Groundwater Use Planning Strategies and Best Management Practices for Drought Scenarios, Val Verde County, Texas

Groundwater Management Report 23-01

Special Report to the Texas Legislature

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Texas Water Development Board

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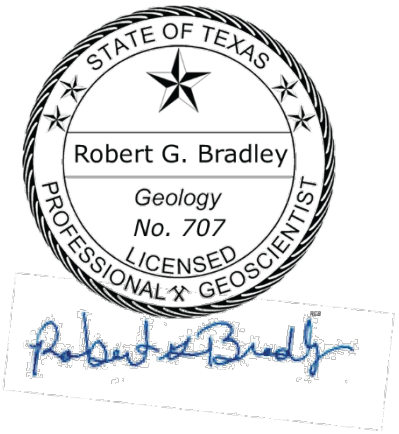

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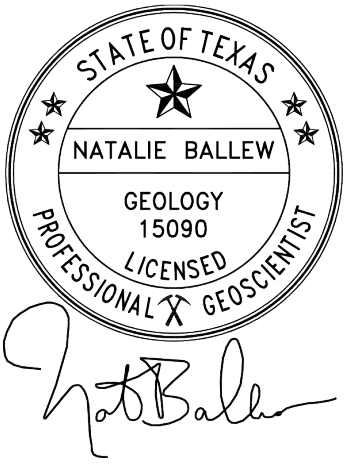

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Executive Summary

The hydrological landscape in Val Verde County is unique and complex. Groundwater and surface water resources are intimately connected, sensitive wildlife species are dependent on groundwater flows supporting streamflow, and potential future groundwater development is on the horizon. Establishing a better understanding of the resources and setting management goals that address the interests of a broad group of stakeholders is critical to effective groundwater management in the county.

In 2018, the TWDB completed the *Overview of Groundwater Conditions in Val Verde County, Texas* report (Weinberg and others, 2018) to provide an overview and an assessment of the feasibility of employing hydrologic triggers to manage the Edwards-Trinity (Plateau) Aquifer. Article 6, Rider 25 of the 2021 General Appropriations Act tasked the TWDB to use the 2018 report (Weinberg and others, 2018) to identify possible groundwater planning strategies, including, and prioritizing, best management practices for drought scenarios.

Informed decisions begin with data. Accurate, available data form the foundation of groundwater management decision-making. Refined groundwater monitoring and filling data gaps for key factors, such as groundwater-surface water interactions, aquifer storage, and recharge, will go a long way to inform effective groundwater management in Val Verde County.

Suggesting groundwater management strategies, particularly for drought periods, in an area without a groundwater conservation district is difficult without an entity to incorporate stakeholder interests and monitor implementation and compliance. In identifying possible groundwater use planning strategies, the TWDB investigated groundwater management in areas with similar springs, geology, and species protection issues to provide background and examples for potential groundwater management strategies in Val Verde County. These examples may be applied to the proposed groundwater management zones from Weinberg and others (2018; Figure ES-1).

The recommendations and information included in both Weinberg and others (2018) and in this report can be used to guide groundwater management efforts by Val Verde County, the City of Del Rio, any future groundwater conservation district, and any other entities involved in groundwater-related decision making. The TWDB proposes the following recommendations:

Education and outreach

Education and outreach are important aspects of any groundwater management plan, within a city or in more rural areas.

- Develop a county-wide drought and water awareness campaign. The Texas Water Foundation's statewide campaign, Texas Runs on Water (Texas Water Foundation, 2023)

may be an effective campaign to pursue because it can be localized to specific communities and combined with local interests.

- Set up a web-based drought portal to improve knowledge of groundwater drought conditions, including citizen-based reporting of groundwater levels and drought conditions and providing education about water wells during drought conditions. This could include the creation of indices to show the occurrence of groundwater drought. An initial web-based portal could include links to existing resources, such as the TWDB Water Data for Texas drought and groundwater dashboards and the U.S. Geological Survey National Water Data Dashboard.
- Provide rural well owners with educational opportunities, such as those offered through the Texas Well Owner Network, with an emphasis on conservation and drought.

Data and research

As noted in this report and in Weinberg and others (2018), more detailed hydrogeological assessments are needed to support groundwater management objectives.

- Consider a technical advisory workgroup composed of stakeholders actively engaged in data collection and research in Val Verde County.
- Fill data gaps for key factors, such as groundwater-surface water interactions, aquifer storage, and recharge.
- Establish a representative groundwater monitoring network of at least 25 to 30 wells equipped with instruments to provide daily water level measurements.
- Monitor groundwater production. Val Verde County, the City of Del Rio and others may monitor water levels and establish a voluntary water well metering and reporting program to inform estimates of groundwater production in the absence of a groundwater conservation district. Voluntary water well metering may be used to establish historic use for permitting by any future groundwater conservation district.
- Further refine proposed management zones (Figure ES-1) based on data and research initiatives.

Groundwater management and planning

- Val Verde County, the City of Del Rio, and others may consider preparing groundwater management strategies consistent with groundwater management plan goals required by Texas Water Code Chapter 36 requirements for groundwater conservation district management plans.
- Val Verde County may consider requiring groundwater availability certifications for subdivisions (Local Government Code § 232.0032). The City of Del Rio already requires these certifications under authority granted by Local Government Code § 212.0101.

Information from these groundwater availability studies can be another source of data collection for the groundwater resources in the county.

- Val Verde County, the City of Del Rio, and other interested parties would benefit from participating in Groundwater Management Area 7 activities. Providing funding and input to the joint groundwater planning process would ensure that conditions adopted by the district members include consideration of groundwater concerns for Val Verde County.
- Utilize the proposed groundwater management zones (Figure ES-1) as a starting point to improve groundwater data collection and cooperation to support future groundwater management, whether by a groundwater conservation district or other existing entity.

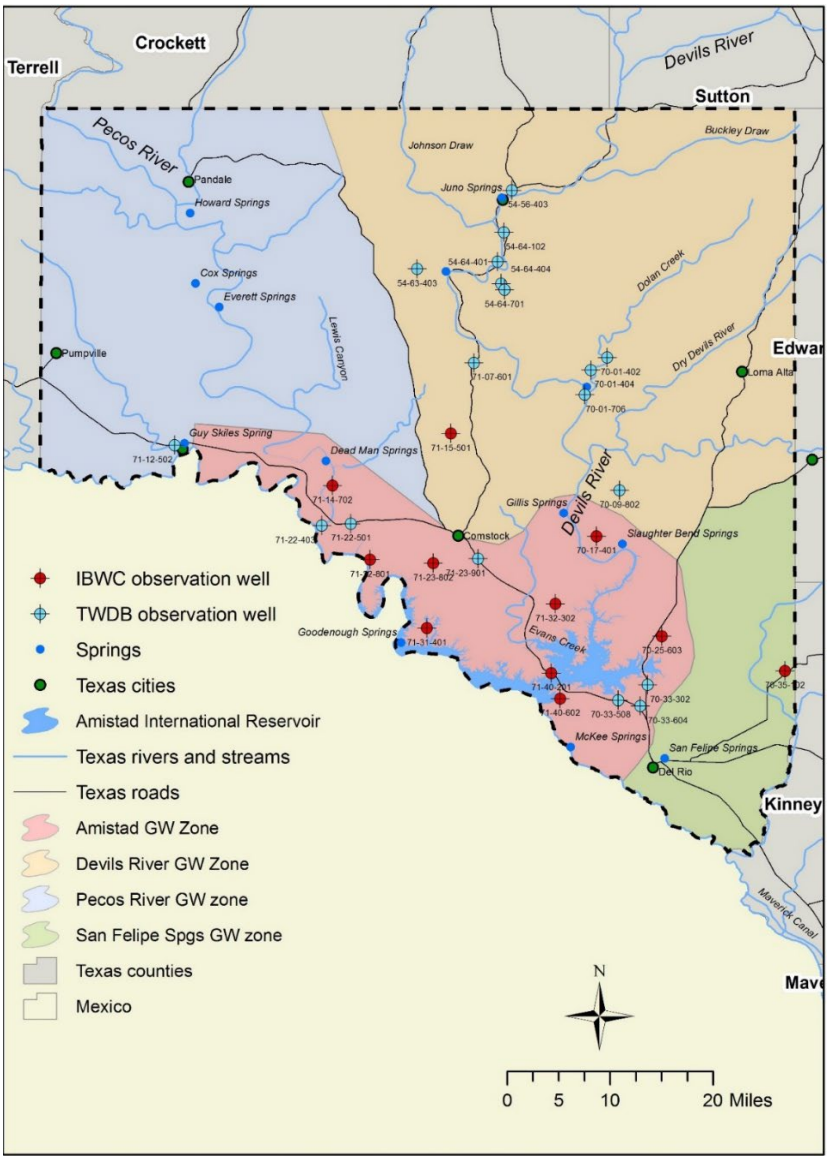


Figure ES-1. Map of possible groundwater management zones for Val Verde County (from Weinberg and others, 2018).

1 Introduction

Val Verde County is located at the southwestern edge of the Edwards Plateau in Texas. Groundwater is the main source of water supply for municipal, domestic, and livestock uses in the county. Most water wells in the county are completed in the Edwards-Trinity (Plateau) Aquifer, a major aquifer in Texas extending throughout much of Central Texas. Val Verde County is an area of regional groundwater discharge and has numerous springs, including several of the largest in Texas. These springs, such as San Felipe Springs, supply surface water for the City of Del Rio, sustain baseflow in San Felipe Creek and the Devils River, contribute flow in the Lower Rio Grande, and help to maintain ecosystems for several threatened and endangered species.

In 2018, the Texas Water Development Board (TWDB) completed a comprehensive overview of the hydrogeology of Val Verde County in cooperation with the Texas Commission on Environmental Quality and the Texas Parks and Wildlife Department (Weinberg and others, 2018). Using the information and recommendations from the 2018 TWDB report, this report primarily focuses on the groundwater planning and management landscape in Val Verde County, possible groundwater use planning strategies, and best management practices for drought scenarios in the county, as required by legislative intent.

While groundwater development in Val Verde County has been limited to date, the possibility of future groundwater development has raised questions regarding groundwater-surface water relationships, groundwater management, and possible impacts to streams supporting threatened or endangered species.

Groundwater conservation districts in Texas are the state's preferred method of groundwater management (TWC § 36.10015). They are enabled with authority provided under Chapter 36 of the Texas Water Code and are empowered to regulate water well spacing and groundwater production to manage groundwater resources (TWC § 36.101). There have been several unsuccessful efforts in the last decade to establish a groundwater conservation district in Val Verde County to manage local groundwater production.

In 2018, the TWDB completed the *Overview of Groundwater Conditions in Val Verde County, Texas* report (Weinberg and others, 2018) to provide an overview and an assessment of the feasibility of employing hydrologic triggers to manage the Edwards-Trinity (Plateau) Aquifer. Article 6, Rider 25 of the 2021 General Appropriations Act tasked the TWDB to use the 2018 report (Weinberg and others, 2018) to identify possible groundwater planning strategies, including, and prioritizing, best management practices for drought scenarios. The act further stated that "The Board, the Texas Parks and Wildlife Department, or the board of a groundwater conservation district in the county may use the comprehensive 2018 study to develop guidelines or standards for groundwater use in the district or other district or management area under the

Board's jurisdiction. The Board may adopt rules to carry out the provisions described herein." This report only includes groundwater planning strategies and does not provide standards for groundwater use. Recommendations included in this report may be used in the future to inform such standards.

1.1 Scope of study

This report includes a summary of groundwater conditions in Val Verde County, including summaries and excerpts from Weinberg and others (2018) and groundwater data collection and modeling efforts in the area. However, this report focuses primarily on water planning and groundwater management in the context of Val Verde County and identifying possible groundwater use planning strategies and best management practices for drought scenarios.

When identifying possible groundwater use planning strategies, the TWDB referenced management goals and practices from existing groundwater conservation districts throughout Texas that may be applicable to address groundwater concerns in Val Verde County. Informed decisions begin with data. Accurate, available data form the foundation of groundwater management decision-making. Refined groundwater monitoring and filling data gaps for key factors, such as groundwater-surface water interactions, aquifer storage, and recharge, will go a long way to inform effective groundwater management in Val Verde County.

2 Groundwater conditions in Val Verde County

In 2018, the TWDB completed the *Overview of Groundwater Conditions in Val Verde County, Texas* report (Weinberg and others, 2018), which compiled and analyzed scientific and technical data on the groundwater and related natural resources in the county. This section provides a brief synopsis of the groundwater conditions in Val Verde County, as reported in the 2018 TWDB report, and includes any general updates regarding current research initiatives since the previous report. For more detailed information on groundwater conditions in Val Verde County, please refer to the previous report.

2.1 Location

Val Verde County is in southwestern Texas, bordered by Terrell, Crockett, Sutton, Edwards, and Kinney counties, and the state of Coahuila in Mexico. The county's southern boundary is the Rio Grande. It covers an area of 3,145 square miles, or 2,085,760 acres, and had a population of 47,586 at the time of the 2020 census. Nearly 75 percent of the county's population lives in the City of Del Rio, located in the southeastern corner of the county (Figure 2-1).

Val Verde County is situated at the southwestern margin of the Edwards Plateau, "a resistant carbonate upland of nearly flat-lying limestone and dolostone, typically veneered with loose, thin soils. Caprock mesas, broad alluvial fans, and dry arroyos are the most prominent features" (Barker, Bush, and Baker 1994). The southwestern corner of the county, west of the Pecos River, is the easternmost part of the Trans-Pecos region, while the southeastern corner of the county is the northwestern-most part of the Gulf coastal plain. Geography is a major factor in water availability and water use. Topography, climate, soils, vegetation, and land use affect runoff and groundwater recharge, while habitat requirements for sensitive wildlife populations can influence water resource planning and management.

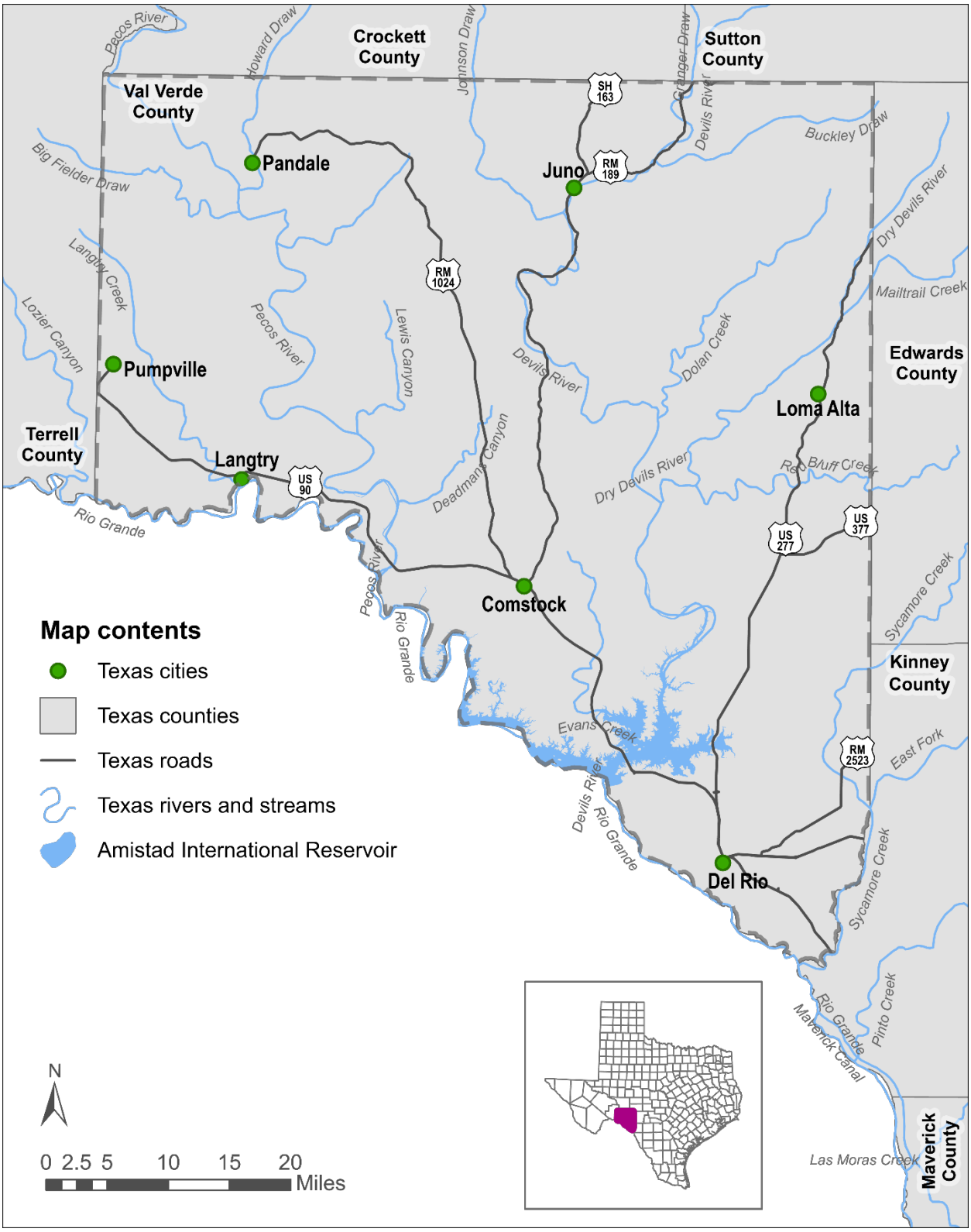


Figure 2-1. Map of Val Verde County, Texas.

2.2 Groundwater resources

The main source of groundwater in Val Verde County is the Edwards-Trinity (Plateau) Aquifer, a major aquifer extending across much of the southwestern part of the state. The water-bearing units are mainly limestones and dolomites of the Edwards Group, with a few wells screened in the underlying Trinity Group limestone and sands. The occurrence and movement of groundwater may be strongly influenced by cavities and conduits in the southern part of the county where small normal faults and joints are common.

Groundwater is found at depths ranging from a few feet below ground surface along major waterways and near springs to several hundred feet below ground surface at higher elevations and between drainage systems. Well yields vary from less than one gallon per minute to over 2,000 gallons per minute. Groundwater quality is generally good but is typically hard because of its mineral contents, and there are areas where some wells have encountered brackish groundwater.

2.2.1 Water levels

Weinberg and others (2018) found that groundwater elevations in most Val Verde County wells completed in the Edwards Group of the Edwards-Trinity (Plateau) Aquifer mostly show no increasing or decreasing trends over time However, there can be significant deviation from the trends depending on wet or dry climatic periods. Hydrographs of water level measurements in wells with at least 10 years of data (reported and depicted in Weinberg and others, 2018, p. 33) mostly show stable trends over time. However, water levels in wells near Amistad Reservoir show an increase as much as 100 feet between 1968 and 1977 as the effect of Amistad Reservoir filling propagated through the hydrological system (Weinberg and others, 2018, p. 34). Several wells in other parts of the county show a decreasing trend since about 2011, which could represent the effects of the drought that began in that year or the effects of increased local pumping in response to the drought. Water levels in parts of the county outside the area influenced by Amistad Reservoir are very consistent over the period of record and do not exhibit any long-term decline in response to pumping or reduced recharge.

Weinberg and others (2018, p. 30) developed an interpolated groundwater elevation map based on the average of wintertime (non-pumping) water level measurements in TWDB Groundwater Database wells listed as completed in the Edwards Group or Edwards and associated limestones (Figure 2-2). Measurement dates range from 1937 to 2015, and thus represent long-term average groundwater conditions. To the extent that groundwater levels in Val Verde County have changed over time, these contours may not accurately represent current conditions.

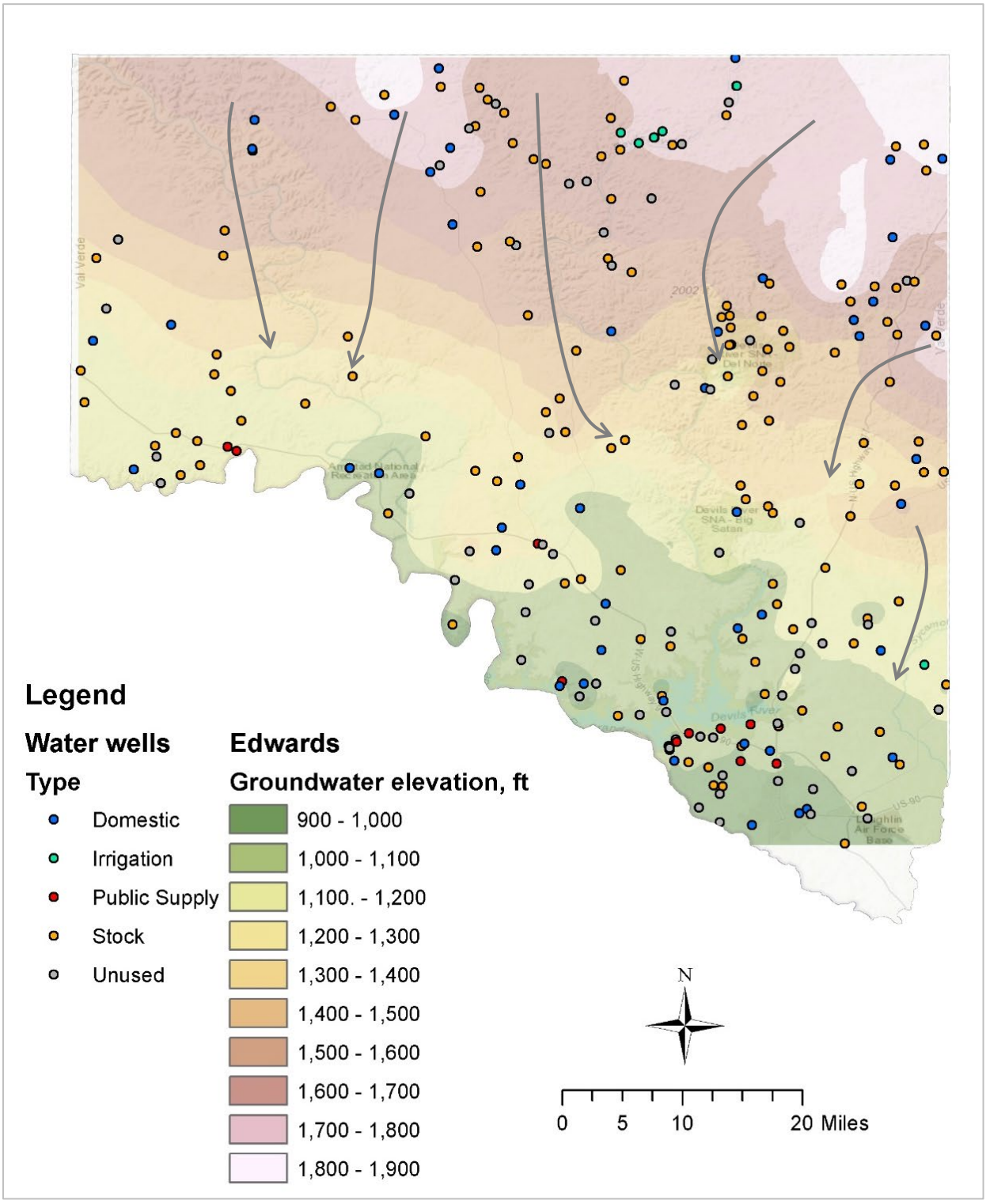


Figure 2-2. **Water level contour map constructed from average winter water levels (1937 to 2015) in wells completed in the Edwards Group of the Edwards-Trinity (Plateau) Aquifer. Arrows indicate general flow paths (from Weinberg and others, 2018).**

2.2.2 Water quality

Water quality is good in most wells completed in the Edwards Group of the Edwards-Trinity (Plateau) Aquifer and is typically suitable for all municipal, agricultural, and industrial uses. Weinberg and others (2018) assessed water quality data in Val Verde County and found the groundwater to be a calcium bicarbonate type with near neutral pH and low total dissolved solids content. The groundwater is typically hard and is saturated with respect to calcite. Several wells in Val Verde County produce brackish groundwater, characterized by total dissolved solids content exceeding 1,000 milligrams per liter. The brackish wells are mostly in the Del Rio area but also occur in other parts of the country.

2.2.3 Groundwater recharge

Natural recharge to the Edwards-Trinity (Plateau) Aquifer occurs as diffuse recharge from precipitation over the aquifer outcrop, direct recharge from surface runoff into sinkholes, and direct recharge from losses along intermittent streams and normally dry draws. Since evaporation losses significantly exceed average precipitation, recharge tends to occur only where fractures and joints allow water to rapidly percolate down past the root zone or where surface runoff collects.

Estimates of recharge to the Edwards-Trinity (Plateau) Aquifer vary widely, reflecting geographic trends in rainfall and differences in the methods and assumptions used to estimate recharge. Weinberg and others (2018) details how published recharge estimates fluctuate. Such variability introduces significant uncertainties in the Val Verde County groundwater budget. The amount of recharge entering the aquifer system plays a major role in long-term groundwater availability.

The TWDB recently contracted a study to develop estimates of recharge and groundwater-surface water interactions for the aquifers of Central and West Texas, including the Edwards-Trinity (Plateau) Aquifer (WSP, 2022). This study compared models and techniques for estimating recharge by comparing the application of the Soil Water Balance model, Soil and Water Assessment Tool, and the Soil Conservation Services method. The groundwater availability model for the Edwards Plateau regional aquifers, which is currently in development at the TWDB and includes Val Verde County, will include recharge distribution based on the findings of this study.

2.2.4 Groundwater flow

Groundwater flow patterns in karst aquifers are particularly challenging to determine on regional and local scales. In the larger, county-scale context, groundwater in the Edwards Group of the Edwards-Trinity (Plateau) Aquifer in Val Verde County generally flows from north to south and discharges to springs and creeks draining to the Rio Grande, generally following the surface topography in the area. However, on smaller, basin-level scales, groundwater flow directions can deviate significantly from those general patterns.

Weinberg and others (2018) found that available data suggest that the groundwater flow system in conduits is poorly connected to the limestone rock matrix. The conduit system is largely recharged separately from the aquifer matrix and there is limited mixing between the two systems. Conduits are primarily recharged by runoff that is concentrated along the surface drainage system and enters the aquifer through large openings, such as sinkholes and solution-enlarged fractures. The limestone rock matrix is recharged by precipitation percolating through soils and smaller fractures. Because the flow through the rock matrix is much slower than in the conduit system, groundwater originating from the rock matrix represents a small fraction of the overall volume of groundwater discharged from the major springs under normal flow conditions. However, the matrix contains a larger fraction of the total groundwater in storage. Karst conduits associated with stream drainages are important elements of the Val Verde groundwater system, although ambiguity remains as to the nature of the conduits and their effects on groundwater movement and production at locations of interest.

Weinberg and others (2018) concluded that the Trinity aquifer unit of the Edwards-Trinity (Plateau) Aquifer has limited connection to the overlying Edwards aquifer unit. Discharge from major springs at the down-gradient end of the aquifer system shows no evidence of Trinity Aquifer groundwater upwelling and mixing with Edwards water. Isolated areas of brackish groundwater in the Edwards Aquifer suggest that localized communication with the Trinity aquifer unit can occur along fractures and faults. The possibility of increased communication between these aquifer units in the event of increased groundwater pumping in the Edwards has not been evaluated.

2.3 Groundwater-surface water interaction

Perennial surface water resources in Val Verde County are regional points of discharge for the groundwater system and include the Rio Grande, Amistad Reservoir, Pecos River, Devils River, San Felipe Creek, and Sycamore Creek. Springs in Val Verde County represent regional points of discharge from the Edwards-Trinity (Plateau) Aquifer, and an accurate representation of spring discharges is essential for developing groundwater models for local management. Annual flows from Goodenough Springs, the Devils River, and San Felipe Springs are estimated to provide about 23 percent of the flow in the Rio Grande below Amistad Reservoir (Green and others,

2014). As reported in Weinberg and others (2018), springflow from Goodenough Springs, San Felipe Springs, and the Devils River (spring-fed baseflow) totals almost 330,000 acre-feet per year, a rate substantially greater than discharge from pumping wells, which totals about 5,000 acre-feet per year. Permitted surface water rights and environmental flow standards in Val Verde County may have implications for groundwater management.

In an analysis of groundwater levels, springflow, and streamflow data, Weinberg and others (2018) suggest that variations in these data are primarily a response to natural variability in rainfall and not an artifact of groundwater development. San Felipe Springs may be an exception to this pattern, reflecting more intensive groundwater use in the Del Rio area than in other parts of Val Verde County.

2.4 Endangered species

Threatened or endangered aquatic species in Val Verde County include the Devils River minnow, proserpine shiner, Rio Grande darter, the Conchos pupfish (Devils River subspecies), the Mexican blindcat, and the Texas hornshell mussel. Evaluation of threatened or endangered species or habitats is an important consideration for groundwater management decisions. As noted in Weinberg and others (2018), streamflow requirements for these species are linked to spring discharges and are therefore tied to groundwater conditions. Aquatic habitats for these species depend upon groundwater inflows to maintain sufficient, good quality river flows, particularly during droughts and summer low-flows when surface runoff is minimal and water quality begins to deteriorate. Maintaining streamflow and water quality are important components of wildlife management efforts led by the U.S. Fish and Wildlife Service, the Texas Parks and Wildlife Department, The Nature Conservancy, and cooperating landowners in Val Verde County.

The Texas Parks and Wildlife Department (TPWD) has observed an 86-percent decline in the Texas hornshell over the last century (Burlakova and Karatayev, 2014). A contracted research study was recently completed for the TPWD to determine the critical lethal temperatures for the Devils River minnow, and other sensitive species like the Texas hornshell, and under what flows they might occur in the Devils River (Wolaver and others, 2018). In Val Verde County, the U.S. Fish and Wildlife Service recently approved a recovery plan for the endangered Texas hornshell (U.S. Fish and Wildlife Service, 2021), and cites potential impacts on groundwater production for successful plan implementation. The critical habitat for the Texas hornshell is depicted in Figure 2-3.

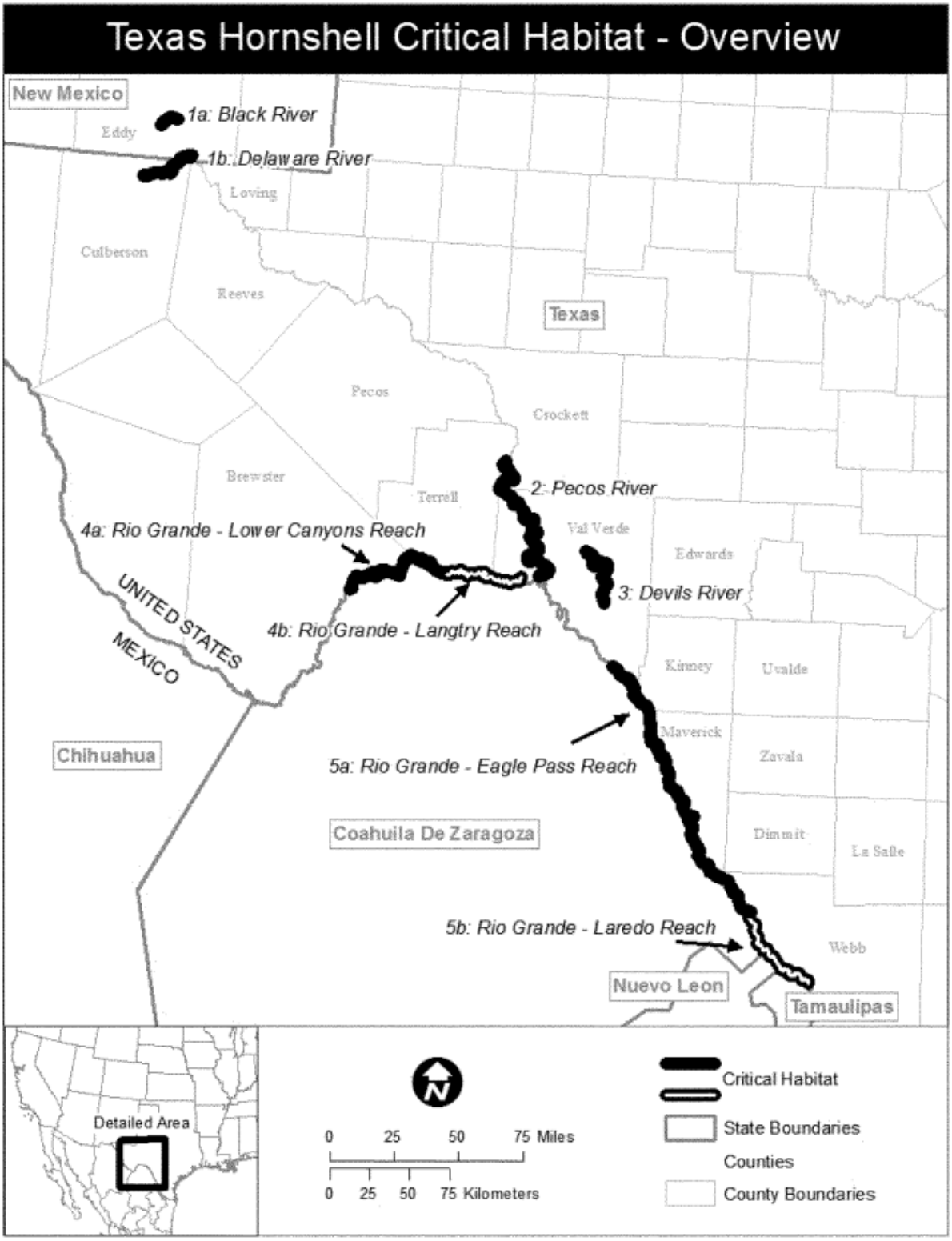


Figure 2-3. Texas hornshell critical habitat (from U.S. Fish and Wildlife Service, 2021)

3 Groundwater data collection and modeling in Val Verde County

Groundwater data with appropriate spatial and temporal coverage is key to developing tools to help decision makers with groundwater management issues in Val Verde County. Water level measurements are the fundamental record required to assess groundwater resources, but additional data, such as groundwater quality, groundwater production, recharge rates, and hydrogeologic frameworks, are key components in assessing groundwater resources. This section outlines available groundwater data and models in Val Verde County and identifies future enhancements to groundwater monitoring and modeling efforts.

3.1 Groundwater data

The TWDB Groundwater Monitoring Program maintains an extensive, state-wide network of wells, collecting water level and water quality measurements in conjunction with cooperators, such as the U.S. Geological Survey and groundwater conservation districts. For the state water planning process, the TWDB collects groundwater pumpage information from the annual Water Use Survey and water use estimates for irrigation, livestock, and mining use categories. Work done in the TWDB Brackish Resources Aquifer Characterization System (BRACS) Program to map brackish groundwater resources produces detailed geological information for aquifer mapping and identifies brackish groundwater volumes that can be used as a potential water supply.

3.1.1 Water levels

The TWDB and the International Boundary and Water Commission (IBWC) maintain observation well networks in Val Verde County (Figure 3-1). Three TWDB recorder wells measure water levels every hour and about 20 current observation wells are measured manually by the TWDB once a year. These wells are mostly located along the Devils River and near Amistad Reservoir. In addition, the IBWC measures water levels in 10 wells in the southern half of the county.

The current groundwater monitoring networks are adequate for defining regional changes in groundwater conditions but do not provide sufficient spatial or temporal detail to define local groundwater features, such as drainage areas around springs or areas of influence around pumping wells. Some locations listed as TWDB observation wells are no longer accessible or cannot be measured. In addition, monitoring has been discontinued at about half of the IBWC observation wells since 2011; therefore, the TWDB has not received any of the IBWC monitoring data since 2011. There are no observation wells in the Pecos River drainage area; there is only one observation well in the Sycamore Creek drainage area; and there is sparse coverage along tributaries to the Devils River, such as the Dry Devils River, Dolan Creek, and Johnson Draw.

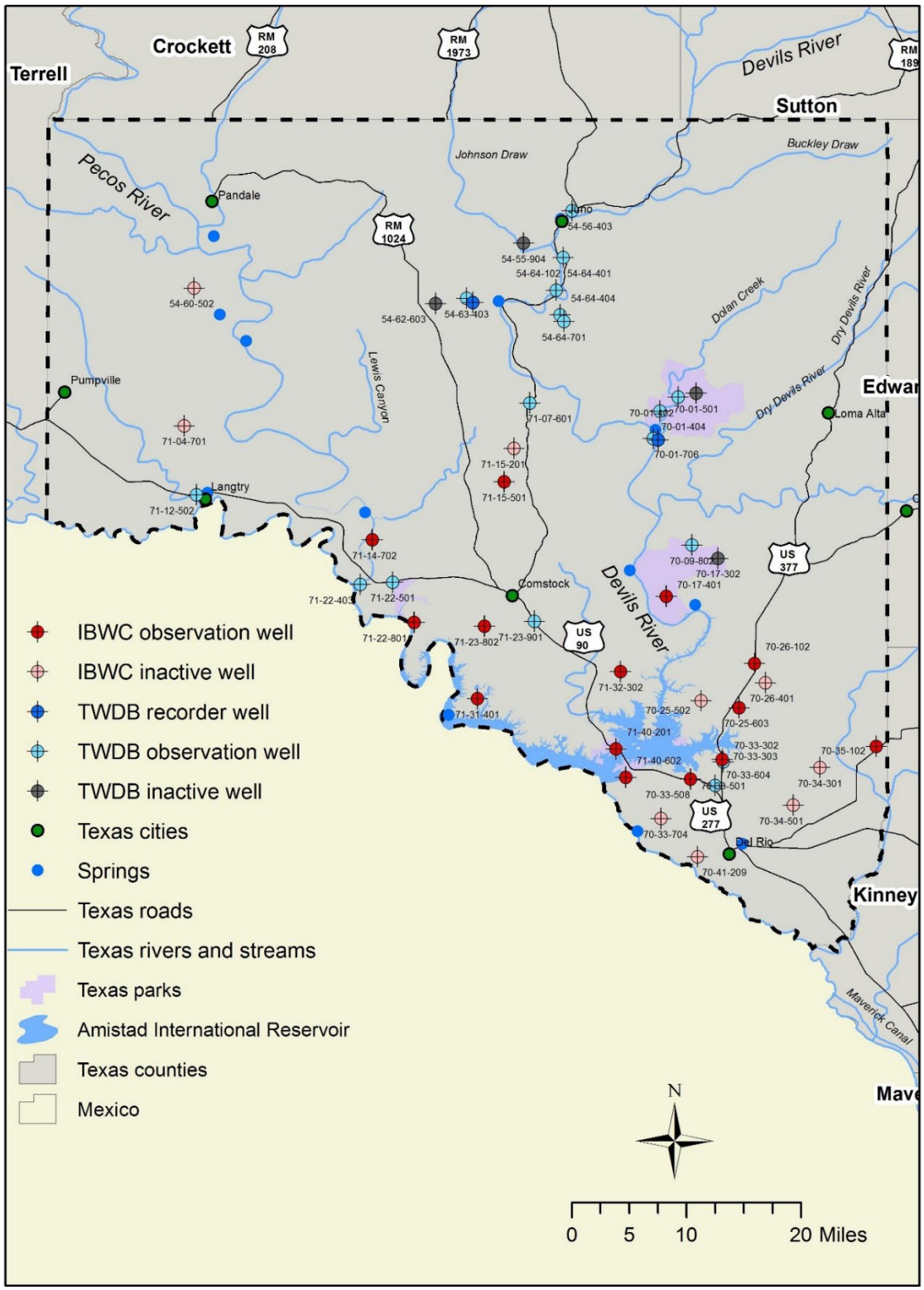


Figure 3-1. Observation well locations in Val Verde County (from Weinberg and others, 2018). Note: TWDB recorder wells have changed slightly since the creation of this map. State well numbers 54-63-401, 70-01-402, and 70-01-707 are equipped with instruments to provide continuous water level measurements.

3.1.2 Water quality

Water quality data provide a means to evaluate several aspects of the hydrogeological system, including the connection between the Edwards and Trinity portions of the aquifer, the effects of Amistad Reservoir on the groundwater system, groundwater flow paths, occurrence of salinity, and groundwater residence over time. Maintaining water quality in the context of streamflow is an important component of wildlife management efforts led by the U.S. Fish and Wildlife Service, the Texas Parks and Wildlife Department, The Nature Conservancy, and cooperating landowners in Val Verde County.

The TWDB collects water samples from wells and springs in the state's aquifers as part of its ambient groundwater quality monitoring program. These samples provide data to characterize the natural quality of groundwater and any changes that have occurred over time.

Brackish aquifer study

The Brackish Resources Aquifer Characterization System (BRACS) is currently engaged in a study of the Edwards-Trinity (Plateau) Aquifer. The BRACS study boundary includes the major aquifer boundary and extends into a newly identified groundwater source in the deep Glen Rose Formation in South Texas, currently identified as the 'Maverick Basin' aquifer (Kinney and Maverick counties). The goal of the BRACS study is to calculate brackish groundwater storage volume estimates and map groundwater salinity using publicly available data, including but not limited to geophysical well logs collected for oil and gas exploration, driller descriptions of lithology, measured water quality samples, and aquifer pump tests. Study results and methodologies will be detailed in a report that will be released on the TWDB website.

The BRACS study of the Edwards-Trinity (Plateau) Aquifer is expected to be complete by the end of 2025. Currently, BRACS staff are mapping the aquifer framework (the top and bottom of the Edwards and Trinity strata). A complete draft of stratigraphic interpretation in Val Verde County is complete but still needs to be finalized. BRACS staff may further subdivide the Edwards and Trinity strata if data density is sufficient and warranted by the geology. Future phases of the study will involve groundwater salinity interpretation and mapping, aquifer property data mining, and brackish groundwater volume calculation.

3.1.3 Springs

Springs in Val Verde County represent regional points of discharge from the Edwards-Trinity (Plateau) Aquifer and an accurate representation of spring discharges is essential for groundwater models of the area. In general, springflow measurements in Val Verde County are sparse. The 2018 TWDB report documents available quantitative and qualitative data on springs in Val Verde County.

3.1.4 Groundwater production

Groundwater production is an important component of numerical groundwater model development and effective groundwater management. Accurate estimates of pumping locations, amounts, and timing is essential in determining future groundwater availability. As reported in Weinberg and others (2018), groundwater pumping has the potential to affect streamflow and spring discharges in Val Verde County. Due to the strong linkages between surface water and groundwater, reduction in groundwater levels resulting from pumping may decrease surface flows.

For the state water planning process, the TWDB collects groundwater pumpage information from the annual Water Use Survey and water use estimates for irrigation, livestock, and mining use categories. Past groundwater use and pumping data are inconsistent and incomplete. The TWDB contracted a study to improve estimates of groundwater pumping in the Edwards Plateau Region as a research study that will be incorporated in the updated groundwater availability model for the Edwards Plateau regional aquifers (LRE Water, 2022).

Measuring groundwater production is also a key factor in implementing effective groundwater and drought management plans. A better accounting system for tracking groundwater production in Val Verde County is needed if more active groundwater management is planned.

3.1.5 Future enhancements to data collection

Comprehensive analysis of water level changes over time requires a denser and more stable network of monitoring locations with regular measurements. Water level measurements are the fundamental record required to assess groundwater resources. The current network of observation wells does not provide adequate spatial or temporal detail over the extent of Val Verde County. As recommended in Weinberg and others (2018), establishing a representative network of at least 25 to 30 wells with known well completion and collecting regular water level measurements would give an improved technical basis from which to support future groundwater management. Current observation wells should be logged and evaluated for instrument installation to collect daily water level measurements at suitable wells with suitable completion. Additional observation wells are needed in several parts of the county, including the Pecos River drainage, the Dry Devils River drainage, and some reaches of Dolan and Sycamore creeks. Selected wells in these areas should be equipped with data loggers. Mechanisms to share observation well data with the International Boundary and Water Commission are also being pursued at the TWDB, and active cooperation between any future groundwater management entity and the Commission will be essential for future groundwater management in Val Verde County.

Aquifer properties are poorly defined in most of Val Verde County because there are few data on aquifer responses to pumping stresses. These data are needed to estimate critical

parameters, such as aquifer hydraulic conductivity and storage. Preferably, aquifer tests could be designed and conducted on wells constructed for this purpose and located where data are most needed. Alternatively, data collection from wells near active high-capacity municipal supply or irrigation wells could be used to simulate an aquifer test and estimate these aquifer properties. In addition to aquifer tests, other techniques, such as dye tracers, may be useful for estimating aquifer properties and flow systems at larger scales.

There is a need for a better definition of the Trinity Aquifer and how it communicates with the Edwards Aquifer. Data presented in Weinberg and others (2018) suggest that Trinity Aquifer in Val Verde County is largely stagnant and brackish and does not contribute much flow to area springs and streams, but direct measurements of groundwater conditions in the Trinity aquifer formations are lacking.

In the absence of a groundwater conservation district, local entities interested in collecting groundwater data may consider soliciting interest from local water well owners in participating in a voluntary water well metering program to collect and report pumping information. While the number of participants may initially be small, this solicitation paired with an education and outreach campaign could serve as an initial step to supplement the limited amount of groundwater production data available.

Additionally, various entities, including the TWDB, the Texas Parks and Wildlife Department, the University of Texas Bureau of Economic Geology, the Devils River Conservancy, and the Nature Conservancy, are involved in data collection efforts and research studies in Val Verde County that will improve understanding of the groundwater resources in the county. Most of these studies are focused on the Devils River but can be used as models for research in other areas of the county. A working group of those involved in groundwater-related research within Val Verde County may be a way to share ongoing and recently completed efforts and to plan for future collaboration.

3.2 Groundwater Modeling

Numerical groundwater models are computer tools used to represent and understand aquifer flow systems. When properly calibrated, models may also be used to simulate groundwater conditions for a given set of assumptions. The level of complexity and usefulness of groundwater flow models are generally constrained by the availability of data and the range of conditions reflected in the available data. The relative scarcity of historical measurements for much of Val Verde County constitutes a challenge for modeling the Edwards-Trinity (Plateau) Aquifer groundwater flow system.

The available groundwater flow models have varying applicability for groundwater management and the how appropriate one model or another depends on the management issue under

consideration. The TWDB develops regional-scale groundwater availability models for all major and minor aquifers in Texas for use in groundwater management and planning. The current Edwards-Trinity (Plateau) Aquifer GAM (Anaya and Jones, 2009) is regional in scale and currently undergoing an update. Water budget information from groundwater availability models is required to be included groundwater conservation district management plans. Groundwater availability models are also used to evaluate policy decisions as part of the joint groundwater planning process (see Section 4.2.3). While groundwater availability estimates from the models must be considered by groundwater conservation districts in permitting decisions, groundwater availability models are not intended for use in site-specific resource management decisions and are not appropriate for modeling groundwater behavior around a spring or single well without further refinement.

Different groundwater flow models have been developed to evaluate groundwater conditions in all or parts of Val Verde County. The 2018 TWDB report examined model documentation and the hydrogeological parameters used in each of these models to assess their applicability for groundwater management in Val Verde County, providing a brief overview of the models and their applicability for groundwater management in Val Verde County. Table 3-1 summarizes existing groundwater models in Val Verde County and outlines their applicability to groundwater management.

Quantitative evaluation of the effects of potential future pumping on recharge, streamflow, and groundwater-surface water interaction requires an appropriately scaled, calibrated, and validated numerical model of coupled groundwater and surface water processes. Such a model is not currently available, however, with further refinement of the Val Verde County model (EcoKai and Hutchison, 2014) may present the best path forward for a decision-making tool in Val Verde County.

Table 3-1. Groundwater models covering all or portions of Val Verde County (summarized from Weinberg and others, 2018).

Models in Val Verde County	
Val Verde County model EcoKai and Hutchison (2014)	
Purpose	Evaluate effects of potential large-scale pumping and develop groundwater management guidelines applicable to Val Verde County
Potential for use	– Continued refinement of this model as data become available may be the best path forward for supporting groundwater management objectives in Val Verde County
Edwards-Trinity (Plateau) Aquifer groundwater availability model Anaya and Jones (2009)	
Purpose	Evaluate regional groundwater flow and availability
Applicability	– Best suited to long-term evaluation of dispersed processes that establish the overall water budgets for groundwater management plans – Joint groundwater planning – Not appropriate for local resource management decisions
Kinney County groundwater flow model Hutchison, Shi, and Jigmond (2011)	
Purpose	Evaluate effects of potential groundwater withdrawal on springs and river flows
Potential for use	– Not appropriate for local resource management decisions
Edwards-Trinity (Plateau) and Pecos Valley aquifers – one-layer model Hutchison, Jones, and Anaya (2011)	
Purpose	Improve calibration of the Edwards-Trinity (Plateau) Aquifer groundwater availability model
Potential for use	– Not appropriate for local resource management decisions
Devils River Watershed model Toll and others (2017)	
Purpose	Model groundwater in the Devils River watershed in Val Verde, Crockett, and Sutton counties
Potential for use	– May be applied on watershed basis – Would require further extrapolation and conjecture given the relative scarcity of data outside the Devils River drainage for application to the whole of Val Verde County; may not be a practical alternative, pending additional monitoring, data collection, and hydrogeological study

4 Current groundwater planning and management in Val Verde County

Val Verde County is in the Plateau Regional Water Planning Area and Groundwater Management Area 7. While there is currently no groundwater conservation district in the county to engage in the joint groundwater planning or regional water planning processes, future planning goals are included for the county under each process. There are also elements of groundwater regulation occurring via the Texas Department of Licensing and Regulation, the Texas Parks and Wildlife Department, the Texas Commission on Environmental Quality, and the City of Del Rio. This section presents information regarding future water planning in Val Verde County and existing groundwater regulatory entities.

4.1 Regional water planning

Val Verde County is in the Plateau Regional Water Planning Area (Area) (Figure 4-1). The Area is located along the southern Edwards Plateau and extends from the Central Texas Hill Country west to the Rio Grande and comprises Bandera, Edwards, Kerr, Kinney, Real and Val Verde Counties (Plateau Regional Water Planning Group, 2021, p. 1-8). The Far West Texas, Region F, Lower Colorado, South Central Texas, and Rio Grande regional water planning areas surround the Area.

All the Plateau Regional Water Planning Group (Group) plans from 2000 to 2021 have discussions about drought and the impact it had on the regional water planning process. These plans discuss drought management of the aquifers in the area, including Val Verde County.

The 2021 Plateau Regional Water Plan notes that the largest projected population increase, and municipal water demands, are within Val Verde County. The largest municipal demand is served by Del Rio Utilities. Fifty-five percent of the municipal use in the Area is used within Val Verde County. Del Rio Utilities is the only designated wholesale water provider in the county, which supplies water to Laughlin Air Force Base, subdivisions near the city, and two colonias (Plateau Regional Water Planning Group, 2021, p. 1-19). The Group also identified mining water use as significant within Val Verde County. Details of the population and demands are included in Section 4.3 of this report.

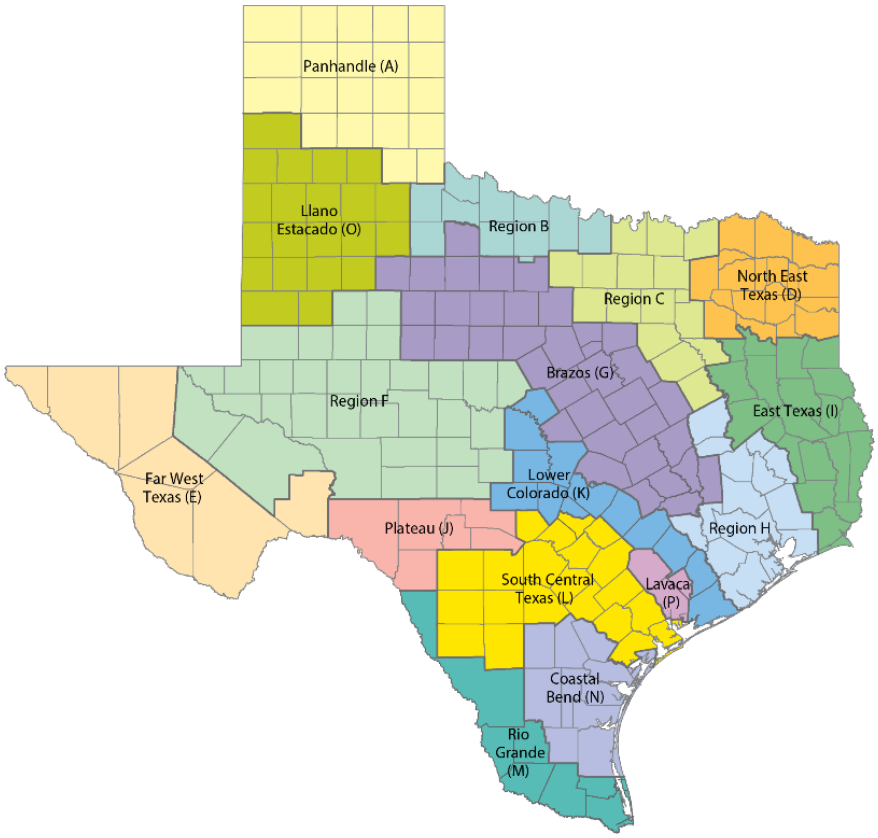


Figure 4-1. Regional water planning areas (from TWDB, 2022a)

The 2001 Plateau Regional Water Plan discusses the use of drought triggers to accommodate water shortages. The plan states that the purpose of drought triggers is to "provide a response that is intended to the damaging effects caused by the water shortage conditions (Plateau Regional Water Planning Group, 2001). The Group lists a drought trigger monitoring well for the Edwards-Trinity (Plateau) Aquifer in Val Verde County (Plateau Regional Water Planning Group, 2001, p,5-40), however, this well (State Well No. 70-42-205) was destroyed in 2004 (TWDB, 2022b).

Again, the 2006 Plateau Regional Water Plan emphasizes the use of drought triggers for groundwater dependent entities. The plan lists specific triggers for the City of Del Rio for San Felipe Springs/Edwards Trinity (Plateau) Aquifer (Plateau Regional Water Planning Group, 2006, p. 6-14):

1. Water level in Bedell Street Storage Reservoir is less than a designated depth
2. Significant decline in spring flow or aquifer water level
3. Aquifer water level

In 2011, the Plateau Regional Water Plan "aquifer water level" for the City of Del Rio was removed from the list of "Suggested or Mandated Drought Triggers for Groundwater Dependent Entities" (Plateau Regional Water Planning Group, 2011, p. 6-17).

The 2001 and 2006 regional water plans also noted that the City of Del Rio is responsible for designating trigger levels and establishing a drought response in Val Verde County, and that appropriate responses to drought are also the responsibility of private well owners (Plateau Regional Water Planning Group, 2001, p. 5-40; 2006, p. 6.14). The Group also suggested the use of another drought trigger well for the Edwards-Trinity (Plateau) Aquifer in Val Verde County, called the "Old Y Well" (Plateau Regional Water Planning Group, 2006, p. 6-15; 2011, p. 6.18). This well does not have a state well number assigned to it.

The 2016 Plateau Regional Water Plan listed a selection of three drought trigger wells for the City of Del Rio, the previously suggested Old Y Well, and the Agarita and Tiera del Largo wells. The location of the Old Y well is shown on Figure 7-11 in the plan (Plateau Regional Water Planning Group, 2016), however the locations of the two other wells are not shown.

Additional reports were commissioned by the Group to study groundwater resources in the Area. In 2005, the Group contracted the *Springs of Kinney and Val Verde Counties* report (Ashworth and Stein, 2005). This study produced a database of hydrogeologic and spring data for Kinney and Val Verde counties that could be used for a better understanding of the relationship between springs and their source aquifers (groundwater-surface water interaction). The study also considered the impacts that increased water demand, including groundwater exports, could have on the local aquifers. Information from this study is in the 2006 Plateau Regional Water Plan. The plan also includes a summary discussion based on this report (Plateau Regional Water Planning Group, 2006, p. 3F-2), where the Group defined groundwater availability as:

> *"A maximum level of aquifer withdrawal that results in an acceptable level of long-term aquifer impact such that the base flow in rivers and streams is not significantly affected beyond a level that would be anticipated due to naturally occurring conditions."*

Modeling based on this assumption showed that estimated maximum pumping for Val Verde County should be 49,607 acre-feet per year. This value was determined prior to the implementation of the joint groundwater planning process and desired future conditions (discussed in the following section) that were first required to be completed in 2010, though it is remarkably similar to a desired future condition statement.

Another report commissioned by the Group was *Groundwater Data Acquisition in Edwards, Kinney and Val Verde Counties, Texas* (Ashworth, 2009). This study assisted in the further characterization of the Edwards and associated aquifers in the western part of the Plateau

Region. "The project included four general tasks: (1) review of existing aquifer evaluations, field studies and new well data; (2) performance of dye tracer tests to analyze groundwater flow direction and speed; (3) measurement of water levels in wells during two seasonal periods; and (4) review of recent water quality sampling projects." (Plateau Regional Water Planning Group, 2011, p. 3-9). This report was not referenced in the 2018 TWDB report on Val Verde County.

4.2 Joint groundwater planning

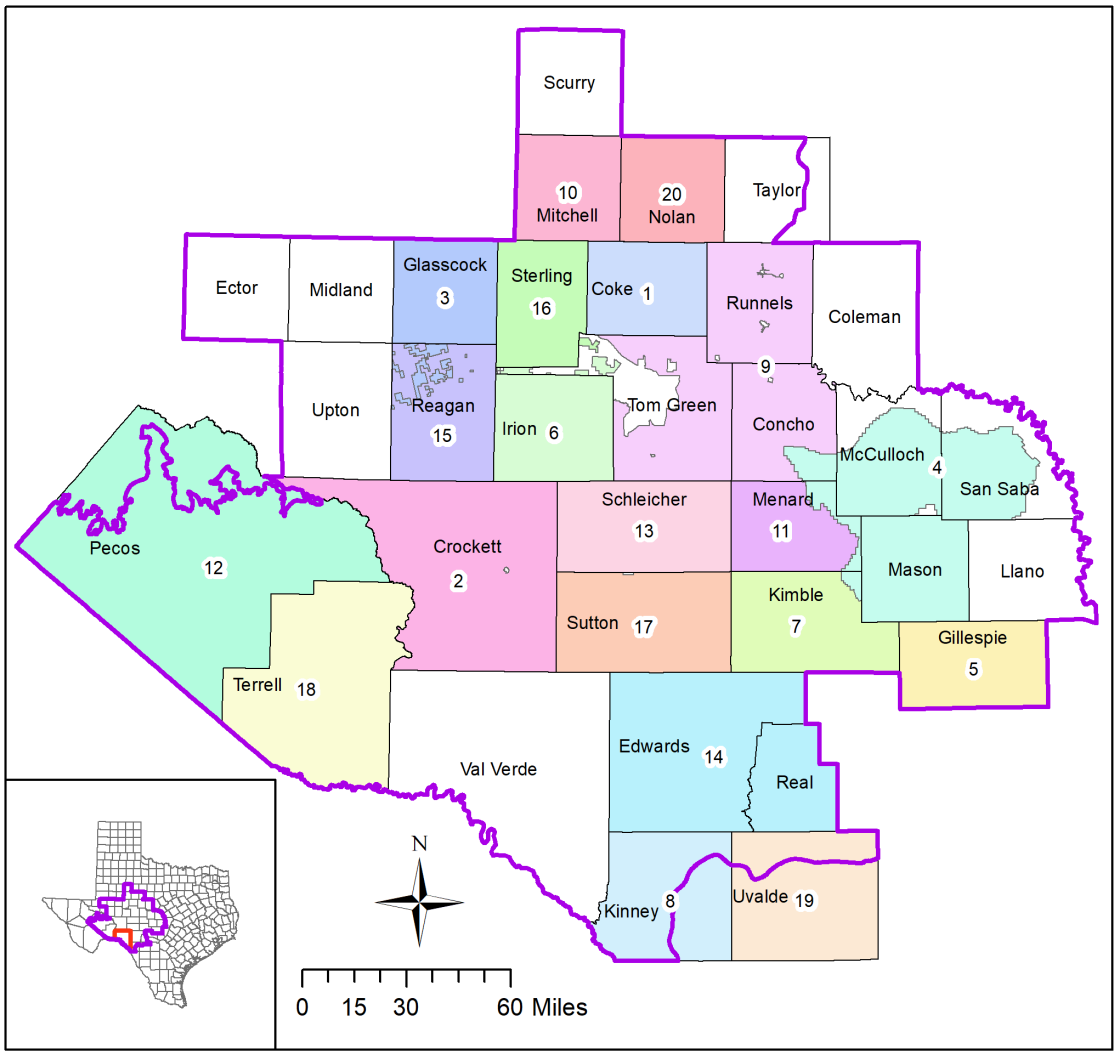
In a process adjacent to the regional water planning process, groundwater conservation districts within groundwater management areas conduct joint groundwater planning. In 2001, Senate Bill 2 directed the TWDB to delineate groundwater management areas encompassing all the major and minor aquifers in Texas. This bill directed the TWDB to delineate groundwater management areas based on aquifer boundaries or subdivisions of aquifer boundaries, however, other factors, such as political boundaries, were also used to create these areas. In November 2002, the TWDB adopted groundwater management area boundaries encompassing all the major and minor aquifers in Texas.

4.2.1 Groundwater Management Area 7

TWDB staff primarily used the boundary of the Edwards-Trinity (Plateau) Aquifer and other hydrologic boundaries to guide the delineation of the Groundwater Management Area 7. In northern Pecos County, the boundary coincides with the Pecos River Alluvium. The boundaries are also aligned with county and existing groundwater conservation district boundaries. Val Verde County is in the south-central portion of the area. Val Verde County does not have a groundwater conservation district but is included in Groundwater Management Area 7, which consists of all or part of 33 counties and 20 groundwater conservation districts in West-Central Texas (Figure 4-2).

The State of Texas encourages public participation in the joint groundwater planning process in areas within a groundwater management area not represented by a groundwater conservation district (TWC § 35.020). As an example, groundwater conservation districts in Groundwater Management Area 14 (2022) executed an interlocal agreement between two counties without districts and two subsidence districts in the interest of sharing the responsibility of joint groundwater planning. This agreement allows cost and expense sharing in the preparation of desired future conditions.

Val Verde County, the City of Del Rio, and other interested parties would benefit from participating in Groundwater Management Area 7 activities. Providing funding and input to the Groundwater Management Area 7 joint groundwater planning process would ensure that conditions adopted by the district members reflect groundwater concerns for Val Verde County.



Groundwater Management Area 7
Groundwater Management Area 7 Counties

1, Coke County UWCD
2, Crockett County GCD
3, Glasscock GCD
4, Hickory UWCD No. 1
5, Hill Country UWCD
6, Irion County WCD
7, Kimble County GCD
8, Kinney County GCD
9, Lipan-Kickapoo WCD
10, Lone Wolf GCD
11, Menard County UWD
12, Middle Pecos GCD
13, Plateau UWC and Supply District
14, Real-Edwards C and R District
15, Santa Rita UWCD
16, Sterling County UWCD
17, Sutton County UWCD
18, Terrell County GCD
19, Uvalde County UWCD
20, Wes-Tex GCD

Figure 4-2. Groundwater Management Area 7 and groundwater conservation districts.

4.2.2 Desired future conditions

Groundwater conservation districts within groundwater management areas determine desired future conditions for relevant aquifers within the area. This is one of the main purposes of joint groundwater planning. A desired future condition is 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 (31 Texas Administrative Code § 356.10). While Val Verde County does not have a groundwater conservation district, Groundwater Management Area 7 districts have adopted desired future conditions for Val Verde County for all three rounds of joint groundwater planning since 2010.

In 2010, Groundwater Management Area 7 member districts adopted an aquifer-wide desired future condition of an average drawdown of seven feet for the Edwards-Trinity (Plateau) Aquifer for the years 2010 through 2060, including Val Verde County. The main exception to this is that the desired future condition for Kinney County was based on spring flow at Los Moras Springs (Groundwater Management Area 7, 2010).

In 2018, Groundwater Management Area 7 member districts evaluated the desired future conditions for Val Verde County using a model funded by Val Verde County and the City of Del Rio (EcoKai and Hutchison, 2014; Hutchison, 2018, p. 9-11). Based on this model, member districts adopted a desired future condition where the total net drawdown in Val Verde County in 2070, as compared with 2010 aquifer levels, shall be consistent with maintenance of an average annual flow of 73 to 75 million gallons per day at San Felipe Springs (Hutchison, 2018). This flow is equivalent to about 81,800 to 84,000 acre-feet per year. The districts adopted this same desired future condition in 2021 for the third round of joint groundwater planning (Hutchison, 2021).

As discussed in Weinberg and others (2018, p. 98), the adopted desired future condition is focused and tied to discharge of San Felipe Springs, and not applicable to the rest of the aquifer in Val Verde County, specifically the Devils River or Pecos River drainage areas. In addition, without a groundwater conservation district to monitor and ensure achievement of the desired future condition, there is no way to determine if the desired future condition is being met.

Participation in, and possible funding, by Val Verde County interests in the Groundwater Management Area 7 planning process would help to ensure those interests are represented in desired future condition considerations and would assist the applicability of desired future conditions for the entire county.

4.2.3 Modeled available groundwater

Modeled available groundwater is the amount of water that may be produced on an average annual basis to achieve a desired future condition (TWC § 36.001; 31 TAC § 356.10). It is considered the groundwater availability based on the policy decisions made by member districts within a groundwater management area and is required to be considered by groundwater conservation districts when issuing permits (TWC § 36.1132). The TWDB uses groundwater availability models to estimate modeled available groundwater based on desired future conditions adopted by member districts. For the San Felipe Springs desired future condition in Groundwater Management Area 7, the TWDB used the Val Verde County model (EcoKai and Hutchison, 2014; Jones, 2022, p. 4) to estimate modeled available groundwater. The modeled available groundwater for the Edwards-Trinity (Plateau) Aquifer in Val Verde County is 50,000 acre-feet per year for all decades from 2030 to 2070 (Jones, 2022, p. 40).

4.2.4 Relationship to the state water plan

Desired future conditions and the associated modeled available groundwater estimates are integrated in the state water plan through the regional water planning process. Each regional water planning group submits a regional water plan that is consistent with the desired future conditions adopted by groundwater conservation districts in a groundwater management area and that identifies the amount of modeled available groundwater (TWC § 16.053). The volume of modeled available groundwater is the supply of groundwater available for regional water planning. Areas of the state that do not have groundwater conservation districts but have desired future conditions have modeled available groundwater estimates that become the groundwater availability in regional water plans, as is the case in Val Verde County.

According to the 2022 State Water Plan, the State Water Implementation Fund for Texas (SWIFT) along with its associated funding mechanism, State Water Implementation Revenue Fund for Texas (SWIRFT), were enacted to develop and optimize water supply projects in the state water plan (TWDB, 2022a, p. 138). Consequently, to be eligible for SWIFT funding, a project and its associated capital costs must be included in the state water plan.

In addition to the SWIFT, the Texas Water Development Fund, the State Participation Program, and the Rural Water Assistance Fund all have requirements to only fund projects consistent with the state water plan (TWDB, 2022a, p. 138).

4.3 State Water Plan

The 2022 State Water Plan, released in July 2021, is the fifth state water plan based on a bottom-up process that involves regional water planning groups. This process assesses the existing water supplies and demands on the state's water resources to determine needs for all water user groups within a regional water planning area.

4.3.1 Water use

For the state planning process, the TWDB estimates water use for categories related to regional water planning. Records from 2015 through 2020 indicate that historical water use within Val Verde County was groundwater for municipal use and surface water for irrigation (Table 4.1).

Table 4-1. Historical use estimates in Val Verde County. Values in acre-feet per year (TWDB, 2023).

Category	2015	2016	2017	2018	2019	2020	Average
Irrigation Groundwater	59	31	52	30	25	42	40
Irrigation Reuse	0	0	0	0	0	0	0
Irrigation Surface Water	2,739	2,914	3,478	3,342	3,980	4,165	3,436
Livestock Groundwater	321	319	336	344	346	340	334
Livestock Reuse		0	0	0	0	0	0
Livestock Surface Water	17	17	18	18	18	18	18
Manufacturing Groundwater	0	0	1	1	7	7	3
Manufacturing Reuse	0	0	0	0	0	0	0
Manufacturing Surface Water	0	0	0	0	0	0	0
Mining Groundwater	0	0	0	0	1	0	0
Mining Reuse & Brackish	0	0	0	0	0	0	0
Mining Surface Water	0	0	0	0	88	88	29
Municipal Groundwater	9,202	10,697	10,733	11,254	10,644	11,386	10,653
Municipal Reuse	0	0	0	0	0	0	0
Municipal Surface Water	7	83	101	77	88	88	74
Power Groundwater	0	0	0	0	0	0	0
Power Reuse	0	0	0	0	0	0	0
Power Surface Water	0	0	0	0	0	0	0
County total	**12,345**	**14,061**	**14,719**	**15,066**	**15,197**	**16,134**	**14,278**

4.3.2 Population

As part of the state planning process, population estimates are used to determine water demands. The population of Val Verde County is projected to increase 50 percent by 2070, increasing from 54,694 in 2020 to 82,161 in 2070 (Table 4-2, Figure 4-3). The increase in water demands is the direct cause of increased population within the county from 2020-2070.

Table 4-2. Population estimates for Val Verde County, 2020 to 2070.

Entity	2020	2030	2040	2050	2060	2070	Percent growth from 2020
City of Del Rio	37,775	40,196	42,540	44,948	47,242	49,453	31
County other (municipal)	15,152	18,242	21,233	24,379	27,479	30,469	101
Laughlin Air Force Base	1,767	1,951	2,129	2,239	2,239	2,239	27
County total	**54,694**	**60,389**	**65,902**	**71,566**	**76,960**	**82,161**	**50**

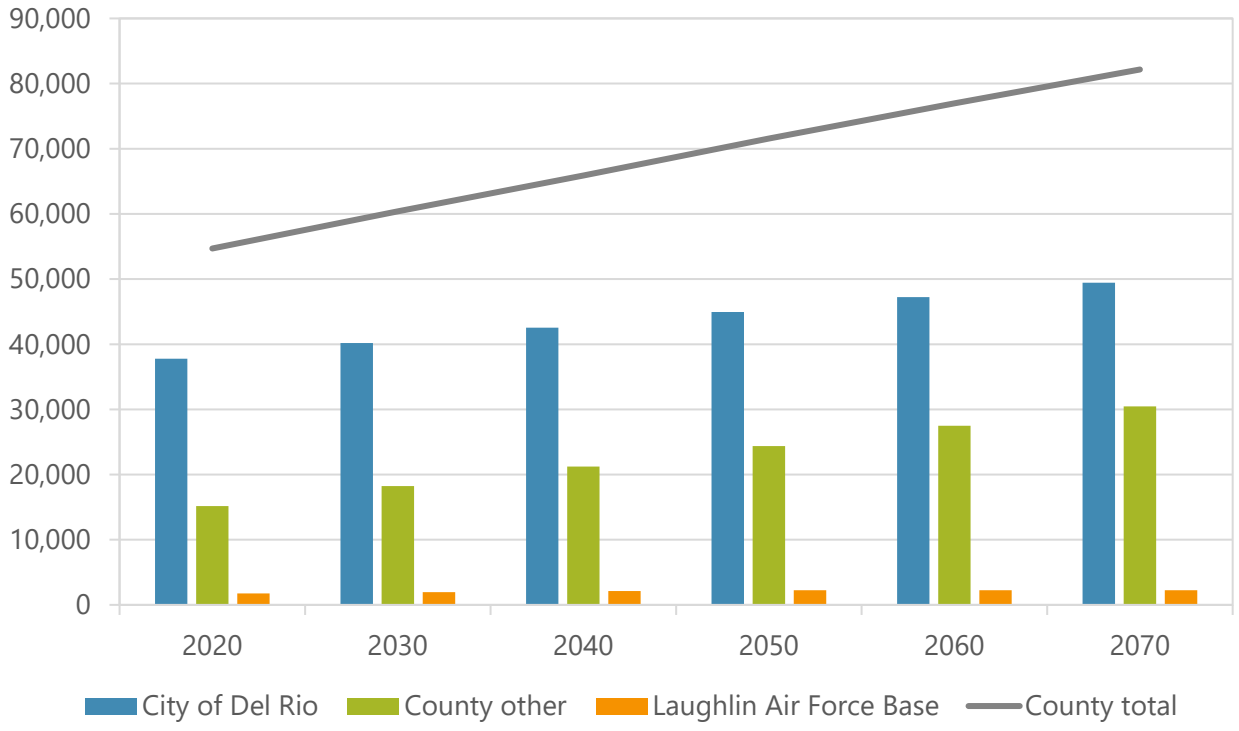


Figure 4-3. Projected population growth by entity for Val Verde County, 2020 to 2070.

4.3.3 Demands

As stated in the 2022 State Water Plan, "The TWDB projects water demand across the 50-year planning horizon for municipal and all non-municipal sectors [irrigation, livestock, manufacturing, mining, and steam-electric power] of the Texas economy to determine how much water the state will need during a single year repeat of drought of record conditions." The TWDB projects total annual water demand to increase across all water use categories in Val Verde County by 29 percent, from 16,471 acre-feet in 2020 to 21,243 acre-feet in 2070 (Table 4-3; Figure 4-4). The highest demand is the City of Del Rio, where the demand is estimated to increase by 26 percent, from 10,558 acre-feet in 2020 to 13,326 acre-feet in 2070. The largest percentage increase in demand is in county other, where demand is estimated to increase by 89 percent over the same period.

Table 4-3. Projected annual water demand by water use category (acre-feet)

Entity	2020	2030	2040	2050	2060	2070	Percent growth from 2020
City of Del Rio	10,558	11,053	11,554	12,130	12,733	13,326	26
County other (municipal)	1,976	2,307	2,637	3,002	3,376	3,741	89
Laughlin Air Force Base	1,018	1,114	1,215	1,277	1,276	1,276	25
Irrigation	2,319	2,319	2,319	2,319	2,319	2,319	0
Livestock	410	410	410	410	410	410	0
Mining	190	249	259	223	192	171	-10
County total	**16,471**	**17,452**	**18,394**	**19,361**	**20,306**	**21,243**	**29**

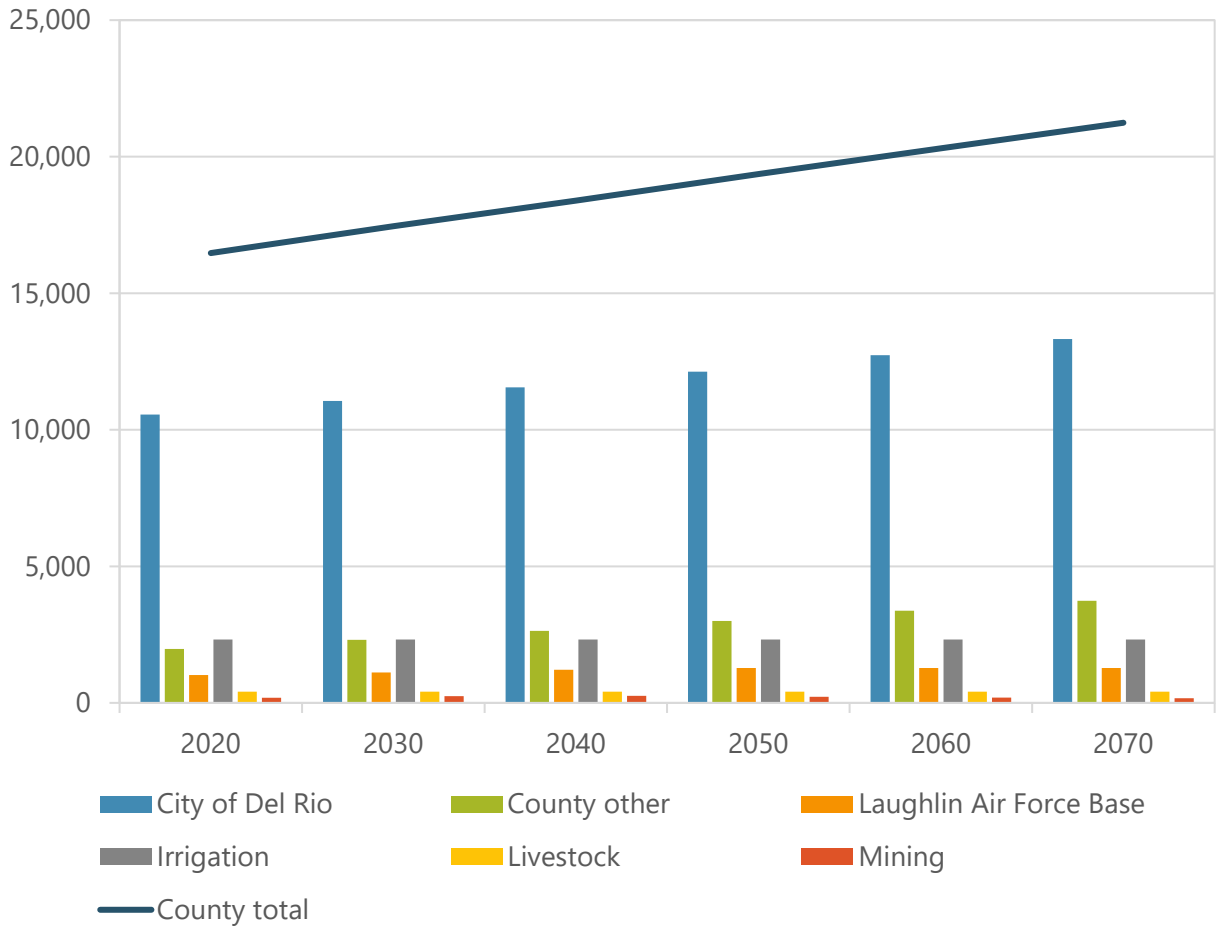


Figure 4-4. Projected annual water demand by water use category (acre-feet).

4.3.4 Existing Supplies

Existing water supplies in the state water plan is the amount that can be legally produced and delivered to water user groups based on existing infrastructure during a repeat of the drought of record (TWDB, 2022a). Groundwater supply is from modeled available groundwater volumes determined from the desired future conditions as adopted by groundwater management area member districts. Table 4-4 shows the existing supplies in Val Verde County from the 2022 State Water Plan, where water supplies are from surface water from the Rio Grande and groundwater from the Edwards-Trinity (Plateau) Aquifer. The projected existing supply volume is consistent from 2020 to 2070 and shown as one value in Table 4-4. Surface water supplies most municipal and irrigation uses, but groundwater also supplies a significant amount for municipal use.

Table 4-4. Projected annual water supplies by water use category (acre-feet).

Entity	Source	Projected supply 2020 to 2070
County other (municipal)	Edwards-Trinity (Plateau) Aquifer	2,904
Laughlin Air Force Base	Edwards-Trinity (Plateau) Aquifer	60
Irrigation	Edwards-Trinity (Plateau) Aquifer	276
Livestock	Edwards-Trinity (Plateau) Aquifer	506
Mining	Edwards-Trinity (Plateau) Aquifer	39
Subtotal	***Groundwater***	***3,785***
City of Del Rio	Rio Grande run of river	6,135
County other (municipal)	Rio Grande run of river	460
Laughlin Air Force Base	Rio Grande run of river	871
Irrigation	Rio Grande run of river	6,310
Subtotal	***Surface Water***	***13,776***
Total		**17,561**

4.3.5 Needs

If existing water supplies are less than projected water demands, there is a potential water shortage. The potential water shortages are water supply needs in the water planning process. The needs for Val Verde County are listed in Table 4-5. The bulk of the water supply needs are for the City of Del Rio, where there is a 63 percent increase in needs from 2020 to 2070. Irrigation needs increase by 25 percent during the same period.

Table 4-5. Projected annual water supply needs by water use category (acre-feet).

Entity	2020	2030	2040	2050	2060	2070	Percent growth from 2020
City of Del Rio	4,423	4,918	5,419	5,995	6,598	7,191	63
County other (municipal)	0	0	0	0	12	377	—
Laughlin Air Force Base	2,319	2,319	2,319	2,319	2,319	2,319	0
Irrigation	1,018	1,114	1,215	1,277	1,276	1,276	25
Livestock	410	410	410	410	410	410	0
Mining	190	249	259	223	192	171	-10
County total	**8,360**	**9,010**	**9,622**	**10,224**	**10,807**	**11,744**	**40**

4.3.6 Recommended Projects

The Plateau Regional Water Planning Group is responsible for identifying, evaluating, and recommending management strategies to avoid potential shortages for water user groups within the region (TWDB, 2022a). Water management strategies allocate water supply to specific water user groups. Table 4-6 lists the water management strategies for Plateau Regional Water Planning Area; decades 2050 through 2070 are listed as one column in the table because the values are the same.

The largest volume strategy is a new water well for the City of Del Rio to produce 7,191 acre-feet per year, which is enough to meet the 2070 need (Table 4-6). The other water use category with a groundwater strategy is mining, estimated to produce 242 acre-feet per year.

Table 4.6. Annual volume of recommended water management strategies (acre-feet).

Entity	Strategy	2020	2030	2040	2050 to 2070
City of Del Rio	Water loss audit and main line repair	12	12	12	12
City of Del Rio	Develop a wastewater reuse program	0	3,092	3,092	3,092
City of Del Rio	Water treatment plant expansion	0	943	943	943
City of Del Rio	Drill and equip a new well	7,191	7,191	7,191	7,191
County other	Water loss audit and main-line repair	12	12	12	12
Laughlin AFB	Purchase water from City of Del Rio	87	183	284	346
Mining	Additional groundwater wells	242	242	242	242
	Total	**7,544**	**11,675**	**11,776**	**11,838**

4.4 Groundwater regulation in Val Verde County

Even though a groundwater conservation district does not exist within Val Verde County, there are some groundwater regulation activities occurring within the county that deal with certain aspects of groundwater management. This section discusses the roles that the Texas Department of Licensing and Regulation, the Texas Commission on Environmental Quality, the Texas Parks and Wildlife Department, the City of Del Rio, and Val Verde County have in groundwater regulation.

4.4.1 Texas Department of Licensing and Regulation

The Texas Department of Licensing and Regulation is the primary state agency responsible for the oversight of businesses, industries, general trades, and occupations that are regulated by the State and assigned to the agency by the legislature (Texas Occupations Code, Chapter 51). Within this broad purview of occupational regulation, the agency is tasked with licensing, complaint procedures, continuing education, and technical standards for well drillers and pump installers, ensuring the quality of the State's groundwater for the safety and welfare of the public under the Texas Occupations Code, Chapters 1901 and 1902 (16 Texas Administrative Code § 76.1).

The minimum standards of groundwater regulation within Val Verde County are the Texas Department of Licensing and Regulation standards for water well drilling and completion and for pump installation. The technical requirements for water well drilling and completion are established by rule (16 Texas Administrative Code § 76.100). The rules specify minimum well construction standards and requirements for well locations, including setback distances from adjacent property lines and sources of potential contamination (Figure 4-5). Without a groundwater conservation district in areas outside a municipality, the only regulations of groundwater wells are these rules that provide for well spacing from property lines and for water quality protection and Texas Commission on Environmental Quality regulations regarding public water supply wells (see Section 4.4.2).

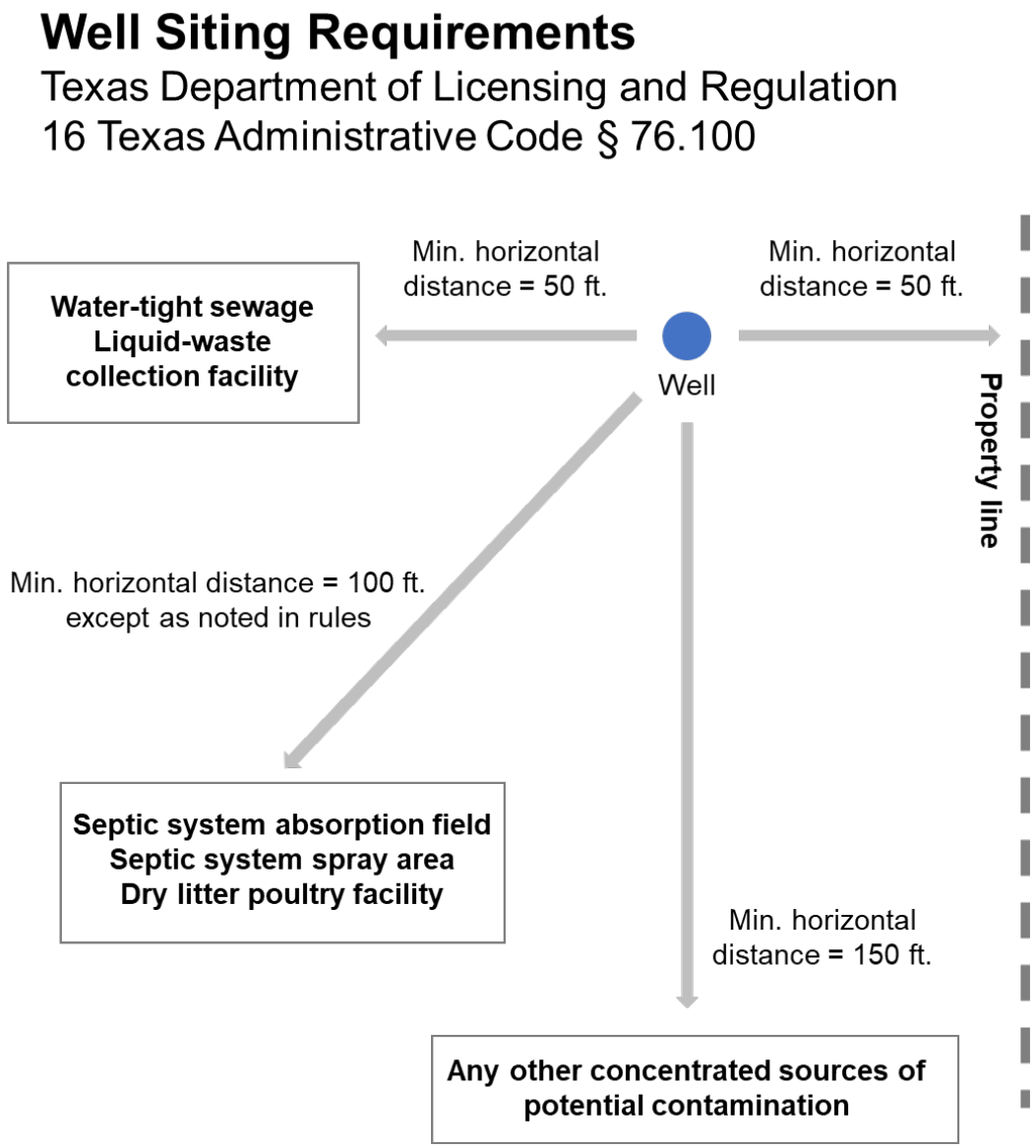


Figure 4-5. Texas Department of Licensing and Regulation well siting requirements (modified from 16 Texas Administrative Code § 76.100).

4.4.2 Texas Commission on Environmental Quality

The Texas Commission on Environmental Quality is the environmental regulatory agency in Texas. In the water quality space, the Commission ensures that public water systems operating water wells are protecting groundwater sources from contamination.

The Texas Commission on Environmental Quality is responsible for public water system standards. The Texas Commission on Environmental Quality Groundwater Rule provides public health protection against microbial pathogens and applies to all public water systems that provide groundwater (TCEQ, 2023). 30 Texas Administrative Code § 290.41 contains siting and casing requirements for public water systems sourcing groundwater, including testing for potential public water supply wells and minimum siting distances from sewage/sewage treatment infrastructure, chemical storage tanks, and abandoned and improperly sealed wells. 30 Texas Administrative Code § 290.116 outlines treatment techniques and corrective actions for public water systems that use groundwater. The Commission also provides guidance on requirements for well construction, completion, and operation; reviews completed water well plans and specifications; and approves water well construction for public water supply wells.

4.4.3 Texas Parks and Wildlife Department

The Texas Parks and Wildlife Department has primary responsibility for protecting the state's fish and wildlife resources. Resource protection activities include investigating fish kills and seeking restoration for lost resources, providing recommendations for protecting fish and wildlife resources to local, state, and federal agencies that approve development projects, and providing recommendations to the TCEQ on the scheduling of instream flows and freshwater inflows to Texas estuaries for the management of fish and wildlife resources (TP&W Code § 12.0011). Studies produced by the Texas Parks and Wildlife Department regarding threatened and endangered species have implications for groundwater management in Val Verde County and may be used to inform the development of management strategies to conserve aquatic habitats in the county.

In Val Verde County, the U.S. Fish and Wildlife Service recently approved a recovery plan for one of the endangered species in the county, the Texas hornshell (U.S. Fish and Wildlife Service, 2022). Recovery plans are not regulatory but provide a framework necessary for the recovery of endangered species. Cooperation among federal, state, and local agencies (such as any future groundwater conservation district), private landowners, and other stakeholders is key to the success of a recovery strategy.

4.4.5 City of Del Rio

The City of Del Rio (the City) is the only incorporated municipality in Val Verde County. The City of Del Rio, Texas, Code of Ordinances, Chapter 29, Article II stipulates the powers that the City of Del Rio has regarding water wells. The City currently requires a permit to drill or otherwise construct, repair, correct, abandon, or plug a well, or to do this work within the jurisdiction of the City or within two miles of the city limits. A permit is granted by the city council if an application is filed, fees are paid, and the applicant complies with all requirements within the ordnance (City of Del Rio, Texas, Code of Ordinances, § 29-54). The City inspects the property prior to drilling to see if the property meets drainage and other sanitary conditions (City of Del Rio, Texas, Code of Ordinances, § 29-56). The City also requires that wells cannot exceed the permitted well depth without getting an additional permit for a deeper well and that the minimum casing requirements are met based on casing size (City of Del Rio, Texas, Code of Ordinances, §§ 29-57.1, 29-60).

The City further regulates all wells that contaminate other water sources, are defective, or abandoned to protect the City's water supply (City of Del Rio, Texas, Code of Ordinances, §§ 29-61, 29-62, 29-63). However, there are no provisions to limit water use from any of these wells during times of drought to protect the City's water supply.

The City of Del Rio (2019) implements drought triggers impacting customers of the water system based on a water conservation and drought contingency plan. The trigger conditions recognize the use of surface water and groundwater supplies, and are based on historic performance of system storage, transmission, and delivery issues before a supply shortage. The triggers are based on specific conditions and shortages are classified as mild, moderate, severe, critical, or emergency. A summary of the drought stages and triggers are in Table 4-6.

Additionally, the City has the authority to regulate subdivisions under Local Government Code Chapter 212, Municipal Regulation of Subdivisions and Property Development. The City requires groundwater availability certification reports by a licensed engineer or geoscientist to be provided with a subdivision plat application that is allowed under the Local Government Code § 212.0101 (City of Del Rio, Texas, Code of Ordinances, § 26-102). Information from these reports could provide additional data to assess groundwater resources in Val Verde County

Table 4-6. Summary of the City of Del Rio hydrologic drought triggers and response actions. (modified from City of Del Rio, 2019).

Trigger monitor location	Stage 1 Mild	Stage 2 Moderate	Stage 3 Severe	Stage 4 Extreme
Bedell Street Reservoir water levels	Do not recover to 100% in 24 hours or are less than 30 feet at any time.	Maximum water levels decrease over three consecutive days, or water levels are less than 25 feet at any time.	Maximum water levels decrease over five consecutive days, or water levels are less than 20 feet at any time.	Maximum water levels decrease over seven consecutive days, or water levels are less than 15 feet at any time.
San Felipe Spring flow	Falls below 25.0 million gallons per day	Falls below 20.0 million gallons per day	Falls below 15.0 million gallons per day	Falls below 10.0 million gallons per day
Drought response goals				
	Increase public awareness of water supply conditions and reduce daily total water demand to at or below 95% of the average of the 30 days prior to the initiation of the drought plan. Restrictions under this stage are voluntary.	Reduce daily water demand to at or below 93% of the average of the 30 days prior to the initiation of the drought plan. Restrictions under this stage are mandatory.	Reduce daily water demand to at or below 90% of the average of the 30 days prior to the initiation of the drought plan. Restrictions under this stage are mandatory.	Restrictions to ensure adequate water supply for public health and safety, as demonstrated by meeting minimum system pressure requirements and fire flow demands.

4.4.6 Val Verde County

An investigation into Val Verde County regulation of groundwater conceded that the county does not regulate groundwater wells (Velarde, 2022). The county does regulate subdivisions as required by Local Government Code Chapter 232, County Regulation of Subdivisions. However, it does not require groundwater availability certification reports by a licensed engineer or geoscientist to be provided with a subdivision plat application that is allowed under the Local Government Code § 232.0032.

5 Groundwater planning strategies discussion

As discussed previously, Val Verde County is part of the Plateau Regional Water Planning Group and Groundwater Management Area 7 but is not currently part of any groundwater conservation district. Managing groundwater in the Edwards-Trinity (Plateau) Aquifer would involve consideration of historical groundwater usage, private property interests, complex groundwater-surface water interactions, and ecological and species habitat concerns. There are several areas in Texas where the Edwards (Balcones Fault Zone) Aquifer discharges through major springs, and the process through which groundwater management has developed in those areas may inform the path forward for Val Verde County.

Approaches to groundwater management in Val Verde County should be considered in conjunction with regional groundwater management strategies, such as those for groundwater conservation districts neighboring Val Verde County in Groundwater Management Area 7. Some springs in Val Verde County represent the discharge points for a regional groundwater flow system that extends well outside the area of the county. The surface water drainage systems that recharge groundwater in Val Verde County extend into neighboring counties, New Mexico, and Coahuila, Mexico. Future groundwater management may require cooperation across political boundaries.

Weinberg and others (2018) proposed four separate management zones, based on approximate watershed boundaries in Val Verde County (Figure 5-1). This section provides an overview of these zones, best management practices for drought scenarios, and examples from several groundwater conservation districts for groundwater management during drought periods.

5.1 Groundwater management zones

Texas Water Code § 36.108(d-1) gives a groundwater conservation district latitude in managing certain aspects of the groundwater resources within its territory. Recognizing that there can be considerable variation in groundwater occurrence, aquifer properties, groundwater flow, and groundwater use patterns within a district, the Texas Water Code allows districts to establish management zones whereby customized criteria can be applied for groundwater management within a district. Several existing districts have established different management zones, some with different desired future conditions, to facilitate appropriate management.

Weinberg and others (2018) determined that Val Verde County has sufficient hydrogeologic variability to support the establishment of aquifer management zones in the event a groundwater conservation district is established. Four separate groundwater management zones, based on approximate watershed boundaries, could be defined in Val Verde County as shown in Figure 5-1.

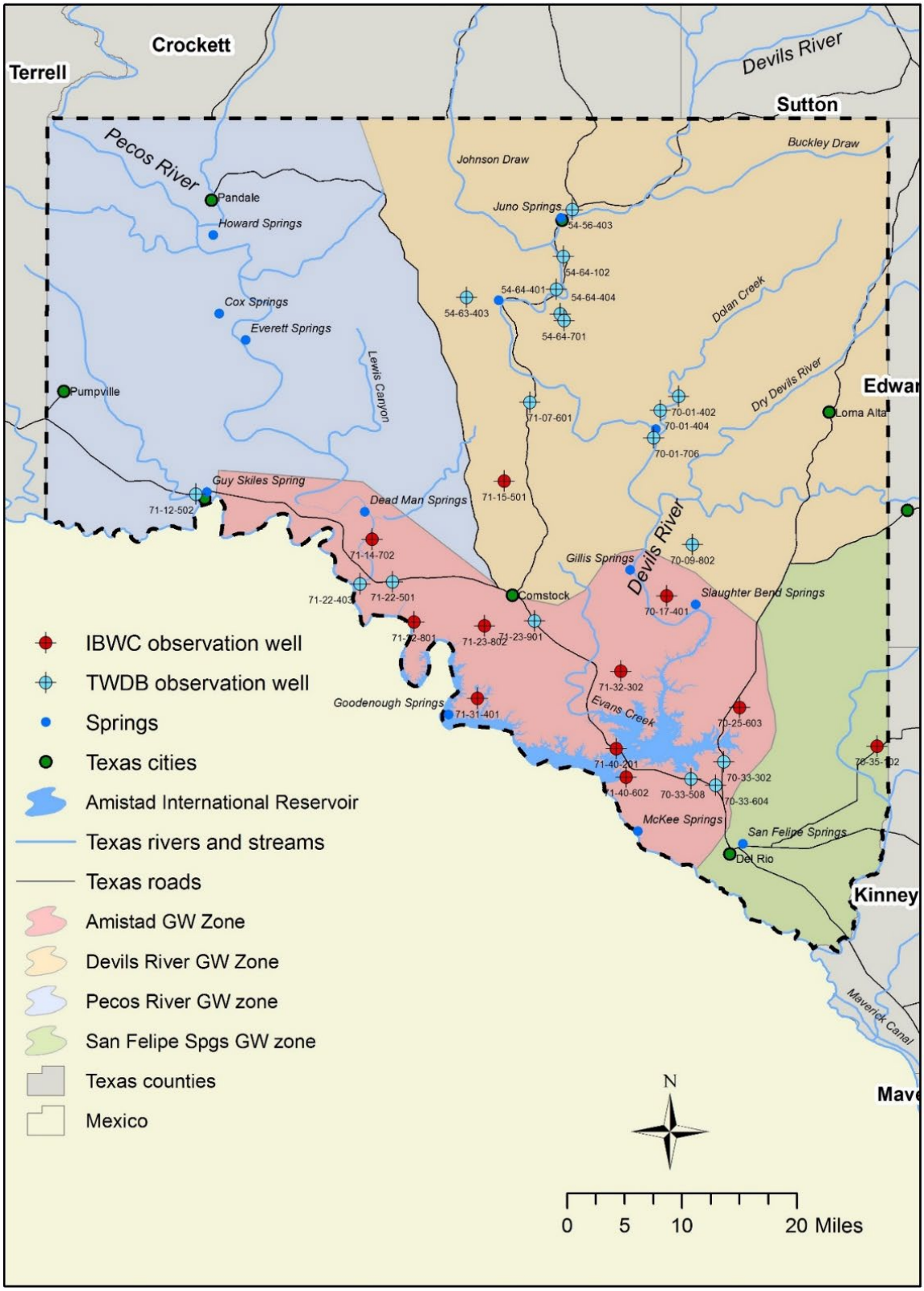


Figure 5-1. Map of possible groundwater management zones for Val Verde County (from Weinberg and others, 2018).

As noted by Weinberg and others (2018), groundwater contributing baseflow to the Pecos River, Devils River, and Sycamore/San Felipe Creek drainages are separate flow systems. Threatened and endangered wildlife populations in each drainage may need separate management. The Sycamore/San Felipe Creek system also supports the Del Rio water supply. And the area around Amistad Reservoir may require special management considerations. Additionally, reservoir levels in Amistad Reservoir strongly influence the groundwater levels near the reservoir. This may cause issues with international management of the Rio Grande/Rio Bravo and the needs of Texas users who rely on water from Amistad Reservoir.

A more detailed hydrogeological assessment is needed to define the boundaries of the groundwater drainage basins and the area of potential surface water impact around Amistad Reservoir. Additional water level monitoring in a well-established monitor well network will be integral to defining management zones and supporting other potential groundwater management objectives. Additionally, groundwater geochemistry and micro-particulate analysis may all play a role in refining the boundaries of possible management zones.

The exact proposed zones from Weinberg and others (2018, p. 104; Figure 5-1) are as follows:

Amistad Groundwater Zone
"The Amistad Groundwater Zone would cover the area where groundwater levels and flow in the Edwards-Trinity (Plateau) Aquifer are believed to be affected directly by reservoir levels. Selected groundwater observation wells could serve as monitoring points to evaluate changing groundwater conditions, particularly as they could affect withdrawal points and spring flow hydraulically downgradient of the reservoir."

San Felipe Springs Groundwater Zone
"The San Felipe Springs Groundwater Zone would cover the watershed area that contributes to the San Felipe Springs complex. However, groundwater outside this zone (in the vicinity of Amistad Reservoir) exerts influence on the flow characteristics of the springs, where groundwater levels and flow in the Edwards-Trinity (Plateau) Aquifer are believed to be affected directly by reservoir levels. Selected groundwater observation wells could serve as monitoring points to evaluate changing groundwater conditions, particularly as they could affect withdrawal points and springflow hydraulically downgradient of the reservoir. Connections between the San Felipe drainage basin and the Sycamore Creek drainage basin need to be evaluated further; a separate management zone may be justified for Sycamore Creek."

Pecos River Groundwater Zone
"The Pecos River Groundwater Zone extends over the western portion of the county. This area currently has few suitable observation wells that could serve as hydrologic triggers, but the

Pecos River flow has been well characterized and would be a probable component of any groundwater management approach. "

Devils River Groundwater Zone

"The Devils River Groundwater Zone would cover the Devils River watershed area. This zone has a number of possible suitable observation wells, springs, and gaging stations that could be used for hydrologic trigger locations. The two TWDB recorder wells have yielded nearly continuous water level measurements since the mid-2000s and would provide a useful baseline from which to measure possible future changes in groundwater levels."

The assumption in the 2018 TWDB report was for these areas to be implemented by a future groundwater conservation district. However, implementation of the potential zones could be part of any monitoring and study programs by other entities in the future despite there not being a groundwater conservation district. Another possibility is to use zones as the basis of a localized groundwater conservation district as a subdivision of the aquifer within Val Verde County. For example, to protect the flow of San Felipe Springs, either the City of Del Rio could monitor groundwater within the San Felipe Springs zone or a localized groundwater conservation district may be more appropriate.

5.2 Best management practices for drought scenarios

Trigger levels related to index well water levels or spring discharges are established mechanisms for groundwater conservation districts to manage groundwater resources, especially during periods of drought. Hydrologic triggers can be established to provide decision-makers with data to implement strategies that address changing hydrologic conditions such as water supply or water quality concerns. Examples of how other groundwater conservation districts in Texas have implemented the use of hydrologic triggers for drought management are discussed in the following section.

Without a groundwater conservation district in the county, the current best management practice for Val Verde County and the City of Del Rio is to provide educational opportunities and materials to well owners to encourage conservation during drought conditions. Items to consider are a drought awareness campaign or water conditions report to inform citizens of drought conditions.

5.3 Groundwater management examples

In identifying possible groundwater use planning strategies, the TWDB investigated groundwater management in areas with similar springs, geology, and species protection issues to provide background and examples for potential groundwater management strategies in Val Verde County. These examples may be applied to the proposed groundwater management zones from Weinberg and others (2018; Figure 5-1).

As suggested in Weinberg and others (2018), a combination of spring discharge and index well measurements could be used as hydrologic triggers to support groundwater management in Val Verde County. Spring discharge could be directly linked to potential management goals and objectives, such as preserving minimum streamflow requirements. Spring discharge can be readily determined from water level measurements in the spring pool or in a monitoring well adjacent to the spring and an established stage/discharge relationship. Index well water levels in the aquifer should have a demonstrated correlation with groundwater management goals, such as maintaining streamflow or endangered species habitat. Ideally, index well trigger levels should also have a predictive capability so that management options can be implemented proactively before problems develop. Therefore, index wells may be located upgradient of critical springs or reaches of streams depending on the nature of the hydrologic feature to be protected.

The following examples range from springflow to drought indexing methods to determine drought or conservation stages. The examples are intended to be a reference for any future groundwater conservation district or to guide local government to better educate and inform constituents.

5.3.1 Edwards Aquifer Authority

The Edwards Aquifer Authority regulates the use of the San Antonio segment of the Edwards (Balcones Fault Zone) Aquifer and was created to preserve the aquifer and protect threatened and endangered species in the Comal and San Marcos springs through a capped permitting system that limits aquifer withdrawals. The Edwards Aquifer Authority has invested in extensive data collection, research, and modeling efforts to understand how the Edwards (Balcones Fault Zone) Aquifer works, which is essential to proper groundwater management and drought period management plans.

The Edwards Aquifer Authority Critical Period Management Plan for the Edwards (Balcones Fault Zone) Aquifer is intended to: "(1) effectively control the Aquifer to protect terrestrial and aquatic life, domestic and municipal water supplies, the operation of existing industries and the economic development of the state and region; (2) recognize the extent of the hydro-geologic connection and interaction between surface water and groundwater; (3) protect aquatic and

wildlife habitat; (4) protect species that are designated as threatened or endangered under applicable federal or state law; (5) provide for instream uses, bays, and estuaries; and (6) implement §§ 1.14(f) and (h), and 1.26 of the [Edwards Aquifer Authority] Act" (Edwards Aquifer Authority, 2019, p. 715-15).

The Edwards Aquifer Authority summarizes the plan as follows:

> *"The intent of the [Edwards Aquifer Authority] Critical Period Management (CPM) Plan is to sustain aquifer and springflow levels during times of drought. CPM applies to most well owners who have a permit to withdraw water from the Edwards Aquifer by temporarily reducing their authorized withdrawal amount. Based on ten-day averages of certain aquifer level and springflow readings, which are indicators of the current condition of the aquifer, CPM reductions are divided by aquifer 'pools'."* (Edwards Aquifer Authority, 2022).

The San Antonio pool stages indicate permit reductions needed within Atascosa, Bexar, Caldwell, Comal, Guadalupe, Hays, and Medina counties. The stages for these areas are based on water levels in an index well in combination with springflow from specific springs (Table 5-1). The Uvalde pool pumping permit reductions are based on water levels in an index well and only apply to Uvalde County (Table 5-2).

Table 5-1. Edwards Aquifer Authority critical period stages for the San Marcos pool (Edwards Aquifer Authority, 2022).

Critical period stage	J-17 index well level above mean sea level (amsl)	San Marcos Springs flow cubic feet per second (cfs)	Comal Springs flow cubic feet per second (cfs)	Water reduction
No Stage indicates stable levels	660 feet or above	96 or above	225 or above	0%
Stage 1	less than 660 feet	less than 96	less than 225	20%
Stage 2	Less than 650 feet	less than 80	Less than 200	30%
Stage 3	Less than 640 feet	Not Applicable	Less than 150	35%
Stage 4	Less than 630 feet	Not Applicable	Less than 100	40%
Stage 5	Less than 625 feet	Not Applicable	Less than 45/40*	44%

* Stage 5 Comal Springs Flow - to enter this stage based on the springflow, the reading must be less than 45 cfs on a ten-day rolling average, or less than 40 cfs based on a three-day rolling average. To leave this stage, the ten-day rolling average must be 45 cfs or greater.

Table 5-2. Edwards Aquifer Authority critical period stages for the Uvalde pool (Edwards Aquifer Authority, 2022).

Critical period stage	J-27 index well level above mean sea level (amsl)	Water reduction
No Stage indicates stable levels	850 feet or above	0%
Stage 1	N/A	0%
Stage 2	Less than 850 feet	5%
Stage 3	Less than 845 feet	20%
Stage 4	Less than 842 feet	35%
Stage 5	Less than 840 feet	44%

The index well and spring discharge approach can be a guide for groundwater management during drought periods within Val Verde County and any future groundwater management structure. The aquifer "pools" used in the Edwards Aquifer Authority Critical Period Management Plan may be analogous to the groundwater management zones identified in Weinberg and others (2018). A springflow and water-level based drought management approach would be beneficial to the San Felipe Springs groundwater management zone (Weinberg and others, 2018), especially since that the City of Del Rio already has complimentary drought triggers that reflect flow from San Felipe Springs for reducing municipal demands during droughts (Table 4-6).

5.3.2 Barton Springs/Edwards Aquifer Conservation District

The index well and spring discharge approach to groundwater management during drought periods is also used by the Barton Springs/Edwards Aquifer Conservation District. This groundwater conservation district regulates the use of the Barton Springs segment of the Edwards (Balcones Fault Zone) Aquifer and the Trinity Aquifer and maintains springflow through groundwater management strategies to maintain endangered species habitat. The Barton Springs/Edwards Aquifer Conservation District has also invested in extensive data collection, research, and modeling efforts to support its core management objectives.

The Barton Springs/Edwards Aquifer Conservation District identified management zones that allow for permitting and production rules unique to aquifer subdivisions within the district. The district monitors specific conditions of aquifer water level elevations, spring discharges, and water quality to use as indicators of drought conditions with identified management zones for purposes of declaring the various drought severity stages (BSEACD, 2021 and 2022). Either the

springflow at Barton Springs or the water level at a drought indicator well (the Lovelady Monitor Well) can initiate a drought declaration by the district's board of directors.

Drought severity stages for the district's management zones are triggered by declines in the rate of discharge at Barton Springs and/or increases in depth to water in the district's drought indicator well (BSEACD, 2021 p. 126). The drought stages and trigger conditions are depicted in Figure 5-2, and the associated curtailments for each management zone are depicted in Figure 5-3. Stages include a no drought condition that, during the summer months of May 1 through September 30, is designated as a "Stage 1 – Water Conservation Period". There are voluntary measures in place to reduce water use during this stage when seasonal groundwater demand typically increases. The remaining drought stages include mandatory pumping curtailments for permitted well owners. To track whether permittees are meeting required curtailments, the district requires permittees to submit monthly meter readings, which are used by the district to calculate actual monthly pumpage volumes relative to monthly drought curtailment targets (BSEACD, 2023).

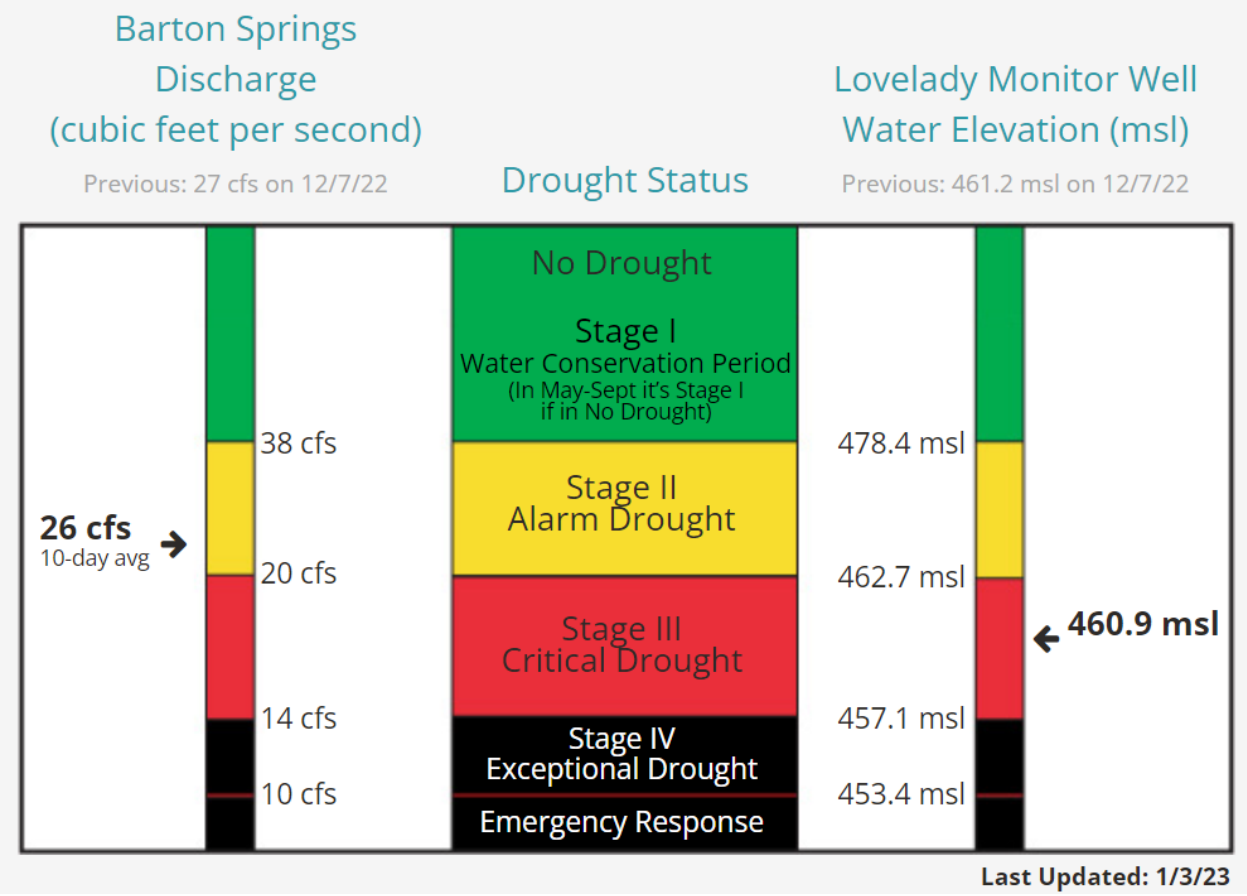


Figure 5-2. Example drought stage image from the Barton Springs/Edwards Aquifer Conservation District (2023).

Drought Curtailment Chart

Aquifer		Edwards Aquifer						Trinity Aquifer			
Management Zone		Eastern/Western Freshwater					Saline	Lower	Middle	Upper	Outcrop
Permit Type		Historical	Conditional				Hist.	Hist.	Hist.	Hist.	Hist.
			Class A	Class B	Class C	Class D					
Drought Stages	No Drought	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	Water Conservation (Voluntary)	10%	10%	10%	10%	10%	0%	10%	10%	10%	10%
	Alarm	20%	20%	50%	100%	100%	0%	20%	20%	20%	20%
	Critical	30%	30%	75%	100%	100%	0%	30%	30%	30%	30%
	Exceptional	40%	50%[1]	100%	100%	100%	0%	30%	30%	30%	30%
	Emergency Response Period	50%[3]	>50%[2]	100%	100%	100%	0%	30%	30%	30%	30%

Percentages indicate the curtailed volumes required during specific stages of drought.

1 Only applicable to NDUs and existing unpermitted nonexempts after A to B reclassification triggered by Exceptional Stage declaration

2 Curtailment > 50% subject to Board discretion

3 ERP (50%) curtailments become effective October 11, 2015. ERP curtailments to be measured as rolling 90-day average after first three months of declared ERP.

Figure 5-3. Drought curtailment chart for management zones for Barton Springs/Edwards Aquifer Conservation District drought stages (from BSEACD, 2023).

5.3.3 Clearwater Underground Water Conservation District

The Clearwater Underground Water Conservation District uses a slightly different approach for groundwater management during drought periods. This groundwater conservation district regulates the use of the northern segment of the Edwards (Balcones Fault Zone) Aquifer and the Trinity Aquifer and maintains springflow through groundwater management strategies to maintain threatened species habitat. The Clearwater Underground Water Conservation District also continues to invest in extensive data collection, research, and modeling efforts to support understanding of the local groundwater resources.

The Clearwater Underground Water Conservation District uses a drought plan that provides status reports for the Edwards (Balcones Fault Zone) and Trinity aquifers within Bell County (CUWCD, 2022). For the Edwards (Balcones Fault Zone) Aquifer, the district uses a combination of the Precipitation Deficit Index and daily maximum spring discharge averaged monthly. Drought stages are triggered when either the Precipitation Deficit Index or the average spring discharge fall below specified trigger levels (Table 5-3). The Precipitation Drought Index is based on a daily running year average and on NEXRAD radar rainfall estimates, and the index trigger must be exceeded for a 28-day period prior to entering a drought stage. The spring discharge is monitored daily with the daily maximum discharge values averaged over a period of five consecutive days on a running five-day basis. The water usage reductions recommended for each drought management stage in the district are voluntary.

Table 5-3. Clearwater Underground Water Conservation District Edwards (Balcones Fault Zone) Aquifer Drought Management Plan and voluntary water usage reductions (modified from CUWCD, 2022).

Drought management stage	Precipitation Deficit Index for Edwards Aquifer region in Bell County (percent of average rainfall)	Salado Springs discharge (acre-feet per month)	Percent usage reduction
Stage 1 Awareness	70-79 (mild drought)	900	10
Stage 2 Concern	60-69 (moderate drought)	700	20
Stage 3 Serious	50-59 (severe drought)	400	30
Stage 4 Critical	< 50 (extreme drought)	200	40

5.3.4 Hill Country Underground Water Conservation District

The Hill Country Underground Water Conservation District regulates the use of the Edwards-Trinity (Plateau), Trinity, Ellenburger-San Saba, and Hickory aquifers. Unlike the other spring-based examples, the Hill Country Underground Water Conservation District (2014) established a drought management plan and developed a local drought index to guide the groundwater management during drought periods for aquifers within the district. The drought index is based on

- water levels from two Ellenburger-San Sava Aquifer wells, located in areas where heavy pumpage occurs for municipal and irrigation demands;
- Pedernales River flow data;
- the previous 10-month cumulative rainfall amounts as recorded at Lady Bird Johnson Park; and
- the Palmer Drought Severity Index for the Edwards Plateau climatic region.

The trigger conditions that implement the drought plan for the district are based on local drought indices, however the district may choose to use the local drought index or any other drought indices the district believes most accurately reflect drought conditions. The district may make a Critical Groundwater Depletion Designation at any time when local conditions warrant a designation. Once the district makes a Critical Groundwater Depletion Designation, all permitted wells in Gillespie County, including all grandfathered wells, must reduce production to prescribed levels in the drought index levels.

The application of a local drought index to signal the need for water conservation to the public is one way to use limited monitoring points along with a publicly available drought index. This method could be applied to areas of the state without groundwater conservation districts.

Table 5-4. Hill Country Underground Water Conservation District Drought Management Plan and water demand reduction schedule (modified from HCUWCD, 2014).

Drought stage	Local drought index	Average daily water demand reduction	Maximum daily water demand reduction	Drought Stage Termination (Local Drought Index)
Stage 1 – Mild	-1.0 to -1.9	5%	10%	>-1.0
Stage 2 – Moderate	-2.0 to -2.9	10%	20%	>-2.0
Stage 3 – Severe	–3.0 to –3.9	15%	25%	>-3.0
Stage 4 – Critical	–4.0 to –4.9	20%	40%	>-4.0
Stage 5 – Emergency	>-5.0	30%	50%	>-5.0

6 Conclusions and recommendations

The hydrological landscape in Val Verde County is unique and complex. Groundwater and surface water resources are intimately connected, sensitive wildlife species are dependent on groundwater flows supporting streamflow, and potential future groundwater development is on the horizon. Establishing a better understanding of the resources and setting management goals that address the interests of a broad group of stakeholders is critical to effective groundwater management in the county.

Suggesting groundwater management strategies, particularly for drought periods, in an area without a groundwater conservation district is difficult without an entity to incorporate stakeholder interests and monitor implementation and compliance. However, the recommendations and information included in both in Weinberg and others (2018) and in this report can be used to guide groundwater management efforts by Val Verde County, the City of Del Rio, any future groundwater conservation district, and any other entities involved in groundwater-related decision making. The TWDB proposes the following recommendations:

Education and outreach

Education and outreach are important aspects of any groundwater management plan, within a city or in more rural areas.

- Develop a county-wide drought and water awareness campaign. The Texas Water Foundation's statewide campaign, Texas Runs on Water (Texas Water Foundation, 2023) may be an effective campaign to pursue because it can be localized to specific communities and combined with local interests.
- Set up a web-based drought portal to improve knowledge of groundwater drought conditions, including citizen-based reporting of groundwater levels and drought conditions and providing education about water wells during drought conditions. This could include the creation of indices to show the occurrence of groundwater drought. An initial web-based portal could include links to existing resources, such as the TWDB Water Data for Texas drought and groundwater dashboards and the U.S. Geological Survey National Water Data Dashboard.
- Provide rural well owners with educational opportunities, such as those offered through the Texas Well Owner Network, with an emphasis on conservation and drought.

Data and research

As noted in this report and in Weinberg and others (2018), more detailed hydrogeological assessments are needed to support groundwater management objectives.

- Consider a technical advisory workgroup composed of stakeholders actively engaged in data collection and research in Val Verde County.

- Fill data gaps for key factors, such as groundwater-surface water interactions, aquifer storage, and recharge.
- Establish a representative groundwater monitoring network of at least 25 to 30 wells equipped with instruments to provide daily water level measurements.
- Monitor groundwater production. Val Verde County, the City of Del Rio and others may monitor water levels and establish a voluntary water well metering and reporting program to inform estimates of groundwater production in the absence of a groundwater conservation district. Voluntary water well metering may be used to establish historic use for permitting by any future groundwater conservation district.
- Further refine proposed management zones (Figure ES-1) based on data and research initiatives.

Groundwater management and planning

- Val Verde County, the City of Del Rio, and others may consider preparing groundwater management strategies consistent with groundwater management plan goals required by Texas Water Code Chapter 36 requirements for groundwater conservation district management plans.
- Val Verde County may consider requiring groundwater availability certifications for subdivisions (Local Government Code § 232.0032). The City of Del Rio already requires these certifications under authority granted by Local Government Code § 212.0101. Information from these groundwater availability studies can be another source of data collection for the groundwater resources in the county.
- Val Verde County, the City of Del Rio, and other interested parties would benefit from participating in Groundwater Management Area 7 activities. Providing funding and input to the joint groundwater planning process would ensure that conditions adopted by the district members include consideration of groundwater concerns for Val Verde County.
- Utilize the proposed groundwater management zones (Figure 5-1) as a starting point to improve groundwater data collection and cooperation to support future groundwater management, whether by a groundwater conservation district or other existing entity.

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