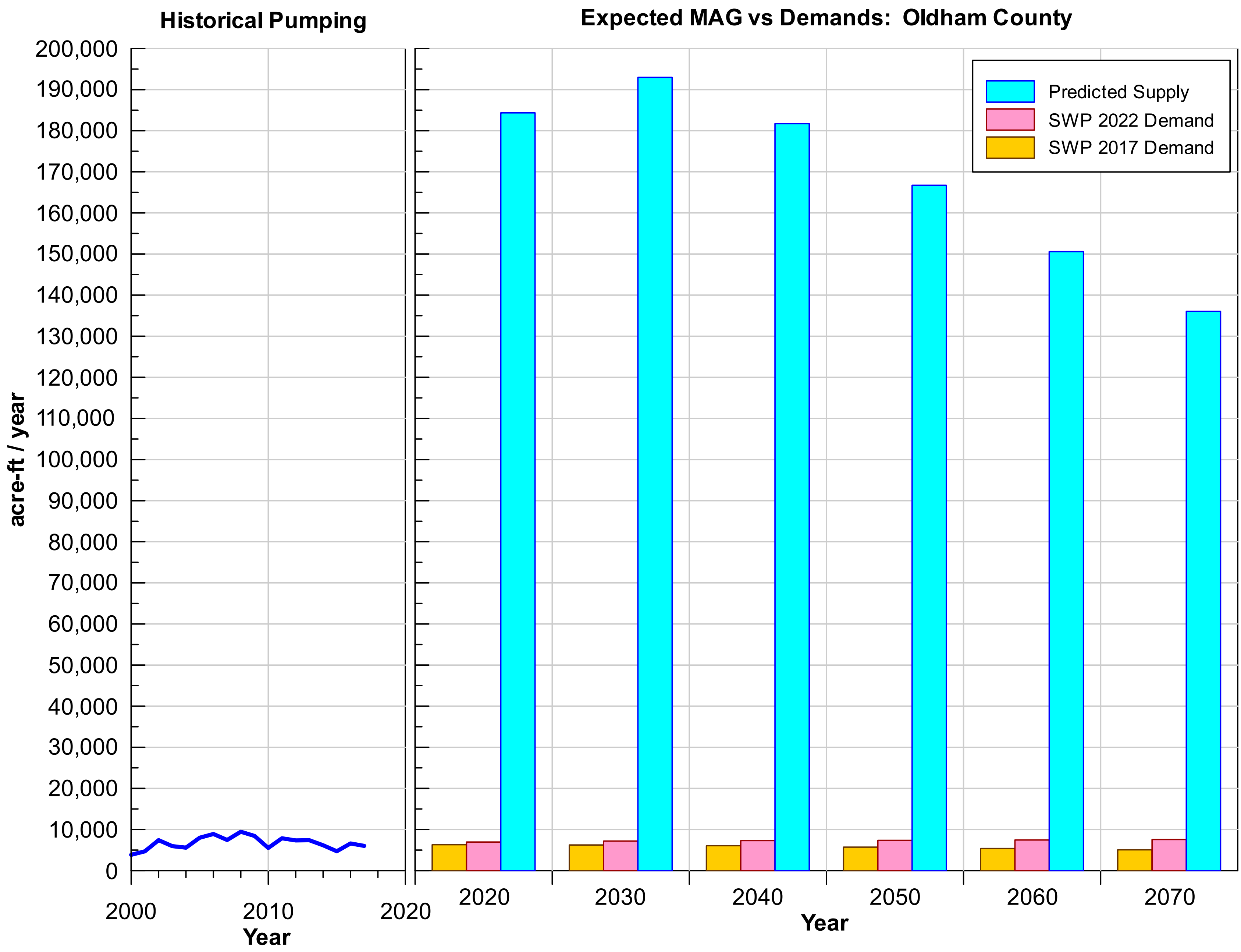
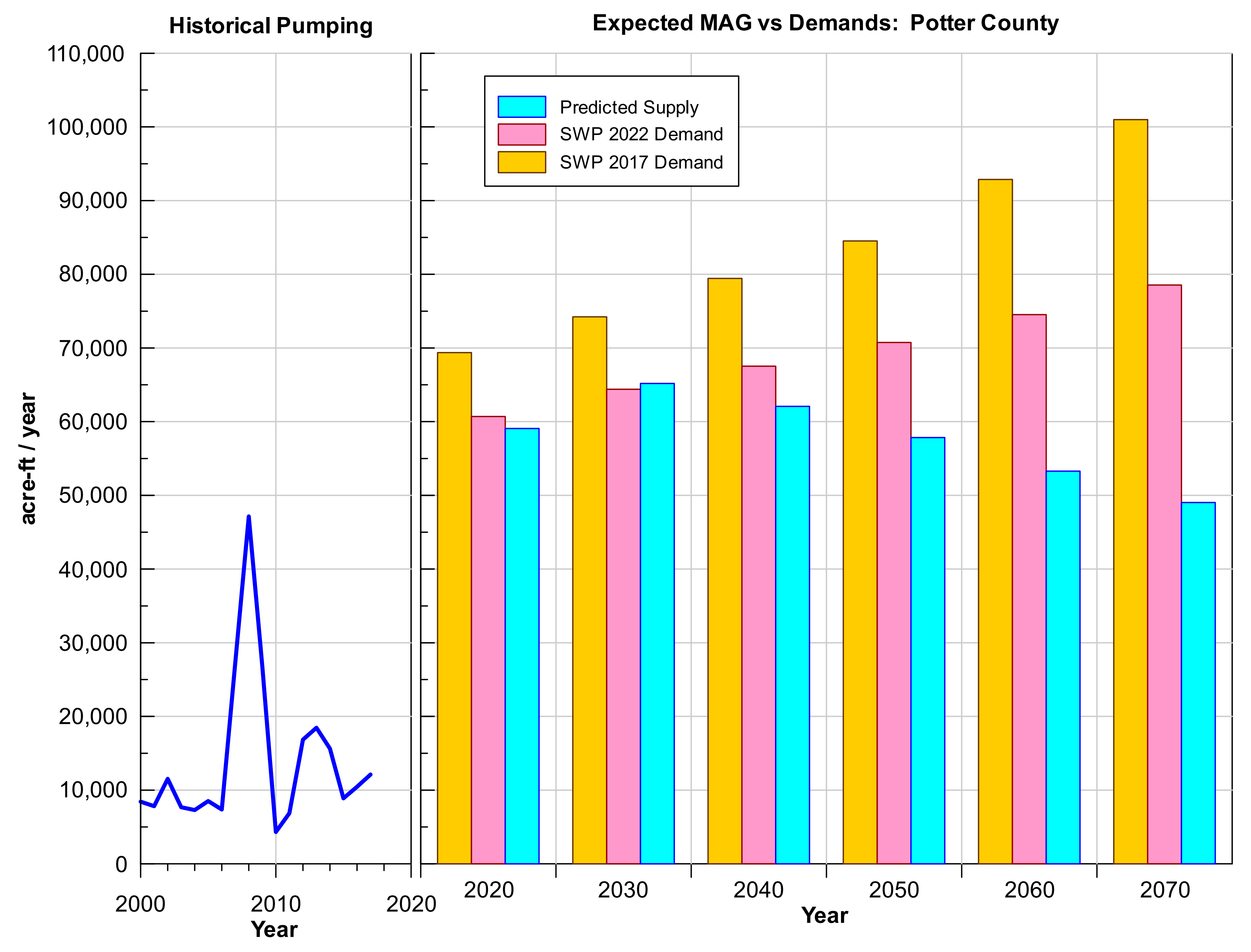
2050
2060
2070
Year
Predicted Supply
SWP 2022 Demand
SWP 2017 Demand



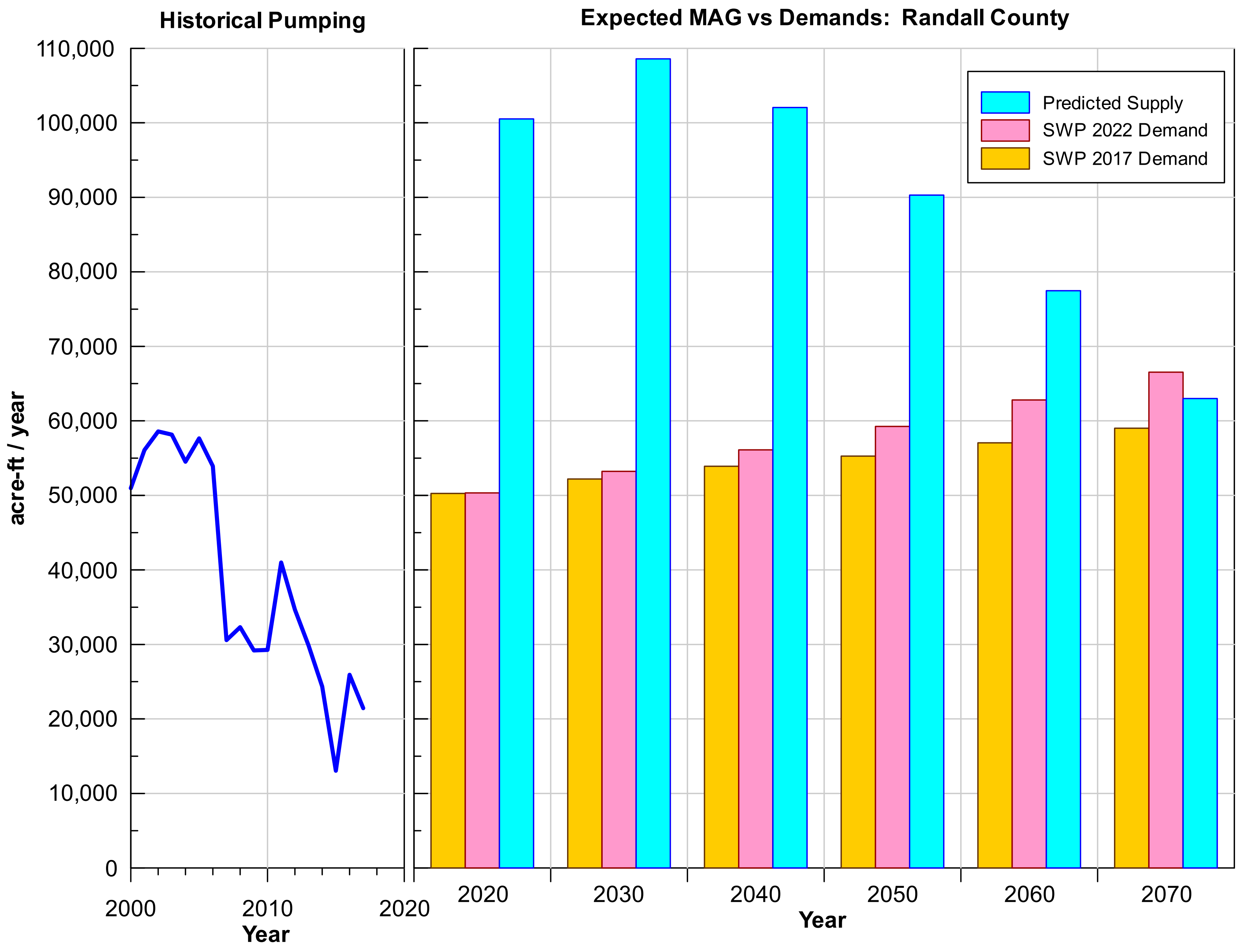
Historical Pumping
Expected MAG vs Demands: Ochiltree County
acre-ft / year
280,000
260,000
240,000
220,000
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
2000
2010
2020
Year
2020
2030
2040
2050
2060
2070
Year
Predicted Supply
SWP 2022 Demand
SWP 2017 Demand



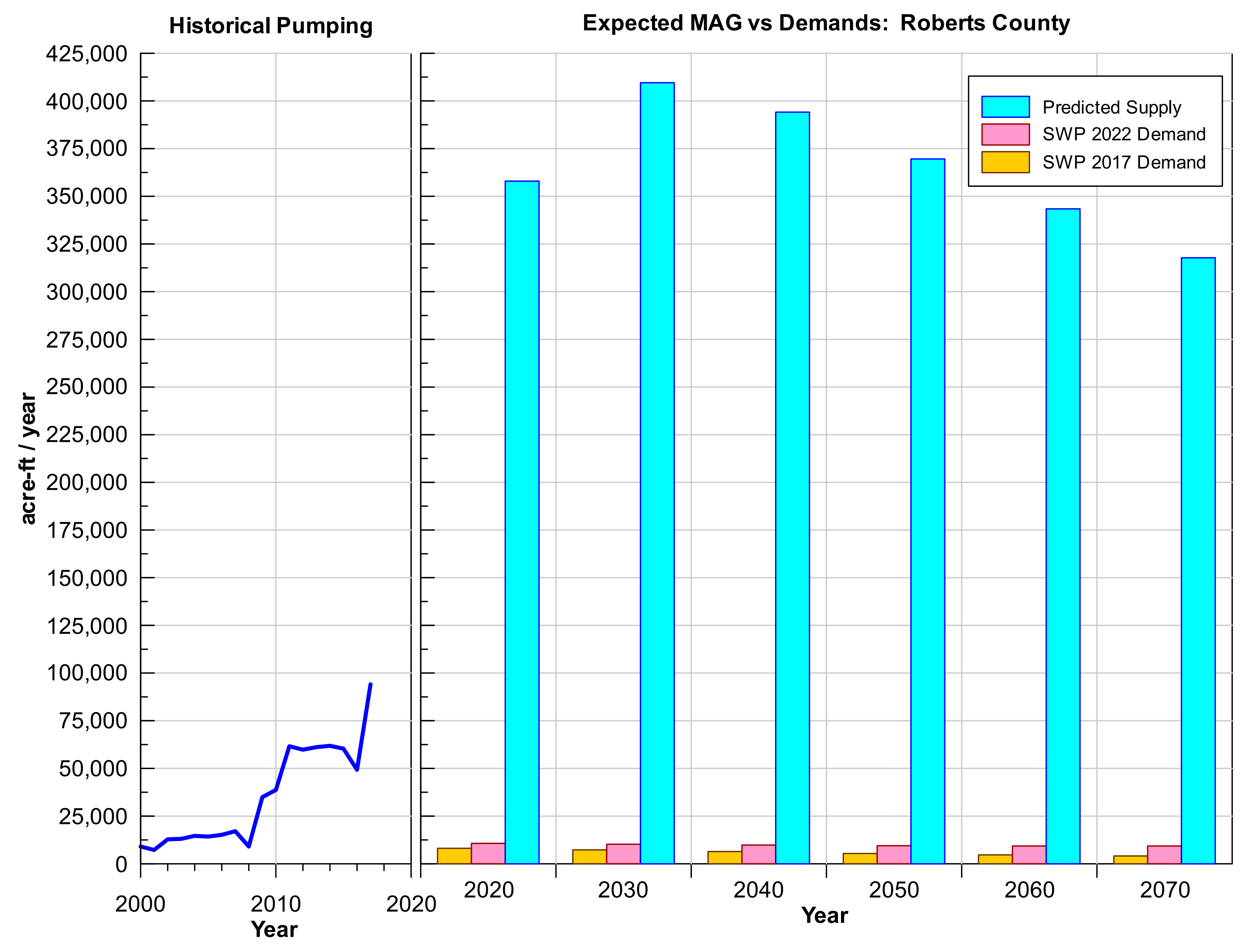
Historical Pumping
Expected MAG vs Demands: Oldham County
acre-ft / year
200,000
190,000
180,000
170,000
160,000
150,000
140,000
130,000
120,000
110,000
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
2000
2010
2020
Year
2020
2030
2040
2050
2060
2070
Year
Predicted Supply
SWP 2022 Demand
SWP 2017 Demand



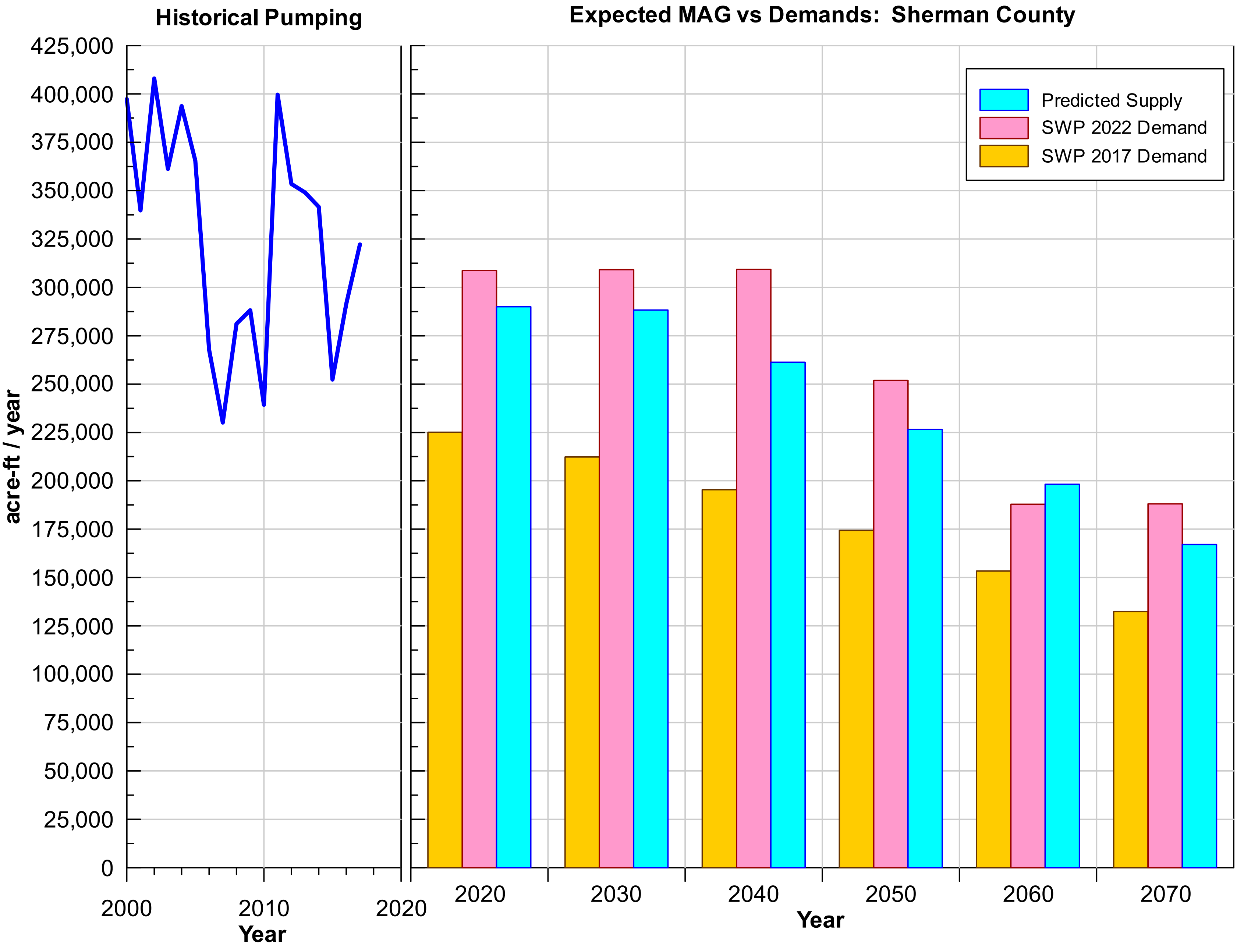
Historical Pumping
Expected MAG vs Demands: Potter County
Predicted Supply
SWP 2022 Demand
SWP 2017 Demand
acre-ft / year
0
10,000
20,000
30,000
40,000
50,000
60,000
70,000
80,000
90,000
100,000
110,000
2000
2010
2020
Year
2020
2030
2040
2050
2060
2070
Year



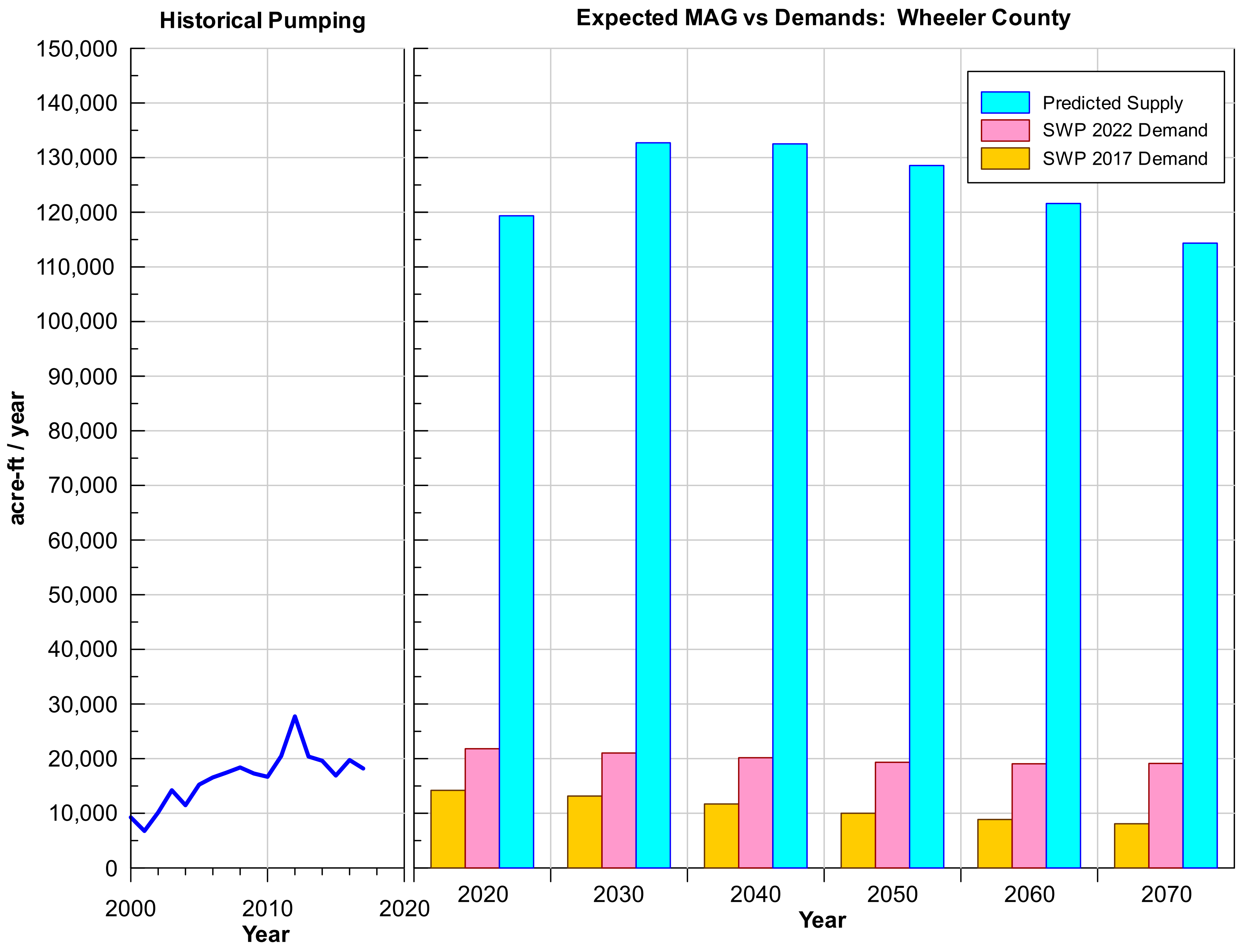
Historical Pumping
Expected MAG vs Demands: Randall County
acre-ft / year
110,000
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
2000
2010
2020
Year
2020
2030
2040
2050
2060
2070
Year
Predicted Supply
SWP 2022 Demand
SWP 2017 Demand



Historical Pumping
Expected MAG vs Demands: Roberts County
acre-ft / year
425,000
400,000
375,000
350,000
325,000
300,000
275,000
250,000
225,000
200,000
175,000
150,000
125,000
100,000
75,000
50,000
25,000
0
2000
2010
2020
Year
2020
2030
2040
2050
2060
2070
Year
Predicted Supply
SWP 2022 Demand
SWP 2017 Demand



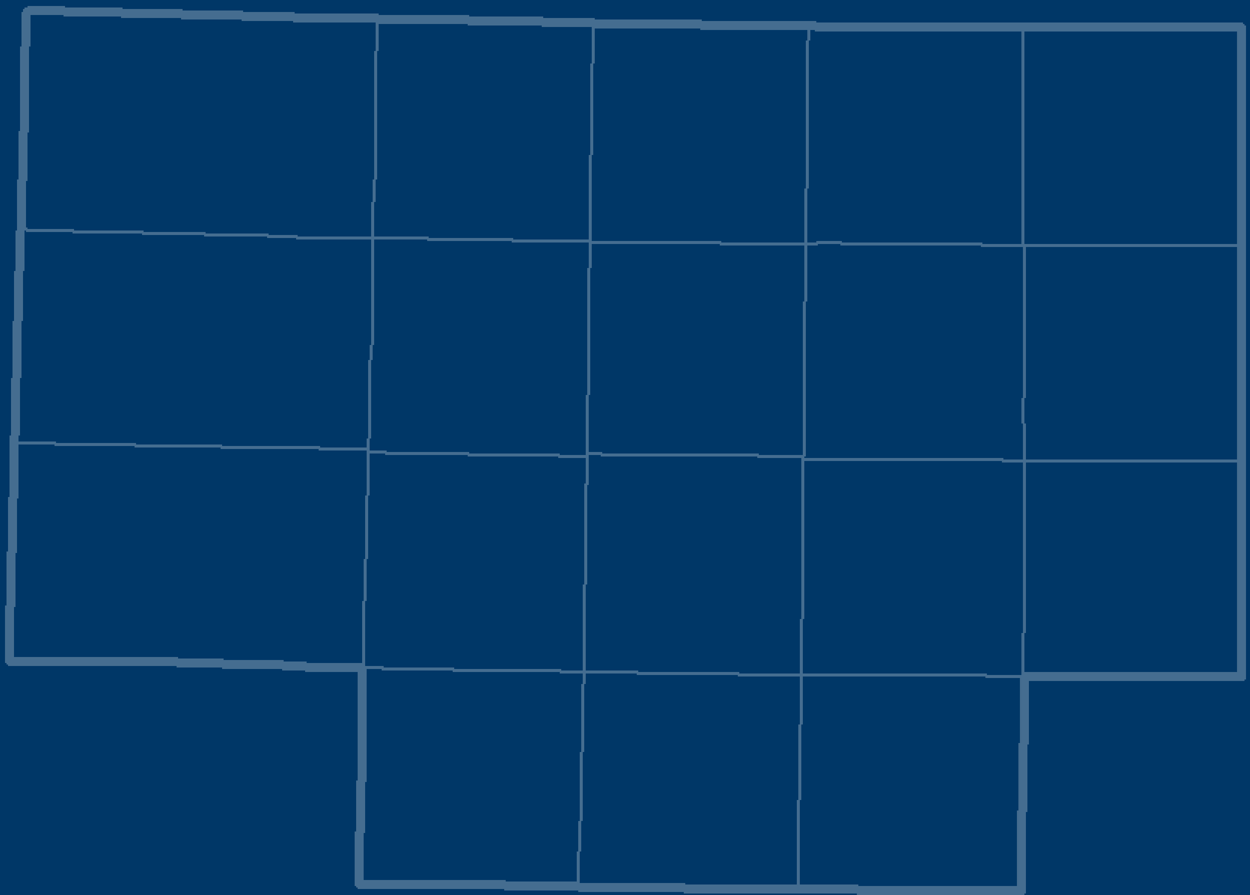
Historical Pumping
Expected MAG vs Demands: Sherman County
acre-ft / year
425,000
400,000
375,000
350,000
325,000
300,000
275,000
250,000
225,000
200,000
175,000
150,000
125,000
100,000
75,000
50,000
25,000
0
2000
2010
2020
Year
Predicted Supply
SWP 2022 Demand
SWP 2017 Demand
2020
2030
2040
2050
2060
2070
Year


Historical Pumping
Expected MAG vs Demands: Wheeler County
Predicted Supply
SWP 2022 Demand
SWP 2017 Demand
acre-ft / year
150,000
140,000
130,000
120,000
110,000
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
2000
2010
2020
Year
2020
2030
2040
2050
2060
2070
Year

Consideration of Subsidence and Socioeconomic Impacts

A Presentation to GMA 1
Joint Planning Group

November 19, 2020



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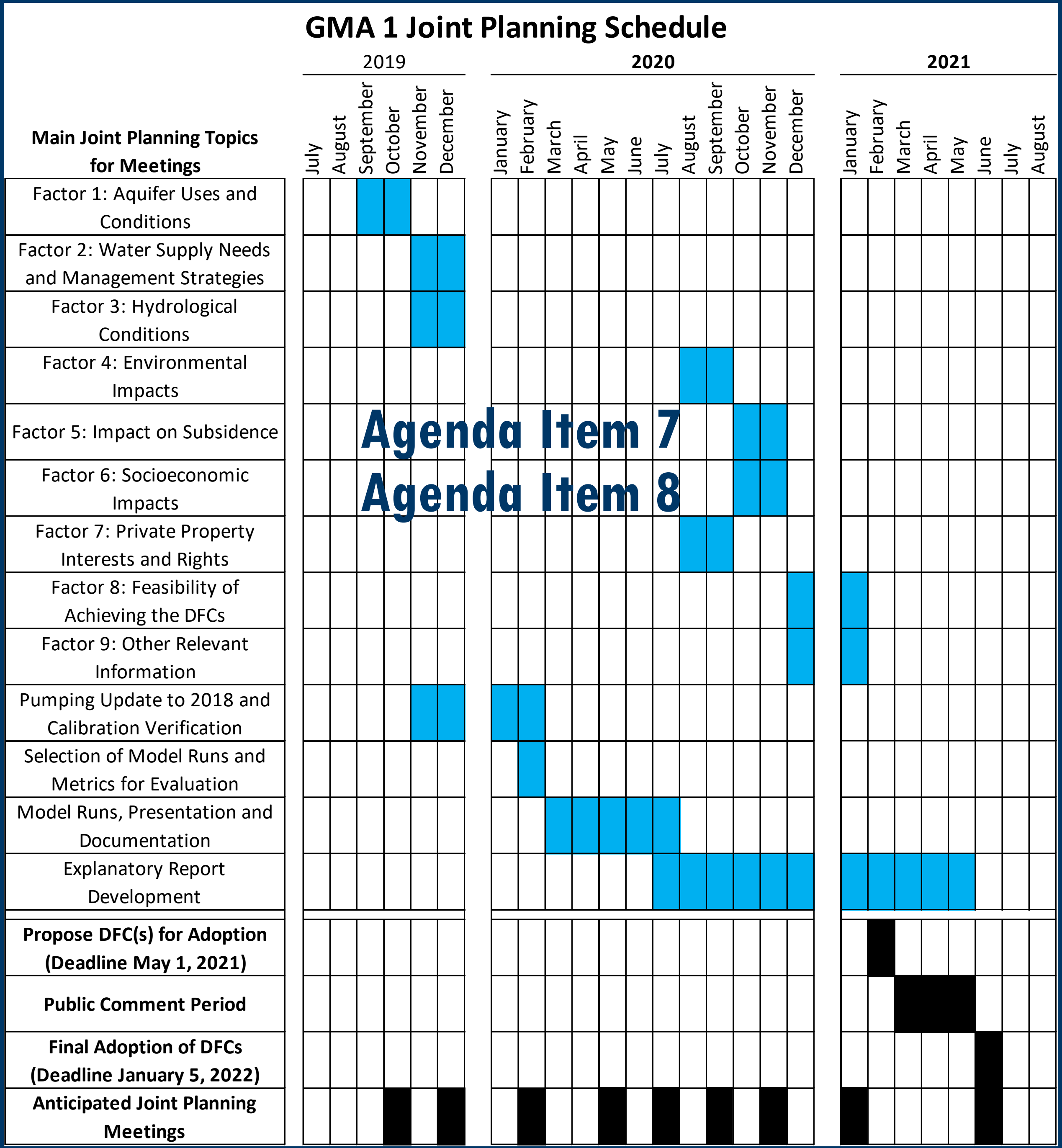
The "9 Factors" to Consider

- **Aquifer uses or conditions (10/28/2019)**
- **Water supply needs and management strategies (12/12/2019)**
- **Hydrological conditions (12/12/2019)**
- **Other environmental impacts (09/24/2020)**
- **Impact on subsidence**
- **Socioeconomic impacts**
- **Impact on private property rights (09/24/2020)**
- **Feasibility of achieving the DFC**
- **Any other relevant information**

Schedule


GMA 1 Joint Planning Schedule
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2020
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Factor 1: Aquifer Uses and Conditions
Factor 2: Water Supply Needs and Management Strategies
Factor 3: Hydrological Conditions
Factor 4: Environmental Impacts
Factor 5: Impact on Subsidence
Factor 6: Socioeconomic Impacts
Factor 7: Private Property Interests and Rights
Factor 8: Feasibility of Achieving the DFCs
Factor 9: Other Relevant Information
Pumping Update to 2018 and Calibration Verification
Selection of Model Runs and Metrics for Evaluation
Model Runs, Presentation and Documentation
Explanatory Report Development
Propose DFC(s) for Adoption (Deadline May 1, 2021)
Public Comment Period
Final Adoption of DFCs (Deadline January 5, 2022)
Anticipated Joint Planning Meetings
Agenda Item 7
Agenda Item 8

Agenda Item 7
Consideration of Subsidence Impacts

The Balancing Test

Desired Future Conditions must provide:

"a balance between the highest practicable level of groundwater production and the conservation, preservation, protection, recharging, and prevention of waste of groundwater and <u>control of subsidence</u> in the management area" (TWC Ch. 36)

Subsidence Concepts

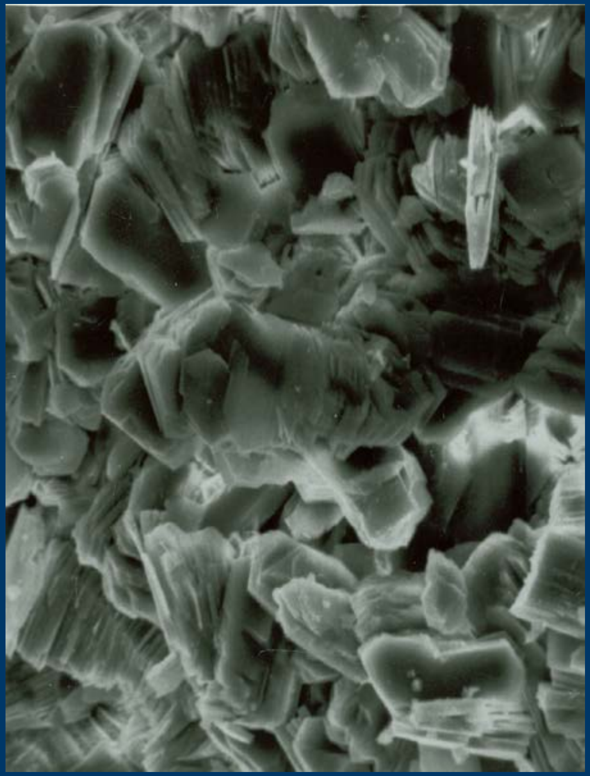
Subsidence: Lowering or sinking of the land surface, typically in response to removal of subsurface support ⇐ **At the surface**

Compaction: A decrease in the volume (i.e. thinning) of a geologic formation ⇐ **Beneath the surface**

Subsidence Concepts

Sand Grains: Larger – Round(ish)

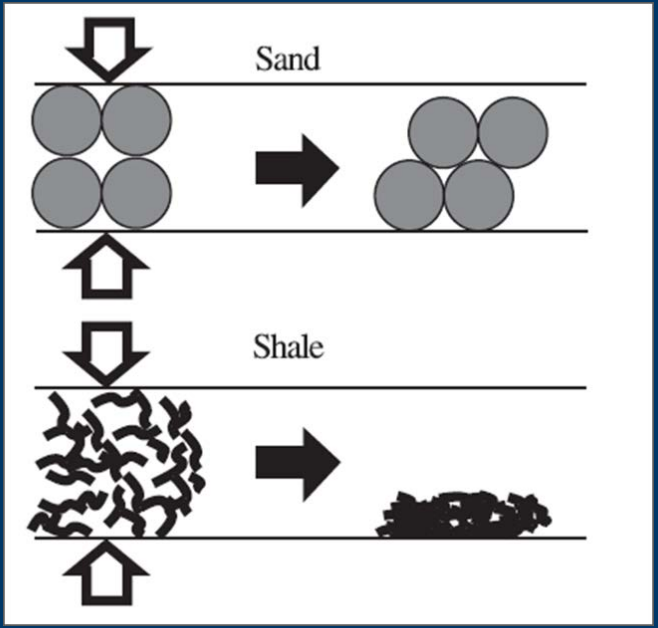
Image Source: Wilson44691 - Own work, CC0, https://commons.wikimedia.org/w/index.php?curid=37934665

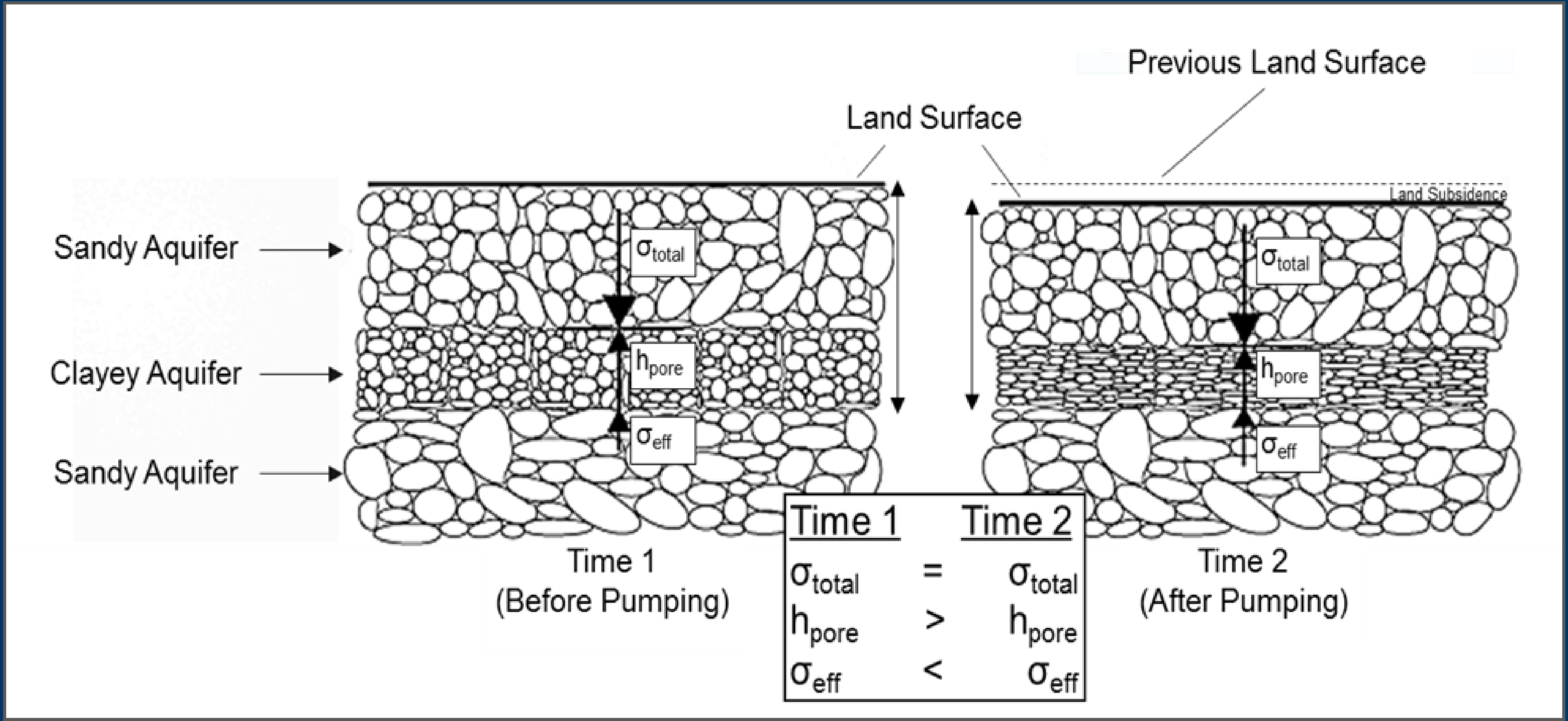


Clay Grains: Very Small – Flat

Image Source: USGS, Public Domain

Subsidence Concepts





Land Subsidence in the United States

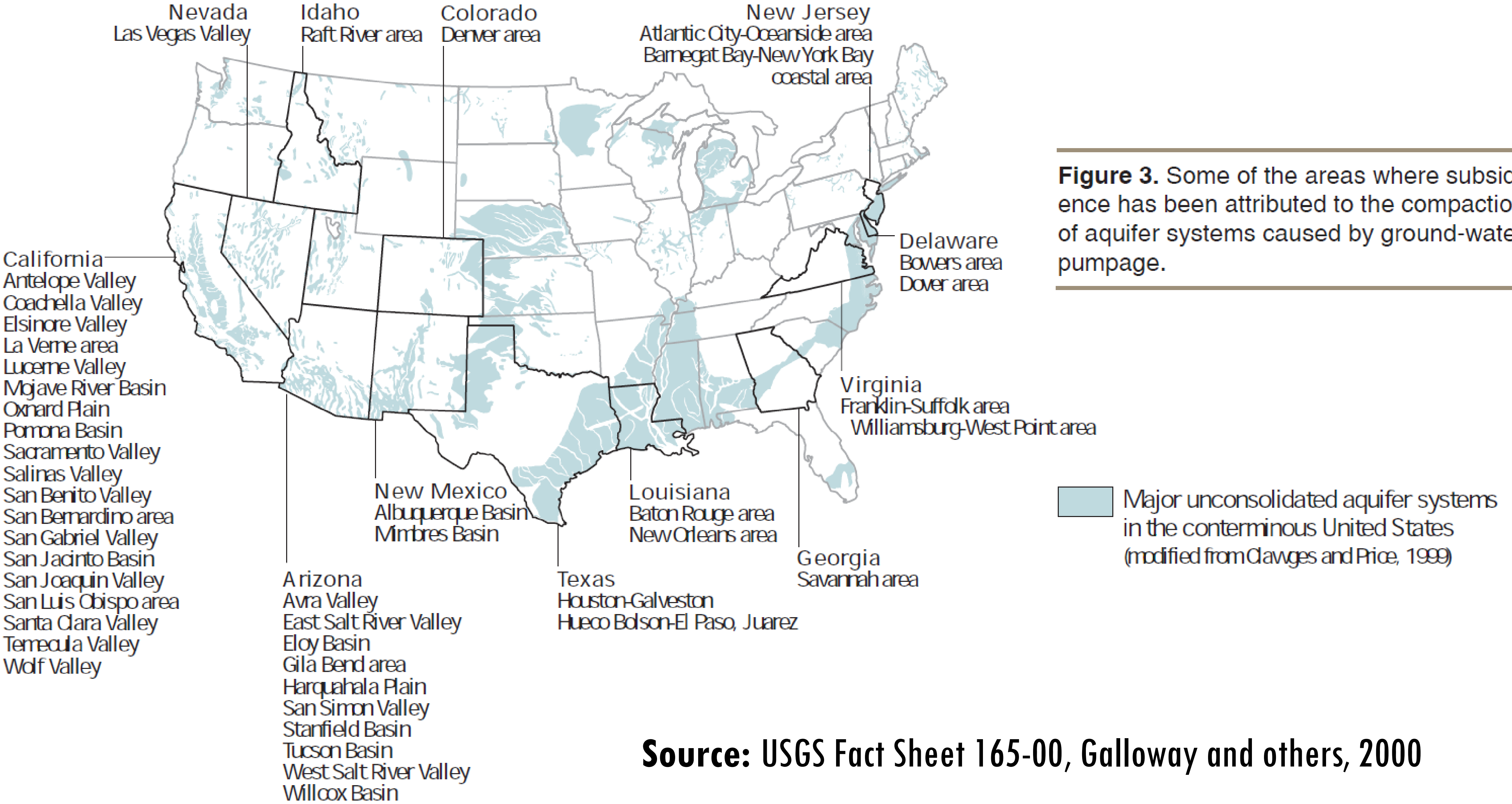


Figure 3. Some of the areas where subsidence has been attributed to the compaction of aquifer systems caused by ground-water pumpage.

Source: USGS Fact Sheet 165-00, Galloway and others, 2000

Statewide Subsidence Risk Assessment

Identification of the Vulnerability of the Major and Minor Aquifers of Texas to Subsidence with Regard to Groundwater Pumping
(Furnans and others, 2017)

- Source information: Driller's logs lithology, TWDB water levels, TWDB GAM hydraulic properties
- Three primary factors considered (clay distribution, thickness and compressibility; water level changes; and historical low water level)
- Concludes: Ogallala a "High" risk and Dockum a "Medium" risk of subsidence

Final Report: Identification of the Vulnerability of the Major and Minor Aquifers of Texas to Subsidence with Regard to Groundwater Pumping – TWDB Contract Number 1648302062

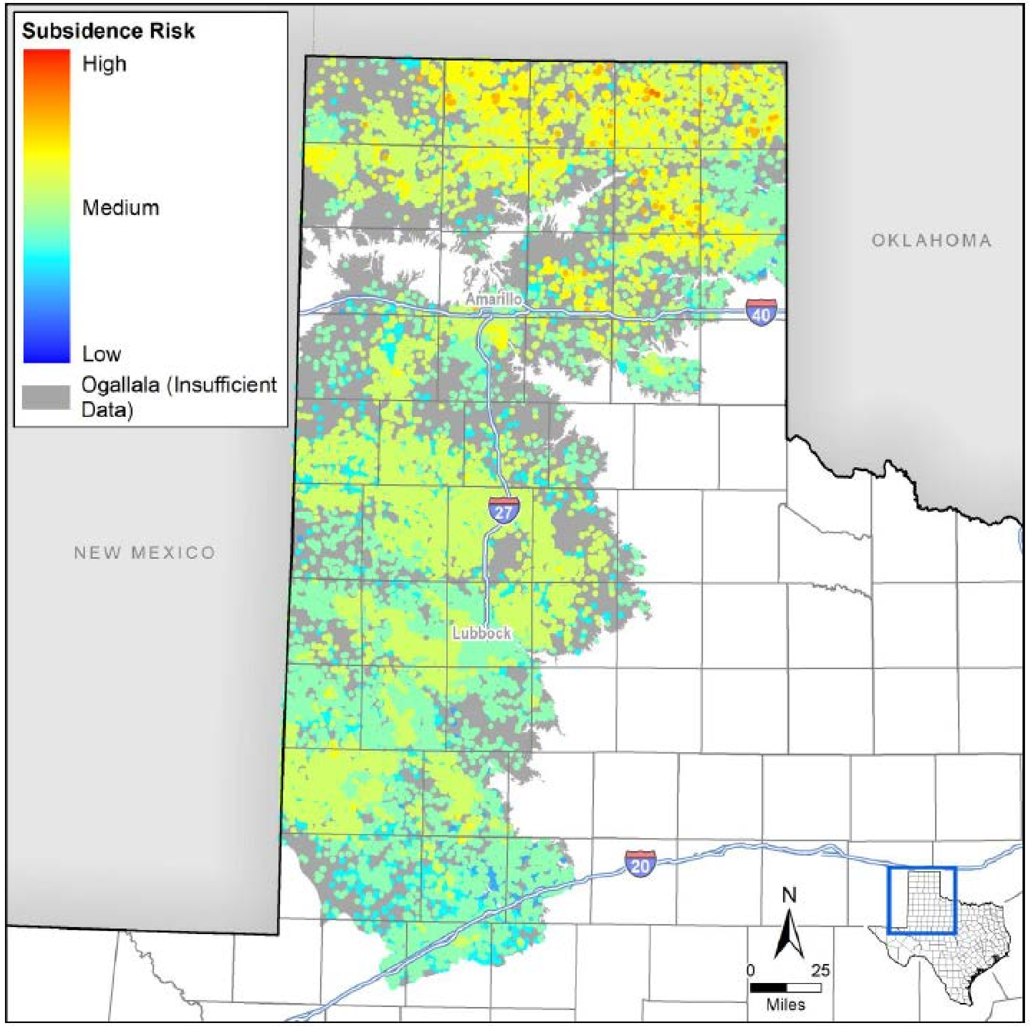


Figure 4.33. Ogallala Aquifer subsidence risk vulnerability at well locations.

Statewide Subsidence Risk Assessment

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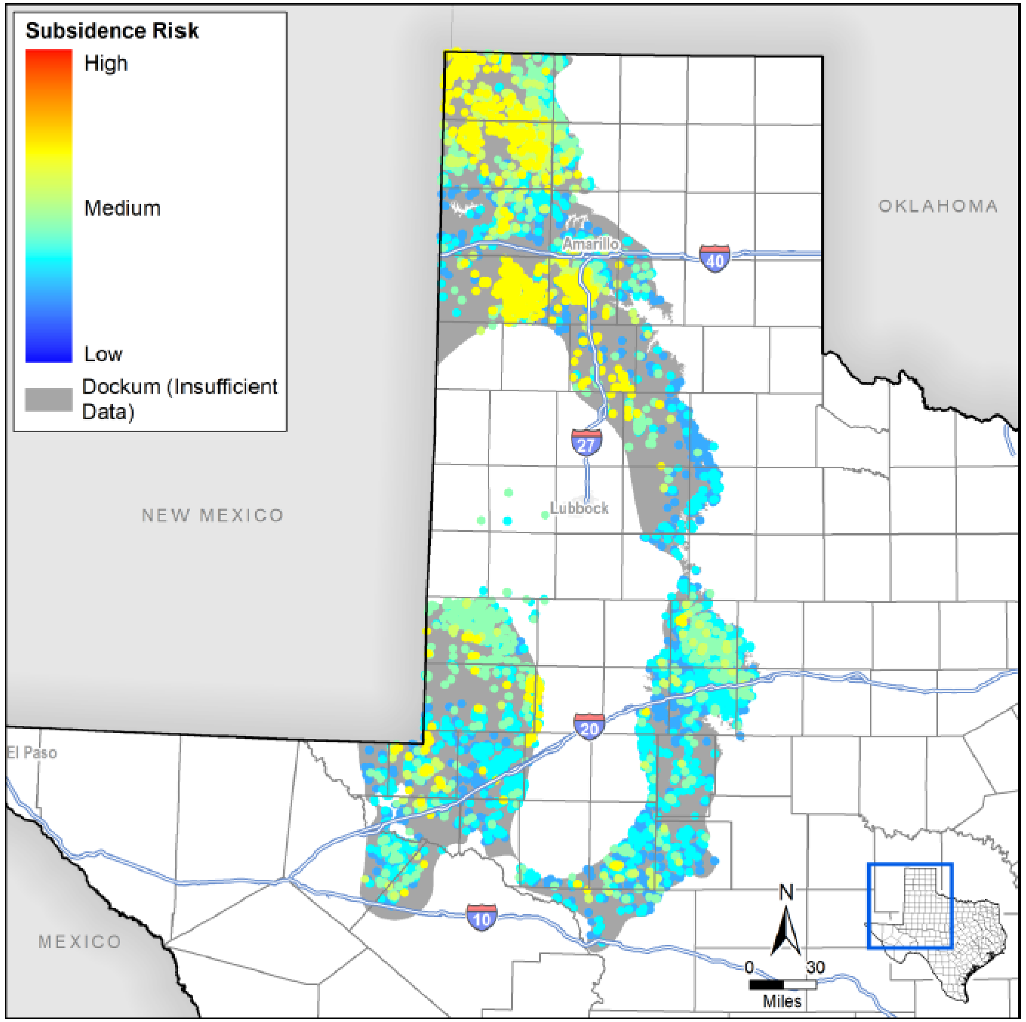


Figure 4.80. Dockum Aquifer subsidence risk vulnerability at well locations.

Conclusions

3.4.5 Subsidence impacts

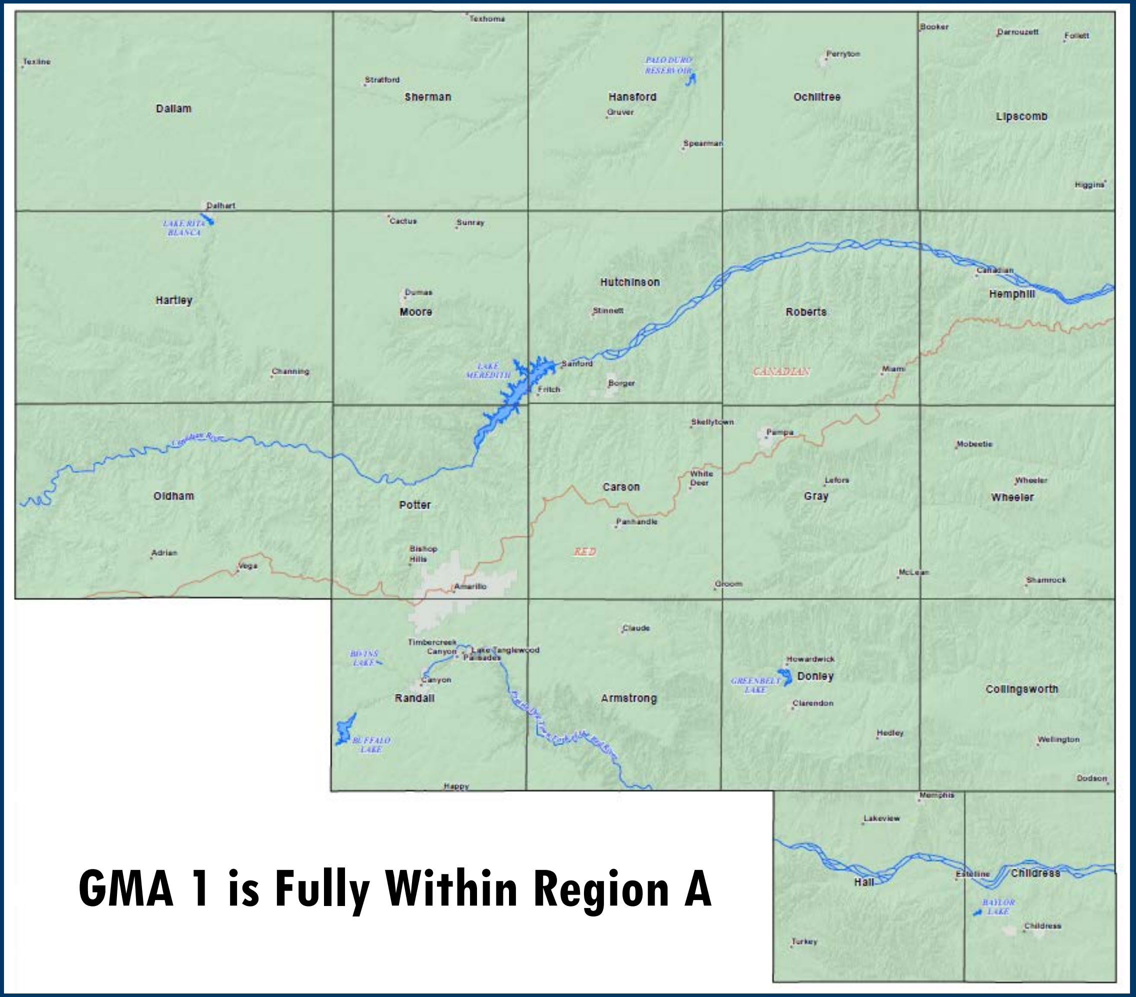
GMA 1 District Representatives considered impacts of the adopted DFCs on land subsidence based primarily on the 2017 State Water Plan and individual district records, GMA 1 District Representatives determined groundwater withdrawals from the Ogallala Aquifer create no significant impacts on subsidence in the management area and therefore the adopted DFCs should not impact subsidence.

- **There has been substantial water level decline in GMA 1 historically**
- **Subsidence has not been an issue and is unlikely to be an issue moving forward**

Agenda Item 8
Consideration of Socioeconomic Impacts Reasonably Expected to Occur

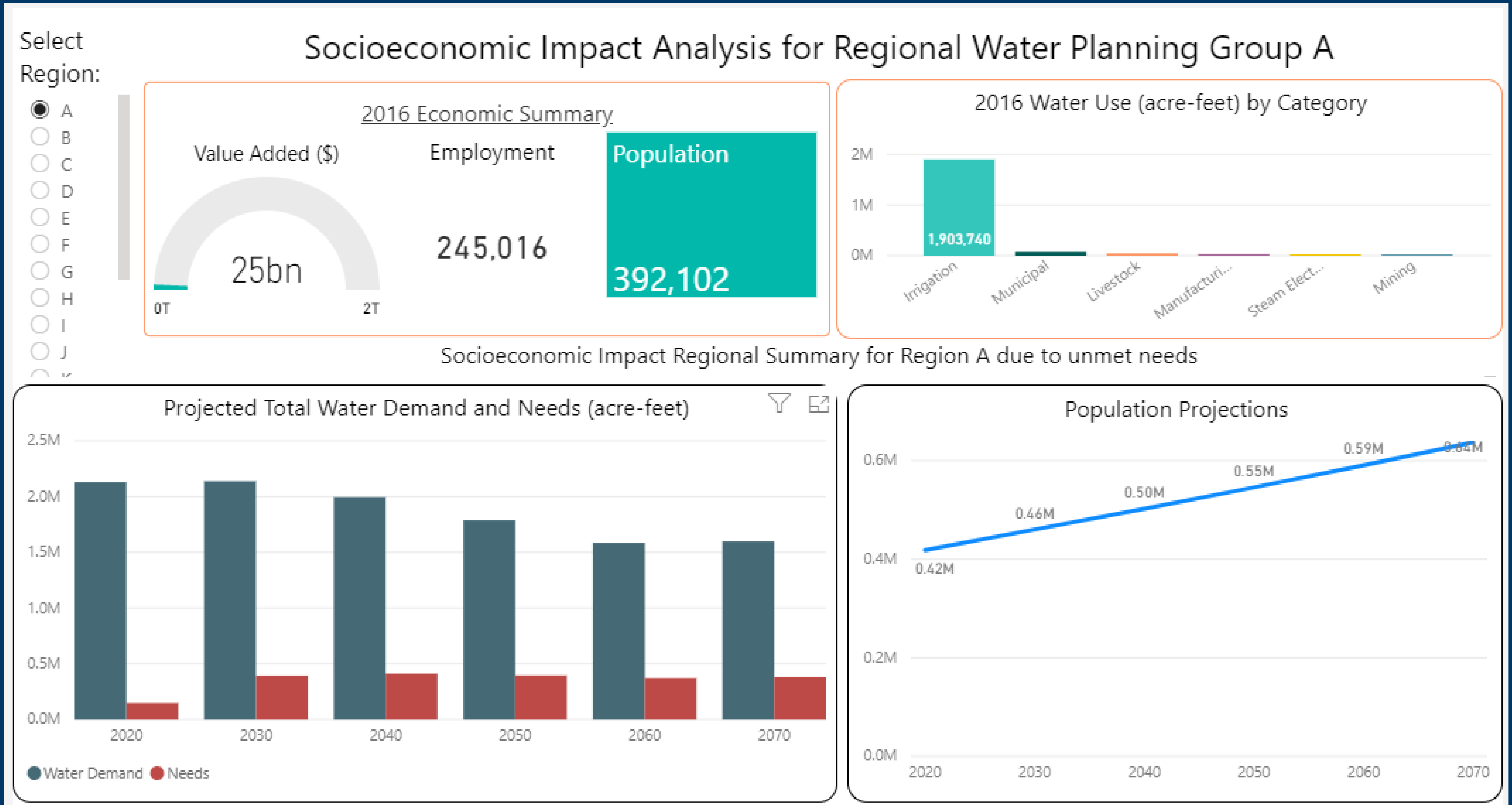
Socioeconomic Impacts in the Regional Water Planning Process

- An evaluation of the impact of not meeting water needs during a repeat of the drought of record
- Analysis is limited to categories of users with an identified water need (i.e. potential shortage)
- Socioeconomic Analyses by Region:
  - Region A for 2021 assessment
  - Additional information can be found here: https://www.twdb.texas.gov/waterplanning/data/analysis/index.asp



GMA 1 is Fully Within Region A

From the 2016 Regional Water Plans



Impacts ($ millions)

Impact	2020	2030	2040	2050	2060	2070
Value Added	$79.95	$431.74	$866.81	$2,261.64	$3,224.51	$3,511.22
Utility Tax Loss	$0.02	$0.34	$0.80	$1.32	$1.84	$2.17
Utility Revenue Loss	$2.74	$20.98	$45.45	$73.17	$101.22	$118.83
Trucking Cost	$3.84	$3.96	$8.32	$9.81	$18.71	$25.11
Tax Loss	$4.27	$22.94	$57.53	$171.41	$249.32	$271.56
Consumer Surplus	$5.78	$13.45	$28.61	$71.71	$168.23	$198.40

Impacts

Impact	2020	2030	2040	2050	2060	2070
Job Loss	771	4,379	9,534	23,413	33,966	37,960
Population Loss	142	805	1,751	4,300	6,233	6,970

*All monetary values are in 2018 Dollars and in Millions ($)

*Job Loss and Population Loss are rounded to the nearest whole number

Socioeconomic Impacts for RWP (2021)

		Income losses (Million $)*						Job losses					
County	**Water Use Category**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
CARSON	MUNICIPAL	-	$4.04	$5.14	$5.09	$5.09	$5.09	-	73	93	92	92	92
CARSON Total		**-**	**$4.04**	**$5.14**	**$5.09**	**$5.09**	**$5.09**	**-**	**73**	**93**	**92**	**92**	**92**
CHILDRESS	MUNICIPAL	-	-	-	-	$0.29	$2.04	-	-	-	-	5	37
CHILDRESS Total		**-**	**-**	**-**	**-**	**$0.29**	**$2.04**	**-**	**-**	**-**	**-**	**5**	**37**
COLLINGSWORTH	IRRIGATION	$1.37	$4.01	$3.59	$4.06	$4.94	$4.22	18	54	49	55	67	57
COLLINGSWORTH	MUNICIPAL	$1.49	$1.53	$1.56	$1.61	$1.65	$1.69	27	28	28	29	30	31
COLLINGSWORTH Total		**$2.86**	**$5.55**	**$5.15**	**$5.67**	**$6.59**	**$5.91**	**45**	**82**	**77**	**84**	**97**	**88**
DALLAM	IRRIGATION	$1.31	$41.18	$43.22	$39.36	$31.89	$31.89	17	520	546	497	403	403
DALLAM	MUNICIPAL	$1.12	$5.72	$8.45	$11.31	$14.17	$15.51	20	104	153	205	257	281
DALLAM Total		**$2.43**	**$46.90**	**$51.67**	**$50.68**	**$46.06**	**$47.41**	**37**	**624**	**699**	**703**	**660**	**684**
DONLEY	MUNICIPAL	-	-	-	-	$0.03	$0.19	-	-	-	-	1	3
DONLEY Total		**-**	**-**	**-**	**-**	**$0.03**	**$0.19**	**-**	**-**	**-**	**-**	**1**	**3**
GRAY	IRRIGATION	-	-	-	-	$0.10	$0.10	-	-	-	-	1	1
GRAY	MUNICIPAL	-	-	$2.49	$6.33	$10.93	$16.06	-	-	45	115	198	291
GRAY Total		**-**	**-**	**$2.49**	**$6.33**	**$11.03**	**$16.16**	**-**	**-**	**45**	**115**	**200**	**293**
HALL	IRRIGATION	$9.59	$8.78	$6.16	$2.98	$1.04	$1.75	123	113	79	38	13	22
HALL	MUNICIPAL	-	$0.01	$0.09	$0.30	$0.62	$0.65	-	0	2	5	11	12
HALL Total		**$9.59**	**$8.79**	**$6.25**	**$3.28**	**$1.65**	**$2.40**	**123**	**113**	**81**	**44**	**25**	**34**
HANSFORD	MUNICIPAL	-	$0.00	$0.18	$1.18	$2.43	$2.58	-	0	3	21	44	47
HANSFORD Total		**-**	**$0.00**	**$0.18**	**$1.18**	**$2.43**	**$2.58**	**-**	**0**	**3**	**21**	**44**	**47**
HARTLEY	IRRIGATION	$17.44	$87.72	$80.81	$72.60	$64.35	$64.35	228	1,145	1,054	947	840	840
HARTLEY	MUNICIPAL	$0.52	$2.48	$3.34	$4.11	$4.78	$4.89	10	45	61	75	87	89
HARTLEY Total		**$17.97**	**$90.19**	**$84.15**	**$76.71**	**$69.13**	**$69.24**	**237**	**1,189**	**1,115**	**1,022**	**926**	**928**
HUTCHINSON	MANUFACTURING	-	-	-	-	$12.18	$35.53	-	-	-	-	41	120
HUTCHINSON	MUNICIPAL	-	$1.56	$3.21	$6.35	$9.24	$10.30	-	28	58	115	168	187
HUTCHINSON Total		**-**	**$1.56**	**$3.21**	**$6.35**	**$21.43**	**$45.83**	**-**	**28**	**58**	**115**	**209**	**307**

Socioeconomic Impacts for RWP (2021)

		Income losses (Million $)*						Job losses					
County	Water Use Category	2020	2030	2040	2050	2060	2070	2020	2030	2040	2050	2060	2070
LIPSCOMB	MANUFACTURING	-	-	$1.50	$13.33	$27.21	$30.95	-	-	21	187	382	434
LIPSCOMB	MUNICIPAL	-	-	$0.06	$0.57	$1.23	$1.43	-	-	1	10	22	26
LIPSCOMB Total		**-**	**-**	**$1.55**	**$13.90**	**$28.44**	**$32.38**	**-**	**-**	**22**	**197**	**404**	**460**
MOORE	IRRIGATION	-	$9.58	$12.29	$12.60	$13.01	$13.01	-	119	153	156	161	161
MOORE	MANUFACTURING	$46.63	$187.54	$316.42	$1,140.20	$1,592.31	$1,596.73	319	1,281	2,162	7,789	10,878	10,908
MOORE	MUNICIPAL	$0.49	$4.84	$17.34	$26.53	$34.85	$38.75	9	88	314	481	632	703
MOORE Total		**$47.11**	**$201.97**	**$346.05**	**$1,179.34**	**$1,640.17**	**$1,648.48**	**327**	**1,488**	**2,629**	**8,427**	**11,671**	**11,772**
OCHILTREE	MUNICIPAL	-	-	$0.00	$0.03	$0.57	$1.24	-	-	0	1	10	22
OCHILTREE Total		**-**	**-**	**$0.00**	**$0.03**	**$0.57**	**$1.24**	**-**	**-**	**0**	**1**	**10**	**22**
POTTER	MANUFACTURING	-	$10.78	$135.77	$392.58	$662.23	$794.03	-	145	1,827	5,282	8,910	10,684
POTTER	MUNICIPAL	-	$6.85	$55.50	$161.98	$246.67	$294.00	-	124	1,006	2,937	4,473	5,331
POTTER Total		**-**	**$17.63**	**$191.27**	**$554.56**	**$908.90**	**$1,088.03**	**-**	**269**	**2,833**	**8,219**	**13,383**	**16,015**
RANDALL	MANUFACTURING	-	$49.51	$121.17	$214.00	$252.52	$270.35	-	411	1,007	1,778	2,098	2,247
RANDALL	MUNICIPAL	-	$5.60	$47.21	$140.57	$224.12	$267.66	-	101	856	2,549	4,064	4,854
RANDALL Total		**-**	**$55.11**	**$168.38**	**$354.57**	**$476.64**	**$538.01**	**-**	**513**	**1,863**	**4,327**	**6,163**	**7,100**
SHERMAN	IRRIGATION	-	-	$1.31	$3.93	$5.74	$5.81	-	-	16	49	72	73
SHERMAN Total		**-**	**-**	**$1.31**	**$3.93**	**$5.74**	**$5.81**	**-**	**-**	**16**	**49**	**72**	**73**
WHEELER	MUNICIPAL	-	-	-	$0.02	$0.32	$0.42	-	-	-	0	6	8
WHEELER Total		**-**	**-**	**-**	**$0.02**	**$0.32**	**$0.42**	**-**	**-**	**-**	**0**	**6**	**8**
REGION A Total		**$79.95**	**$431.74**	**$866.81**	**$2,261.64**	**$3,224.51**	**$3,511.22**	**770**	**4,380**	**9,535**	**23,417**	**33,968**	**37,964**

Source: Socioeconomic Impact of Projected Water Shortages for the Panhandle (Region A) Regional Water Planning Area (Ellis, 2019)

Socioeconomic Impacts in RWP Process

While the socioeconomic impact analysis developed for regional water planning is quantitative, it does not directly translate to the evaluation of potential desired future conditions:

- Limited to impacts of unmet needs
- Influenced by availability of other supply sources
- Does not consider potential negative socioeconomic impacts from groundwater production

Balancing Socioeconomic Impacts

Impacts of Developing Groundwater

- More today, less tomorrow
- Lowering pumps, deepening wells, or drilling more wells
- Impacts on groundwater production efficiency
- Influence on economic growth

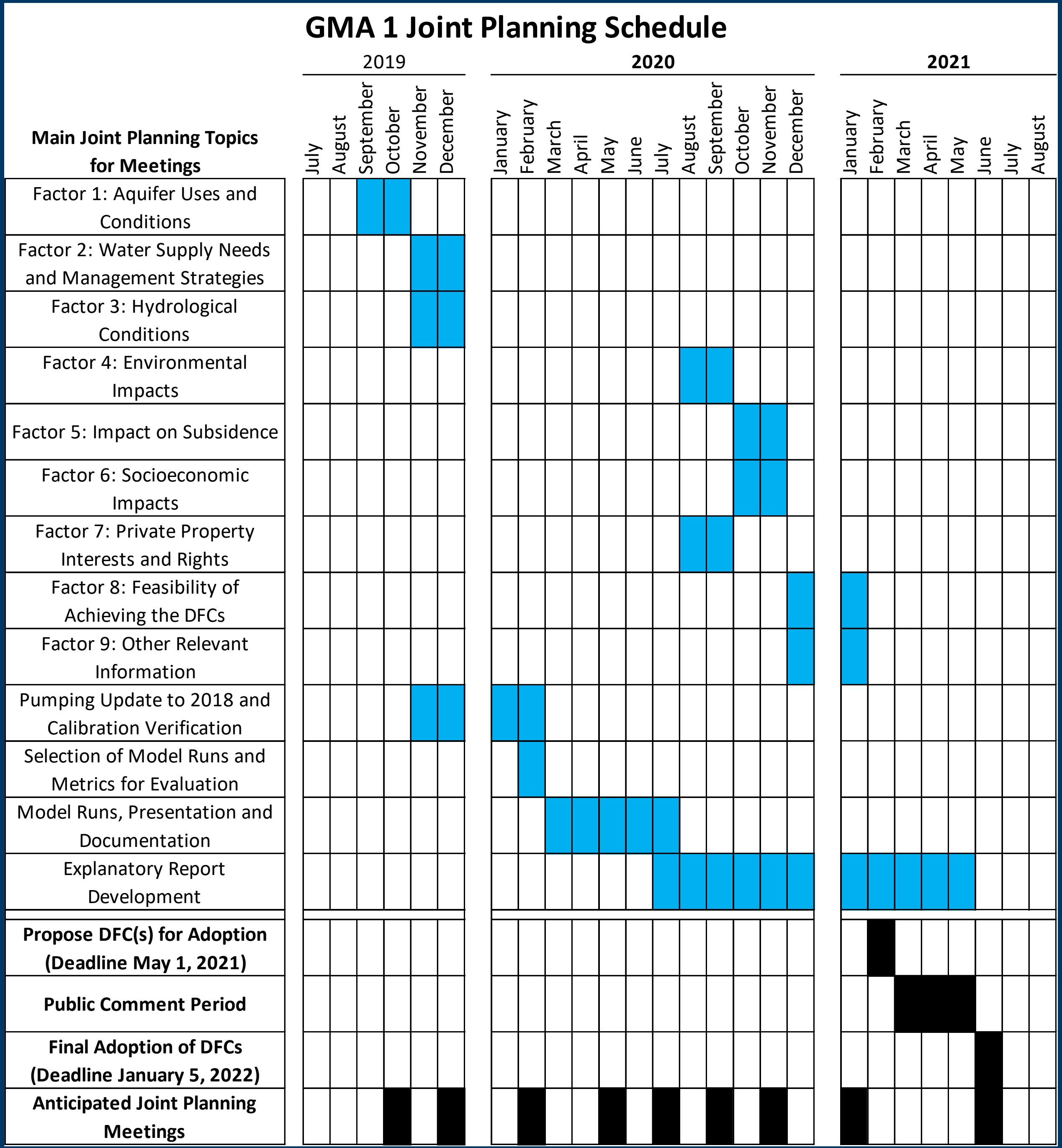
Impacts of Not Developing Groundwater

- Less today, more tomorrow
- Unmet water supply need(s)
- Influence on economic growth

Other Resources on Socioeconomic Impacts

- Economic Impacts of Selected Water Conservation Policies in the Ogallala Aquifer Report (Amosson et.al, 2014);
- Economic Impacts of Groundwater Management Standards in the Panhandle Groundwater Conservation District of Texas (Weinheimer, 2012);
- Evaluation of Changing Land Use and Potential Water Conservation Strategies: North Plains Groundwater Conservation District (Amosson et.al, 2014);
- Farm Level Financial Impacts of Water Policy on the Southern Ogallala Aquifer (Weinheimer, 2008);
- Multi-year water allocation: an economic approach towards future planning and management of declining groundwater resources in the Texas Panhandle (Tewari et.al, 2014);
- Water Conservation Policy Alternatives for the Ogallala Aquifer in Texas (Johnson, et.al, 2007); and
- Letter of Opinion Concerning Texas Panhandle Land Values: Hemphill UWCD (Scott Land Company LLC, Clift Land Brokers and the USFMRA Land Trends, 2016)

Next Steps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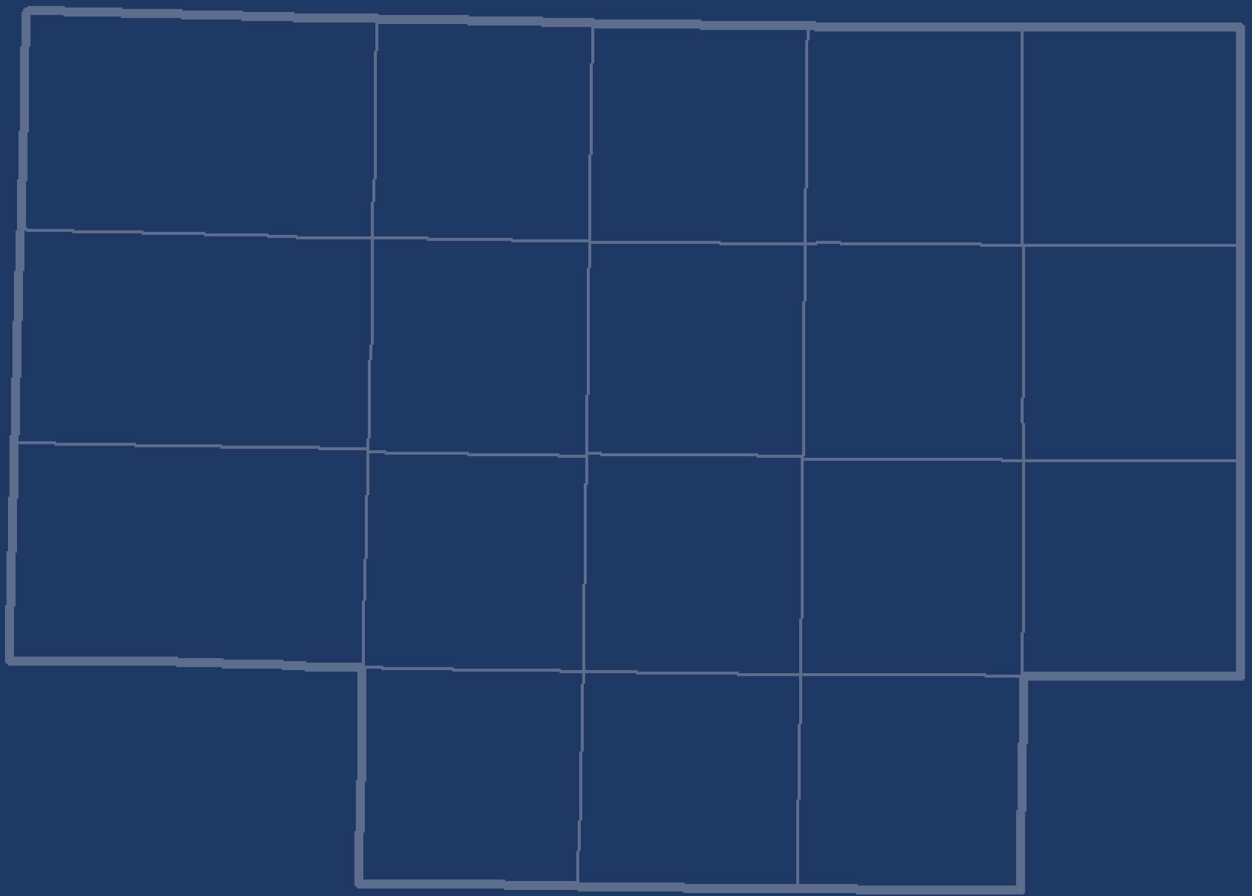
GMA 1 Review of Factors Considered in Joint Planning

A Presentation to GMA 1
Joint Planning Group



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January 21, 2021

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Desired Future Conditions (DFCs)

"a balance between the highest practicable level of groundwater production and the conservation, preservation, protection, recharging, and prevention of waste of groundwater and control of subsidence in the management area"
(TWC Ch. 36)

The Balancing Test

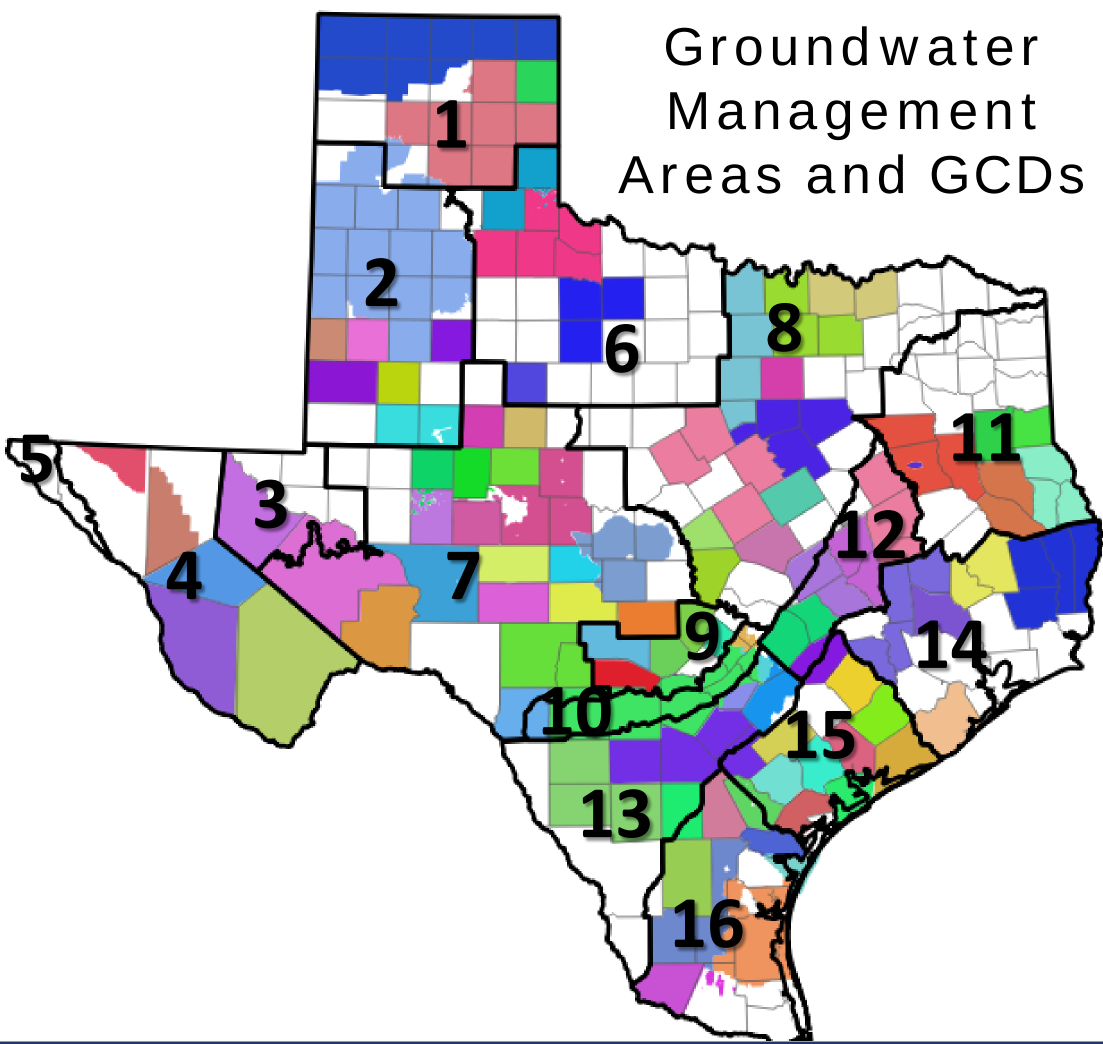
Conservation, Preservation, Prevention of Subsidence, etc.	Highest Practicable Level of Groundwater Production
Aquifer uses or conditions	Aquifer uses or conditions
Environmental Impacts	Water supply needs and management strategies
Water supply needs and management strategies	Socioeconomic Impacts
Socioeconomic Impacts	Feasibility of achievement
Subsidence Impacts	Private Property Rights
Feasibility of achievement	Hydrological Conditions
Hydrological Conditions	

The Plan

Purpose: Review the "9 Factors" that have been considered and discussed in previous meetings.

The 9 Factors:

1. Aquifer uses or conditions
2. Water supply needs and management strategies
3. Hydrological conditions
4. Other environmental impacts
5. Impact on subsidence
6. Socioeconomic impacts
7. Impact on private property rights
8. Feasibility of achieving the DFC
9. Any other relevant factors



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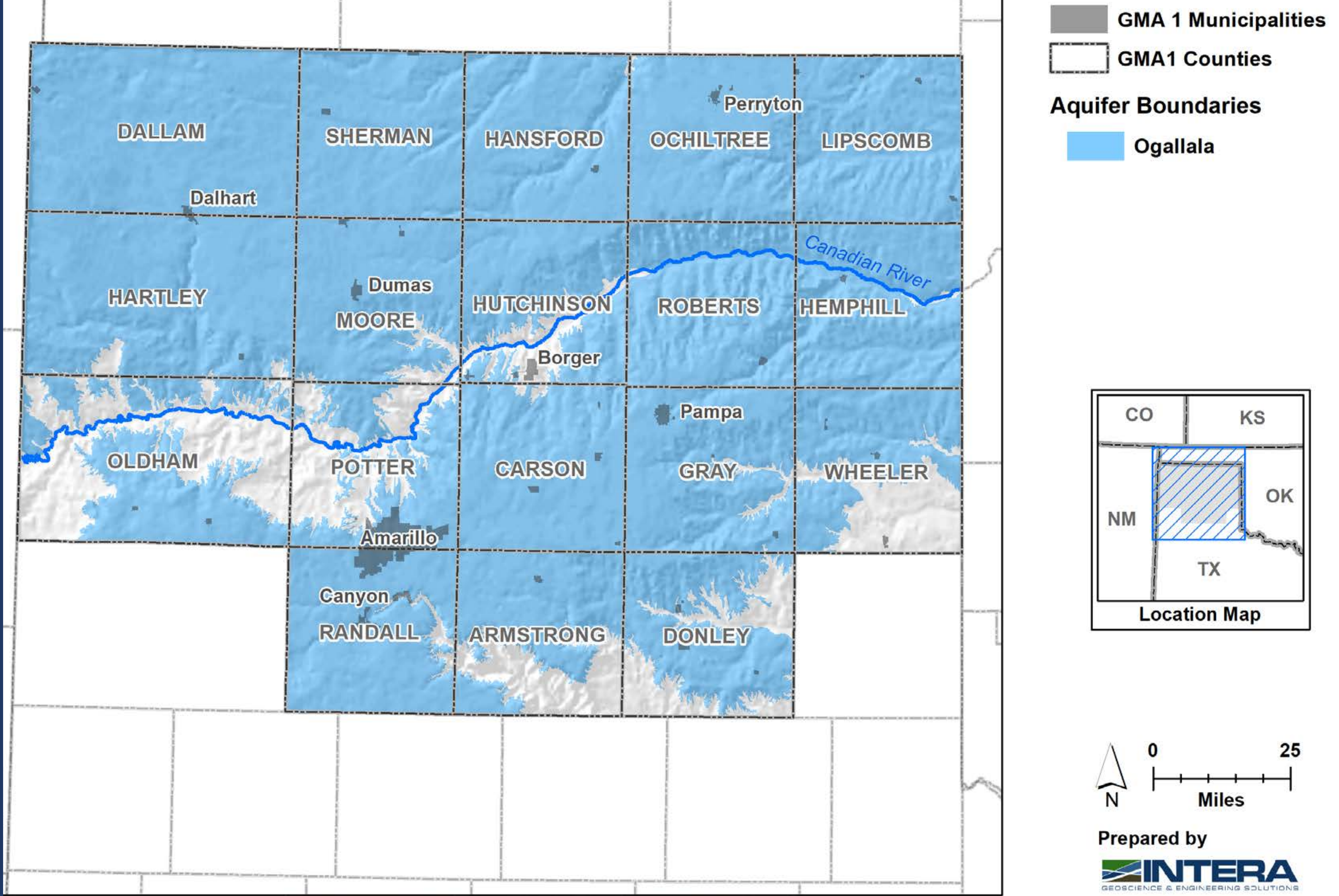
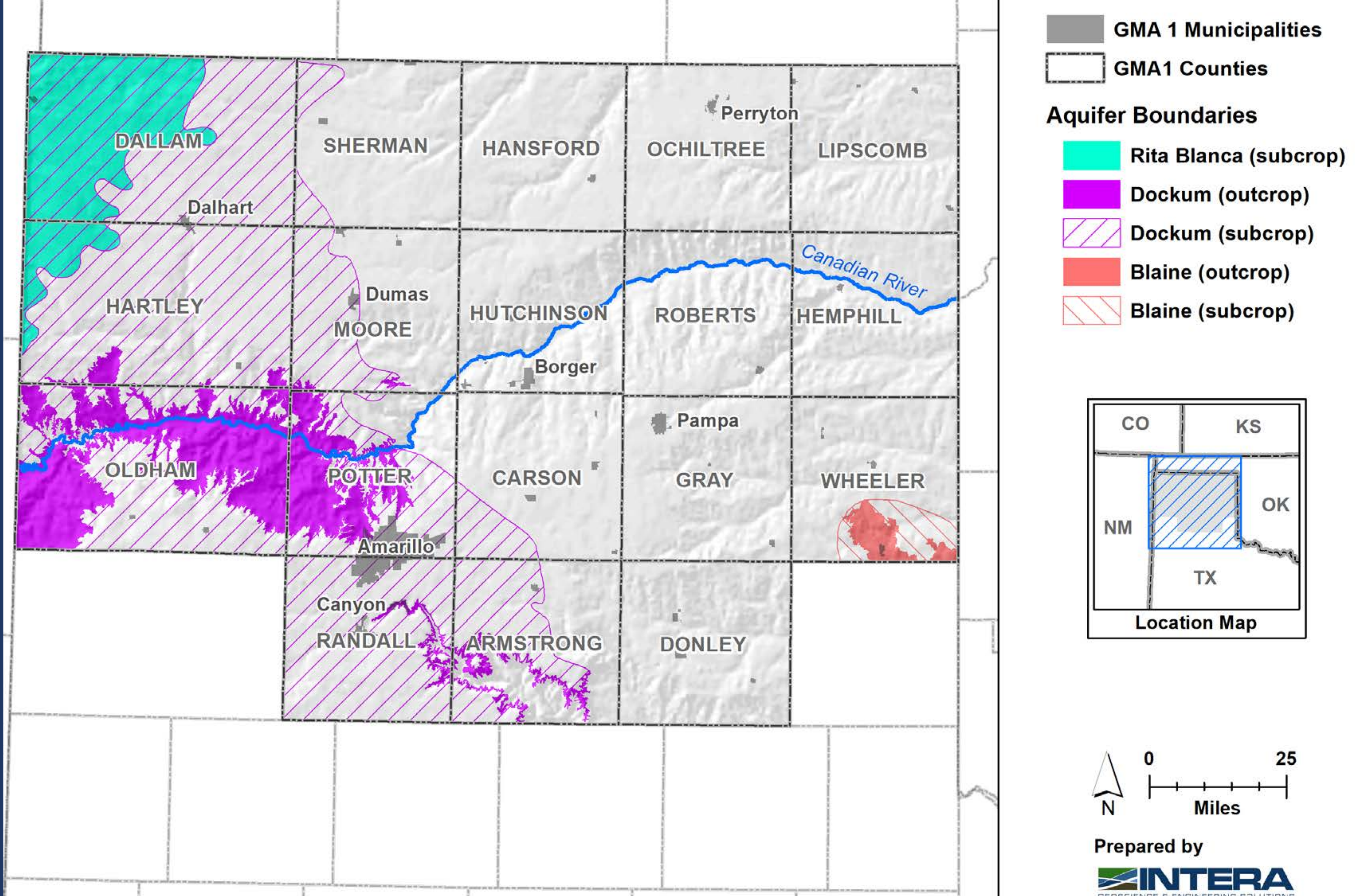
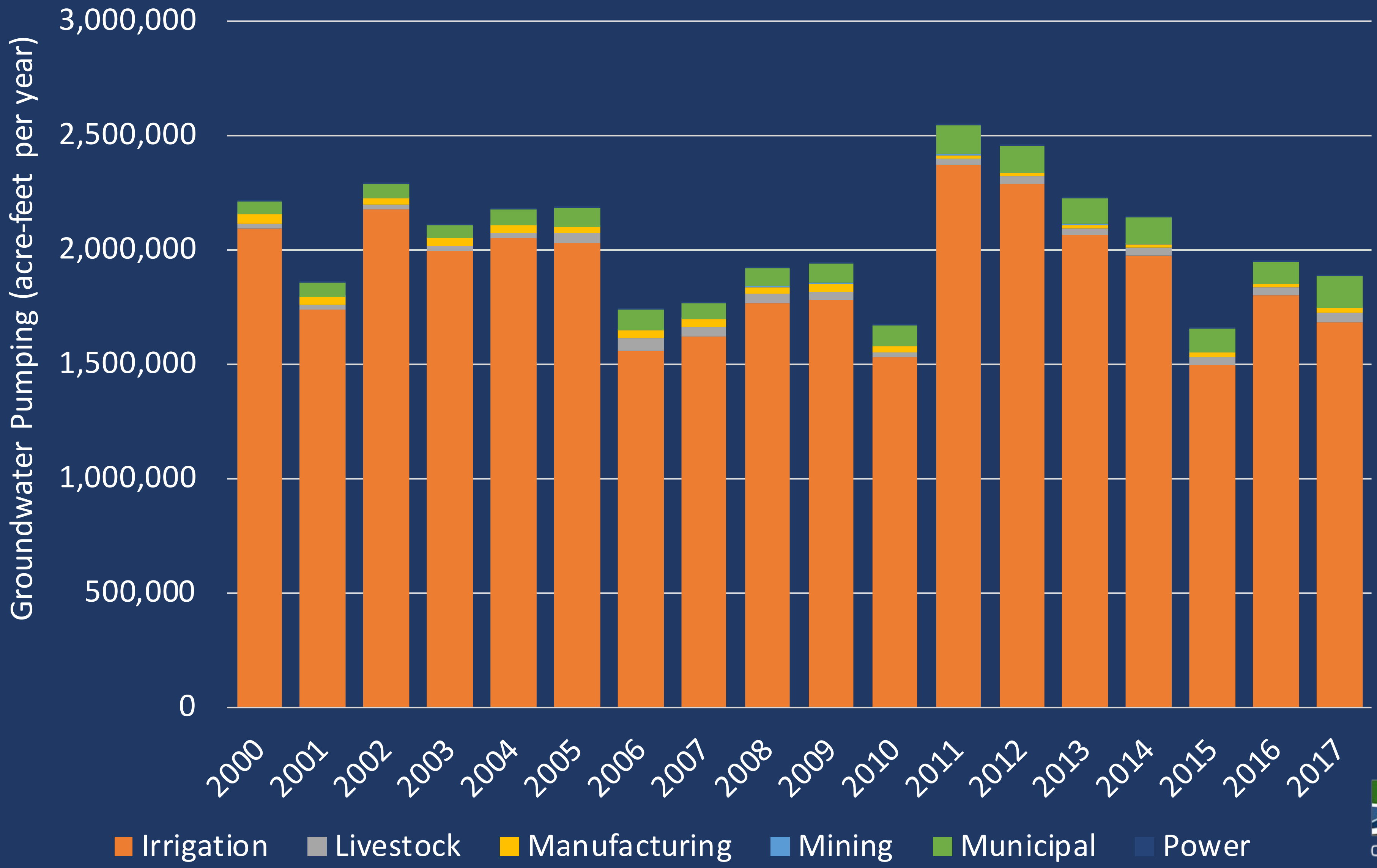
Major Aquifers in GMA 1



Minor Aquifers in GMA 1



1. Aquifer Uses or Conditions



Groundwater Pumping by Use Type in GMA 1

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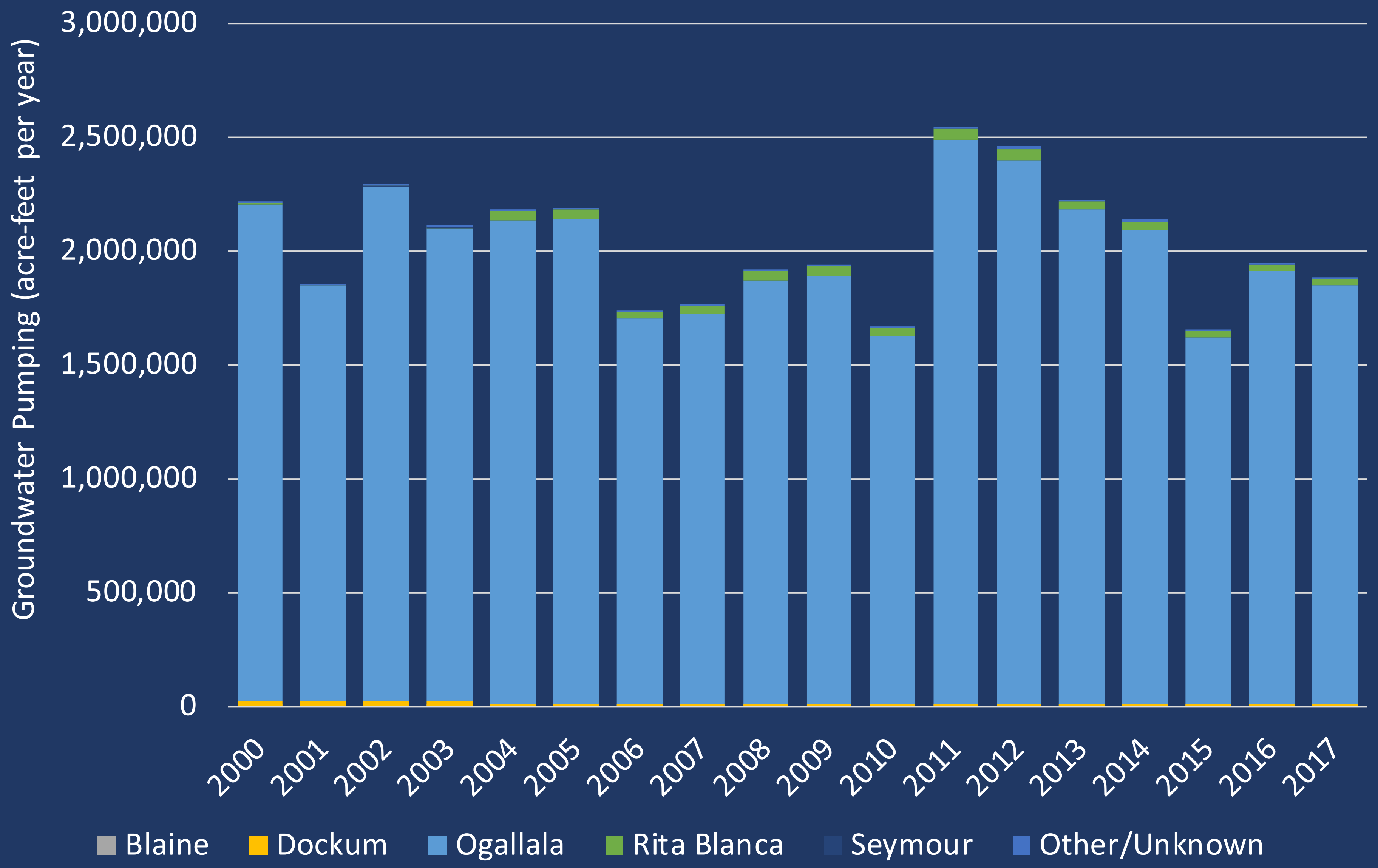
1. Aquifer Uses or Conditions



Annual Pumping by Aquifer in GMA 1

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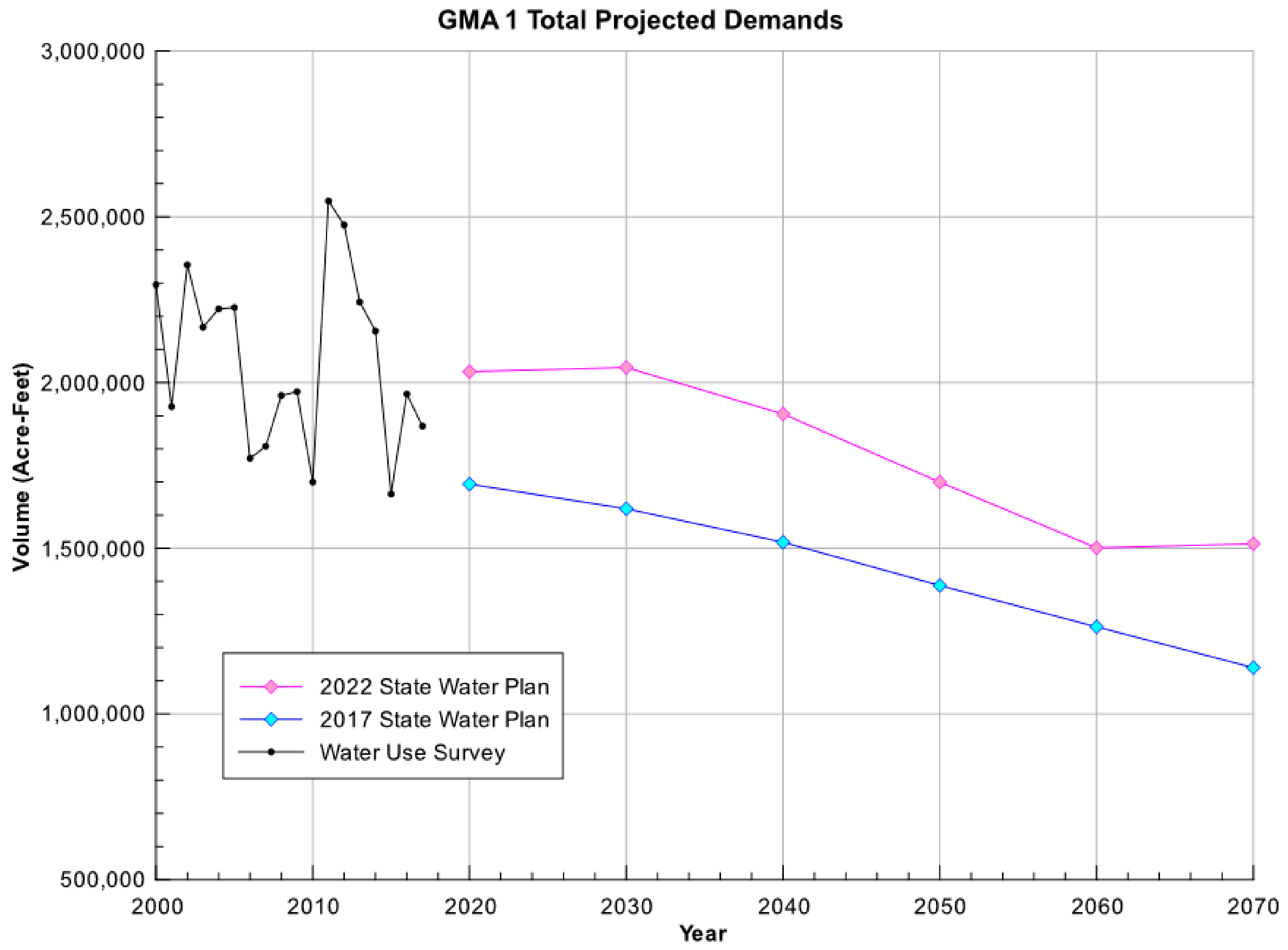
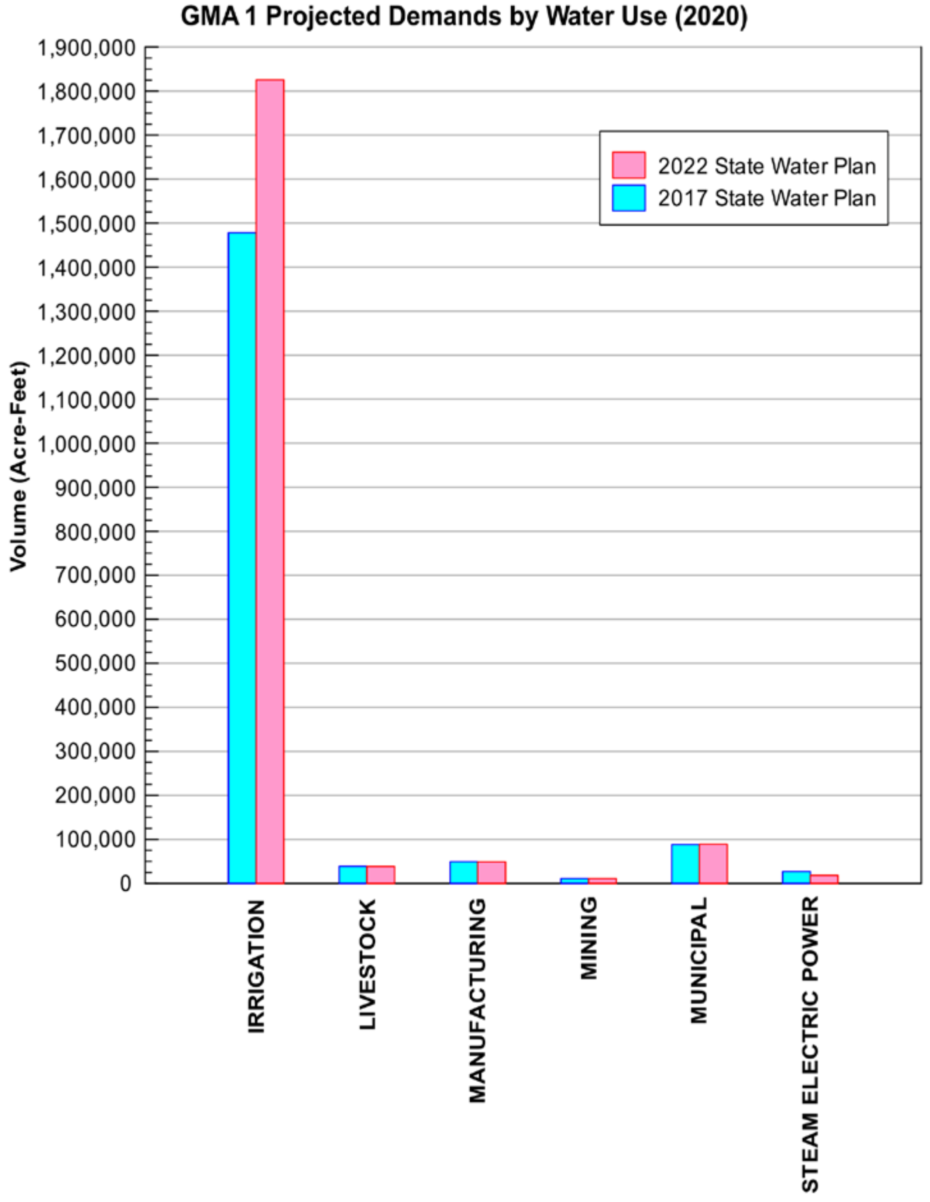
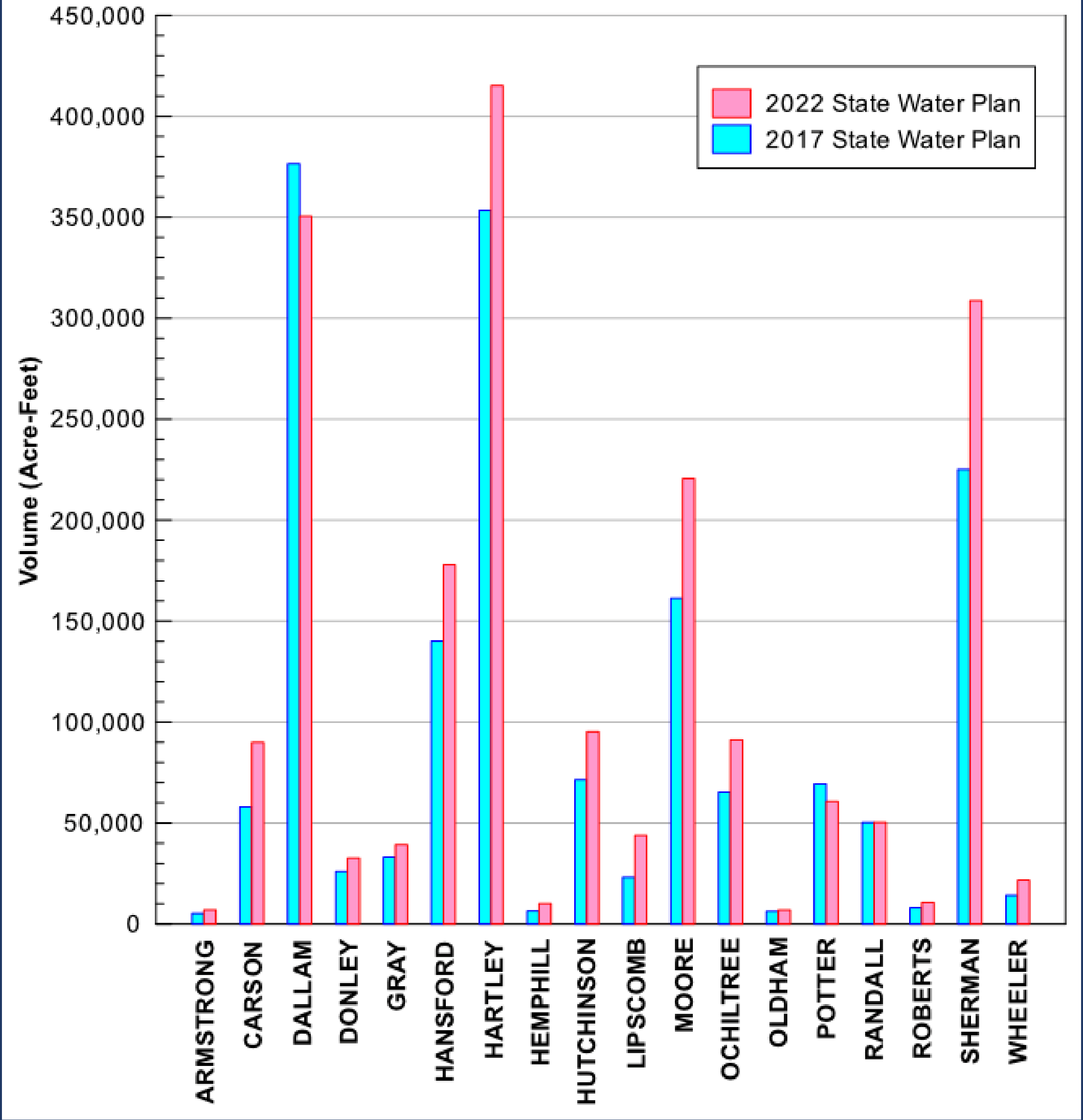
2. Water supply needs and management strategies

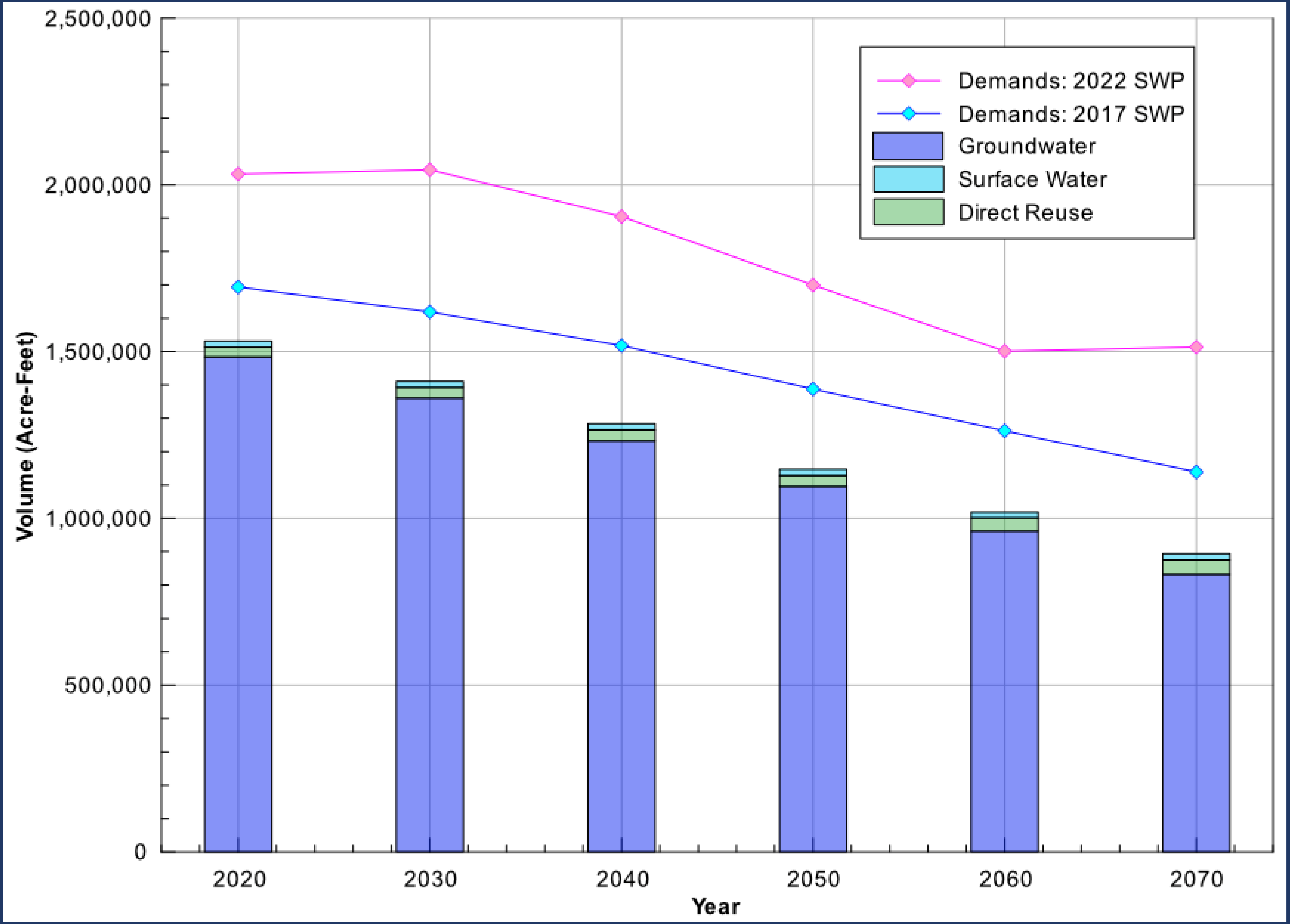




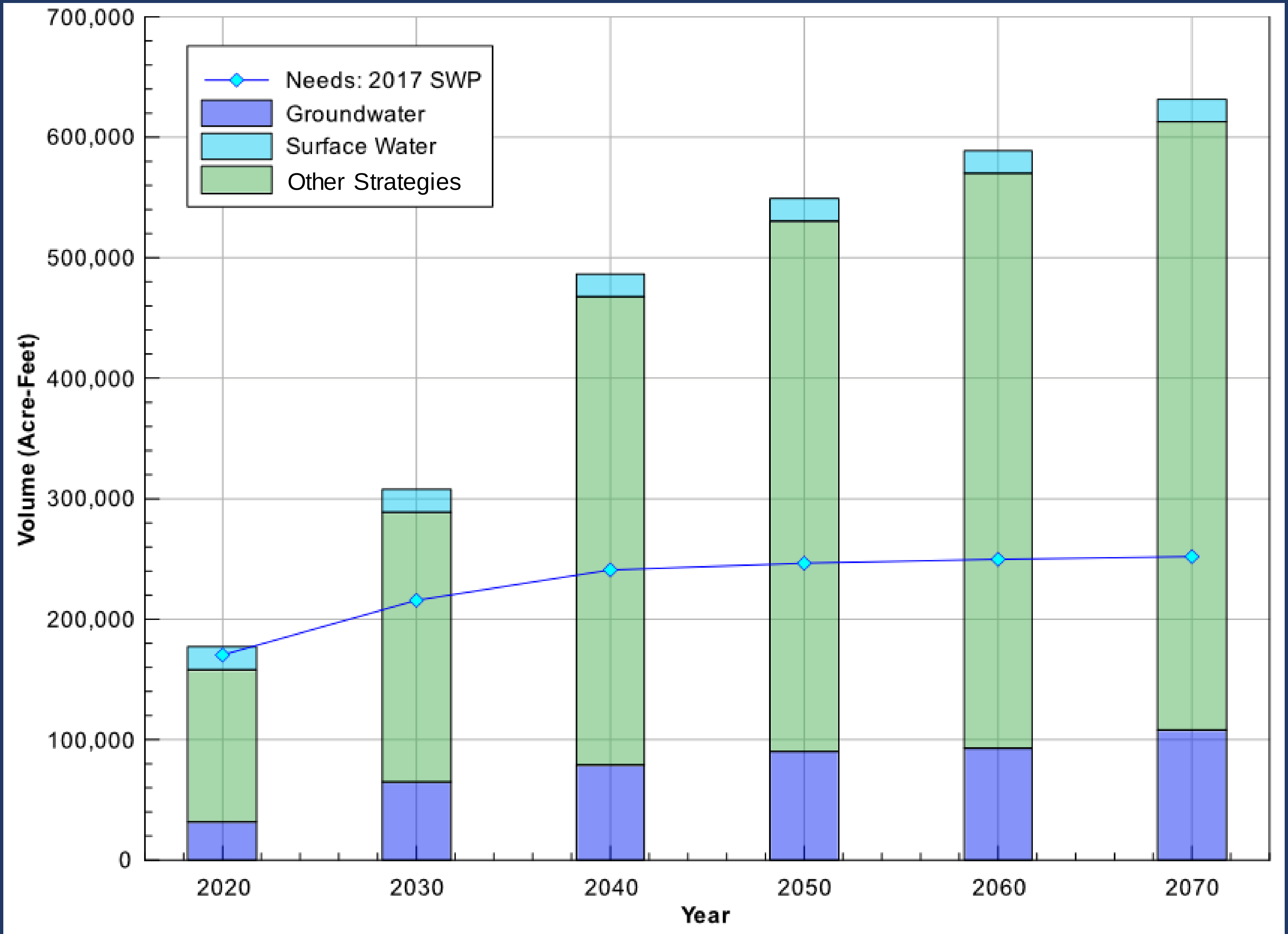
GMA 1 Projected Demands by County (2020)



GMA 1 Existing Supplies



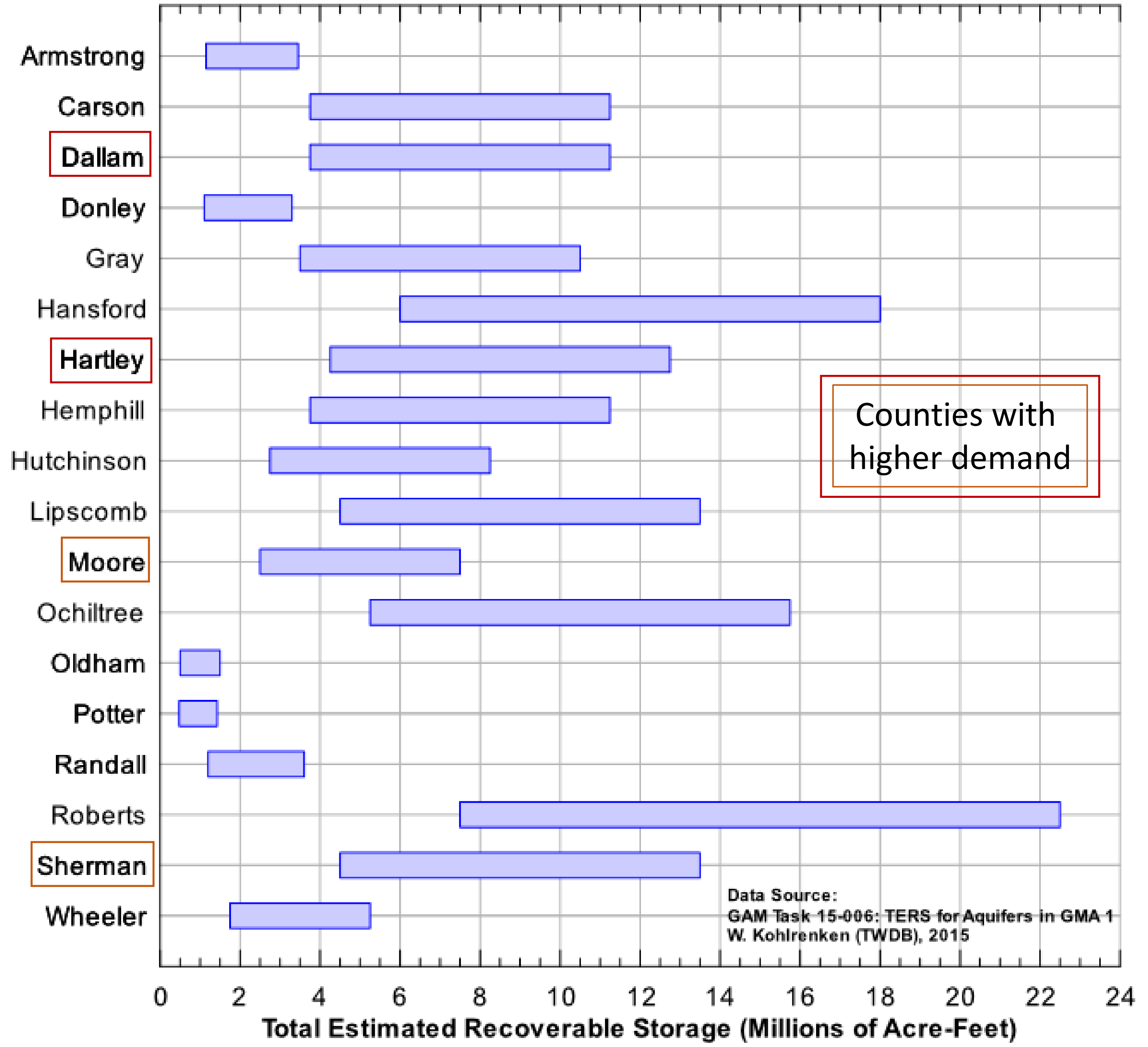
GMA 1 Total Needs and Identified Strategies



3. Hydrogeologic Conditions

Total Estimated Recoverable Storage (TERS) in 2015 –
The estimated amount of groundwater within an aquifer that accounts for recovery scenarios that range between 25% and 75% of the porosity-adjusted aquifer volume

Texas Administrative Code Sec. 356.10



INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS

3. Hydrogeologic Conditions

Total Estimated Recoverable Storage - Limitations

<u>No consideration given to:</u>

- Aquifer water quality
- Water levels dropping below pumps
- Land surface subsidence
- Degradation of water quality
- Changes to surface water-groundwater interaction
- Recharge
- Practicality/economics of development

As calculated, the 25% to 75% TERS range represents the approximate fraction of total storage in the aquifer that is in the water-producing zones (e.g. sands), not what is “recoverable” from those zones.

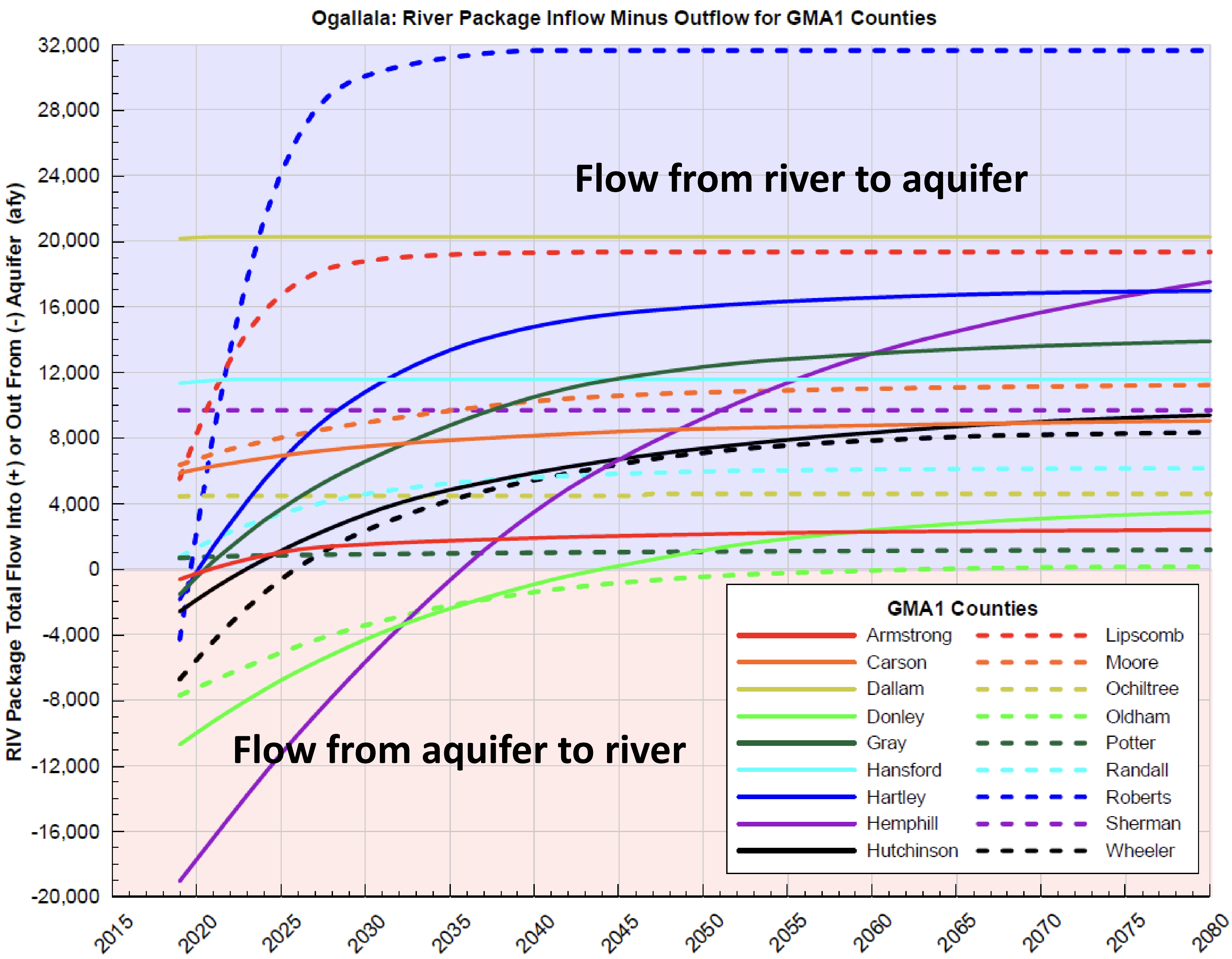
TERS is a simple volumetric calculation that does not account for many important factors that limit groundwater production

4. Impacts on Other Environmental Factors

Groundwater production can:

- Influence interaction between surface water features and aquifers
- Reduce flow to springs

Flow Between Ogallala Aquifer and Rivers



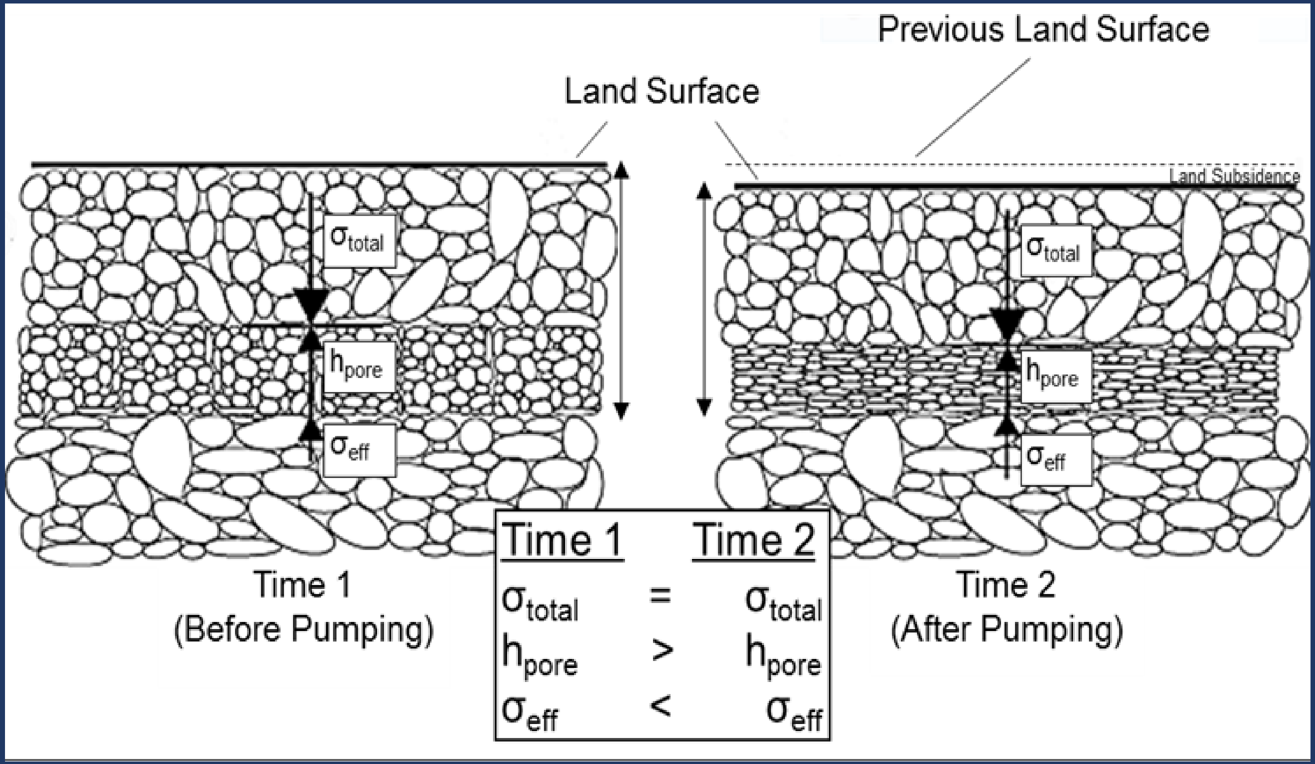
5. Subsidence Impacts – Subsidence Concepts

Subsidence: Lowering or sinking of the land surface, typically in response to removal of subsurface support

At the surface

Compaction: A decrease in the volume (i.e. thinning) of a geologic formation

Beneath the surface



5. Subsidence Impacts in GMA 1

3.4.5 Subsidence impacts

GMA 1 District Representatives considered impacts of the adopted DFCs on land subsidence based primarily on the 2017 State Water Plan and individual district records, GMA 1 District Representatives determined groundwater withdrawals from the Ogallala Aquifer create no significant impacts on subsidence in the management area and therefore the adopted DFCs should not impact subsidence.

There has been substantial water level decline in GMA 1 historically

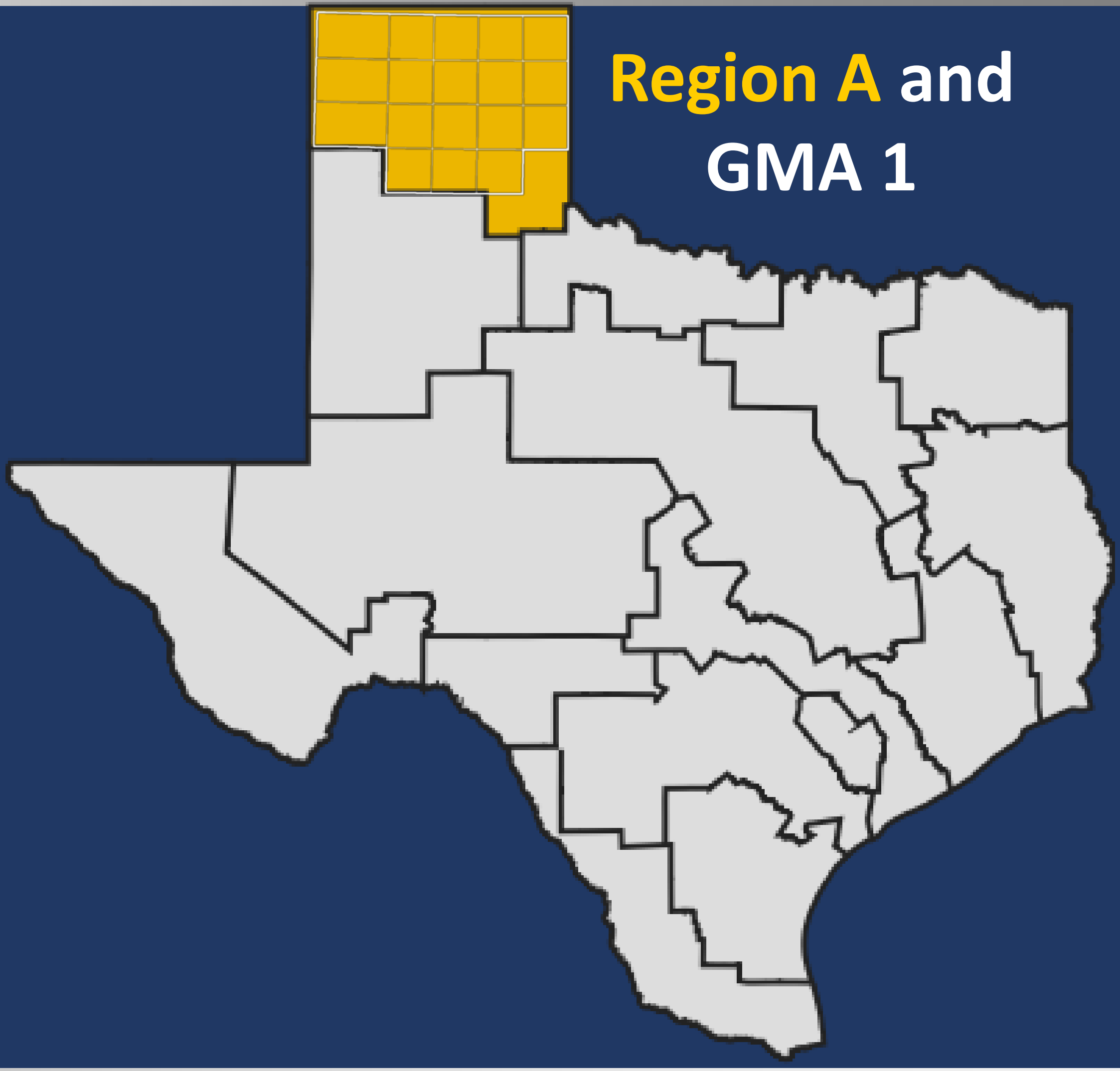
Subsidence has not been an issue and is unlikely to be an issue moving forward

6. Socioeconomic Factors

- An evaluation of the impact of not meeting water needs during a repeat of the drought of record
- Analysis is limited to categories of users with an identified water need (i.e. potential shortage)
- Socioeconomic Analyses by Region:

    Region A for 2021 assessment

    Additional information can be found here: https://www.twdb.texas.gov/waterplanning/data/analysis/index.asp

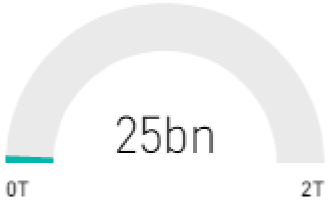


Socioeconomic Impact Analysis for Region A

A
B
C
D
E
F
G
H
I
J

2016 Economic Summary

Value Added ($)

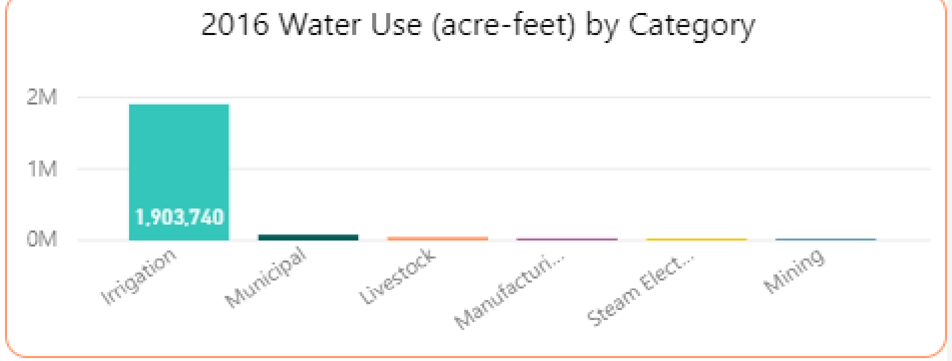


Employment

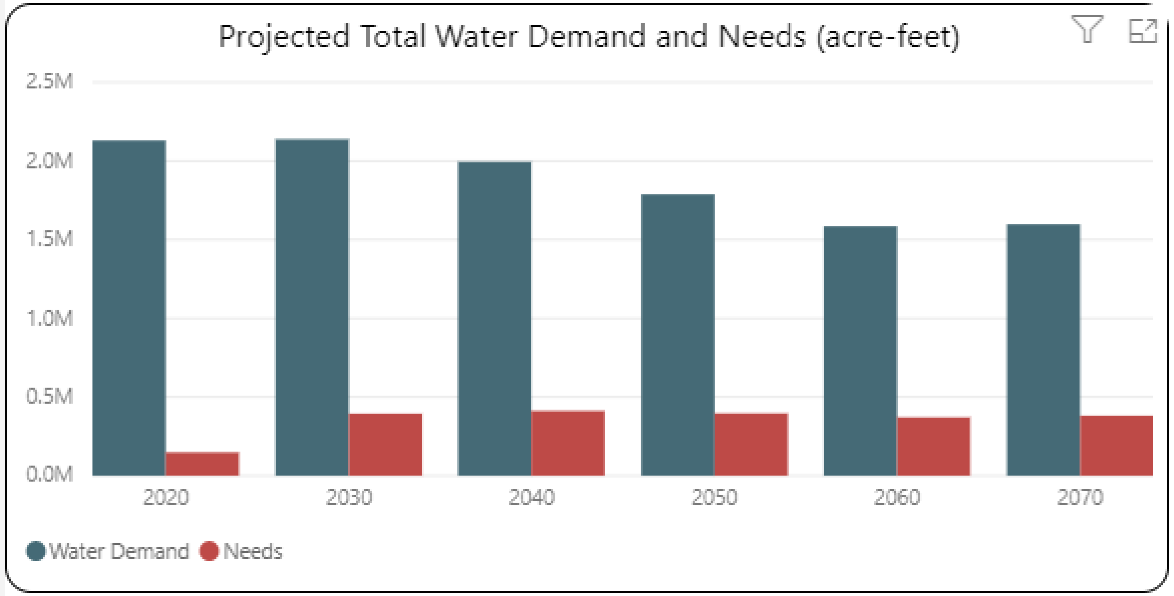
245,016

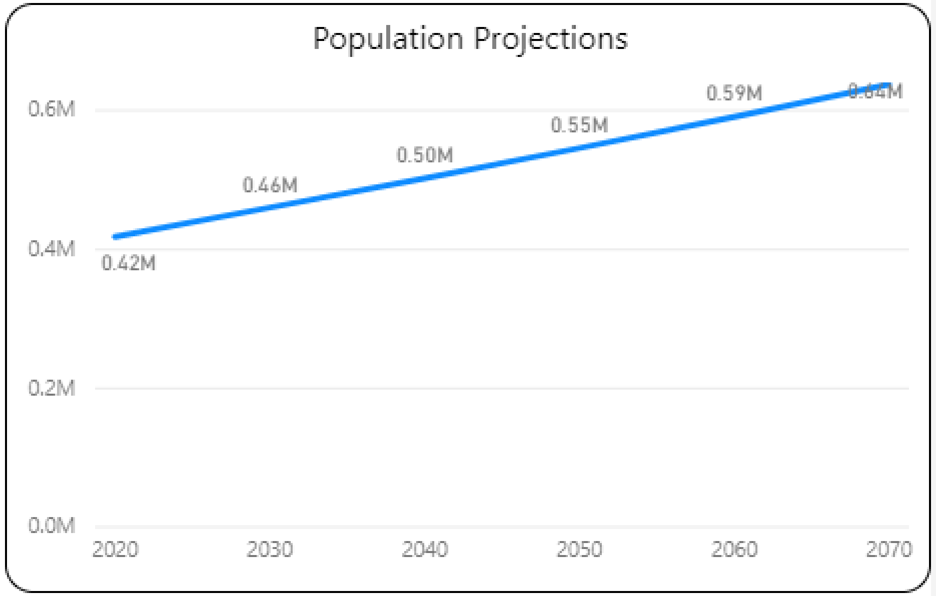
Population

392,102



Socioeconomic Impact Regional Summary for Region A due to unmet needs





Impacts ($ millions)

Impact	2020	2030	2040	2050	2060	2070
Value Added	$79.95	$431.74	$866.81	$2,261.64	$3,224.51	$3,511.22
Utility Tax Loss	$0.02	$0.34	$0.80	$1.32	$1.84	$2.17
Utility Revenue Loss	$2.74	$20.98	$45.45	$73.17	$101.22	$118.83
Trucking Cost	$3.84	$3.96	$8.32	$9.81	$18.71	$25.11
Tax Loss	$4.27	$22.94	$57.53	$171.41	$249.32	$271.56
Consumer Surplus	$5.78	$13.45	$28.61	$71.71	$168.23	$198.40

Impacts

Impact	2020	2030	2040	2050	2060	2070
Job Loss	771	4,379	9,534	23,413	33,966	37,960
Population Loss	142	805	1,751	4,300	6,233	6,970

*All monetary values are in 2018 Dollars and in Millions ($)

*Job Loss and Population Loss are rounded to the nearest whole number

6. Socioeconomic Factors - Limitations

Socioeconomic impact analysis developed for regional water planning is quantitative, but does not directly translate to the evaluation of potential desired future conditions:

- Limited to impacts of unmet needs
- Influenced by availability of other supply sources
- Does not consider potential negative socioeconomic impacts from groundwater production

6. Socioeconomic Factors – Finding a Balance

Impacts of Developing Groundwater

More today, less tomorrow

Lowering pumps, deepening wells, or drilling more wells

Impacts on groundwater production efficiency

Influence on economic growth

Impacts of Not Developing Groundwater

Less today, more tomorrow

Unmet water supply need(s)

Influence on economic growth

7. Private Property Rights

- State is empowered to regulate groundwater production
- Regulation is essential to groundwater conservation
- Each landowner "owns separately, distinctly, and exclusively all water under his land."
- DFCs can have a potential impact on private property rights
- Impacts can be viewed as restricting and benefiting property rights

Source: EAA vs Day case as summarized by Keith Good's presentation to GMA 1 in 2015

7. Private Property Rights

"Permissive" DFCs

Allow existing users to produce more groundwater

- Poses risks to water supply and future needs
- Increased drainage from neighboring landowners, may reduce well efficiencies, and surface water

DFCs

District Rules

"Conservative" DFCs

May require some users to reduce production

- May extend groundwater supply and levels to meet future needs
- Minimizes well interference
- Limiting groundwater drainage between property owners

Changes in Ogallala Aquifer Saturated Thickness

Saturated Thickness Changes
from 2018 through 2080

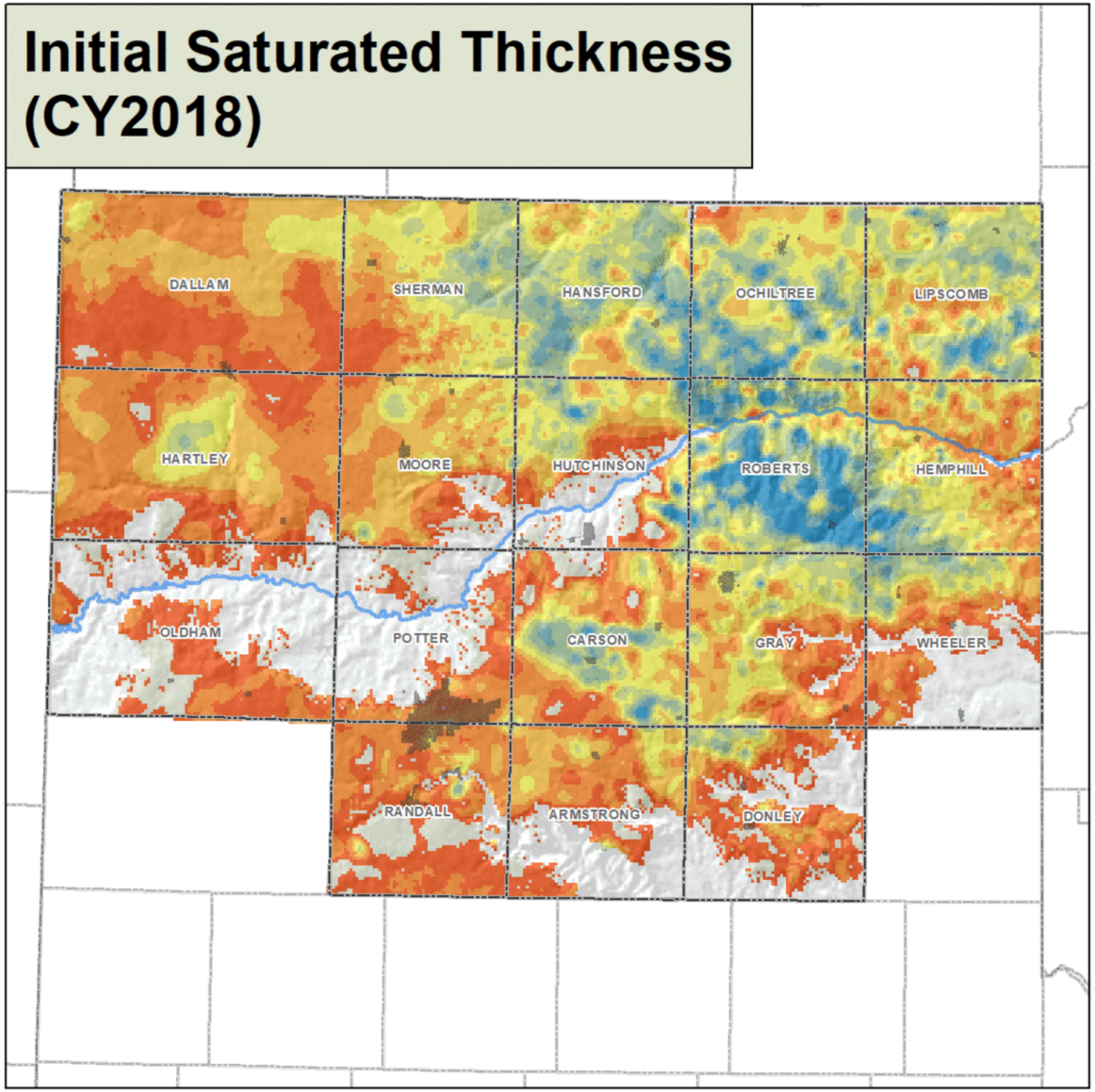
For the DFCs, this is combined with the Rita Blanca

GMA 1 Municipalities

GMA1 Counties

Saturated Thickness (ft)

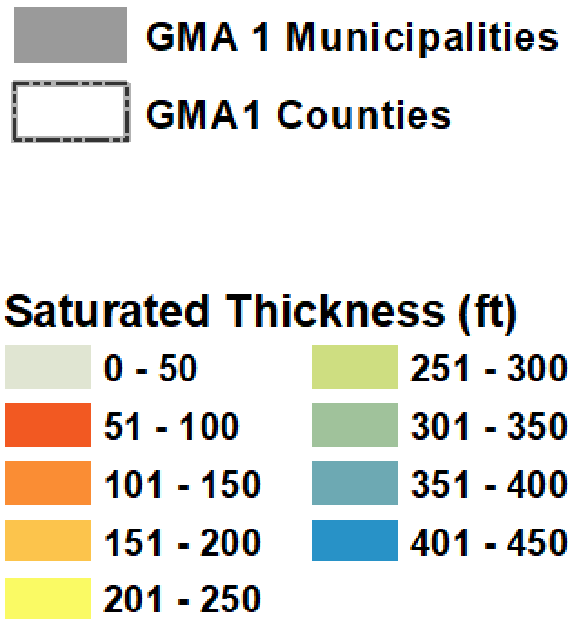
< 10	201 - 250
11 - 50	251 - 300
51 - 100	301 - 350
101 - 150	351 - 700
151 - 200	

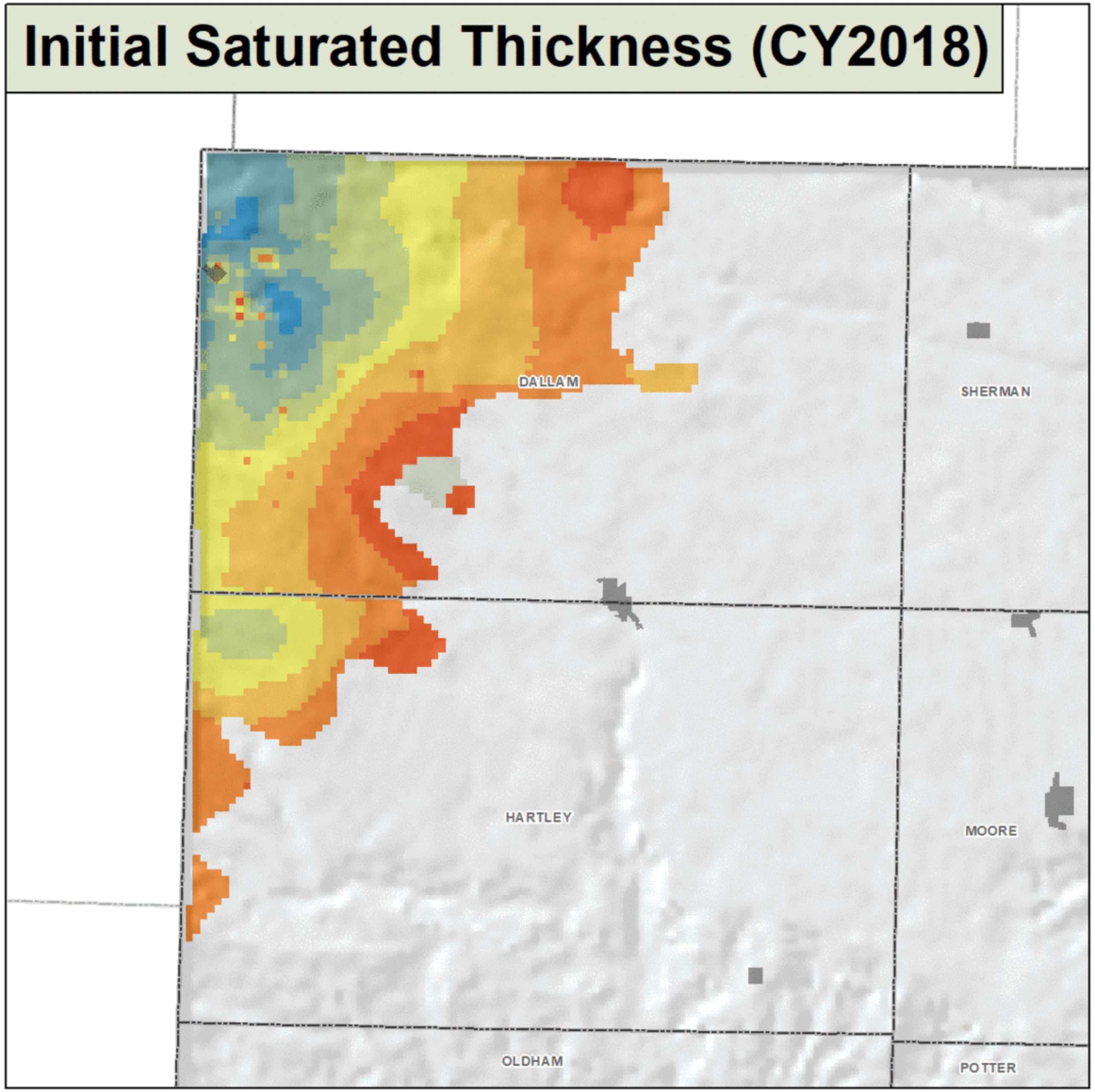


Changes in Rita Blanca Aquifer Saturated Thickness

Saturated Thickness Changes from 2018 through 2080

For the DFCs, this is combined with the Ogallala





Upper Dockum Aquifer Drawdown

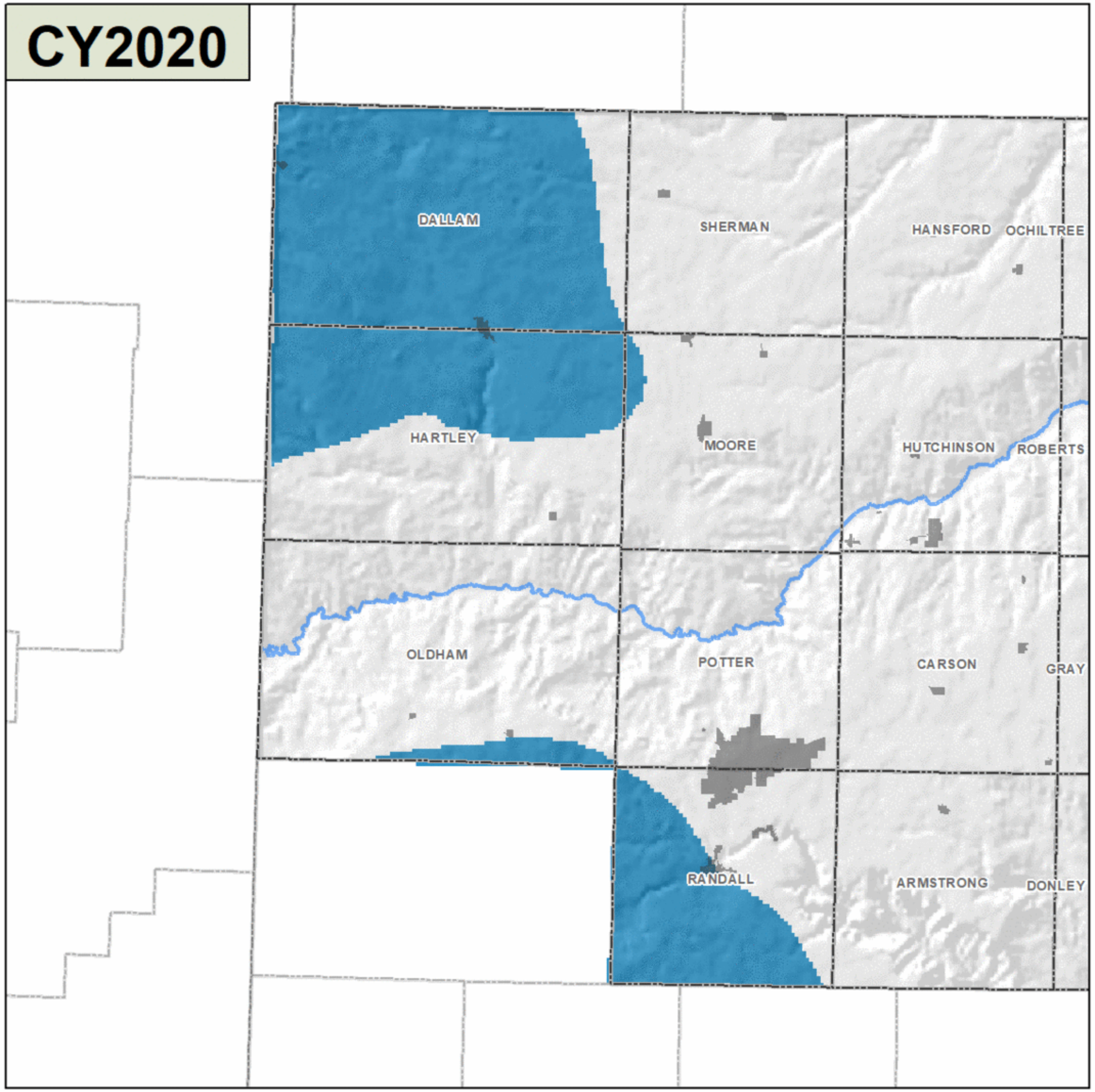
Drawdown from 2018 through 2080

GMA 1 Municipalities

GMA1 Counties

Drawdown (ft)

- < 26
- 26 - 50
- 51 - 75
- 76 - 100
- 101 - 125
- 126 - 150
- 151 - 175
- 176 - 200
- 201 - 225



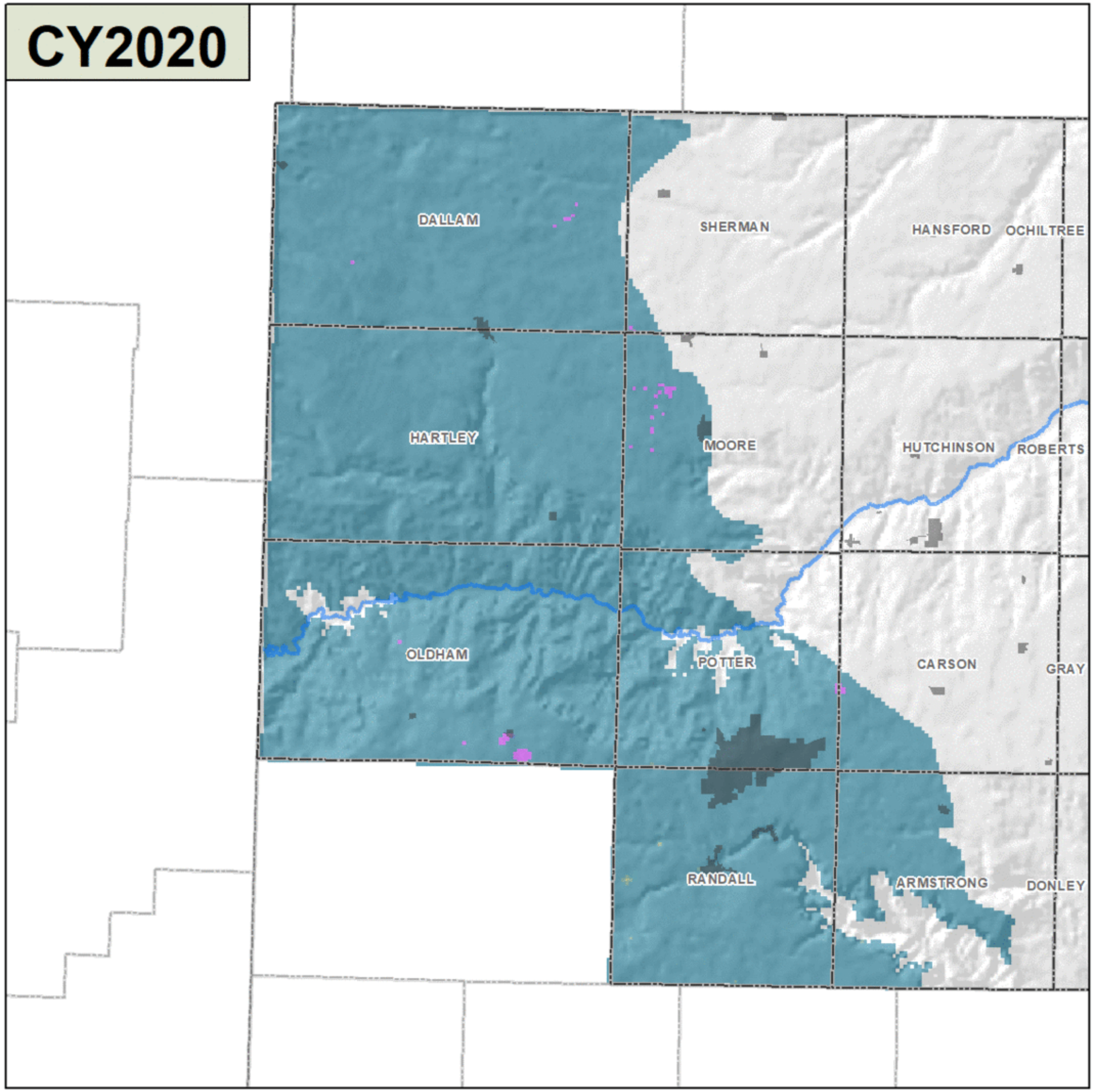
Lower Dockum Aquifer Drawdown

Drawdown from 2018 through 2080

GMA 1 Municipalities
GMA1 Counties

Drawdown (ft)

- < 0
- 0 - 50
- 51 - 100
- 101 - 150
- 151 - 200
- 201 - 250
- 251 - 300
- 301 - 350
- 351 - 400
- 401 - 450
- 451 - 500
- 501 - 550



8. Feasibility of achieving the DFC

- **Physical Feasibility:**
  As demonstrated in the model run, the DFCs being considered in GMA 1 can each be achieved simultaneously
- **Regulatory Feasibility:**
  The DFCs being considered in GMA 1 can be achieved using the existing regulatory tools available to the GCDs

9. Any other relevant information

The GMA 1 members and consultant did not identify any additional considerations not covered within the other eight factors warranting further review

Questions and Next Steps

Appendix V

Summary Reports and Public Comments Received

HEMPHILL COUNTY
Underground Water Conservation District
Conserving a Texas Oasis

August 9, 2021

GMA 1
ATTN: Dustin Meyer
c/o Panhandle Regional Planning Commission
ATTN: Wade Oliver
Intera Inc.

RE: Summary of Public Comments Received on Proposed DFC for Ogallala Aquifer in Hemphill County

Dear Mr. Meyer and Mr. Oliver:

On behalf of the Hemphill County Underground Water Conservation District Board of Directors, please accept this summary report regarding public input on the Proposed Desired Future Condition (DFC) for the Ogallala Aquifer in Hemphill County adopted by GMA 1 on March 18, 2021. The adopted proposed DFC statement for Hemphill County is: At least 80 percent volume in storage remaining for each 50-year period between 2018 and 2080 in Hemphill County. The District ran two Notices of Hearing on Proposed Desired Future Conditions in the local newspaper on April 8, 2021, and April 29, 2021. The meeting was held in accordance with the Texas Open Meetings Act and notice and hearing provisions found in Chapter 36 of the Texas Water Code. The notice was posted at the Hemphill County Courthouse on April 6, 2021, and at the District office on 4/6/2021. We also offered the public the opportunity to participate online via Zoom. While we did have members of the public attend the hearing in person and online, we did not receive any public comments regarding the proposed DFC for Hemphill County.

If you have any questions, or need additional information please feel free to contact me.

Sincerely,

Janet Guthrie
General Manager

PUBLIC COMMENTS REGARDING PROPOSED DFCs RECEIVED BY MEMBER DISTRICTS

DISTRICT	HEARING DATE	COMMENTS
Garza County UWCD	April 29, 2021	No public comment
High Plains UWCD	June 8, 2021	No public comment
High Plains UWCD	July 13, 2021	Two persons offered oral comments One written comment received
Llano Estacado UWCD	June 17, 2021	No public comment
Mesa UWCD	June 16, 2021	No public comment
Permian Basin	June 15, 2021	No public comment
Sandy Land UWCD	June 16, 2021	No public comment
South Plains UWCD	June 15, 2021	No public comment

Minutes of July 13, 2021 HPWD Public Hearing at Canyon

AGENDA ITEM # 4 -- The Board will receive public comment on: (a) Proposed DFCs for relevant aquifers in GMA1 and (b) Proposed DFCs for relevant aquifers in GMA2.

President Tate invited those present to offer public comments regarding the proposed DFCs for Groundwater Management Area # 1.

- Jim Steiert of Hereford told the Board that setting a Desired Future Condition is a difficult and elusive topic. He is impressed by those in Hemphill County who have worked to set a DFC that allows for preservation of springs. Steiert said he believes it is a fallacy for water planners to say we will have a percentage of water left 50 years in the future. People are running out of water now. We have attempted to manage the resource all these years—but have we really been successful? He encouraged the GCDs to work harder to preserve and recharge the water we currently have available--so that it will be available in 50 years. This includes taking care of playas for improved recharge to aquifers, promoting rainwater harvesting, and educating the public.

President Tate invited those present to offer public comment regarding the proposed DFCs for Groundwater Management Area #2.

No comments were received.

President Tate then invited any other members of the audience to comment on proposed DFCs in either GMA.

- Chris Grotegut of Hereford told the Board that he understands the legal ramifications of GCDs not setting a DFC within their respective GMA. Setting a DFC is a difficult target for GCDs. It is a fact that some areas will have water in the future while other areas will not. However, Grotegut said it is important to realize that "zero = zero." No water equals no life in those areas. If some of the area is converted to grasslands, then some portions will recover quickly and others will not. In his opinion, it is important to balance water usage with recharge to the aquifer. This is probably not possible--but he wonders how low people are willing to drop the water table level.

Both Grotegut and Steiert commended HPWD for its dedication to educating young people about the importance of water and water conservation.

As a matter of record, the only comments received prior to today's hearing is a letter from Hadley Perkins of Amarillo. It was mailed to HPWD on June 21, 2021. A scanned copy of the envelope/letter was emailed to the HPWD Board of Directors on June 23, 2021.

The deadline for written public comment is 5 p.m., Friday, July 30, 2021.

ey Perkins
Birkshire Dr.
o, TX 79109

AMARILLO TX 791
21 JUN 2021 PM 1 L

HPWD
% DFC Comments
2930 Ave. Q
Lubbock, TX 79411-2499

JUN 23 2021

79411$2499

Comment on Proposed DFCs in GMA 1 & 2

Dear Board of Directors,

As a person born, raised, and currently employed by agriculture within the High Plains Underground Water Conservation District it has been hard to watch the decline of the Ogallala Aquifer for the sake of our area's sustainability in the future.

Through the scope of my work, I am privy to multiple wells on irrigated farms and non-municipal water supplied homes across the region. In only 70+ years of irrigation we have raped and pillaged our water supply into something that will be depleted in our kid's lifetime at the rate we are on. We have areas of 0'-10'+/- saturated thickness decline annually and some irrigation wells pumping all summer with only 10'-30' of saturated thickness in them! I know of multiple wells which only produce 20 gpm and are tied into pivots. I understand that the when the water district was created our pumping was already a run-away train, and there has to be a fine line between regulation and property rights/profitability for our farmers, but when it comes to water, we have to be able to leave something! Gradually our area will become inefficient to irrigate and at that time the cornerstone of our agriculture industry, say dairy and feedyards, will be forced to move on. How devastating for our economy. We will still be agriculturally based, but will look a lot like Kim Colorado, which is not a pleasant thought.

I am not proposing anything drastic, but would like to see the water district practice SOME type of CONSERVATION as that word is in the title. Right now the district only acts as a shell in order to tell Austin that we have control, but in actuality the district has no control. I would like to see it enacted to prohibit the pumping of irrigation wells which do not have at least 30' of saturated thickness in addition to the banning of pumping an irrigation well which cannot produce 50+ gallons per minute. Something like this only seems logical for how far out of control we are.

Sincerely,

A Concerned Citizen

SUMMARY REPORT FOR COMMENTS RECEIVED DURING 90-DAY COMMENT PERIOD FOR PROPOSED STATEMENTS OF DESIRED FUTURE CONDITIONS

"CONSERVING WATER FOR FUTURE GENERATIONS"

Prepared by the Panhandle Groundwater Conservation District for consideration by the District Representatives in Groundwater Management Area 1 in compliance with the requirements of Texas Water Code Section 36.108 (d-2)

July 29, 2021

INTRODUCTION

1. The purpose of this Summary Report is to document a compilation of comments received during the 90-day public comment period by the Panhandle Groundwater Conservation District (Panhandle GCD) regarding the proposed desired future conditions (DFCs) adopted by the District Representatives of Groundwater Management Area 1 (GMA 1). The Panhandle GCD covers all or parts of 8 counties in the Texas Panhandle as illustrated in Figure 1.

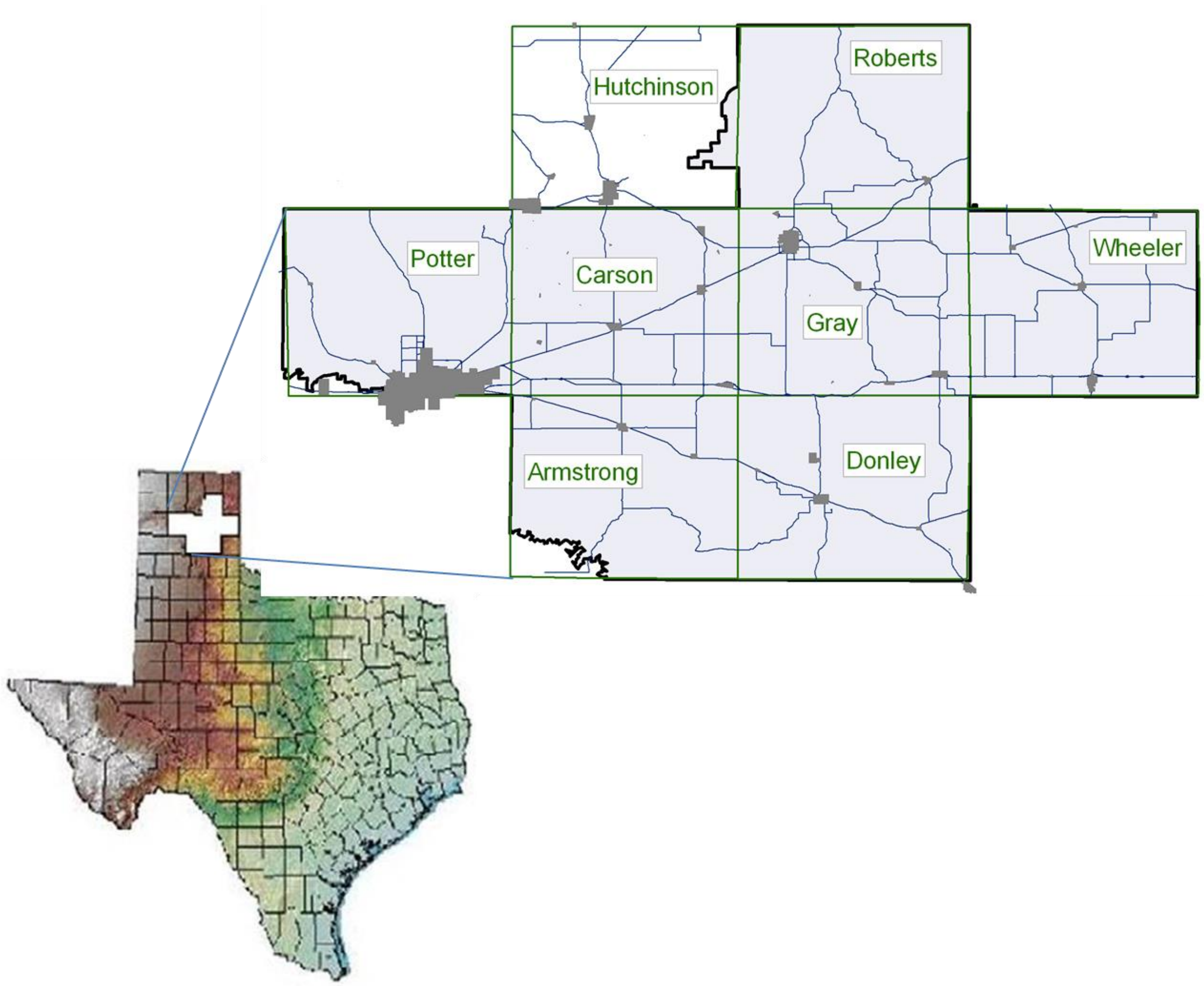


Figure 1. Location of Panhandle GCD.

For reference, Texas Water Code Section 36.108 (d-2) states as follows:

> The desired future conditions proposed under Subsection (d) must provide a balance between the highest practicable level of

> groundwater production and the conservation, preservation, protection, recharging, and prevention of waste of groundwater and control of subsidence in the management area. This subsection does not prohibit the establishment of desired future conditions that provide for the reasonable long-term management of groundwater resources consistent with the management goals under Section 36.1071(a). The desired future conditions proposed under Subsection (d) must be approved by a two-thirds vote of all the district representatives for distribution to the districts in the management area. A period of not less than 90 days for public comments begins on the day the proposed desired future conditions are mailed to the districts. During the public comment period and after posting notice as required by Section 36.063, each district shall hold a public hearing on any proposed desired future conditions relevant to that district. During the public comment period, the district shall make available in its office a copy of the proposed desired future conditions and any supporting materials, such as the documentation of factors considered under Subsection (d) and groundwater availability model run results. *After the public hearing, the district shall compile for consideration at the next joint planning meeting a summary of relevant comments received, any suggested revisions to the proposed desired future conditions, and the basis for the revisions.* (Emphasis added)

The GMA 1 District Representatives unanimously adopted proposed desired future conditions (DFCs) for GMA 1 on March 18, 2021. The proposed DFCs, along with all supporting information including consideration of the nine statutory criteria included in Texas Water Code Section 36.108 (d) (1-9), were mailed to all GMA 1 GCDs on March 29, 2021. The 90-day public comment period concluded on June 19, 2021. Desired future conditions required in the joint-planning process are defined by the Texas Water Development Board in 31 Texas Administrative Code Section 356.10 (6) as follows: “Desired future condition--The desired, quantified condition of groundwater resources (such as water levels, spring flows, or volumes) within a management area at one or more specified future times as defined by participating groundwater conservation districts within a groundwater management area as part of the joint planning process." The proposed DFCs adopted by District Representatives in GMA 1 for Panhandle GCD are as follows:

- For the Ogallala Aquifer, at least 50 percent of volume in storage remaining in each 50-year period of 2018 – 2080 in Carson, Donley, Gray, Hutchinson, Roberts, and Wheeler counties and within the Panhandle Groundwater Conservation District in Armstrong and Potter counties.
- For the Dockum Aquifer, no more than 30 feet average decline in water levels for each 50-year period 2018 – 2080 in Carson county and within the Panhandle Groundwater Conservation District in Armstrong and Potter counties.

The Panhandle GCD public hearing was held on May 11, 2021, at the Panhandle GCD offices in White Deer, Texas. See Attachment A for a copy of the public notice for the hearing. Approved meeting minutes for the Panhandle GCD public hearing are included as Attachment B. After introductory remarks by Panhandle GCD Board member Danny Hardcastle an overview of the GMA 1 joint-planning process was provided by Panhandle GCD General Manager C.E. Williams. See Attachment C for a full copy of this presentation.

<u>PUBLIC COMMENTS RECEIVED</u>

No Public comments were received.

SUGGESTED REVISIONS TO THE PROPOSED DFCS

Texas Water Code Section 36.108 (d-2) concludes with the provision that, at the conclusion of the 90-day public comment period, an element of the summary report prepared for the GMA may be any suggested revisions to the proposed desired future conditions that a district may request the district representatives of the GMA to consider. At the regularly scheduled meeting on M the Panhandle GCD Board of Directors, after discussion and consideration of this summary report, instructed the General Manager to notify GMA 1 that it did not have any substantive changes to request to the proposed DFCs at this time.

Submitted to the GMA 1 Joint Planning Committee by:

______________________________ 0n August , 2021.

C. E. Williams, General Manager

AFFP
Public Notice of Hearing on Pr

Affidavit of Publication

STATE OF TEXAS } SS
COUNTY OF POTTER }

Heather Contreras, being duly sworn, says:

That she is Legal Clerk of the Amarillo Globe-News, a daily newspaper of general circulation, printed and published in Amarillo, Potter County, Texas; that the publication, a copy of which is attached hereto, was published in the said newspaper on the following dates:

May 01, 2021

That said newspaper was regularly issued and circulated on those dates.
SIGNED:

Heather Contreras

Legal Clerk

Subscribed to and sworn to me this 1st day of May 2021.

Kimberly Dawn Megrew

Kimberly Dawn Megrew, Notary Public, Potter County, Texas

My commission expires: January 09, 2023

NOTARY PUBLIC STATE OF TEXAS
Kimberly Dawn Megrew
My Commission Expires
01/09/2023
ID No. 131847516

00005334 16099247

Panhandle Groundwater Conservation District.
201 W 3rd Ave
WHITE DEER, TX 79097

Legal Notices

Public Notice of Hearing on Proposed Desired Future Conditions
Panhandle Groundwater Conservation District
May 11, 2021 at 9:00 a.m.

The Board of Directors of the Panhandle Groundwater Conservation District (PGCD) will hold a public hearing and accept public comment on the proposed Desired Future Conditions (DFCs) for the relevant aquifers within the GMA 1 Joint Planning Area. This hearing will be held on **Tuesday, May 11, 2021 at 9:00 a.m.** at the District's Office located at 201 W. 3rd, White Deer, Texas, 79097. The purpose of the hearing is to provide interested members of the public the opportunity to appear and provide comments to PGCD related to the proposed DFCs.

Four groundwater conservation districts are located wholly or partially within Groundwater Management Area 1 (GMA 1), as designated by the Texas Water Development Board; the GMA 1 Districts include the Hemphill County Underground Water Conservation District, the High Plains Underground Water Conservation District, the North Plains Groundwater Conservation District, and the Panhandle Groundwater Conservation District. At the last GMA 1 joint planning meeting on March 18, 2021, the district representatives voted to approve the proposed DFCs. These proposed DFCs were mailed to each of the districts in GMA 1 on March 29, 2021 triggering a 90-day public comment period to close June 28, 2021. Public comments may be submitted in writing to PGCD at any time during this period or may be made addressed in person at the hearing on May 11, 2021.

Proposed DFCs for PGCD are listed below:

Ogallala Aquifer:
- At least 50 percent of volume in storage remaining for each 50-year period between 2018 and 2080 in Carson, Donley, Gray, Hutchinson, Roberts and Wheeler Counties; and within the Panhandle District portions of Armstrong and Potter Counties.

Dockum Aquifer:
- No more than 30 feet average decline in water levels for each 50-year period between 2018 and 2080 in Carson County and the Panhandle District portions of Armstrong and Potter Counties.

Copies of the proposed DFCs may be requested by email at info@pgcd.us, or they are available at the https://www.pgcd.us/public-information and http://www.PanhandleWater.org/gma-1; and may be reviewed or copied at the District Office. Any person who wishes to receive more detailed information on this notice or the proposed DFCs should contact CE Williams or Britney Britten at cew@pgcd.us or britney@pgcd.us or by calling 806-883-2501.

Dockum Aquifer:
• No more than 30 feet average decline in water levels for each 50-year period between 2018 and 2080 in Carson County and the Panhandle District portions of Armstrong and Potter Counties.

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https://www.pgcd.us/public-information and
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- No more than 30 feet average decline in water levels for each 50-year period between 2018 and 2080 in Carson County and the Panhandle District portions of Armstrong and Potter Counties.

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Britney Britten
Posted at 4:00 p.m. 4/28/21

Public Hearing on Adoption of Desired Future Conditions

Panhandle Groundwater Conservation District

201 W. 3rd Street

White Deer, Texas 79097

May 11, 2021

Presentation Outline

- Purpose of public hearing – legal requirements
- What is a “Desired Future Condition”?
- What is Groundwater Management Area 1?
- What are the proposed Desired Future Conditions for the Panhandle Groundwater Conservation District?
- What steps are left in the current joint-planning process?

Purpose of public hearing

- Texas Water Code Section 36.108(d) requires groundwater conservation districts to consider groundwater availability models and other data or information for the management area and to propose for adoption desired future conditions for the relevant aquifers within the management area.

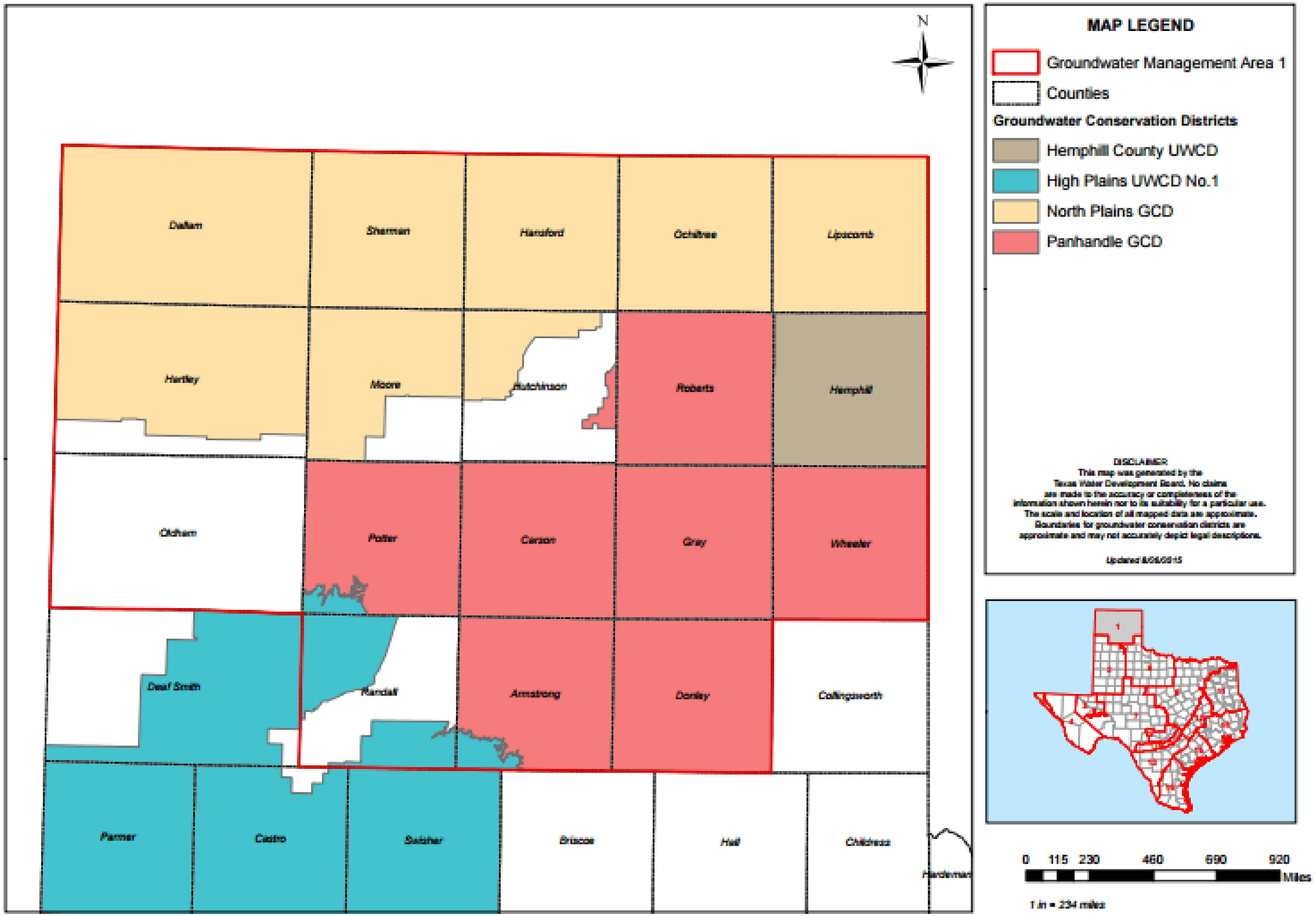
Purpose of public hearing

Texas Water Code Section 36.108 (d-2) requires a period of not less than 90 days for public comments to begin on the day the proposed desired future conditions are mailed to the districts. During the public comment period and after posting notice as required by Texas Water Code Section 36.063, **each district shall hold a public hearing** on any proposed desired future conditions relevant to that district. During the public comment period, the district shall make available in its office a copy of the proposed desired future conditions and any supporting materials, such as the documentation of factors considered under Subsection (d). After the public hearing, the district shall compile for consideration at the next joint planning meeting a summary of relevant comments received, any suggested revisions to the proposed desired future conditions, and the basis for the revisions.

Groundwater Management Areas and Desired Future Conditions

- TWDB designated 16 groundwater management areas (GMAs) across the state that include all major and minor aquifers.
- Beginning in 2005, the GCDs in each management area are charged with engaging in joint planning and developing Desired Future Conditions (DFCs) for the aquifers.
- There can be different DFCs for different aquifers, subdivisions of aquifers, or geographic areas.
- TWDB Rule 31 TAC 356.10 (6) defines DFCs as follows: "*Desired future condition--The desired, quantified condition of groundwater resources (such as water levels, spring flows, or volumes) within a management area at one or more specified future times as defined by participating groundwater conservation districts within a groundwater management area as part of the joint planning process*"

Groundwater Management Area 1



GMA 1 Considerations

1. Aquifer uses or conditions, including conditions that differ substantially from one geographic area to another
2. Water supply needs and strategies in the SWP
3. Hydrogeological conditions, including TERS, recharge, inflows, and discharge
4. Other environmental impacts, including impacts on spring flows and other surface water and groundwater interactions

GMA 1 Considerations (Cont)

5. Impact on subsidence
6. Socioeconomic impacts reasonably expected to occur
7. Impact on interests and rights in private property, including ownership and the rights of landowners, their lessees and assigns
8. Feasibility of achieving the DFC
9. Any other information relevant to the DFCs

GMA 1 Required Considerations

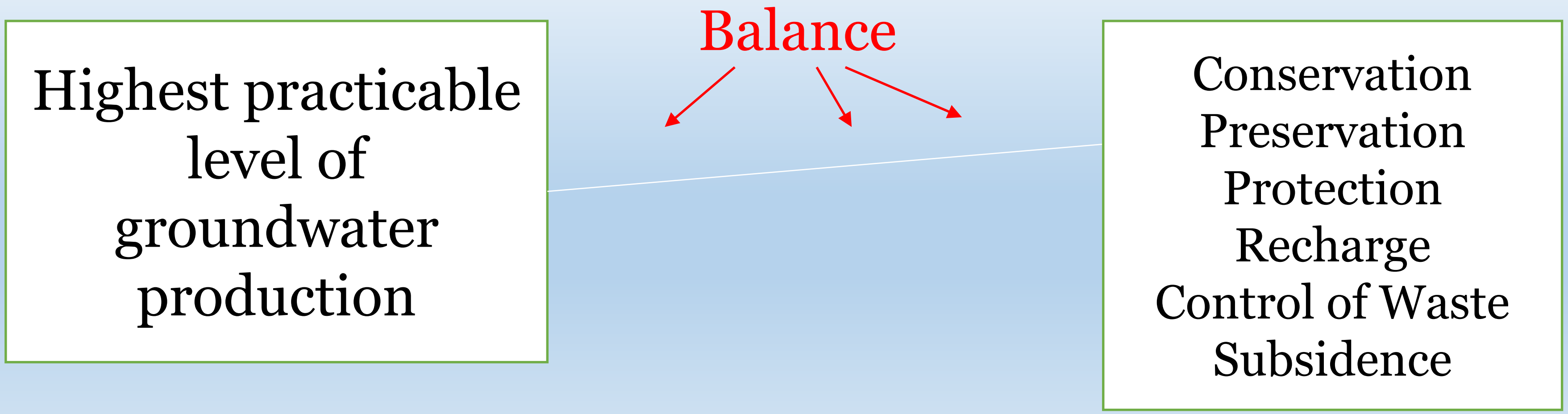
- Groundwater models

- The 9 statutorily required factors were discussed in 10 separate Joint Planning meetings held between August 6, 2019 and January 18, 2021.

- To confirm the 50/50 DFC

Balancing Test to be met by GMA 1

- Balance
  - between two outer limits or "book ends"
  - highest practicable production and conservation, recharge, etc…



Materials considered for proposed Desired Future Conditions for Panhandle Groundwater Conservation District

May be viewed at:
https://www.panhandlewater.org/gma-1

Desired Future Conditions Adopted for GMA 1

GMA 1

The proposed desired future conditions adopted by District Representatives of Groundwater Management Area 1 for the Panhandle Groundwater Conservation District are as follows:

- For the Ogallala Aquifer, at least 50 percent of volume in storage remaining for each 50-year period between 2018 – 2080 in Carson, Donley, Gray, Hutchinson, Roberts, and Wheeler Counties and within the Panhandle Groundwater Conservation District portions of Armstrong and Potter Counties.
- For the Dockum Aquifer, no more than 30 feet average decline in water levels for each 50-year period between 2018 – 2080 in Carson County and Hutchinson counties and within the Panhandle Groundwater Conservation District portions of Armstrong and Potter Counties.

50/50 Desired Future Condition and Panhandle GCD

- The proposed Desired Future Condition (DFC) for the Ogallala Aquifer in the Panhandle GCD, “at least 50 percent of volume in storage remaining for each 50-year period between 2018 – 2080” is a continuation of the DFC adopted by GMA 1 during the last round of joint-planning in 2016.
- Even more important, the 50/50 DFC is a continuation of the management goal adopted by Panhandle GCD in 1998.
- As such, the Panhandle GCD has operated and will continue to operate under a consistent management goal and regulatory structure for more than 20 years.

Estimated Modeled Available Groundwater

- Amount of Groundwater produced and achieve the 50/50 DFC
- Panhandle Groundwater Conservation District on a county-by-county basis

Decade	2020	2030	2040	2050	2060	2070	2080
Armstrong	56,821	51,760	45,662	40,268	35,017	30,705	27,080
Carson	162,975	166,133	159,424	149,866	140,958	134,453	121,522
Donley	72,596	78,318	76,996	72,649	66,893	60,955	53,227
Gray	177,264	181,767	173,242	160,488	146,740	133,890	121,683
Hutchinson	8,506	10,596	11,774	11,792	11,403	10,782	9,586
Potter	23,972	22,260	19,549	16,487	13,579	10,997	8,803
Roberts	357,959	409,569	394,109	369,578	343,395	317,738	285,999
Wheeler	119,354	132,702	132,512	128,557	121,599	114,345	106,707
Total	**979,447**	**1,053,105**	**1,013,268**	**949,685**	**879,584**	**813,865**	**734,607**

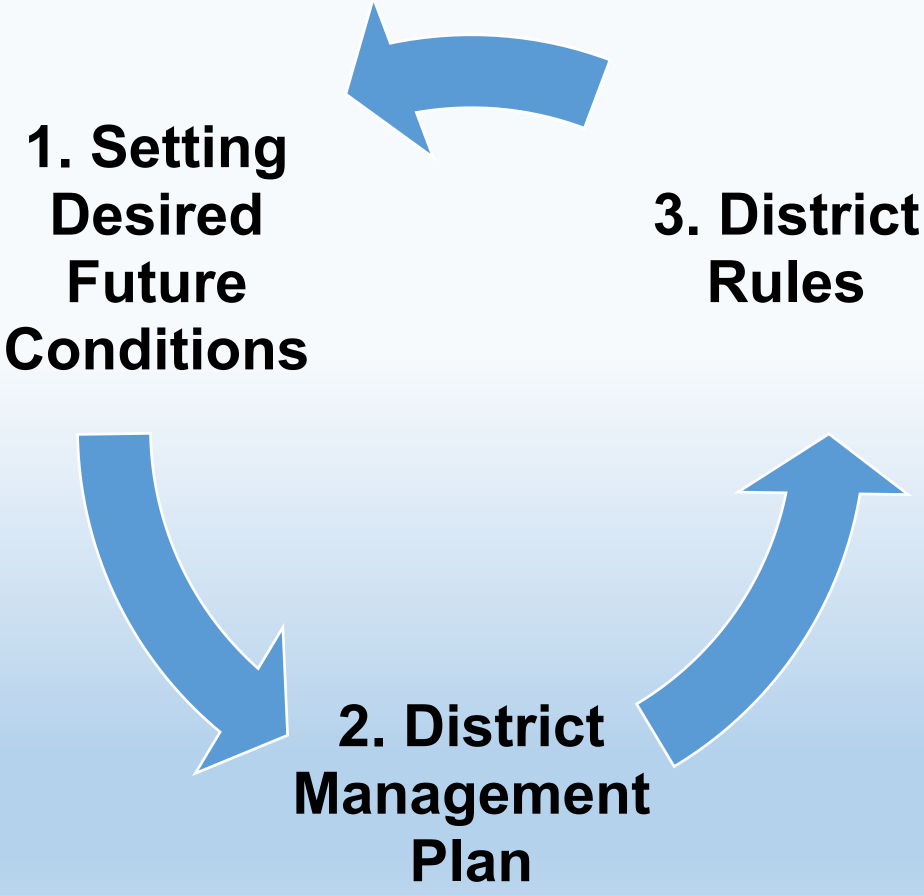
DFC Adoption Process

TODAY

- GMA considers 9 statutory criteria and balancing test
- GMA proposes DFCs for adoption March 18, 2021 – vote of 2/3 majority of district reps
- 90-day public comment period begins March 28, 2021 districts in GMA
- Individual districts hold public hearings within their boundaries
- Individual districts prepare summary reports
- GMA reps meet to consider summary reports, any proposed changes to DFCs, and adopt DFCs by 2/3 vote
- GMA submits explanatory report to TWDB and to districts
- Individual districts adopt DFCs

What steps are left in the current joint-planning process?

Adaptive Management Process



Panhandle GCD Public Hearing on Proposed DFCs

- The proposed DFCs and supporting materials for the Ogallala and Dockum aquifers are available for review and inspection at the District's office at 201 W. Third St, White Deer, Texas.
- This information is also available on the District's website at www.pgcd.us .
- Public comments will be accepted by the District through June 28, 2021 at the District office by mail or email or today during the public hearing.
- For more information, please contact C.E. Williams at the District at cew@pgcd.us or 806-883-2501.
- Comments and questions

NORTH PLAINS
GROUNDWATER
Conservation District

July 9, 2021

SUMMARY OF THE HEARING, RELEVANT COMMENTS RECEIVED DURING THE COMMENT PERIOD, ANY SUGGESTED REVISIONS TO THE PROPOSED DESIRED FUTURE CONDITIONS, AND THE BASIS FOR THE REVISIONS.

On March 18, 2021, Groundwater Management Area -1 district representatives voted to approve the proposed Desired Future Conditions (DFCs). These proposed DFCs were mailed to each of the districts in GMA 1 on March 29, 2021, triggering a 90-day public comment period. Public comments could be submitted in writing to the district at any time during this period or may be made orally at a hearing within the district.

The following proposed DFCs approved by the district representatives of GMA 1 are described in terms of acceptable drawdown levels for each subdivision of the Ogallala Aquifer (Inclusive of the Rita Blanca Aquifer) and the Dockum Aquifer:

Ogallala (Inclusive of 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, Hutchinson, 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 in Potter Counties.

Dockum Aquifer:

- At least 40 percent of the average available drawdown remaining for each 50-year period between 2018 and 2080 for 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; and
- 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.

Any person who desired to appear at the hearing and present comment or other information on the proposed DFCs could do so in person, by counsel, or both. Comments could be presented verbally or in written form.

Copies of the proposed DFCs could be requested by email at swalthour@northplainsgcd.org are available at www.NorthPlainsgcd.org and www.PanhandleWater.org ; and may be reviewed or copied at the North Plains Groundwater Conservation District, 603 East 1st Street, Dumas, Texas.. Any person who wished to receive more detailed information on this notice or the proposed DFCs should contact Steve Walthour, General Manager.

The district's board selected a hearing date for June 1, 2021, in accordance with TWC Section 36.063 and the district's rules. The notice of the public hearing was also posted on the district's website and in the district's offices at 603 East 1st. Street. Dumas, Texas.

The district held a public hearing regarding the district's intent to adopt proposed DFCs on June 1, 2021, at 9:00 a.m. at the North Plains Water Conservation Center, 6045 County Road E., Dumas, Texas. The district's general manager provided a PowerPoint presentation at the hearing regarding the DFC process and procedures. The district had the hearing audio recorded. A copy of the PowerPoint presentation and the recorded transcript are attached to this summary.

The district received no relevant comments from the public during the hearing. No written comments, questions, or requests for additional information concerning the adoption of the proposed DFCs were submitted to the district by the close of the comment period on June 30, 2021.

The North Plains Groundwater Conservation District recommends no amendments to the proposed Desired Future Conditions.

Sincerely,

Bob B Zimmer

Bob B. Zimmer
Board President.

GMA – 1 Joint Planning
Proposed Desired Future Conditions

Steven D Walthour, PG
General Manager
North Plains Groundwater Conservation District
June 1, 2021

Desired Future Conditions (DFCs)

"a balance between the highest practicable level of groundwater production and the conservation, preservation, protection, recharging, and prevention of waste of groundwater and control of subsidence in the management area" (TWC Ch. 36)

The Balancing Test

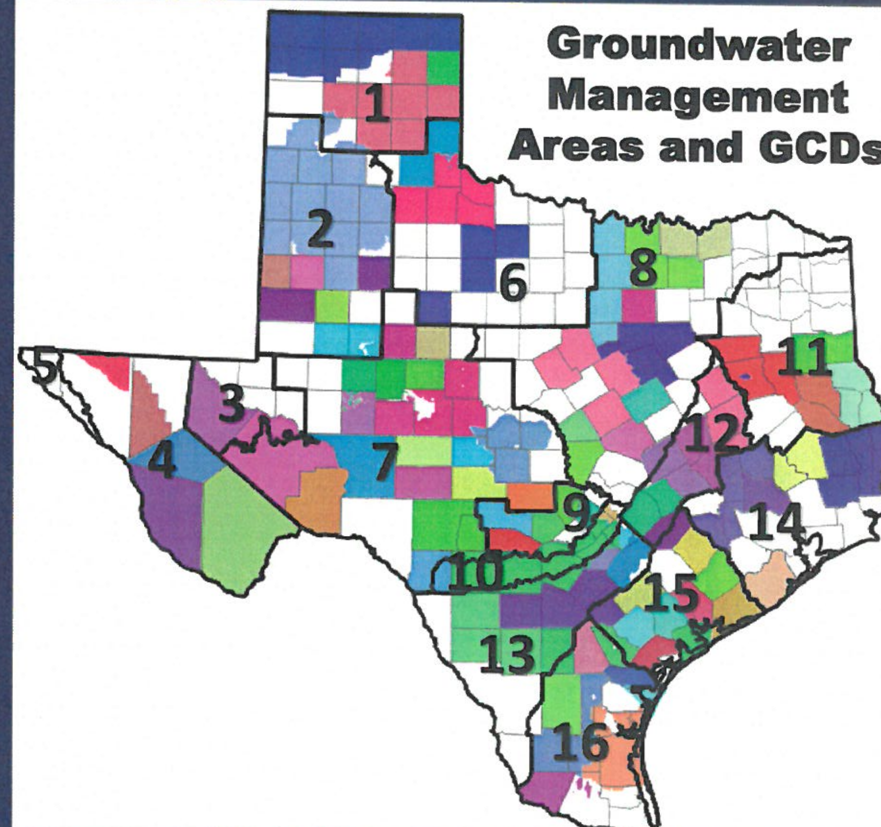
Conservation, Preservation, Prevention of Subsidence, etc.	**Highest Practicable Level of Groundwater Production**
Aquifer uses or conditions	Aquifer uses or conditions
Environmental Impacts	Water supply needs and management strategies
Water supply needs and management strategies	Socioeconomic Impacts
Socioeconomic Impacts	Feasibility of achievement
Subsidence Impacts	Private Property Rights
Feasibility of achievement	Hydrological Conditions
Hydrological Conditions	

Groundwater Management Area Joint Planning

Purpose: Review the "9 Factors" that have been considered and discussed in previous meetings.

The 9 Factors:

1. Aquifer uses or conditions
2. Water supply needs and management strategies
3. Hydrological conditions
4. Other environmental impacts
5. Impact on subsidence
6. Socioeconomic impacts
7. Impact on private property rights
8. Feasibility of achieving the DFC
9. Any other relevant factors



Proposed Desired Future Conditions

Ogallala Aquifer (Inclusive of Rita Blanca):

- 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, Hutchinson, Lipscomb, Ochiltree.

Dockum Aquifer

- At least 40 percent of the average available drawdown remaining for each 50-year period between 2018 and 2080 for Dallam, Hartley, Moore, and Sherman Counties

North Plains GCD Production 2016-2020

County	2016	2017	2018	2019	2020	Average
Dallam	339,200	312,300	349,900	303,200	342,745	329,500
Hartley	391,600	376,000	422,600	349,200	402,242	388,300
Moore	185,700	173,100	200,600	157,700	199,359	183,300
Sherman	285,300	265,100	312,000	255,400	328,409	289,200
Hansford	170,400	146,700	190,800	162,300	195,120	173,100
Hutchinson	67,700	63,600	75,500	68,400	79,388	70,900
Lipscomb	42,300	44,200	44,200	43,400	54,522	45,700
Ochiltree	81,400	77,300	95,500	81,800	105,241	88,200
West	**1,201,800**	**1,126,500**	**1,285,100**	**1,065,500**	**1,272,756**	**1,190,300**
East	**361,800**	**331,800**	**406,000**	**355,900**	**434,273**	**377,900**
Total	**1,563,600**	**1,458,300**	**1,691,100**	**1,421,400**	**1,707,029**	**1,568,200**

Proposed MAG (acre-feet)

Ogallala -Rita Blanca Aquifers MAG (2022)

	2020	2030	2040	2050	2060	2070	2080
Dallam	319,323	269,752	228,251	195,016	165,443	144,455	127,992
Hansford	296,868	295,895	281,027	264,464	247,229	229,951	211,025
Hartley	354,907	270,408	207,323	170,002	144,264	124,448	108,128
Hutchinson	77,759	80,242	77,674	74,510	70,462	67,541	63,950
Lipscomb	250,966	270,997	262,931	250,133	235,071	219,119	201,565
Moore	140,116	139,837	132,461	121,696	105,913	88,223	72,976
Ochiltree	259,136	260,144	246,760	231,654	215,169	199,455	180,919
Sherman	289,546	287,846	260,978	226,290	197,926	166,784	145,097
WEST	**1,103,892**	**967,843**	**829,012**	**713,004**	**613,546**	**523,910**	**454,193**
EAST	**884,730**	**907,277**	**868,392**	**820,761**	**767,932**	**716,066**	**657,459**
SUB TOTAL	**1,988,622**	**1,875,121**	**1,697,404**	**1,533,765**	**1,381,478**	**1,239,976**	**1,111,652**

Dockum Aquifer MAG (2022)

	2020	2030	2040	2050	2060	2070	2080
Dallam	15,953	15,549	14,687	14,045	13,502	12,920	12,406
Hartley	12,379	11,802	11,031	10,343	9,737	9,242	8,815
Moore	4,487	5,402	5,398	5,068	4,773	4,477	4,204
Sherman	444	416	309	289	293	288	290
SUB TOTAL	**33,262**	**33,170**	**31,424**	**29,745**	**28,304**	**26,928**	**25,715**
TOTAL MAG							
WEST	**1,137,155**	**1,001,013**	**860,436**	**742,749**	**641,851**	**550,838**	**479,909**
EAST	**884,730**	**907,277**	**868,392**	**820,761**	**767,932**	**716,066**	**657,459**
TOTAL	**2,021,884**	**1,908,290**	**1,728,829**	**1,563,510**	**1,409,783**	**1,266,904**	**1,137,367**

Groundwater Management Planning

- JOINT MANAGEMENT PLANNING TO ESTABLISH DESIRED FUTURE CONDITIONS – CURRENT Planning Cycle (2017-2021)
- DISTRICT MANAGEMENT PLAN (2018) Anticipated Revision (2022/23)
- DISTRICT RULES (ADOPTED April 2015) Not Planned.

MINUTES OF THE JUNE 1, 2021,
BOARD OF DIRECTORS MEETING OF
NORTH PLAINS GROUNDWATER CONSERVATION DISTRICT

The Board of Directors of North Plains Groundwater Conservation District met in regular session on June 1, 2021, at 9:02 a.m. at the barn located at the North Plains Water Conservation Center, 6045 West County Road E., Dumas, Texas 79029-7201. The following persons participated in the Meeting:

Members Present at 9:02 a.m.:

Bob B. Zimmer, President;
Mark Howard, Vice-President;
Zac Yoder, Secretary;
Daniel L. Krienke, Director
Gene Born, Director;
Harold Grall, Director; and
Justin Crownover, Director.

Staff present during part or all of the meeting:

Steve Walthour, General Manager;
Kristen Blackwell, Finance/Administration Manager;
Paige Glazner, Conservation Outreach Assistant;
Dale Hallmark, Hydrologist; and,
Curtis Schwertner, Natural Resource Specialist.

Others present during part or all of the meeting:

Stan Spain;
Clinton Born;
Raymond Brady;
F. Keith Good, General Counsel for the District;
Ellen Orr, Paralegal; and,
Kalen Youtsey, Summer Clerk.

President Zimmer declared a quorum present and called the meeting to order at 9:02 a.m. Director, Gene Born, gave the invocation and President, Bob B. Zimmer, led the pledge.

General Counsel, F. Keith Good, introduced Kalen Youtsey, who is a summer clerk for the law firm of Lemon, Shearer, Phillips & Good, P.C.

At 9:04 a.m., President Zimmer recessed the regular Board meeting and called and opened the public hearing to accept public comments on the proposed Desired Future Conditions (DFCs) for the relevant aquifers within Groundwater Management Area 1 Joint Planning Area.

Mr. Zimmer stated:

This public hearing is to provide interested members of the public the opportunity to appear and provide comments on the proposed Desired Future Conditions (hereinafter "DFCs") for the area aquifers that were recently proposed by Groundwater Management Area 1 under § 36.108, Texas Water Code. The 90-day Public Comment Period began on March 29, 2021 and will close at 5:00 p.m. CDT on June 28, 2021.

The proposed DFCs for the District are:

Ogallala (inclusive of 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, Hutchinson, 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; and,
- 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 in Potter Counties.

Dockum Aquifer:

- At least 40 percent of the average available drawdown remaining for each 50-year period between 2018 and 2080 for 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; and,
- 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.

The Board is not required to make a decision today in regard to the District's intent to adopt the proposed DFCs.

Cell phones are very distracting. As a courtesy to all of the parties present at this hearing, please do as I have done and turn you cell phones off. If you must take a cell phone call during the hearing, please leave the room so that you do not distract from the speaker.

This formal hearing is being recorded.

All written comments timely received, will be made a part of the formal record of this hearing. However, the comment period for the DFCs are a minimum of 90-days, which will extend past this hearing date until June 28, 2021, at 5:00 p.m. CDT.

The Board will not respond to questions, but the Board may ask questions of the commentators. In order to encourage commentary, time limits will be liberally imposed. However, as the presiding officer, I may, in my discretion, limit redundant or irrelevant commentary.

Prior to public comment, each commentator will be called by name and asked to estimate the amount of time for his or her comments. If it appears that the number of comments and the time required will consume an inordinate amount of time, as the presiding officer, I will impose a five-minute time limit on each commentator. Please note that all comments shall be limited to the Proposed DFCs. The Proposed DFCs are the sole issue before the Board in this hearing. If you are not speaking in your individual capacity, please state the person or entity you represent.

Every person attending this hearing must conform to ethical standards of conduct and exhibit courtesy and respect for all other participants or observers. No person may engage in any activity during this hearing that interferes with the orderly conduct of District business. If, in my judgment, as the presiding officer, a person is acting in violation of this provision, I will first warn the person to refrain from engaging in such conduct. Upon further violation by the same person, as the presiding officer, I may exclude that person from the proceeding.

Steve Walthour, the District's General Manager, made a presentation regarding the proposed DFCs.

President Zimmer then called for public comments and no public comments were made at the hearing.

President Zimmer thanked everyone for their participation and input in the hearing process. President Zimmer stated that all written and oral commentary presented to the Board will be taken under advisement. President Zimmer further stated that you may continue to submit written comments regarding the proposed DFCs to the District at the District's office in Dumas, Texas; however, all written comments must be delivered by 5:00 p.m. CDT on June 28, 2021.

At 9:32 a.m., President Zimmer closed the public hearing and reconvened the regular Board meeting.

1 – Public Comment

No Public Comment was made to the Board.

2 – Consent Agenda

The Consent Agenda was discussed by the Board and consisted of: (a) the review and approval of the Minutes of the regularly scheduled Board of Directors Meeting held on April 13, 2021; (b) the review and approval of un-audited District expenditures for April 1, 2021 through April 30, 2021, including the General Manager's expense and activity report; and, (c) the review and approval of payment to Lemon, Shearer, Phillips & Good, P.C. for professional services and out-of-pocket expenses incurred from April 1, 2021 through April 30, 2021, in the amount of $10,515.75.

Gene Born moved to approve the Consent Agenda. Harold Grall seconded the motion and it was unanimously approved by the Board.

Action Agenda 3.a. - Receive report and discuss public hearing and public comment regarding the proposed Desired Future Conditions for the relevant aquifers within the Groundwater Management Area.

The General Manager reported to the Board that the proposed Desired Future Conditions were mailed to each of the districts in GMA 1 on March 29, 2021, triggering a 90-day public comment period to close on June 28, 2021. Public comments may be submitted in writing to North Plains Groundwater Conservation District at any time during this period or may be made orally at this hearing. A copy of the draft explanatory report and proposed DFCs can be found at https://www.panhandlewater.org/gma-1, or on the District's website http://northplainsgcd.org/.

Mr. Walthour stated that the District has until June 28, 2021 to put together the summary report that he will submit to the Board. If the Board has additional comments it would like to make at that time based upon that summary report, they will be included in the final report to GMA 1.

Mr. Walthour also stated that to his knowledge, no written or oral commentary regarding the proposed DFCs had been received by the District to-date.

Action Agenda 3.b. - Consider groundwater production reporting for 2020 and its relationship to Desired Future Conditions.

Mr. Walthour reported that Municipal, Industrial, and Agriculture water user groups reported 1,707,029.93 of acre-feet groundwater production in the North Plains Groundwater Conservation District in 2020. Production by District county in acre-feet is as follows:

County	2020
Dallam	342,745.65
Hartley	402,242.14
Moore	199,359.43
Sherman	328,409.54
Hansford	195,120.62
Hutchinson	79,388.98
Lipscomb	54,522.30
Ochiltree	105,241.27
West	**1,272,756.76**
East	**434,273.17**
Total	**1,707,029.93**

District groundwater production exceeded the 5-year historical production average by approximately 138,830 acre-feet. 2020 production was 15,230 acre-feet higher than 2018 but ranged 38,381 to 341,381 acre-feet less than the District's annual production from 2011 to 2014. The table below represents annual groundwater production in acre-feet from 2016 to 2020, collectively, from all aquifers in the District.

County	2016	2017	2018	2019	2020	Average
Dallam	339,200	312,300	349,900	303,200	342,745.65	329,500
Hartley	391,600	376,000	422,600	349,200	402,242.14	388,300
Moore	185,700	173,100	200,600	157,700	199,359.43	183,300
Sherman	285,300	265,100	312,000	255,400	328,409.54	289,200
Hansford	170,400	146,700	190,800	162,300	195,120.62	173,100
Hutchinson	67,700	63,600	75,500	68,400	79,388.98	70,900
Lipscomb	42,300	44,200	44,200	43,400	54,522.30	45,700
Ochiltree	81,400	77,300	95,500	81,800	105,241.27	88,200
West	**1,201,800**	**1,126,500**	**1,285,100**	**1,065,500**	**1,272,756.76**	**1,190,300**
East	**361,800**	**331,800**	**406,000**	**355,900**	**434,273.17**	**377,900**
Total	**1,563,600**	**1,458,300**	**1,691,100**	**1,421,400**	**1,707,029.93**	**1,568,200**

The District annually reviews groundwater production from the previous year and determines if there are conditions that may trigger District Rule 8.4 and District Rule 8.5 evaluation to reduce Allowable Annual Production. The determination in part is based on the Modeled Available Groundwater (MAG) measured in acre-feet to achieve the Desired Future Conditions (DFCs) in the District. Texas Water Development Board GR16-029 MAG

Report provides the model data for the assessment. The table below is a compilation of MAG for the Dockum aquifer, Ogallala aquifer and Rita Blanca aquifer DFCs.

		Modeled Available Groundwater (Acre-Feet)					
County	Aquifer	2020	2030	2040	2050	2060	2062
Dallam	Ogallala/ Rita Blanca	387,471	287,205	225,573	166,890	112,864	103,258
Hansford	Ogallala	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Moore	219,654	199,359	-9.24%	183,300	-16.55%
Sherman	398,183	328,410	-17.52%	289,200	-27.37%
Hansford	275,016	195,121	-29.05%	173,100	-37.06%
Hutchinson	62,803	79,389	26.41%	70,900	12.89%
Lipscomb	266,809	54,522	-79.57%	45,700	-82.87%
Ochiltree	243,778	105,241	-56.83%	88,200	-63.82%
West	**1,428,687**	**1,272,757**	**-10.91%**	**1,190,300**	**-16.69%**
East	**848,406**	**434,273**	**-48.81%**	**377,900**	**-55.46%**
Total	**2,277,093**	**1,707,030**	**-25.03%**	**1,568,200**	**-31.13%**

Gene Born noted that the District's 2020 Annual Production does not exceed the 2020 MAG. Mr. Born moved that there are no conditions that trigger District Rule 8.4 and District Rule 8.5 to reduce Allowable Annual Production. Mark Howard seconded the motion and it was unanimously approved by the Board.

Action Agenda 3.c. - Consider final compliance approval of Water Well Permits as active and complete wells.

The General Manager reported that District Rule 2.13 provides, after the site inspection is complete, and it is determined that the Well (and all Wells within the Groundwater Production Unit) is/are in compliance with the Rules of the District, and the Well Permit application, the General Manager shall submit the Well Permit to the Board for final compliance approval.

It was noted that 199 non-exempt Well Permits had been issued by the District since January 1, 2021, and that 108 non-exempt Well Permits had been approved by the Board since January 1, 2021.

The General Manager reported that the District staff had processed 30 Water Well Permits which are ready for Board consideration and approval. These permits, listed in the table below, represent completed wells that have been inspected and are in compliance with District Rules. The inspections verify that the wells were completed as required by the respective Permits, including proper well location, well classification, maximum yield, and proper installations of check valves and flow meters. Copies of the individual permits were presented to the Board.

Permit Number	Well Class	Quarter	Section	Block	Survey	Yards NS	Yards EW
DA-11331	C	NW/4	55	1	B&B	168 N	131 W
DA-11406	B	SE/4	57	5	CSS	449 S	463 E
DA-11462	B	NW/4	29	1	CSS	594 N	159 W
DA-11464	B	NW/4	8	2	CSS	377 N	518 W
DA-11465	B	SW/4	8	A-7	PSL	20 S	1313 W
DA-11468	C	SW/4	24	1	CSS	336 S	457 W
DA-11550	D	SW/4	17	48	H&TC	182 S	847 W
DA-11598	C	SW/4	8	7-T	T&NO	531 S	29 W
HA-11448	D	NW/4	5	14	CSS	396 N	133 W
HA-11493	D	NE/4	16	14	CSS	766 N	259 E

HA-11517	D	SE/4	24	14	CSS	278 S	393 E
HA-11518	D	NE/4	24	14	CSS	122 N	385 E
HA-11523	D	NW/4	23	14	CSS	602 N	108 W
HA-11527	D	SW/4	23	14	CSS	234 S	172 W
HA-11528	D	SW/4	23	14	CSS	215 S	689 W
HA-11585	C	NE/4	7	11	CSS	443 N	444 E
HA-11587	C	NW/4	12	11	CSS	558 N	359 W
HA-11588	C	NE/4	7	11	CSS	869 N	173 E
HN-11548	D	SW/4	6	4-T	T&NO	833 S	774 W
HN-11590	D	NW/4	33	R	B&B	102 N	249 W
MO-11320	D	SE/4	413	44	H&TC	22 S	866 E
MO-11334	C	SE/4	412	44	H&TC	536 S	37 E
MO-11335	C	NW/4	19	Q	H&GN	813 N	23 W
MO-11336	C	SE/4	18	Q	H&GN	190 S	331 E
MO-11481	B	NW/4	174	44	H&TC	103 N	350 W
OC-11484	D	NW/4	22	R	B&B	492 N	102 W
SH-11490	C	NE/4	19	3-T	T&NO	767 N	408 E
SH-11507	B	SW/4	240	1-T	T&NO	29 S	270 W
SH-11514	C	SW/4	179	1-C	GH&H	47 S	22 W
SH-11608	C	NE/4	5	2	GH&H	702 N	465 E

Justin Crownover moved to approve all of the well permits on the well permit schedule, noting that the wells are properly equipped and otherwise comply with District Rules. Mark Howard seconded the motion and it was unanimously approved by the Board.

Action Agenda 3.d.- ***Receive report and consider action as needed regarding agriculture water conservation demonstration programs and the North Plains Water Conservation Center.***

The General Manager presented the following report to the Board:

Issues with East Well at WCC

In preparation for beginning to irrigate for the 2021 season, staff discovered that the east well production had dropped to 180 gpm. At this level, it is possible there may not be enough water available to fulfill the needs of the farm for the upcoming production and demonstration season. The Ag Committee has recommended that the pump be pulled, and the well be inspected to determine if the production can be increased before irrigation requirements reach their peak at the WCC. Nich Kenny and Stan Spain determined to get the cotton and corn planted and germinating before pulling the pump and reconditioning the well. Rains have delayed planting and consequently delayed the work on the well. Stan Spain said he anticipated pulling the pump after getting the crops started with 2-3 weeks of irrigation. Work on the well could start the week of 6/7 or 6/14.

The District has received an estimate of $33,854 from Etter Water Well to pull the pump, inspect the well, brush, bail, and surge the well. The estimate also includes a new pump and motor, which may or may not be necessary. Once the well has been cleaned and inspected, the pump may be lowered since we anticipate there may be about 40 feet of casing below the pump.

If this restoration of the well is successful in returning the well to an acceptable pumping rate, it may not be necessary to do anything else. However, if the well does not return to useful production, it could be necessary to drill another well right away, at a cost of approximately $185,000, according to Stan Spain. Management is currently reassessing financial priorities to make sure the total amount of funds needed will be available, if a new well must be drilled. These new priorities mean other projects are currently on hold and may not be completed until we reassess after the east well issue is resolved.

Since this is an extremely time sensitive issue, management recommended that the Board authorize the Agriculture Committee to take whatever action that is required, and expend the necessary funds, not to exceed $218,000, to provide the water needed for the demonstrations and crop production at the WCC.

$218,000 is the sum of the well servicing estimate and the estimated cost of drilling a new well. This authorization will eliminate the need to bring the full Board back together, potentially causing a delay in restoring sufficient irrigation to the farm.

Funding to address the east well issue at the field will require an amendment to the 2020-2021 budget.

Daniel L. Krienke moved, that because of the time sensitivity and the immediate need to get the groundwater well back into production, the Board authorize the Agriculture Committee to take action to provide the water needed for the demonstrations and crop production at the WCC, not to exceed $218,000. Harold Grall seconded the motion and it was unanimously approved by the Board.

WCC Grower Day

The District hosted a Grower Day on April 15 to present findings from the District's demonstrations. Approximately 15 past Master Irrigator graduates and other growers attended the meeting, along with consultants and extension staff. Nich Kenny, PE, and Jourdan Bell, PhD, presented information from the various demonstrations they are conducting relating to agriculture water conservation. Continuing education credits were available, and a drawing was held for a YETI cooler. The meeting ran from 8:30 a.m. to 1:00 p.m. The meeting was available virtually, as well as in-person, observing all health and safety protocols.

Master Irrigator

The District has just completed the fifth year of its award-winning Master Irrigator program. The 2021 class consisted of 19 producers from the eight-county service area, representing over 70,775 acres of irrigated agricultural land. After their graduation, the Master Irrigator family grew to 109 strong, representing about 30 percent of the District's irrigated acres.

Additionally, on May 6, the Texas Water Development Board approved a grant of $250,000 to fund the District's Master Irrigator Program and other irrigation conservation initiatives. The grant will provide funding to assist graduates of the Master Irrigator with implementation of irrigation conservation practices through 2023.

Action Agenda 3.e. - Consider General Manager's request to enter into a five-year professional services agreement with Canadian Well Service, Canadian, Texas

Mr. Walthour stated that North Plains Groundwater Conservation District published the intent to retain a Texas Licensed well driller to provide services to the District for five years. The services are on an as-needed basis, which include the drilling and completion of monitor wells, pumping existing monitor wells for water quality testing, and removing pumping equipment from some of the District's winter water level observation wells. Pumping equipment removal will be with the well owner's permission and at the District's expense.

The District placed requests for proposals for these services in local newspapers and media outlets including the *Moore County News-Press* and the *High Plains Observer*. The bid request ran in the *Moore County News-Press* starting on April 25 and ran in 4 consecutive issues ending on May 6, 2021. Additional ads were run in the *High Plains Observer* for one week beginning the week of May 3, 2021. The *Observer* ads ran locally in Spearman, Dumas, Perryton, Hutchinson, and Stratford. Staff sent emails directly to Hydro Resources, DB&E Drilling, Canadian Water Well, 287 Drilling, and Water Rights Irrigation Services. As of May 20, 2021, three responses were received. Hydro Resources responded with a phone call asking about the equipment removal, but no bid was received. Stewart Brothers Drilling of Milan, New Mexico, submitted a bid on drilling the monitor well only. Canadian Water Well was the only company to submit bids for the services requested.

The General Manager recommended that the Board approve a five-year contract with Canadian Water Well for the following services.

1. Drilling and completing two monitor wells at the cost of $11,300 each, allowing adjustments in the price of materials and labor during the duration of the contract;

2. Pumping monitor wells for water quality testing at the cost of $1,500 per well, allowing adjustments for material and labor cost throughout the contract; and,

3. Pulling pumping equipment from observation wells at the cost of $2,300 per well, allowing for adjustments in material and labor costs throughout the contract.

Before any service is provided, the contractor will provide a cost estimate to the General Manager for approval and shall not exceed the District's annual budget related to the service list.

The General Manager requested that the Board approve Canadian Water Well for water well construction, repair, and testing services related to the District's groundwater monitoring program as listed above, and contingent upon approval of the contract by legal counsel.

The General Manager stated that sufficient funding is included in the 2020-2021 budget for this item. The contract is subject to budgeted funding availability in subsequent years.

Mr. Good stated that counsel was in the process of reviewing the proposed contract.

Gene Born moved that the Board approve Canadian Water Well for water well construction, repair, and testing services related to the District's groundwater monitoring program as listed above, and contingent upon approval of the contract by legal counsel. Justin Crownover seconded the motion and it was unanimously approved by the Board.

Action Agenda 3.f. - Consider General Manager's request to amend the District's 2020 – 2021 Budget.

General Manager, Steve Walthour, reported that to address the immediate need to repair the east Well at the North Plains Water Conservation Center and the unlikely potential of needing to drill a new well during the 2021 irrigation season, the General Manager has reviewed the District 2020 – 2021 Budget to provide funding for the well repairs without immediately raising the District's overall budget. If a new well is required before the end of the fiscal year, the General Manager may ask for an overall District budget increase to cover other priorities later this fiscal year if necessary. The General Manager requested that the Board amend the 2020 - 2021 Budget as follows:

Budget Item description	Current Budget Amount	Increase or (Decrease)	Proposed Budget Amount	Explanation
Capital Outlay	$45,000.00	$188,000.00	$233,000.00	Increased to cover prioritized capital costs for potential well construction/repair at the North Plains Water Conservation Center if a new well is needed and the current east well is also repaired. If all funds are not needed, then the district will drill two monitor wells and purchase telemetry equipment for water well observation network. A portion of the funds may be returned at a subsequent board meeting.
Aquifer Science	$130,000.00	(100,000.00)	$30,000.00	Moved funds to Capital Outlay to cover capital costs for monitor well drilling and monitor well equipment replacement if funding is not needed to replace a well.
Conservation Outreach	$540,000.00	(88,000.00)	$452,000.00	Moved funds to Capital Outlay to cover potential costs of well construction/repair at the North Plains WCC.
Administration	$152,478.95	(20,000.00)	$132,478.95	Decreased – to cover costs for professional fees.
Professional Fees	$198,000.00	$20,000.00	$218,000.00	Increased to subcontracted services for additional funds complete demonstrations this year.
Total overall 2020-2021budget change		**0**		**No change in overall budget**

The proposed budget amendments above reflect no change in the District's overall budget. Once the North Plains WCC well issue is addressed, any funding remaining will be reprioritized to the equipment and program needs contemplated as part of Aquifer Science, Conservation Outreach, and Administrative budgets, as a budget amendment later this summer.

The above proposed budget amendments reflect no change in the District's overall budget. Funding is included in the 2020 - 2021 budget.

Gene Born moved that the Board amend the 2020 -2021 budget as follows:

- Increase Capital Outlay from $45,000.00 to $233,000.00;
- Increase Professional Fees from $198,000 to $218,000;
- Decrease Administration budget from $152,478.95 to $132,478.95;
- Decrease Aquifer Science budget from $130,000.00 to $30,000.00; and
- Decrease Conservation Outreach budget from $540,000.00 to $452,000.00.

Daniel L. Krienke seconded the motion and it was unanimously approved by the Board.

Action Agenda 3.g. - Discuss development and schedule Committee Meetings regarding the 2021-2022 District Budget.

Steve Walthour presented the following report:

This item is to discuss the development of the 2021-2022 Budget and set committee meetings to prepare committee recommendations before the July Board meeting. Since the District receives preliminary appraisals from eight different county appraisal districts, the General Manager assumed that the preliminary appraisals would be computed eight different ways. For example, some CADs reduce their preliminary appraisals by 10% to

12% while other CADs do not. The appraisal process has not been completed in any county and therefore the final values will be different. The preliminary values for 2021 are as follows:

County	PRELIMNARY VALUES 2020	CERTIFIED VALUES 2020	PRELIMINARY VALUES 2021
Dallam	938,729,086	973,517,076	976,570,496
Hansford	542,987,221	547,689,169	540,508,221
Hartley	717,499,720	768,066,970	726,851,228
Hutchison	92,851,552	110,352,750	94,055,170
Lipscomb	331,297,206	432,158,279	388,885,859
Moore	1,785,001,204	2,027,103,420	1,827,225,381
Ochiltree	1,243,389,922	1,227,855,479	994,886,752
Sherman	442,542,824	463,525,100	496,606,444
TOTAL	**6,094,298,735**	**6,550,268,243**	**6,045,589,551**

District staff will be developing a draft proposed budget for Fiscal Year 2021-2022 with input from the Board's committees. The General Manager proposed to provide the preliminary budget in July.

Action Agenda 3.h. - ***Receive report regarding water level drawdown and decline rate field data collection and analysis.***

The General Manager presented the following report to the Board:

Purpose:

Continued declines in the annual water level measurements reveal more significant reductions than the District's decline models suggest. The District proposes a study that will provide additional data to help calibrate the model to represent the actual aquifer conditions. This study aims to monitor the changes in the aquifer levels within areas of the District over the next year. The study is slated to begin in June, 2021 and will end in June, 2022. The District hydrologist and field manager have selected 20 properties within Hartley, Moore, and Sherman Counties on which to conduct the study. The study will collect data on pumping rates, the number of pumping days, and decline rates in non-pumping wells near these study areas. The District will look at properties consisting of seasonal crop production, confined animal feeding operations, municipal well fields, and industrial pumping. Measurements and monitoring will occur weekly or bi-weekly throughout the study.

Procedure:

District staff will conduct visits to these properties to collect meter readings and flow rates. In addition to this data, the staff will measure the depth to water in non-pumping wells near the study areas. The staff will collect data from these sites on a two-week cycle for the duration of the study. The staff has selected a range of study areas to include seasonal water production on croplands, year-round pumping for animal production, including dairies, cattle feeding operations, and swine production. The staff will also monitor municipal and industrial water production. Each study area type will be compared to an agricultural-only control plot consisting of similar acreage and number of producing wells.

Findings:

At the end of the study period, the study results will evaluate the aquifer models and provide better aquifer information to the public.

Action Agenda 3.i. - ***Receive report regarding Panhandle – Texas Runs on Water Public Information Campaign.***

The General Manager reported that The Texas Water Foundation (TWF) is coordinating a statewide water campaign like the concept of the well-known *Don't Mess with Texas* campaign. The Texas Runs on Water campaign will reach the entire state with the message of the value of water and the importance of each of us being good stewards of the water we have. The campaign is beginning with three pilot programs to be presented in the City of Houston, the Hill Country and in the Panhandle. In the Panhandle, the TWF currently has an agreement with Channel 7 in Amarillo to produce content for their newscasts and to be distributed over their social media and other outlets. Panhandle Groundwater Conservation District has a MOU with TWF to provide content for the campaign as well. The District has been asked to cooperate with the pilot program by providing content and financial support. Management recommended that the District participate in this conservation education program. The outreach staff will continue to gather more information and will keep the Board informed of the District's role going forward. Mr. Walthour stated that he was considering authorizing financial support in the amount of $10,000 for the conservation education program.

Mr. Walthour stated that some homeowners put more water on an acre of grass than irrigators do growing corn. Most irrigators water once every seven days. Some homeowners water their grass every day and use more water on their grass around the house than farmers do growing crops.

Action Agenda 3.j. - ***Receive report regarding Region A Water Planning Area.***

The General Manager presented the following report to the Board:

The Region A - Panhandle Water Planning Group is scheduled to meet on Tuesday, June 29th at 9:30-11:00 a.m. Primary meeting topics are as follows:

- Receive public input and comments on issues that should be addressed or provisions that should be included in the 2026 Regional Water Plan and 2027 State Water Plan;
- Review of water planning activities since the last meeting and consider working timeline for the sixth cycle of Regional Water Planning;
- Review responses to Solicitation for Nominations to fill voting member position in the General Public interest category vacated by Don Allred and receive recommendation from the Executive Committee;
- Approval and selection of firm to perform Technical Consulting Services for the 2026 Regional Water Plan;
- Discuss the potential process for conducting interregional coordination regarding water management strategies during development of the 2026 Regional Water Plans, including the identification of such strategies and course of action for coordination; and,
- Selection of Officers to the PWPG Executive Committee.

Action Agenda 3.k. - ***Receive report regarding USGS water quality sampling in the District.***

The General Manager reported that District staff met with the project leader, Craig Mobley, and others of the United States Geological Survey, Monday, May 17, 2021. The purpose of the meeting was to inform the District of the progress and expected delivery of the final Water Quality Investigative Report from the 2019-2020 Water Quality Pumping Project. The report is currently under USGS departmental review, and then it will undergo a peer review. The USGS expects to deliver the report to the Board of Directors in December 2021.

Action Agenda 3.l. - ***Receive report and consider action regarding Missouri River Transfer Project to Mitigate Flooding and Protect the Six-State Ogallala-High Plains Regional Socio-Economic Viability.***

The General Manager reported that since January, the District has worked with Texas Cattle Feeders Association to develop a white paper that can be used to promote this project to interested parties. The most recent copy of the white paper associated with the transfer project was presented to the Board.

Action Agenda 3.m. - ***Receive report and consider action regarding compliance and contested matters before the District.***

The General Manager stated that there were twenty-six (26) Groundwater Production Units (GPUs) that potentially exceeded 2020 Annual Allowable Production and Conservation Reserve, if available. The staff sent compliance notices to each alleged violator on May 19, 2021, with a due date to pay fees and install flow meters, if not already installed, by June 30, 2021.

Historically, the District has allowed producers to address their noncompliance by establishing new GPUs after December 31st of the reporting year because of District staffing and system limitations. In 2020, there were 20 different owners on 26 GPUs out of 2901 GPUs that exceeded their total authorized production limit and conservation reserve (if they had one). Three agents represented ten of the owners and 15 GPUs of the 26 overproduced GPUs.

Beginning 2021, the General Manager intends to notify all owners and agents throughout the year to pay attention to their groundwater production and address potential overproduction by December 31st.

Preliminarily, the 26 GPUs exceeded authorized groundwater withdrawals by 4,718 acre-feet. Well owners have the opportunity to contest the overproduction estimate by the staff.

Well owners filed eight 2020 Annual Production Reports after March 1. Late Filing fee letters, with fees of $50 per day up to $500 per report, were sent on May 19, 2021, with payment due by June 30, 2021, or install flow meters at all wells if not already installed by June 30, 2021. Late fees are refundable if the same-named Production Reports for 2021 are filed no later than January 15, 2022.

By consensus, the Board set December 31 of the groundwater production reporting year as the final day to establish new GPUs for the groundwater production reporting year, beginning December 31, 2021, and continuing for each ensuing year thereafter.

Action Agenda 3.n. - ***Receive report and consider action regarding compliance and contested matters before the District.***

The General Manager reported that as of Friday May 21, 2021, the Texas Legislature has sent two bills to the Governor's desk for signature that affect the District. HB1118 amends the Cybersecurity Act and HB1082 amends the disclosure of information for by adding all elected officials.

The District is following SB10 related to lobbying for public entities and SB 152 in which the House of Representatives struck the attorney's fees language. Apparently, Senator Perry will need to approve the Committee amendment on SB152 dropping the attorney's fees portion of the Bill for it to reach the governor.

It appears that the Legislature is not going to pass a Bill that would allow public entities to expand participation in public meetings by video conferencing.

This is the year for redistricting. The Governor will probably call a special session near the end of the summer for the Legislature to go through the redistricting process.

Action Agenda 3.o. - ***Closed Session.***

None.

Discussion Agenda 4.c. - ***General Manager's Report.***

Steve Walthour presented a report to the Board, which included the General Manager's activity summary, the District's activity summary, permits issued by the District in April 2021, post-drill well inspections as of April 30, 2021, and upcoming meetings and conferences.

Discussion Agenda 4.- ***Discuss Items for Future Board Meeting Agendas and Set Next Meeting Date and Time.***

By consensus, the Board set its next regular Board meeting in person on July 13, 2021, at 9:30 a.m., at the Water Conservation Center. By consensus, the Board also set its regular meeting in August on August 10, 2021.

Action Agenda 4.a. - ***District Director Reports regarding meetings and/or seminars attended, weather conditions and economic development in each Director's precinct.***

District Director reports were presented to the Board regarding meetings and/or seminars attended, weather conditions and economic development in each Director's precinct.

Discussion Agenda 4.b. - ***Committee Reports.***

No Committee reports were presented to the Board.

Agenda 6. - ***Adjournment.***

There being no further business to come before the meeting, Gene Born moved to adjourn the meeting. Harold Grall seconded the motion and it was unanimously approved. President Zimmer adjourned the meeting at 10:46 a.m.

Bob B. Zimmer, President

Zac Yoder, Secretary

MINUTES OF THE JULY 13, 2021,
BOARD OF DIRECTORS MEETING OF
NORTH PLAINS GROUNDWATER CONSERVATION DISTRICT

The Board of Directors of North Plains Groundwater Conservation District met in regular session on July 13, 2021, at 9:00 a.m. in the Conference Room in the Richard S. Bowers Water Conservation Learning Center Building at the North Plains Water Conservation Center, 6045 West County Road E., Dumas, Texas 79029-7201. The following persons were present:

Members Present at 9:03 a.m.:

Bob B. Zimmer, President;
Mark Howard, Vice-President;
Zac Yoder, Secretary;
Daniel L. Krienke, Director
Gene Born, Director;
Harold Grall, Director; and
Justin Crownover, Director.

Staff present during part or all of the meeting:

Steve Walthour, General Manager;
Kirk Welch, Assistant General Manager;
Dale Hallmark, Hydrologist;
Kristen Blackwell, Administration Manager;
Odell Ward, Field Service Manager;
Casey Tice, Production Coordinator;
Curtis Schwertner, Natural Resource Specialist;
Paige Glazner, Conservation Outreach Assistant;
Baylee Barnes, Conservation Outreach Specialist;
Krystal Donley, Administrative Assistant;
Sherry Robinett, Administrative Assistant;
Dakota Young, Natural Resource Specialist;
Braden Cadenhead, Natural Resource Specialist;
Ryan Walters, Natural Resource Specialist;
Dusty Holt, Permitting Specialist/Finance Assistant; and,
Lou Orthman, Compliance Coordinator.

Others present during part or all of the meeting:

Steve Amosson;
Stan Spain;
Clinton Born;
Nich Kenny;
Pauletta Rhoades;
James McAlister;
Lee Hall;
Tom Forbes, Esq.;
F. Keith Good, General Counsel for the District; and
Ellen Orr, Paralegal.

President Zimmer declared a quorum present and called the meeting to order at 9:03 a.m. Director, Zac Yoder, gave the invocation and President, Bob B. Zimmer, led the pledge.

1 – Public Comment

No Public Comment was made to the Board.

2 – Consent Agenda

The Consent Agenda was discussed by the Board and consisted of: (a) the review and approval of the Minutes of the regularly scheduled Board of Directors Meeting held on June 1, 2021; (b) the review and approval of un-audited District expenditures for May 1, 2021 through June 30, 2021, including the General Manager's expense and activity report; (c) the review and approval of payment to Lemon, Shearer, Phillips & Good, P.C. for professional services and out-of-pocket expenses incurred from May 1, 2021 through June 30, 2021, in the amount of $11,335.16; (d) the review and approval of the Dallam County Appraisal District Collection Contract for 2022-2023; and, (e) review, consideration and approval of the Texas Municipal League rerate notice option one and the EyeMed option F for employee health insurance.

Harold Grall moved to approve the Consent Agenda, with the exception of item 2d, the and approval of the Dallam County Appraisal District Collection Contract for 2022-2023. Mark Howard seconded the motion and it was unanimously approved by the Board.

Action Agenda 3.a. - Consider final compliance approval of water well permits as active and complete wells.

The General Manager reported that District Rule 2.13 provides, after the site inspection is complete, and it is determined that the Well (and all Wells within the Groundwater Production Unit) is/are in compliance with the Rules of the District, and the Well Permit application, the General Manager shall submit the Well Permit to the Board for final compliance approval.

It was noted that 254 non-exempt Well Permits had been issued by the District since January 1, 2021, and that 138 non-exempt Well Permits had been approved by the Board since January 1, 2021.

The General Manager reported that the District staff had processed 30 Water Well Permits which are ready for Board consideration and approval. These permits, listed in the table below, represent completed wells that have been inspected and are in compliance with District Rules. The inspections verify that the wells were completed as required by the respective Permits, including proper well location, well classification, maximum yield, and proper installations of check valves and flow meters. Copies of the individual permits were presented to the Board.

Permit Number	Well Class	Quarter	Section	Block	Survey	Yards N S	Yards E W
DA-10771	C	SW/4	11	7	CSS	760 S	297 W
DA-11459	C	NE/4	17	48	H&TC	833 N	263 E
DA-11466	B	NE/4	73	4	CSS	416 N	514 E
DA-11467	C	NW/4	21	1	CSS	521 N	424 W
DA-11544	C	SE/4	287	1-T	T&NO	8 S	475 E
HA-11441	D	SE/4	15	14	CSS	543 S	29 E
HA-11519	D	NE/4	24	14	CSS	644 N	406 E
HA-11520	D	SE/4	24	14	CSS	695 S	86 E
HA-11543	B	SW/4	62	2	B&B	104 S	111 W
HA-11573	C	SW/4	11	11	CSS	801 S	216 W
HA-11574	C	NE/4	11	11	CSS	445 N	71 E
HA-11577	C	SE/4	13	11	CSS	809 S	719 E
HA-11578	C	NW/4	13	11	CSS	22 N	28 W
HA-11579	C	NW/4	13	11	CSS	269 N	379 W
HA-11580	C	NE/4	12	11	CSS	567 N	522 E
HA-11581	C	SE/4	12	11	CSS	775 S	716 E
HA-11583	C	NE/4	13	11	CSS	857 N	257 E
HA-11584	C	NE/4	13	11	CSS	10 N	249 E

HA-11586	C	SE/4	12	11	CSS	805 S	285 E
HA-11626	C	SW/4	7	11	CSS	376 S	798 W
HA-11629	C	SW/4	54	48	H&TC	437 S	446 W
HA-11643	D	SE/4	0	0	TB RUSSELL	100 S	151 E
HA-11644	C	NE/4	113	4	CSS	443 N	444 E
HA-11647	C	SE/4	7	11	CSS	437 S	484 E
HA-11648	C	NE/4	15	11	CSS	24 N	205 E
HA-11650	C	NE/4	15	11	CSS	45 N	618 E
HN-11506	C	NW/4	211	2	GH&H	798 N	728 W
HN-11572	D	NW/4	8	4-T	T&NO	408 N	106 W
HU-11443	C	SW/4	54	M-23	Robert Sikes	478 S	1473 W
MO-11866	C	SW	153	3-T	T&NO	421 N	459 W

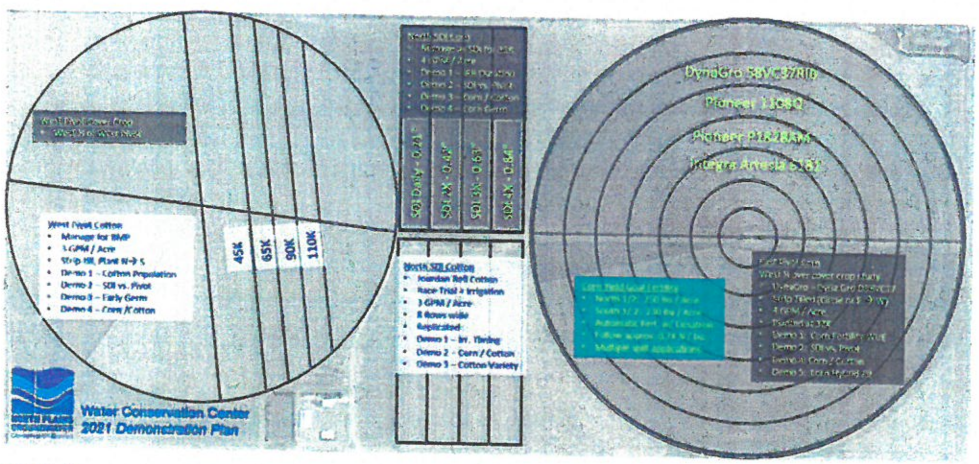
Harold Grall moved to approve all of the well permits on the well permit schedule, noting that the wells are properly equipped and otherwise comply with District Rules. Mark Howard seconded the motion and it was unanimously approved by the Board.

Action Agenda 3.b.- ***Receive report and consider action as needed regarding agriculture water conservation demonstration programs and the North Plains Water Conservation Center.***

Nich Kenny presented the following report to the Board:

3 July 2021 – NPGCD Water Conservation Center
Update Nicholas Kenny, P. E.

Figure 1: 2021 WCC Field plan for Corn and Cotton Rotation



2021 Cropping Season

The 2021 cropping season at the Water Conservation Center is underway and has a few unique items of note.

1. East Well repairs
2. New well in fiscal year 2022
3. Cotton and Corn Planting Summary
4. Stand Counts

East Well Repairs

The production at the East Well declined early in the 2021 production season witnessed by pump surging at reduced operating speeds compared to previous seasons. The pump was pulled by Etter Water Well on 2 June. The well was videoed on 8 June and the pump reinstalled on 15-16 June following brushing and baling. The well was pumped to waste for a few hours and reconnected to the system. Due to favorable rainfall timing, the east well has not been run for a sustained period following the rehabilitation effort and the final status of the rehabilitation work is not yet known.

The well video indicated that surface scale was light on the well casing and perforations were visible throughout. No major breaks or column compromises were present. Dry ice was installed in the well to mechanically surge the well by raising the water in the column. Prior to installation, brushing and baling was performed to scrub and surge the well. The baling process extracted significant rust flakes and fresh filter gravel indicating that the efforts to further open perforations was likely successful. However, it is not expected that substantial water production will be gained from this operation, rather, the production is likely to be better maintained instead of declining rapidly again.

An additional column pipe joint was added to the pump assembly to lower the pump an additional 21 feet to the final set depth of approximately 630 ft. It is expected that this step will improve production of this well to greater than 300 GPM. The service pump was tested and re- installed with a new 75-hp submersible motor.

Figure 2: Etter Water Well pump rig pulling the pump from the East Well on 2 June.

Figure 3: Flaked scale and gravel-pack filter material from the East well during baling on 15 June. The well video did not indicate any obvious breaks.

New well in Fiscal Year 2022

To maintain the corn and cotton production system at the Water Conservation Center, total irrigation system capacity will need to maintain at or above 825 GPM, just above 3.5 GPM / Acre to account for years when corn is in the East Pivot. The sustainable capacity from the West Well is approximately 550 GPM (higher seasonally) and the expected capacity from the East Well is approximately 300 GPM but declining. The East Well was drilled to 650 ft. deep in April 1971, now exceeding 50 years old. The West well was drilled to 681 ft. in January 1999.

Prior to the work on the East Well, production had dipped below 285 GPM which approaches the critical low level to continue the corn and cotton rotation. This exposes two crucial items for the WCC:

1. Within the next few seasons, the irrigation system capacity is expected to permanently fall below the critical level to sustain a demonstration program at WCC which includes field-scale corn production.
2. A well that goes down during June, July, or August will likely result in a compromised crop or failed annual demonstration event.
3. 2021 production is not expected to be limited now that the East Well has been addressed.

It is recommended to pursue an additional well to be drilled at the Water Conservation Center to secure the demonstration program, primarily to contain the risk of losing the East Well completely. It is not recommended to abandon or replace the East Well as its production will be very useful in the case of either one of the other wells is compromised. The following steps are being pursued currently with the consideration of drilling the new well during the winter months of 2021 / 2022.

1. Locate an "ideal" physical location on WCC to consider pipeline tie-ins, electrical run length, and potential obstruction to field operations, etc.
2. Engage with multiple well drillers to determine cost and availability to drill and equip a well during the winter timeframe. The drillers considered early in the process are Hydro Resources #145 (previously Henkle Drilling who drilled the West Well in 1999), Hydro Resources – Sunray (Randy Taylor), Etter Water Well, and Les Burkett Drilling – Sunray.
3. Consider pursuing available hydrogeological survey methods for locating the well, based on Items 1 and 2.
4. Develop a potential cost and project schedule.
5. Present findings to the Ag Committee and Board by the August 2021 Board meeting.
6. Proceed according to the Board's direction.

Cotton and Corn Planting

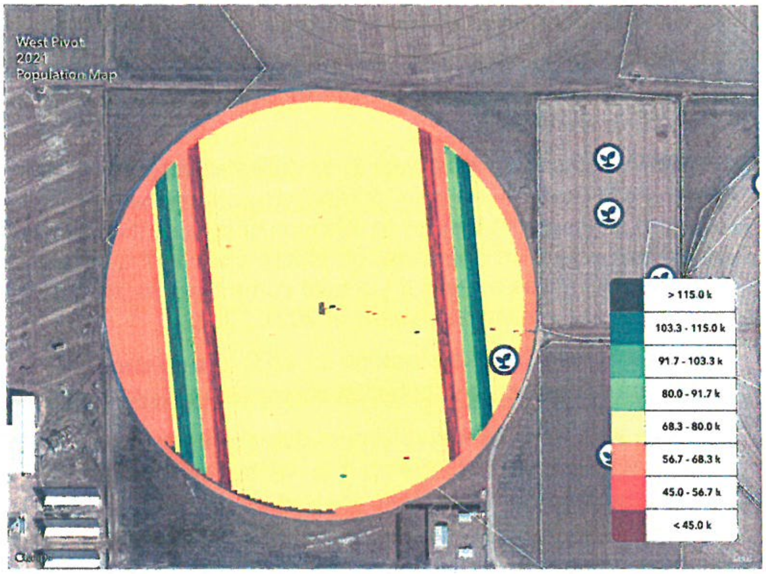
The 2021 planting operation at WCC was as follows.

1. 13 May – Cotton: West Pivot, 75K seeds / acre field rate with demonstration rates of 45K, 65K, 90K, and 110K planted on the west and east side of the field.
2. 24 May – Corn: North SDI at 32K seeds/acre for the SDI irrigation depth demonstration
3. 25 May – Cotton: South SDI at 75K seeds / acre with varieties as part of Jourdan Bell's RACE project
4. 25 May – Corn: East Pivot at 32K seeds / acre for yield goal comparisons

The biggest item in this section is the delayed cotton planting date; 13 May on the west pivot and 25 May on the South SDI. This concept was considered based on the poor germination performance on all cotton plantings at WCC over the past three seasons. If the objective is to secure an early cotton fruit set, a uniform, dense stand may be more valuable than gross accumulation of heat units. The attempt wasn't to delay planting in 2021, but because of soil conditions with rainfall events, pre-water, and crusting, the planting date was pushed back a week. Time will tell if we did indeed stumble into a useful management strategy. Earlier planting (late April) was not pursued because of lower soil temperatures during 2021.

The corn planting is approximately 5 days later than the normal 20 May planting date due to wet field conditions. Given the dry winter and depleted soil moisture from 2020, this rainfall period was very welcome and greatly improved the planting conditions for seed to soil contact.

Figure 4: West Pivot cotton planting map for 2021



Corn and cotton germination improvements

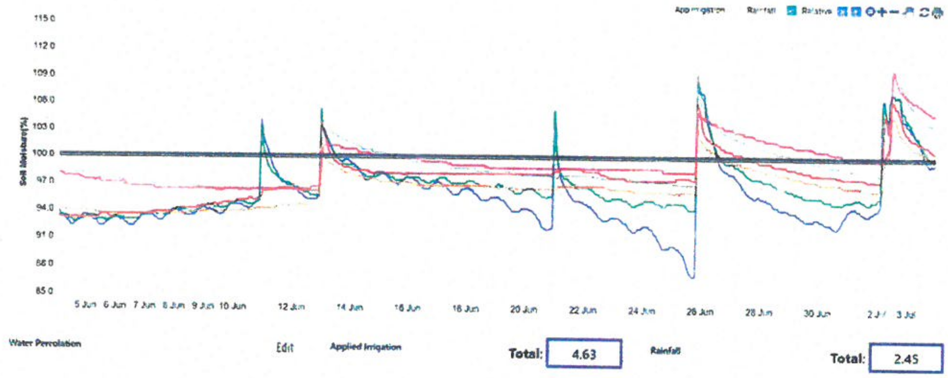
Likely a result of later planting dates and beneficial rainfall events that created ideal seed bed conditions, both the corn and cotton germination rates were greatly improved in 2021 at the WCC.

The East Pivot corn remained consistent near the 100% germination, rate. After noticing weaker final stands in the SDI corn plots in 2020 (28K-30K), addition attention was given to planting conditions in the North SDI plot and produced near perfect stands in the Corn SDI Plots, ranging from 96% to 109% compared to 32K ideal population. Considering that the SDI corn outperformed the pivot with a weaker stand in 2020, it will be interesting to see if a yield jump occurs with an improved stand.

Figure 5: West pivot cotton stand counts from 11 June 2021, approximately 1 month after planting. Notice the frequency of plots sampling greater than 70% and many lower seed drop replications approaching 80%. There appears to be a marginal return in percentage, although all denser seeding rates produce a denser final stand in these plots.

	NW		SW		NE		SE	
Plot	Stand	%	Stand	%	Stand	%	Stand	%
45K	35,600	79%	35,200	78%	34,800	77%	32,400	72%
65K	48,800	75%	49,600	76%	44,000	68%	46,400	71%
95K	65,200	72%	65,600	73%	51,200	57%	52,800	59%
110K	72,000	65%	79,400	71%	78,800	72%	66,800	61%
75K	52,400	70%	55,600	74%	50,400	67%	51,200	68%

Figure 6: GroGuru chart from the East Pivot corn. The pivot has been stopped at the time of this screenshot with the plan of being off for 5 days given the condition of the soil moisture profile. This probe is in the Southwest quadrant of the field. The WCC corn is set-up to have a full profile and full capacity at all critical crop stages in 2021, the next concern being the impact of cooler day-time weather during the early corn stages.



Master Irrigator

Dr. Steve Amosson made a presentation to the Board regarding the results from the 2021 Master Irrigator Program, as well as an update regarding both the 2016 and 2017 Master Irrigator participant surveys.

Action Agenda 3.j. - Receive report regarding the 87th regular legislative session and the special session.

Tom Forbes, Esq., presented the following report to the Board:

The main piece of legislation that we worked on this past session of the legislature was SB 152, which was originally suggested by the Farm Bureau. The bill would have changed the requirements for posting notice and rulemaking along with some other provisions. The notice and rulemaking provisions in the original bill would have, if passed, created substantial problems for the North Plains district. Along with other GCDs we worked with the bill's author, Senator Charles Perry and other interested parties to explain the difficulties that would be caused if the bill passed as drafted. As we discussed at Board meetings early in the Session, it appeared that the Farm Bureau did not have the widespread support that they may have been counting on in the beginning. This gave us and other districts the opportunity to have our concerns heard. By the end of the session the language had been changed sufficiently to satisfy the concerns the North Plains district had expressed (since the beginning of the session). It appeared that the amended bill would pass, but the differences between the Senate version of the bill and the House version could not be reconciled and the bill failed.

There were several bills dealing with statutory changes which would have prohibited governmental bodies, such as cities, counties, school districts, hospital boards, special districts (including groundwater conservation districts) and other types of governmental bodies from hiring government affairs experts (government entity lobbying). These bills would have made it more difficult (and possibly impossible) for governmental bodies to hire the expert assistance they require. These bills were opposed by a broad range of civic leaders, professional associations, business associations, city councils, school boards, county commissioners and special districts. A couple of these bills passed the Senate but were defeated in the House.

The Lieutenant Governor is strongly in favor of this legislation, however the Speaker is less enthusiastic. House members heard from their mayors, school board members, community leaders, and others. These leaders explained to the legislature that entities like the North Plains Groundwater Conservation District are complex enterprises and have to be able to hire the experts they need to do the job they have been asked to do. These organizations have the authority to engage engineers, accountants, architects, insurance experts, lawyers and other consultants so they can have the expert help they need. We explained that these governmental entities have governing boards that are chosen by their constituents. If the boards are not handling the job they way they should, those board members can be replaced by the local constituents. Representative Mayes Middleton has filed H.B. 107 which is one of these bills that were defeated last session. We are being told today that the Governor will add government entity lobbying to his proclamation. If the Governor takes this action, Representative Middleton's bill will be eligible for consideration. There will be a vigorous effort to defeat it. We will keep you advised of developments about this and any other additions that may affect the District.

Also, one of the bills being considered in the special session deals with the conduct of elections. While it doesn't appear to have much, if any, effect on the District we will keep you advised about its progress.

The meeting was recessed at 10:31 a.m. and was reconvened at 10:39 a.m.

Action Agenda 3.c. - Consider General Manager's recommendation in proposing the 2021-2022 District Budget.

General Manager, Steve Walthour, presented the following report to the Board:

As a taxing entity, the District must propose a budget to determine its fiscal needs before setting a tax rate. The general manager has analyzed the Districts fund balance reserves and developed a preliminary 2021-2022 budget for the purposes of estimating a tax rate and providing a starting point for the Board to adopt a budget.

The District began the 2020-2021 budget year with $3,217,596 total fund balances. As of June 30, 2020, the District's cash and certificates of deposit were $3,167,485.44 By the end of this fiscal year (EOY) the General Manager estimated that the funds will be reduced by $321,032.47 leaving $2,843,452.97 in reserves to start the 2021-2022 budget year. If the District elects to keep the same tax income for 2021-2022 as the previous year and adopts the income and expense budget shown below the District would further decrease its general fund reserves by $683,934.76 to $2,157,518.21. Normally the District does not spend all the expense budget. The District's preliminary income and expense budget is as follows:

Income Description	Current 2020-2021 Budget	Estimate 2020-2021 EOY	2021-2022 Income Budget	Explanation
Taxes	2,209,152.00	2,110,554.56	2,085,870.24	
Penalties and Interest	15,600.00	16,716.96	15,600.00	
Delinquent Taxes	14,800.00	7,967.36	14,800.00	
North Plains Water CC	42,000.00	42,000.00	42,000.00	
Refunds	5,000.00	116,978.39	5,000.00	
Sale of Assets	5,000.00	0.00	5,000.00	
Fees for District Services	130,000.00	235,813.00	150,000.00	Primarily Permitting
Other Income	16,000.00	119,707.81	16,000.00	Funds moved from Interest and Sinking Account after paying TWDB Loan
TWDB #1734	0.00	18,321.44	0.00	Closed
TWDB Meter/ Equipment Grants	150,000.00	132,478.35	150,000.00	Program funds end December 2021

TWDB Master Irrigator/ICI Grants	250,000.00	242,538.12	250,000.00	Total of $500,000 available plan on spreading over 2 years for 2 MI Courses.
USDA/NRCS Grant	0.00	15,876.41	0.00	Not available at this time
TWDB AGRI Loan Program	0.00	0.00	0.00	Paid Loan in 2020-2021
Investment Income	20,000.00	20,267.53	9,000.00	Lower interest Income
Dallam Co. PGMA fees	70,000.00	83,000.00	70,000.00	Variable
Export Fees	50,000.00	50,424.24	50,000.00	City of Borger (Variable)
Total Income	**2,977,552.00**	**3,212,644.17**	**2,863,270.24**	

Expense Description	Current 2020-2021 Budget	Estimate 2020-2021 EOY	2021-2022 Expense Budget	Explanation
Director's Expense	65,000.00	37,859.37	65,000.00	
Personnel	1,310,000.00	1,290,000.00	1,310,000.00	
Administrative	132,478.95	105,819.58	143,500.00	
Contracted Services	140,100.00	133,599.53	140,000.00	CAD and GMA-1 Costs
Professional Fees	218,000.00	219,380.63	204,000.00	Legislative Year/ Interstate Water Development, General Legal
Tech.,Comm., & Utilities	160,000.00	176,988.56	177,500.00	
Vehicle; Bldg; Field; Supplies	106,000.00	115,248.35	112,000.00	Vehicle, Building Maint., Repair, fuel
Capital Outlay	233,000.00	113,113.81	415,000.00	New Irrigation Well, Production Reporting Software, Monitor Wells, Vehicles
Aquifer Science	30,000.00	29,523.00	78,000.00	USGS/ field data costs/Telemetry
Conservation Outreach	452,000.00	331,110.55	530,000.00	Radio, Meter program, ICI/MI program, etc. Partially funded TWDB Meter & MI Grants
Conservation Demo Project	228,000.00	194,000.85	300,000.00	Irrigation Demonstrations - MI moved to Cons. Outreach
North Plains WCC	10,000.00	10,000.00	10,000.00	Small equipment and repair
Transfer Out	62,273.00	62,273.00	62,205.00	WWC Irrigation Equipment - Principle $62,000 and Interest $273.00
TWDB AGRI Loan Program	912,282.75	912,282.75	0.00	Closed Loan Account
Total Expenses	**4,059,134.70**	**3,731,199.98**	**3,547,205.00**	
Total Net Income/Expenses	**-1,081,582.70**	**-518,555.81**	**-683,934.76**	

The anticipated funding sources to pay the District's mission include Grants and Outside Assistance, 14%, Taxes and PGMA Fees – 76%, other regulatory, export, WCC and investment income – 10 percent. The table below shows the funding sources and amounts.

2021-2022 Funding Sources	2021-2022 Amount Same Tax collection	Total Percent Funds
Grants and Outside Assistance	400,000.00	14%
Taxes - PGMA Fees	2,186,270.24	76%
Other regulatory, Export, WCC & investment Income	277,000.00	10%
Subtotal	**2,863,270.24**	100%
Funds from Reserves		
District Reserves (Additional)	683,934.76	
Net Income, Reserves & Expenses	**0.00**	
2021-2022 Fiscal Year End District Reserves	**$2,157,518.21**	

The Finance Committee and the Agriculture Committee have not met regarding this recommended budget. The Board may either wait for input from those committees and propose a budget in August that will need to be adopted in September, or the Board may propose the budget and elect to amend the proposed budget or adopt the proposed budget in August.

The General Manager recommended that the Board propose an expense budget as follows:

Budget Item	***Amount***
Director's Expense	65,000.00
Personnel	1,310,000.00
Administrative	143,500.00
Contracted Service s	140,000.00
Professional Fees	204,000.00
Tech., Comm., & Utilities	177,500.00
Vehicle; Bldg.; Field; Supplies	112,000.00
Capital Outlay	415,000.00
Aquifer Science	78,000.00
Conservation Outreach	530,000.00
Conservation Demo Project	300,000.00
North Plains WCC	10,000.00
Transfer Out	62,205.00
Total Expenses	***3,547,205.00***

Mark Howard moved that the Board propose the budget as presented for the District's 2021-2022 fiscal year and amend the budget in August, if necessary, based upon the Agriculture and Finance Committee's additional input. Harold Grall seconded the motion and it was unanimously approved by the Board.

Action Agenda 3.d. - Receive Quarterly Public Funds Investment Report ending March 31, 2021.

The General Manager presented the following report to the Board:

This quarterly investment report for the period from January 1, 2021, through March 31, 2021, reflects the North Plains Groundwater Conservation District investment transactions for all District funds subject to the District's Public Funds Investment Policy.

The report describes in detail the District's investment position as of March 31, 2021; states the maturity date of each separately invested asset that has a maturity date; and states the compliance of the investment portfolio of the District with the investment strategy expressed in the District's investment policy; and relevant provisions of Public Funds Investment Act, Chapter 2256, Texas Government Code (the "Act").

Standard of Care

The Board directs that public funds investments shall be made with judgment and care, under prevailing circumstances, that a person of prudence, discretion, and intelligence would exercise in the management of the person's own affairs, not for speculation, but for investment, considering the probable safety of capital and the probable income to be derived. The order of investment priorities are as follows:

- Preservation and safety of principal.
- Liquidity, and
- Yield.

In determining whether an investment officer has exercised prudence with respect to an investment decision, the determination shall be made taking into consideration the investment of all funds, or funds under the District's control, over which the officer had responsibility rather than a consideration as to the prudence of a single investment; and whether the investment decision was consistent with the District's written investment policy.

Investments

The District may invest in obligations of, or guaranteed by, governmental entities as provided in Section 2256.009(a) of the Act. The District's Board has authorized Perryton National Bank (PNB) as its primary depository and First State Bank as secondary depository as follows:

Bank Accounts	Account Name	Account Number	March 31, 2021	Interest Rate
Perryton National Bank	Main Account	337	$1,945,945.08	0.01%
Perryton National Bank	Default Reserve	116	$11,225.00	Non-Interest Bearing
Perryton National Bank	Interest & Sinking	256	$100.00	Non-Interest Bearing
First State Bank	Late Filer Fees	9005805	$100.00	Non-Interest Bearing
Perryton National Bank	Ag Loan - Interest & Sinking	531	$100.00	Non-Interest Bearing
Perryton National Bank	Ag Loan - Default Reserve	566	$108,059.00	Non-Interest Bearing
Perryton National Bank	Ag Loan - Main	515	$ 100.00	Non-Interest Bearing

Perryton National Bank is the District's primary financial institution that provides the District's main operating account. The main operating account and CDs at Perryton National Bank exceeds the FDIC insurance coverage so the bank pledges funds that are secured by securities more than FDIC insurance for all District funds deposited with the bank. The District is currently holding 3 pledged securities with an original face value of $3,680,000. On March 12, 2021, the District discontinued its irrigation loan program with the Texas Water Development Board. The District paid $912,282.75 representing the principal and interest from the Perryton National Bank Main Account. The Default Reserve Account, the Interest & Sinking Account, the Ag Loan Interest & Sinking Account, the Ag Loan Default Reserve Account and the Ag Loan- Main Account are non-interest-bearing accounts used to service Texas Water Development Board Loans for Water Conservation Center agriculture equipment construction and Ag Loans for Equipment to qualified agriculture growers. By contract these accounts are required to be non- interest bearing. The District holds $230.02 in petty cash at its offices. The First State Bank Account is used by the District to secure funds of well owners that filed their production reports late. The District did not collect fees from late filers in 2020 because of the Pandemic. On February 19, 2021, the general manager swept the account of all funds remaining from 2019 except for $100 into the Perryton National Bank Main Account. Funds in the account collected from 2020 production report late filers will be refunded to the late filers if they turn in their 2021 Production Report by January 15, 2022. Afterward, all remaining funds are swept from the account and are deposited in the District's operating account at Perryton National Bank.

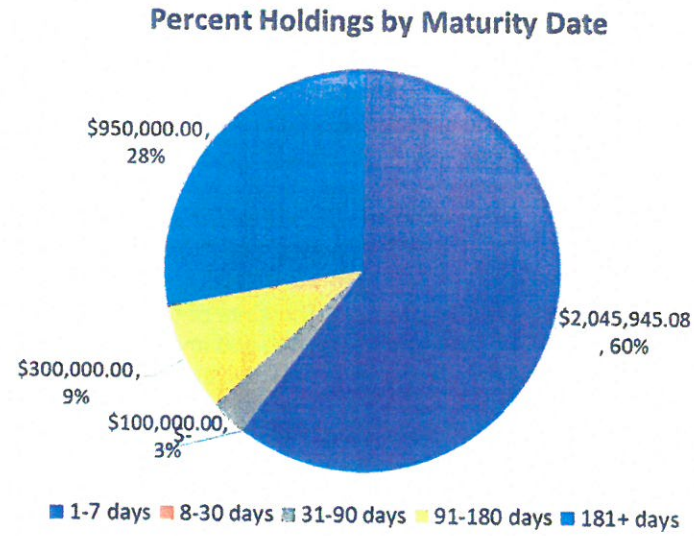
The District primarily secures its funds in certificate of deposits (CDs) issued by a state or national bank domiciled in Texas, a savings and loan association domiciled in Texas and is guaranteed or insured by the Federal Deposit Insurance Corporation (FDIC) or its successor. The maximum allowable maturity of any authorized investment is two (2) years. The District's Board has approved a list of depositories for the District to purchase CDs.

All interest from the CDs are paid by check to the District and deposited into the District's Perryton National Bank main operating account. On March 31, 2021, the District has funds in its Perryton National Bank Main Account which renews daily and one CD that is set to renew within 1 - 7 days, one CD set to mature between 31-90 days, three CDs set to renew within between 91-180 days, and six CDs set to mature after 180 days. The largest amount of the District's investments is held in both the main operating account and certificates of deposit (CD). The District has no investment set to renew from 8-30 days. A summary of District funds by dollar amount, number of days until maturity, and weighted average maturity (WAM) is as follows:

Security Description	Investment Amount	Mat. in Days (DTM)	WAM
Perryton National Bank Main Account	$1,945,945.08	1	0.57
First Bank Southwest CD 10000222	$100,000.00	91	2.68
First State Bank - Spearman CD 45152	$150,000.00	298	13.16
Dalhart Federal Savings & Loan CD 602- 609183-3	$150,000.00	322	14.22
Happy State Bank CD 11297	$150,000.00	321	14.18
Western State Bank CD 20855	$250,000.00	324	23.85
First State Bank CD 21046	$100,000.00	3	0.09
Dalhart Federal Savings & Loan CD 602- 608808-8	$100,000.00	33	0.97
Happy State Bank CD 12046	$100,000.00	129	3.80
Perryton National Bank CD 21457	$100,000.00	145	4.27
First National Bank CD 82875	$100,000.00	291	8.57
Interstate Bank SSB CD 9361-13004190	$150,000.00	726	32.07
Total	**$3,395,945.08**		**118.43**

The Default Reserve Account, the Interest & Sinking Account, the Ag Loan Interest & Sinking Account, the Ag Loan Default Reserve Account, the Ag Loan- Main Account and the First State Bank Late Filer Fees Account are non-interest-bearing accounts and are not included in this analysis. The WAM is used to illustrate the average amount of days it takes District investments to mature. The Perryton National Bank Account is the main operating account used by the District. Funds within this account are available within one day and are shown in the 1-7- day maturity date in the pie chart below. The District is currently operating on a 118.43-day WAM.

The following pie chart shows a snapshot of what percent of District's money is being held in longer investments versus money on hand. Sixty percent of the District's investments are held in the main operating account and one CD with less than eight days maturity, whereas twenty- eight percent of the District's investments are held in CDs with a maturity date of over 180 days. The final three pieces of the pie are investments that are held for a period of 31-90 days, and 91-180 days. The highest interest rates the District receives on CD's is 1.00 percent. The pie chart representing the percent of holdings in investments based on the days to maturity is as follows:



As of March 31, 2021 (last trading day of month), the US Department of Treasury Yield Curve Rates for one month is 0.01 percent and the one year is 0.07 percent. Treasury Yield Curve Rates are commonly referred to as "Constant Maturity Treasury" rates, or CMTs. Yields are interpolated by the Treasury from the daily yield curve. This curve, which relates the yield on a security to its time to maturity is based on the closing market bid yields on actively traded Treasury securities in the over-the-counter market. These market yields are calculated from composites of indicative, bid-side market quotations (not actual transactions) obtained by the Federal Reserve Bank of New York at or near 3:30 PM each trading day.

District Loan Obligations

The District entered into two loan agreements with the Texas Water Development Board. The first loan agreement (TWDB Account# 21743) was executed in October 2014 for $620,000.00 to equip the North Plains Water Conservation Center. The loan is for ten years with an 0.11 percent annual fixed interest rate. Three years are remaining on the loan. The remaining loan amount as of March 31, 2021, and the remaining number of payments are as follows:

Loan	Account #	March 31, 2021	Notes
TWDB	21743	$186,000.00	3 annual payments + 0.11% interest

The schedule of loan payments including interest is as follows:

Amount	Year
62,205	2022
62,136	2023
62,068	2024

The second loan agreement (TWDB Account # 21781) was executed in November 2019 for $1,000,000.00 to loan agriculture producers' funds to update existing irrigation systems for conservation and efficiency purposes. The loan was for ten years with a 1.59 percent annual fixed interest rate. The Board elected to add an additional 1% interest rate to loan amounts to producers to cover District costs for administering the program. The Board authorized repaying the loan in full and discontinuing the program at this time due to lack of interest. On March 12, 2021, the District discontinued its irrigation loan program with the Texas Water Development Board. The District paid $912,282.75 representing the principal and interest from the Perryton National Bank Main Account.

The General Manager recommended that the Board accept the quarterly public funds investment report ending March 31, 2021.

Gene Born moved to accept the quarterly public fund investment report ending March 31, 2021. Mark Howard seconded the motion and it was unanimously approved by the Board.

Action Agenda 3.e. - ***Review and consider approval of District Public Funds Investment Policy.***

The General Manager stated that the Board of Directors of the North Plains Groundwater Conservation District ("District") may purchase, sell and invest its funds under its control in investments authorized under the Public Funds Investment Act, Chapter 2256, Texas Government Code, as amended (the "Act") in compliance with investment policies approved by the Board and according to the standard of care set forth in its Policy. The District's Board must periodically review its Investment Policy.

The General Manager and General Counsel proposed revisions to the policy as follows:

- Authorized Investments – Add new paragraph (C.) to include the District's interest- bearing checking account.
- Collateral Policy – Cleanup and clarify the policy.
- Investment Training – Since the Board must specifically authorize independent sources for training add the following organizations as specifically authorized as independent sources for training:
    - Texas Alliance of Groundwater Districts;
    - Texas Water Conservation Association;
    - Association of Water Board Directors;
    - University of North Texas, Center for Public Management; and,
    - William P. Hobby Center for Public Service at Texas State University.

A redlined-version and a clean-version of the proposed Public Funds Investment Policy were presented to the Board for review and commentary.

The General Manager and General Counsel recommended that the Board adopt the public funds investment policy as presented.

Gene Born moved to adopt the public fund investment policy presented to the Board. Harold Grall seconded the motion and it was unanimously approved by the Board.

Action Agenda 3.g. - ***Review and consider the proposed summary of the hearing, relevant comments received during the comment period, any suggested revisions to the proposed Desired Future Conditions, and the basis for the revisions to be submitted at the next Groundwater Management Area 1 Joint Planning meeting.***

The General Manager reported that on March 18, 2021, Groundwater Management Area 1 ("GMA 1") district representatives voted to approve the proposed Desired Future Conditions (DFCs). These proposed DFCs were mailed to each of the districts in GMA 1 on March 29, 2021, triggering a 90-day public comment period. Public comments could be submitted in writing to the District at any time during this period or may be made orally at a hearing within the District.

The following proposed DFCs approved by the district representatives of GMA 1 are described in terms of acceptable drawdown levels for each subdivision of the Ogallala Aquifer (Inclusive of the Rita Blanca Aquifer) and the Dockum Aquifer:

Ogallala (Inclusive of 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, Hutchinson, 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; and,
- 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 in Potter Counties.

Dockum Aquifer:

- At least 40 percent of the average available drawdown remaining for each 50-year period between 2018 and 2080 for 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; and
- 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.

Any person who desired to appear at the hearing and present comment or other information on the proposed DFCs could do so in person, by counsel, or both. Comments could be presented verbally or in written form.

Copies of the proposed DFCs could be requested by email at swalthour@northplainsgcd.org are available at www.NorthPlainsgcd.org and www.PanhandleWater.org; and may be reviewed or copied at the North Plains Groundwater Conservation District, 603 East 1st Street, Dumas, Texas. Any person who wished to receive more detailed information on this notice or the proposed DFCs should contact Steve Walthour, General Manager.

The District's Board selected a hearing date for June 1, 2021, in accordance with TWC Section 36.63 and the District's Rules. The notice of the public hearing was also posted on the District's website and in the District's offices at 603 East 1st. Street, Dumas, Texas.

The District held a public hearing regarding the District's intent to adopt proposed DFCs on June 1, 2021, at 9:00 a.m. at the North Plains Water Conservation Center, 6045 County Road E., Dumas, Texas. The District's General Manager provided a PowerPoint presentation at the hearing regarding the DFC process and procedures. The District had the hearing audio recorded.

The District received no relevant comments from the public during the hearing. No written comments, questions, or requests for additional information concerning the adoption of the proposed DFCs were submitted to the District by the close of the comment period on June 28, 2021.

A proposed summary report was prepared by the General Manager and submitted to the Board for its review. Mr. Walthour stated that the proposed summary is provided for the Board's review and consideration. The summary may be amended as the Board wishes.

Harold Grall moved to approve the summary report presented to the Board by the General Manager. Mark Howard seconded the motion and it was unanimously approved by the Board.

Action Agenda 3.h. - ***Receive North Plains Hydrology and Groundwater Resources Report 2020-2021.***

Dale Hallmark presented the annual Hydrology and Groundwater Resources 2020-2021 report to the Board. The reports contained information about the regional conditions of the District's groundwater resources. It also included sections on annual groundwater pumping, depth to water, declines, saturated aquifer material and contained a groundwater production - GAM comparison. It also included maps for each county of the District indicating depth to water, declines and saturated aquifer material.

Action Agenda 3.i. - ***Receive report regarding Region A Water Planning meeting and development of new water supplies.***

The General Manager reported that Region A Water Planning Group met at the Panhandle Regional Planning Commission in person and by video conferencing on June 29th in Amarillo. Friese and Nichols, Intera, and Texas A&M AgriLife led by Dr. Stephen Amosson were selected to be the primary and secondary contractors in the new planning cycle. C.E. Williams indicated that he would not be seeking a new term regarding the planning. Mr. Williams had served as chairman of the group since its inception several planning cycles ago.

Ben Weinheimer was elected to Chairman, Judge Vernon Cook - Vice Chairman, David Landis – Secretary, Janet Guthrie – Treasurer and Steve Walthour, as member of the Executive Committee and Agriculture Committee Chairman.

Steve Walthour presented Missouri River Transfer Project to Mitigate Flooding and Protect the Six-State Ogallala-High Plains Regional Socio-Economic Viability as an opportunity for coordination between Region A and Region O during the upcoming planning session. Mr. Walthour made the presentation after Jeff Walker, Executive Director, Texas Water Development Board encouraged him to approach Region O, as well, with this concept.

Region A voted to hold a joint session with Region O to further discuss this issue as a possible point of cooperation. A copy of the presentation was presented to the Board.

Action Agenda 3.f. - ***Review and consider approval of District's depository institutions.***

The General Manager presented the following report to the Board:

Annually, the District's Board must review the terms and conditions of each banking or depository relationship with the District to confirm compliance with this Investment Policy and assure that each such banking or depository relationship is in the best interests of the District.

Texas Water Code § 36.155 requires the Board to name one or more banks to serve as depository for the District funds. The General Manager, the District's Finance and Investment Officer, can only invest District funds in financial institutions approved by the Board. Currently the District uses Perryton National Bank (PNB) as its primary depository and secondary depositories including certificate of deposits (CDs) as follows:

NAME OF BANK	City	Relationship	Insured Max Amount	Current Amount Deposited
Dalhart Federal Savings & Loan	Dalhart	CD	$250,000.00	$250,000.00
First Bank Southwest	Perryton	CD	$250,000.00	$100,000.00
First National Bank	Spearman	CD	$250,000.00	$100,000.00
First State Bank	Dumas	Secondary Account and CD	$250,000.00	Late Fees $2,500.00 CD $100,000.00
First State Bank - Spearman	Spearman	CD	$250,000.00	$150,000.00
Happy State Bank	Dumas	CD	$250,000.00	$250,000.00
Interstate Bank	Perryton	CD	$250,000.00	$150,000.00
Perryton National Bank	Perryton	Primary Operating Account and CD	$250,000 plus $2,000,000 pledged securities	Operating $1,714,374.92 CD $100,000.00
Western State Bank	Gruver	CD	$250,000.00	$250,000.00

The General Manager recommended that the Board approve the primary depository and secondary depositories as identified above.

Daniel L. Krienke moved that the Board approve Perryton National Bank (PNB) as the District's primary depository and the following as secondary depositories of the District:

NAME OF BANK	City	Relationship
Dalhart Federal Savings & Loan	Dalhart	CD
First Bank Southwest	Perryton	CD
First National Bank	Spearman	CD
First State Bank	Dumas	Secondary Account and CD
First State Bank - Spearman	Spearman	CD
Happy State Bank	Dumas	CD
Interstate Bank	Perryton	CD
Perryton National Bank	Perryton	Primary Operating Account and CD
Western State Bank	Gruver	CD

Mark Howard seconded the motion and it was unanimously approved by the Board.

Action Agenda 3.k. - ***Receive report and consider action regarding compliance and contested matters before the District.***

The General Manager stated that there were no compliance and contested matters for discussion with the Board at the meeting.

Action Agenda 3.l. - ***Executive Session - Section 551.071 of the Texas Government Code.***

At 11:07 a.m., Harold Grall moved to go into Executive Session in compliance with the Texas Open Meetings Act, Chapter 551 of the Texas Government Code, §551.071, to obtain legal advice on matters in which the duty of the attorney to the governmental body under the Texas Disciplinary Rules of Professional Conduct of the State Bar of Texas conflicts with Chapter 551. Justin Crownover seconded the motion and it was unanimously approved by the Board.

Executive Session: At 11:10 a.m., the Board went into Executive Session. The Executive Session was recessed at 11:44 a.m. for lunch and reconvened at 12:31 p.m. At 1:10 p.m., Justin Crownover moved that the Board reconvene into regular session. Zac Yoder seconded the motion and it was unanimously approved by the Board. The Board reconvened into regular session at 1:12 p.m.

Discussion Agenda 5.- Discuss Items for Future Board Meeting Agendas and Set Next Meeting Date and Time.

By consensus, the Board set its next regular Board meeting in person on August 10, 2021.

Action Agenda 4.a. - District Director Reports regarding meetings and/or seminars attended, weather conditions and economic development in each Director's precinct.

District Director reports were presented to the Board regarding meetings and/or seminars attended, weather conditions and economic development in each Director's precinct.

Discussion Agenda 4.c. - General Manager's Report.

Steve Walthour presented a report to the Board, which included the General Manager's activity summary, the District's activity summary, permits issued by the District in May through June, 2021, post-drill well inspections as of June 25, 2021, and upcoming meetings and conferences.

Discussion Agenda 4.b. - Committee Reports.

No Committee reports were presented to the Board.

Agenda 6. - Adjournment.

There being no further business to come before the meeting, Justin Crownover moved to adjourn the meeting. Mark Howard seconded the motion and it was unanimously approved. President Zimmer adjourned the meeting at 1:24 p.m.

Bob B. Zimmer, President

Zac Yoder, Secretary