PLUM CREEK CONSERVATION DISTRICT

Groundwater Management Plan
Adopted As Amended

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PLUM CREEK CONSERVATION DISTRICT

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Groundwater Management Plan

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PLUM CREEK CONSERVATION DISTRICT

GROUNDWATER MANAGEMENT PLAN

1. DISTRICT MISSION

The Plum Creek Conservation District (PCCD) mission for groundwater management is to conserve and preserve groundwater availability and protect permitted and exempt groundwater users, by gathering information about groundwater conditions and uses within the District; obtaining information from surrounding Groundwater Districts to assist in understanding groundwater availability within Plum Creek's area; by using that information to adopt Rules consistent with state law in order to maximize the beneficial development and use of the groundwater resources on a sustainable basis in keeping with the desired future conditions of aquifers within Plum Creek Conservation District's jurisdictional area; and by then enforcing these adopted Rules. The District will accomplish this mission by identifying aquifers within the District; and then by (1) determining zones of the various aquifers within the District, (2) imposing spacing requirements, (3) limiting production, (4) requiring permits for non-exempt wells and groundwater production, (5) noting information on exempt wells, (6) establishing water drawdown levels, (7) monitoring aquifer levels and production, (8) making appropriate adjustments to allowable and permitted production as more data become available, and (9) encouraging conservation to limit pumping. These actions are designed to extend the quantity and preserve the quality of the water available in the aquifers in Caldwell and Hays counties regulated by the District. PCCD is committed to protecting, conserving, and preventing waste of the groundwater resources in its District for the benefit of the citizens, economy, and environment.

2. TIME PERIOD OF THIS PLAN

This plan will become effective upon adoption by the PCCD Board of Directors and approval as administratively complete by the Texas Water Development Board. The plan will remain in effect for five years after the date of approval or until a revised plan is adopted and approved, or as otherwise directed by the Texas Legislature.

3. BACKGROUND

The PCCD is situated in parts of Caldwell and Hays Counties. The District was created as a Water Control and Improvement District in the 55th Texas Regular Legislative Session in 1957 with the passage of Senate Bill 289 under the provisions of Section 59, Article XVI of the Texas Constitution. The enabling statute provided the District with the power to control, conserve, protect, distribute and utilize the storm and floodwaters and unappropriated flow of Plum Creek and its tributaries as a Water Control and Improvement District. In 1989 the original 1957 legislation was amended to additionally authorize the District, upon approval of the qualified voters of the District, to exercise the powers and duties imposed under what is now Chapter 36 of the Texas Water Code, for the preservation, conservation, protection, recharge, and prevention of waste and pollution of the underground water of the District except in those areas of the District that were part of the Barton Springs-Edwards Aquifer Conservation District or the Edwards Underground Water District on January 1, 1989. The voters in the District approved the implementation of the powers granted by the Legislature after the 1989 amendment was passed in the Legislature.

1. Introduction: The District recognizes that the groundwater resources of the region are of vital importance not only within the District but to areas outside the District. The District was created, in part, to conserve, preserve, protect, and prevent waste of all the water resources within its jurisdiction. The District believes that the groundwater resources in the District can be managed in a prudent and cost-effective manner through education and conservation, coupled with reasonable regulation, including permitting of new and existing non-exempt wells and registering of exempt wells. Although the District has undertaken studies and has developed information about the occurrence and quality of groundwater in various geologic formations in and near the District, the District continues to conclude that one of the greatest threats to prevent the District from achieving the stated mission are inadequate information about groundwater occurrence, quality, groundwater production volumes, groundwater production rates, groundwater movement and groundwater uses within and from aquifers regulated by the District based in part on a lack of knowledge about groundwater production from exempt wells both within the District and groundwater occurrence and production from all aquifers in areas without groundwater districts adjacent to or in close proximity with the area of Plum Creek Conservation District. The District has concerns about the potential for groundwater quality degradation in some areas of the District related to existing groundwater pumping and to old oil and gas activities. The District continually needs to develop more information to understand how groundwater production, recharge, and flow into and out of the District are interrelated

with production, recharge and flow in areas surrounding the District. Basic knowledge of the aquifers and their hydrogeological properties, a quantification of resources, and development of data on groundwater quality are the foundation from which to build prudent planning measures. This Management Plan is intended as a tool to focus the thoughts and actions of those given the responsibility for the execution of the District's activities in developing information and in driving activities implementing the District's goals.

2. Policy: It shall be the policy of the Board of Directors that the most beneficial use of groundwater in the District is to maintain present non-wasteful groundwater uses of those in the District and then to provide for future groundwater needs of citizens. Groundwater shall be beneficially used, conserved, preserved, protected, and waste prevented within the District to maintain the viability of those resources for current users and for users in the future who are in the District's area. The Board of Directors, with the cooperation of the citizens of the District and of surrounding political subdivisions, shall implement this management plan and any necessary modifications thereof to achieve this goal.

3. Governing Board: The District is governed by an appointed six-member Board of Directors.

4. Daily Operations: The day-to-day management of District activities is carried out currently by a four-member staff led by Daniel Meyer, Executive Manager.

5. Topography: The land surface of Caldwell County ranges from nearly flat to hilly. The minimum elevation, about 295 feet, is at the southern tip of the County where Plum Creek joins the San Marcos River. The maximum elevation in Caldwell County, about 725 feet, is in the area of the so-called "Iron Mountains" peaks, approximately 2.5 miles southeast of McMahan, a small community approximately nine miles southeast of Lockhart. Regionally, the topographic elevations increase from southeast to northwest.

The portion of District located in Hays County generally exhibits the same type of terrain, although the elevation differences are more pronounced. Some of the surface of the District's area extends into Hays County, which overlies the Balcones Escarpment, and provides drainage to a portion of Plum Creek.

Plum Creek drains about 310 square miles, or about 60% of Caldwell County. In addition, a portion of Hays County that is drained by Plum Creek is also in the boundaries of the District. There is a small area of Travis County that drains into Plum Creek, but that area is not within the District's boundaries.

6. Location and Extent: The District is situated within parts of Caldwell and Hays Counties, but the District's boundaries are not conterminous with those of either Caldwell or Hays Counties. The original boundaries of the District are described in Section 3 of the enabling statute that first created the District. In 2008 there were additional properties located in the southeastern portion of Caldwell County annexed into PCCD at the request of the landowners of the properties, however; the area where those properties were located was also annexed into the Gonzales County Underground Water Conservation District. S.B 1225 of the 82nd legislature enacted in 2011 was passed to and allowed the property owners annexed by Plum Creek to choose which district they wanted to belong to with the result that the original boundaries of the District were expanded by approximately 4,672 acres. The most downstream point of the boundaries of the District is in the most southernly corner of Caldwell County near the confluence of Plum Creek and the San Marcos River. The calls in the original description of the boundaries of Plum Creek Conservation District are, generally, along tract or survey lines.

7. Water Resources: The District does not hold, own or otherwise control any groundwater or surface water rights. The District is located within the territory of the Guadalupe-Blanco River Authority ("GBRA"), which controls substantial surface water rights associated with GBRA owned or operated facilities and reservoirs, including Canyon Lake. Some water supply corporations providing retail water service within the District have access to surface water supplies either through direct ownership, through lease, or through long term supply contracts. Most of the permitted surface water rights in the vicinity of Plum Creek Conservation District are from the San Marcos River, which is not in the Boundaries of the District. There are few surface water rights permits for diversions from Plum Creek and none known for diversion from Plum Creek for any purpose other than agricultural use.

As a part of this Plan, each year the District will strive to confer at least once with GBRA on cooperative opportunities for conjunctive resource management between ground and surface water suppliers to retail providers and other users.

4. Groundwater Resources

The PCCD has within its surface area boundaries the following geological formations: Quaternary Alluvium, Leona Gravel, Austin-Pecan Gap, Navarro, Midway, Wilcox Group, Queen City, Reklaw, Saline Edwards, Trinity Group and the Carrizo Sands. A geologic map of the area of the District is appended as Appendix D. The Texas Water Development

Board recently ran a groundwater availability model for the Southern portions of the Carrizo-Wilcox, Queen City, and Sparta, aquifers within the District. No information on discharges from, exchanges among aquifers, or flow into or out of the Leona Gravel, or from recent alluvium deposits in the District is currently available from the Texas Water Development Board. The full modeling report, GAM Run 12-001-Plum Creek Conservation District Management Plan, is appended to this Plan as Appendix C.

5. MANAGEMENT ZONES

1. **Alluvium** – occurs along present-day streams and rivers. Consists of sand, silt and clay. Serves as a limited household and livestock aquifer within the predominant sand facies.

2. **Leona** – occurs along scattered outcrops perpendicular to the Balcones Fault System and the IH-35 corridor. Serves as a shallow limited aquifer utilized manly as a small lot irrigation aquifer. Much of the aquifer has varying levels of nitrates, which are not recommended for human or livestock consumption.

3. **Weches** – is primarily a glauconitic marine clay and is seldom utilized as stray sand or silt aquifer.

4. **Queen City** – occurs as a shallow limited sand and silt aquifer with lesser amounts of clay. The completed wells are generally utilized for household and livestock.

5. **Reklaw** – primarily consists of clay with broken silt and sand intervals that can serve as shallow household and livestock aquifers in limited areas.

6. **Carrizo** – occurs as a major irrigation and municipal aquifer. Consists of ancient barrier island loose fine-coarse sand bodies separated by thin estuary silty clays. It is the major aquifer along the Upper Gulf Coastal Plain across southern Texas capable of high production rates of fresh water.

7. **Wilcox** – often studied and associated with the overlying Carrizo aquifer. It is separated from the Carrizo by a regional disconformity and exhibits some very different deltaic facies as compared to the Carrizo. It is utilized as a household, livestock, irrigation, and municipal source of fresh water over a wide area.

8. **Midway –** occurs primarily as a thick clay with minor amounts of silt near the top of the unit. It does not generally serve as a reliable aquifer, even in limited silty zones.

9. **Navarro –** consists mainly as a thick sequence of expansive clay. It does not serve as an aquifer within the boundaries of the Plum Creek Conservation District.

10. **Pecan Gap –** this limestone and chalk unit does serve as a very limited household and livestock fractured low yield aquifer along and parallel to the southeast side of the IH-35 corridor. Many of the wells eventually go dry.

11. **Austin Chalk** – this very limited limestone and chalk aquifer immediately underlies the Pecan Gap and exhibits similar characteristics.

12. **Eagle Ford –** this unit is a petroliferous thin clay and does not serve as an aquifer.

13. **Buda** – occurs as a dense limestone unit in the PCCD area and does not serve as any known aquifer. It does serve as an aquifer in the Uvalde County area.

14. **Del Rio** – does not serve as an aquifer in Texas. It occurs as a weathered volcanic ash expansive clay.

15. **Georgetown** – occurs as a dense limestone and is not expected to serve as a brackish or saline aquifer in the PCCD area.

16. **Edwards –** this limestone and dolomite karst aquifer is the major fresh water source for the cities, towns and industries along the IH-35 corridor which partially fall within the PCCD area. The unit is also a very strong future candidate of brackish and saline water southeast of the IH-35 corridor that may eventually rival the Carrizo aquifer.

17. **Glen Rose –** certain areas within the Glen Rose along the axis of the San Marcos Arch do harbor large carbonate patch reefs that do contain substantial amounts of brackish and saline water. These Glen Rose patch reefs will undoubtedly be utilized as desalination targets.

18. **Bexar** – occurs as a thin clay and does not serve as an aquifer.

19. **James (Cow Creek)** – does serve as a highly-used household and livestock aquifer along the northwest side of the IH-35 corridor in the Hill Country Balcones Fault System. Recently discovered higher yield Cow Creek wells have been tested in a limited area of the Balcones Fault System.

20. **Pine Island –** occurs as natural gas charged expansive clay that does not serve as an aquifer.

21. **Sligo –** occurs as sandy glauconitic limestone that may serve as a future limited brackish and saline aquifer.

22. **Hosston** – occurs as a sand and basal gravel aquifer, it serves most of the small-town fresh water municipal needs across the Texas Hill Country. The future desalination era will undoubtedly target the brackish and saline portions of the Hosston clastics with the PCCD boundaries.

Management Zone Descriptive Table:

Period	Epoch	Group/Formation/Member	Description
Quaternary	Holocene	Alluvium	Sand, silt, clay
	Pleistocene	Leona	Gravel, sand, silt, clay
Tertiary	Eocene/Paleocene	Weches	Clay, silt, sand
		Queen City	Sand, clay
		Reklaw	Clay, sand, silt

		Carrizo	Sand, clay
		Wilcox	Sand, clay. silt
		Midway	Clay, silt, sand
Cretaceous	Upper	Navarro	Clay, silt, sand
		Pecan Gap	Limestone, clay
		Austin Chalk	Limestone, clay
		Eagle Ford	Clay
	Lower	Buda	Limestone
		Del Rio	Clay
		Georgetown	Limestone
		Edwards	Limestone, dolomite
		Glen Rose	Limestone, dolomite, clay
		Bexar	Clay
		James (Cow Creek)	Limestone
		Pine Island (Hammett)	Clay
		Sligo	Limestone, silt
		Hosston	Sand, clay

6. PRODUCTION AND SPACING OF WELLS

Production and spacing of all wells within the District is regulated by the District according to the Rules of the District. As noted, the Rules may be changed from time to time. The District has recently revised its Rules, with the latest revision becoming effective as of December 16, 2018, to take into account knowledge gained through its geologic studies that have been ongoing and to address anticipated increases in demands on the aquifers in and regulated by the District.

7. MANAGEMENT OF GROUNDWATER SUPPLIES

The District evaluates and monitors groundwater availability, and regulates production consistent with the District Rules, the GMAs (10 & 13) adopted Desired Future Conditions, ("DFC") and the Modeled Available Groundwater determination of the Texas Water Development Board. In consideration of the importance of groundwater availability to the economy and welfare of those in the District, the District anticipates that in the future, groundwater production will be regulated as needed to conserve groundwater, preserve groundwater availability, and protect permitted and exempt groundwater users, in a manner not to unnecessarily and adversely limit production or impact the economic viability of public and private groundwater users. The District will identify and engage in such activities and practices that will permit groundwater production and, as appropriate, will protect the aquifer and groundwater availability by restricting future requested pumping quantities, if necessary, according to the best information then available to the District.

Currently there are a number of monitoring wells that are in PCCD's Aquifer Water Level Observation Program that are being used in order to monitor aquifer conditions within the district and to track compliance with the DFCs. On an annual basis, in accord with advice from its technical consultant, PCCD will, if necessary, modify the program. The District will make a regular assessment of water supply and groundwater storage conditions as observed in data from its network and will report those conditions to the Board and to the public. The District will undertake investigations, and co-operate with third-party investigations including neighboring districts, of the groundwater resources within the District, and the results of the investigations will be made available to the public upon being presented at a meeting of the Board. The District will manage the available groundwater based on the *"Desired Future Conditions"* and Modeled Available Groundwater determination of the aquifers.

The District has adopted Rules to regulate groundwater withdrawals by means of well spacing and production limits or, alternatively, in accord with a study of the effects of the proposed well on the targeted aquifer. The District may deny a water well production permit or limit groundwater withdrawals in accordance with the Rules of the District. In making a determination to deny a permit or limit groundwater withdrawals, the District will consider the available data and evidence and then weigh the public benefit against the individual needs and hardship in accord with State law.

The relevant factors to be considered in a determination to grant or deny a well or a production permit or limit groundwater withdrawals are stated in the District's Rules and information furnished can include:

(a) Whether the application contains all the information required to be submitted to the District pursuant to these Rules;

(b) Whether the application is in conformance with any applicable requirements under Rule 19 – Classification, Spacing and Production Provisions established by the District;

(c) Whether the proposed use of groundwater unreasonably affects existing groundwater or surface water resources;

(d) Whether the proposed use of groundwater is a beneficial use consistent with District's Certified Groundwater Management Plan;

(e) Whether the applicant has agreed to avoid waste and achieve water conservation;

(f) Whether the proposed use of the groundwater will result in subsidence;

(g) Whether the applicant has agreed that reasonable diligence will be used to protect groundwater quality, and that the applicant will follow well plugging guidelines at the time of well closure;

(h) The equitable distribution of the resource; and

(i) The potential effect the permit may have on the aquifer, sustainability of the recharge on the aquifer as a whole, and potential impacts to prior existing permitted groundwater users and exempt groundwater users;

(j) The modeled available groundwater determined by the executive administrator;

(k) The executive administrator's estimate of the current and projected amount of groundwater produced under exemptions granted by district rules and Section 36.117;

(l) The amount of groundwater authorized under permits previously issued by the district;

(m) A reasonable estimate of the amount of groundwater that is actually produced under permits issued by the district;

(n) Yearly precipitation and production patterns;

(o) Estimated Average Annual Recharge.

The transport of groundwater out of the District is regulated by the District according to the Rules of the District.

In pursuit of the District's mission of protecting the resource to facilitate its maximum beneficial use, the District may require reduction of permitted groundwater withdrawals to amounts that, based on then available current information, will not knowingly cause permanent harm to an aquifer. To achieve this purpose, the District may, at the Board's discretion and after notice and hearing, amend or revoke any permit for non-compliance, or reduce the production authorized by permit based upon reliable scientific data for the purpose of protecting the aquifer and groundwater availability. The determination to seek the amendment of a permit will be based on aquifer conditions observed by the District confirmed by reliable scientific analysis. The determination to seek revocation of a permit will be based on compliance and non-compliance with the District's Rules and regulations, and reliable scientific evidence. The District will enforce the terms and conditions of permits and the Rules of the District, as necessary, by fine and/or enjoining the permit holder, or non-permit holder, in a court of competent jurisdiction as provided for in Chapter 36, Texas Water Code.

A drought management plan has been adopted by the Board to cope with the effects of water supply deficits due to climatic or other conditions. In its annual review of the drought management plan, the District, in establishing drought triggers and stages, anticipates consideration of the economic effect of conservation measures upon all water resource user groups, the local implications of the degree and effect of changes in water storage conditions, the unique hydrogeological conditions of the aquifers within the District and the appropriate conditions under which to implement the drought management plan.

The District will employ reasonable and necessary technical resources at its disposal to evaluate the groundwater resources available within the District and to determine the effectiveness of regulatory or conservation measures. The District anticipates that its drought management plan will provide that a public or private user may appeal to the Board for discretion in enforcement of the provisions of the water supply deficit drought management plan on grounds of adverse economic hardship or unique local conditions. The exercise of discretion by the Board, shall not be construed as limiting the power of the Board.

8. ACTIONS, PROCEDURES, PERFORMANCE AND PLAN IMPLEMENTATION

The District will implement the provisions of this Plan and will utilize the provisions of this Plan as a guidepost for on-going evaluation determining the direction or priority for all District activities. All operations of the District, all agreements entered into by the District and any additional planning efforts in which the District may participate will be consistent with the provisions of this Plan.

The District has adopted Rules relating to the permitting of wells, production and transport of groundwater. The Rules adopted by the District will be modified to take into account this Plan once it has been approved and shall be amended as necessary, pursuant to Chapter 36 of the TEXAS WATER CODE consistent with the provisions of this Plan based upon reliable scientific evidence. All Rules will be enforced. The promulgation and enforcement of the Rules will be based on the best technical data reasonably available. A link to the District rules is provides as follows:

http://www.pccd.org/PCCD%20GW%20Management%20&%20Protection%20Rules.pdf

The District shall treat all citizens equally. Citizens may apply to the District for a variance in enforcement of the Rules on grounds of adverse economic effect or unique local conditions. In granting a variance to any rule, the Board shall consider the potential for adverse effect on adjacent landowners and the rights of other groundwater owners and users within the District. The exercise of said discretion by the Board shall not be construed as limiting the power of the Board.

The District will seek cooperation with other agencies in the implementation of this Plan and the management of groundwater supplies within the District.

The District believes that there is a significant issue that affects groundwater within its boundaries and affects the District's ability to effectively manage the groundwater resources within the District and that issue is that there are very productive regions of aquifers that are near but not within Plum Creek Conservation District's regulatory authority. Should there be large volume water production from aquifers in these areas, there is significant potential that such production will impact water quantity and/or water quality of users in the District.

The fact that Plum Creek Conservation District's surface boundaries also includes areas that are within the Barton Springs Edwards Aquifer Conservation District and the Edwards Aquifer Authority [the District does have authority over any aquifers in Hays and Caldwell County within its boundary that are not regulated by either the Edwards Aquifer Authority or the Barton Springs-Edwards Aquifer Conservation District -] indicates that Plum Creek should cooperate with [and provide some assistance to] the EAA and the Barton Springs-Edwards District while developing plans for understanding and use of water resources to the fast growing area along Interstate 35 between San Antonio and Austin. PCCD's territory extends from Northwest of IH-35 to IH-10 and encompasses much of an area that is projected to have continued rapid growth. The completion of SH-130, along with other regional projects is considered by many to be a necessary infrastructure component to allow for population and economic growth. Developers and retail water suppliers are already searching for additional water supplies to meet growing demand.

Finally, there are significant long-existing oil and gas operations in the southern part of the District along with the possible future exploration and development of gas-liquids shale plays. Should those activities continue to increase as the price for oil and gas resources stays high, there may be significant consumption of water, or other groundwater impacts such as the potential for pollution, related to such activities that is outside the scope of regulatory power of any groundwater district.

For these reasons, all activities of the District will be undertaken in co-operation and coordinated with the appropriate state, regional or local water management entities where they are present. However, simply stated, in Hays County there are many such agencies looking at management of groundwater; in Caldwell County the absence of a groundwater agency in the eastern and western part of the county makes management of the groundwater resources in the District more challenging.

9. METHODOLOGY FOR TRACKING DISTRICT PROGRESS IN ACHIEVING MANAGEMENT GOALS

The Groundwater Manager of the District will prepare and present an annual report to the Board of Directors on the performance of the District with respect to achieving its management goals and objectives. The presentation of the report will occur during the last monthly Board meeting each fiscal year, beginning after the adoption and approval of this Plan. The report will include an enumeration and listing of activities furthering the District's management objectives during the fiscal year. Each activity will be referenced to the estimated expenditure of staff time and District resources used in accomplishment of the activity. The notations of activity frequency, staff time and resources used will be referenced to the appropriate performance standard for each management objective describing the activity, so that the effectiveness and efficiency of the District's operations may be evaluated. The Board will maintain the adopted report on file for public inspection at the District's office. This methodology will apply to all management goals contained within this plan.

10. MANAGEMENT GOALS, OBJECTIVES, & PERFORMANCE STANDARDS

10.1 Providing the Most Efficient Use of Groundwater

Management Objectives:

1. The PCCD Aquifer Water Level Observation Well Program will have at least 6 observation wells located according to management zones within the District and measure those wells at least one time a year.

2. As part of the Aquifer Water Level Observation Program, the District will geographically divide the surface area overlying the aquifers of Plum Creek Conservation District into a grid-type network of units and will have a goal of establishing at least one monitoring water well in each of these units.

3. The District will provide educational leadership to citizens within the District concerning this subject. The activity will be accomplished annually through at least one printed publication, such as a brochure, and public speaking at service organizations and/or public schools as provided for in the District's Public Education Program.

4. The District will use its best efforts to obtain information on water being produced from areas in Caldwell County that are outside the boundaries of the District.

5. The District will use its best efforts to obtain information on groundwater being produced from groundwater aquifers in counties surrounding the District as well as in areas close to the District that are not in a groundwater conservation district in order to develop information about impacts of such production on groundwater in the District.

Performance Standards:

1. The PCCD Aquifer Water Level Observation Well Program will have at least 6 observation wells located according to management zones within the District.

2. Water levels at these observation wells will be measured a minimum of one time during the year.

3. As part of the Aquifer Water Level Observation Program the District will geographically divide the surface area overlying the aquifers of Plum Creek Conservation District into a grid type network of units within one year of the adoption of this plan and on an annual basis, the district will assess the District's progress of establishing at least one monitoring well in each of these units.

4. PCCD representatives will circulate at least one publication and participate in one speaking engagement each year.

5. PCCD representatives will attend and participate in GMA meetings appropriate to the District's regulatory authority.

6. PCCD will periodically gather information from nearby groundwater districts not in the same GMA but drawing from the same aquifers regulated by the District.

10.2 Controlling and Preventing Waste of Groundwater

Management Objective:

The District will provide educational leadership to citizens within the District concerning this subject. The activity will be accomplished annually through at least one printed publication, such as a brochure.

Performance Standards:

1. Each calendar year Representatives of Plum Creek will prepare at least one informational article listing current data related to groundwater production and well levels. The goal of the article is to make those who use and depend on the groundwater aware of their use, aware of the impacts of their use, and the need to be responsible in that use.

2. At its offices, Plum Creek will maintain an inventory of publications of others, such as those prepared by the Guadalupe Blanco River Authority about the necessity for conservation and serve as a local source for distribution of those publications.

10.3 Controlling and Preventing Subsidence

Management Objectives:

1. PCCD has reviewed the Texas Water Development Board's (TWDB) Subsidence Report (Final Report: Identification of the Vulnerability of the Major and Minor Aquifers of Texas to Subsidence with Regard to Groundwater Pumping TWDB Contract Number 1648302062 by LRE). This report can be found at this link below. http://www.twdb.texas.gov/groundwater/models/research/subsidence/subsidence.asp. The report indicated that the subsidence risk vulnerability levels in Plum Creek Conservation District range from medium to high for the Carrizo-Wilcox Aquifer(figure 4.7 on page 4-13) The District will monitor those areas that have been categorized as a high subsidence risk for signs of subsidence.

Performance Standard:

1. Once every 3 years the District will monitor those areas that have been categorized as a high subsidence risk for signs of subsidence.

10.4 Addressing Conjunctive Surface Water Management Issues

Management Objective:

1. Each year, the District will send invitations to meet with the Guadalupe-Blanco River Authority (GBRA) and/or other local political subdivisions and water and wastewater utilities on cooperative opportunities for conjunctive resource management.

2. Each year, the District will participate in the regional planning process by attending the Region L Water Planning Group meetings to encourage the development of surface water supplies to meet the needs of water user groups in the District. A representative of the District will attend a minimum of 25 percent of the Region L Water Planning Group meetings.

Performance Standard:

1. Each year the District will send invitations to meet with the GBRA, other political subdivisions or water and wastewater utilities providing retail water service within Plum Creek's boundaries, to gain information about conjunctive resource management.

2. The District will continue to participate in the quarterly meetings of the Plum Creek Watershed Project through the time of completion of the water quality management plan being developed in that effort. The Plum Creek Watershed Project was initiated to address water quality issues in Plum Creek. As part of the project a watershed protection plan was implemented

with the goal of identifying strategies, management measures, outreach and education within the watershed to reduce pollutants and improve water quality in the Plum Creek Watershed. More information can be found here: https://plumcreekwatershed.org

3. The District will, in each annual report, document the participation of District representatives in Region L meetings and the number of meetings attended in the preceding calendar year. Documentation will consist of a table listing all Region L meetings scheduled during the preceding 12 months, and the name(s) of District staff attending.

10.5 Addressing Drought Conditions

Management Objective:

1. Review the Drought Management Strategy Plan annually and revise if necessary, based upon the availability of additional scientific data collected by or presented to the Board. The Drought Management Strategy Plan will be implemented when specified conditions require. Please see the drought management plan here : https://pccd.org/wp-content/uploads/2014/11/Drought-Management-Plan-FINAL-2012.pdf

Performance Standards:

1. Review on an annual basis all the conditions and requirements specified in the Drought Management Strategy Plan that would trigger its implementation.

2. Use data that are available from District monitoring wells and local weather stations monitoring rainfall, looking at rainfall, water levels, and availability.

3. Within one year after the management plan has been approved a link will be provided on the District's website for TWDB's drought web page. https://waterdatafortexas.org/drought

10.6. Addressing Natural Resource Issues That Impact the Use and Availability of Groundwater and Which are Impacted By the Use of Groundwater

Management Objectives:

1. Each year the District will send invitations to meet with a representative of the Texas Railroad Commission (RRC) on the impact of oil and gas production or waste and disposal operations associated with oil and gas production on groundwater availability and quality, as well as the impact of groundwater production on the production of oil and gas in the District.

2. During each year the District will evaluate all permit applications for new production injection or disposal wells permitted by the Railroad Commission, if any are filed, and the information submitted by the applicants on those wells prior to drilling to assess the impact of these wells on the groundwater resources in the District.

The PCCD may inspect abandoned wells to ensure proper closing of wells in accordance to rules set forth by PCCD. Notices will be sent to well owners whose wells do not adhere to District Rules.

Performance Standards:

1. Will send invitations to meet annually with a representative of the Texas RRC;

2. The addition of available RRC well data to the District's database;

3. Report to the PCCD Board of Directors when new groundwater well permit applications are filed, and the possible impacts of those new wells on the groundwater resources in the District; and

4. Annual reports to the Board about consumption and use of groundwater for commercial purposes, including irrigation uses and enhanced oil and gas production when information is available.

5. The following will be the expected key metrics used to measure progress of Management Objectives 3: the number of notices sent out and possible fines assessed to well owners or operators concerning violations of District rules; the number of wells plugged each year.

10.7. Addressing Conservation, Recharge Enhancement, Rainwater Harvesting, Precipitation Enhancement, and/or Brush Control

Management Objectives:

1. The District will provide educational leadership and encouragement to citizens within the District on the need for water conservation and publicize the benefits of rainwater harvesting and brush control. The educational efforts and publicity will be through distribution of brochures produced either by the District or by others and made available by the District and through the presentation annually of informational articles that tabulate data developed by the District on the groundwater resources being monitored. Each of the following topics will be addressed in the publications:

(a) Conservation

(b) Rainwater Harvesting

(C) Brush Control

2. With respect to recharge enhancement, the District will continue to develop geologic data to map and gain understanding of the relationship between recharge to and discharge from various formations to each other and to Plum Creek as it flows through the District. At this time, the relationships among the aquifers and the Creek are not well documented or understood. It is known that recharge of much of the groundwater that can be found in the District and in areas next to the

District that are not in any groundwater district, originate outside the boundaries of the District. There is some natural recharge to aquifers in the District from both streams and from areas where those aquifers are at the surface. However, the formations found in the District are not readily susceptible to recharge enhancement.

3. The District has an active brush control program for the flood water retention structures that it maintains. The District also cooperates with the US Department of Agriculture in agricultural conservation efforts and actively supports the local Soil and Water Conservation District.

4. The District has participated in the funding of a rainwater harvesting demonstration project at the Luling Foundation and will continue to monitor the results of that project and report those results in its articles.

5. The District does not believe that precipitation enhancement is appropriate and cost effective in its area. At the same time, PCCD is aware of efforts being implemented by other districts and will continue to monitor the information gathered from those and determine whether such efforts might be attempted by the District. The District will continue to assess the need and opportunity for precipitation enhancement in the District at least once every five years.

Performance Standards

1. Preparation and distribution of at least one publication each year containing information about conservation, rainwater harvesting and brush control efforts.

2. The District staff will continue to cooperate with the Natural Resource Conservation Service to control brush on the 28 flood water retention structures maintained by the District. In addition, the District will participate in at least one meeting each year with the local soil and water conservation district to discuss brush control efforts and will continue to support the local soil and water conservation districts efforts through an annual financial contribution.

3. The District will obtain, if available, at least one report each year about the relationship between recharge of aquifers in the District and rainfall on the surface to determine whether it would be appropriate and cost effective to develop a trial plan for recharge enhancement.

4. At least once every 5 years the staff will report to the Board on the results of nearby precipitation enhancement activities so the Board can consider the feasibility of participating in any efforts in the area of lands that are serving as sources of recharge for groundwater found in the District. If the Board determines that precipitation enhancement might be appropriate and cost effective, within two years the Board will develop and adopt a program allowing participation in precipitation efforts ongoing in the region.

10.8. Mitigation & Desired Future Conditions of Groundwater Resources

1. The mitigation plan will be reviewed on an annual basis and revised, if necessary, in order to be compliant with the adopted DFCs and any current or new state law in effect. Further, any projects that have been mitigated will also be reviewed on an annual basis.

2. Review of groundwater resources in the District in comparison with the Desired Future Conditions of those resources and preparation of a recommendation for any mitigation actions within six months or later if warranted.

10.9 Addressing Desired Future Conditions

Management Objective:

1. At least once every three years, the District will monitor water levels and evaluate whether the change in water levels is in conformance with the DFCs adopted by the District.

2. The District will estimate total annual groundwater production for each aquifer based on the water use reports, estimated exempted use, and other relevant information, and compare these production estimates to the MAGs.

Performance Standards:

1. At least once every three years, the executive manager will report to the Board the measured water levels obtained from the monitoring wells within each Management Zone, the average measured drawdown for each Management Zone calculated from the measured water levels of the monitoring wells within the Management Zone, a comparison of the average measured drawdowns for each Management Zone with the DFCs for each Management Zone, and the District's progress in conforming with the DFCs.

2. At least once every three years, the executive manager will report to the Board the total permitted production and the estimated total annual production for each aquifer and compare these amounts to the MAGs for each aquifer.

3. In conjunction with information from PCCD's drought management plan, Aquifer Water Level Observation Well Program, water use production patterns, analysis from PCCD's geological consultant and other pertinent technical data, the board, at least once every three years will determine if conditions are present that would jeopardize DFC compliance and if so, schedule a hearing to address limiting water use for water well production permit holders.

10.10 Alternative Supply

Management Objective:

The District will assess the need and feasibility, including funding options, of developing a program to research, participate in regional studies with other groundwater conservation districts and regional agencies in order to look at the potential benefits of alternative water supply sources such as underdeveloped aquifers, one being the Trinity Aquifer, desalinization, rainwater harvesting, and aquifer recovery and storage in and around our district.

Performance Standards:

1. Assess the groundwater resources of the Trinity Group and saline Edwards. The district will assess the need to develop one or more monitoring wells to determine the aquifer characteristics and potential for public supply and to cooperate with GCDs that have similar goals.

2. The district will evaluate and support studies on ASR and on desalination projects through cooperative collaboration or financial assistance.

11. PROJECTED TOTAL DEMAND FOR WATER WITHIN THE DISTRICT

Please refer to Appendix A-Estimated Historical Groundwater Use and 2022 State Water Plan Datasets.

12. PROJECTED SURFACE WATER SUPPLIES WITHIN THE DISTRICT

Please refer to Appendix A-Estimated Historical Groundwater Use and 2022 State Water Plan Datasets.

13. PROJECTED WATER SUPPLY NEEDS

Please refer to Appendix A-Estimated Historical Groundwater Use and 2022 State Water Plan Datasets.

TWC § 36.1071(e)(4) The District has reviewed and considered the 2022 State Water Plan data on water supply needs within the District. The Plum Creek Conservation District is situated within parts of Caldwell and Hays Counties. According to the State Water Plan "When existing water supplies—water that is already anticipated to be legally and physically available during a drought of record—are less than the projected water demands required to support regular economic and domestic activities, potential water shortages exist. These potential water shortages are referred to as "identified water supply needs." The total water supply needs as projected for water user groups in Hays and Caldwell County according to the 2022 State Water plan projects a total water supply need of 766 acre-feet by 2020, rising to 51,409 acre-feet by 2070. Because some of these water supply needs are not exclusively within the District boundaries the detailed data from the 2022 State Water Plan on projected water supply needs as attached in Appendix A were evaluated geographically.

14. PROJECTED WATER MANAGEMENT STRATEGIES

Please refer to Appendix A-Estimated Historical Groundwater Use and 2022 State Water Plan Datasets.

TWC § 36.1071(e)(4) The District has reviewed and considered projected water management strategies and participates in TWDB Regional Water Planning of the South Central Texas Regional Water Planning Area (Region L) Planning Group. The District works with other Groundwater Conservation Districts in Region L to assess potential water management strategies and provide local insight regarding technical groundwater data and insights to support the Modeled Available Groundwater (MAG) estimates by TWDB. In managing its groundwater supplies, the District considers the water management strategies contained in the 2022 State Water Plan. These strategies include development of groundwater and surface water supplies, Aquifer Storage and Recovery, reuse, and demand reduction through water conservation. There are ten strategies listed in the 2022 State Water Plan for Caldwell County in the amount of 7,055 acre-feet per year by 2070. There are 12 strategies listed in the 2022 State Water Plan for Hays County in the amount of 90,058 acre-feet per year by 2070.

15. AMOUNT OF GROUNDWATER BEING USED IN THE DISTRICT ON AN ANNUAL BASIS

Please refer to Appendix A-Estimated Historical Groundwater Use and 2022 State Water Plan Datasets.

16. MODELED AVAILABLE GROUNDWATER REPORTS

Please refer to Appendix B-Modeled Available Groundwater Reports
GAM Run 16-033 MAG (Groundwater Management Area 10)
GAM Run 21-018 MAG (Groundwater Management Area 13)

17. ANNUAL AMOUNT OF RECHARGE FROM PRECIPITATION TO THE GROUNDWATER RESOURCES WITHIN THE DISTRICT

Please refer to Appendix C-GAM Run 12-001: Plum Creek Conservation District Management Plan.

18. ANNUAL VOLUME OF WATER T HAT DISCHARGES FROM THE AQUIFER TO SPRINGS AND SURFACE WATER BODIES

Please refer to Appendix C-GAM Run 12-001: Plum Creek Conservation District Management Plan.

19. ESTIMATE OF THE ANNUAL VOLUME OF FLOW INTO THE DISTRICT, OUT OF THE DISTRICT, AND BETWEEN AQUIFERS IN THE DISTRICT

Please refer to Appendix C-GAM Run 12-001: Plum Creek Conservation District Management Plan.

20. ESTIMATE OF MODELED AVAILABLE GROUNDWATER IN DISTRICT BASED ON DESIRED FUTURE CONDITIONS

Texas Water Code § 36.001 defines modeled available groundwater as “the amount of water that the executive administrator determines may be produced on an average annual basis to achieve a desired future condition established under Section 36.108”. The joint planning process set forth in Texas Water Code § 36.108 must be collectively conducted by all groundwater conservation districts within the same GMA. The District is a member of GMA 10 & 13. GMA 10 and GMA 13 adopted DFCs, as summarized below, and then forwarded them to the TWDB for MAG development which are also shown below

21. GEOLOGY MAP OF PCCD

Please refer to Appendix D.

We, the undersigned members of the Board of Directors, do hereby certify and confirm the adoption of this revised and amended Groundwater Management Plan of the Plum Creek Conservation District on this the 17th day of January, 2023 as evidenced by our signatures below:

Board of Directors

James A. Holt, Jr., President

Peter Reinecke, Vice President

Absent

Lucy Knight, Director

Fred Rothert, Director

Tom Owen, Director

Attested by: ______________________

Daniel Meyer, Executive Manager

APPENDIX A

Estimated Historical Groundwater Use And 2022 State Water Plan Datasets:

Plum Creek Conservation District

Texas Water Development Board
Groundwater Division
Groundwater Technical Assistance Section
stephen.allen@twdb.texas.gov
(512) 463-7317
June 27, 2022

GROUNDWATER MANAGEMENT PLAN DATA:

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

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

The five reports included in this part are:

1. Estimated Historical Groundwater Use (checklist item 2)

   from the TWDB Historical Water Use Survey (WUS)

2. Projected Surface Water Supplies (checklist item 6)
3. Projected Water Demands (checklist item 7)
4. Projected Water Supply Needs (checklist item 8)
5. Projected Water Management Strategies (checklist item 9)

   from the 2022 Texas State Water Plan (SWP)

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

DISCLAIMER:

The data presented in this report represents the most up-to-date WUS and 2022 SWP data available as of 6/27/2022. Although it does not happen frequently, either of these datasets are subject to change pending the availability of more accurate WUS data or an amendment to the 2022 SWP. District personnel must review these datasets and correct any discrepancies in order to ensure approval of their groundwater management plan.

The WUS dataset can be verified at this web address:

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

The 2022 SWP dataset can be verified by contacting Sabrina Anderson (sabrina.anderson@twdb.texas.gov or 512-936-0886).

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

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

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

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

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

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

Groundwater and surface water historical use estimates are currently unavailable for calendar year 2020. TWDB staff anticipates the calculation and posting of these estimates at a later date.

CALDWELL COUNTY *51.56% (multiplier)* All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2019	GW	927	0	0	0	245	120	1,292
	SW	1,588	7	0	0	112	478	2,185
2018	GW	887	0	0	0	236	118	1,241
	SW	1,663	7	0	0	74	472	2,216
2017	GW	999	0	0	0	199	111	1,309
	SW	1,610	0	0	0	88	445	2,143
2016	GW	944	0	0	0	203	74	1,221
	SW	1,577	7	0	0	43	292	1,919
2015	GW	934	0	0	0	207	72	1,213
	SW	1,513	4	0	0	27	286	1,830
2014	GW	1,053	0	1	0	335	81	1,470
	SW	1,521	3	0	0	30	322	1,876
2013	GW	1,046	0	1	0	297	77	1,421
	SW	1,509	2	0	0	20	306	1,837
2012	GW	1,207	0	0	0	390	77	1,674
	SW	1,614	0	0	0	42	305	1,961
2011	GW	1,546	0	0	0	527	86	2,159
	SW	1,624	0	0	0	41	344	2,009
2010	GW	1,357	1	2	0	368	87	1,815
	SW	1,580	0	3	0	19	349	1,951
2009	GW	1,400	1	0	0	76	85	1,562
	SW	1,486	0	0	0	9	338	1,833
2008	GW	1,278	1	0	0	134	91	1,504
	SW	1,617	0	0	0	589	360	2,566
2007	GW	914	1	0	0	32	107	1,054
	SW	1,593	0	0	0	606	427	2,626
2006	GW	1,582	1	0	0	179	99	1,861
	SW	1,393	0	0	0	0	396	1,789
2005	GW	1,131	1	0	0	155	140	1,427
	SW	1,257	0	0	0	13	558	1,828
2004	GW	1,922	1	0	0	82	39	2,044
	SW	704	0	0	0	12	503	1,219

HAYS COUNTY *9.11% (multiplier)* All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2019	GW	1,023	15	27	0	44	8	1,117
	SW	1,571	0	0	94	1	214	1,880
2018	GW	907	14	28	0	38	8	995
	SW	1,527	0	0	92	0	224	1,843
2017	GW	934	14	31	0	34	7	1,020
	SW	1,469	0	0	92	17	226	1,804
2016	GW	951	13	24	0	39	9	1,036
	SW	1,234	0	0	127	2	283	1,646
2015	GW	821	16	27	0	23	9	896
	SW	1,262	0	0	145	17	272	1,696
2014	GW	842	17	34	69	57	7	1,026
	SW	1,208	0	0	0	0	293	1,501
2013	GW	1,092	16	34	91	42	7	1,282
	SW	1,193	0	0	0	0	254	1,447
2012	GW	1,204	18	45	0	60	6	1,333
	SW	1,214	0	0	0	8	223	1,445
2011	GW	1,285	16	31	0	80	9	1,421
	SW	1,221	0	0	0	1	213	1,435
2010	GW	1,201	14	61	0	60	9	1,345
	SW	797	0	32	0	1	249	1,079
2009	GW	1,096	14	60	0	67	28	1,265
	SW	797	0	31	0	0	260	1,088
2008	GW	1,103	16	59	0	65	28	1,271
	SW	724	0	30	0	2	581	1,337
2007	GW	941	13	31	0	112	29	1,126
	SW	635	1	1	0	18	353	1,008
2006	GW	1,120	17	32	0	22	28	1,219
	SW	581	0	0	0	0	313	894
2005	GW	965	16	32	0	13	26	1,052
	SW	481	0	0	0	3	309	793
2004	GW	938	14	32	0	11	18	1,013
	SW	437	1	0	0	29	384	851

Projected Surface Water Supplies
TWDB 2022 State Water Plan Data

CALDWELL COUNTY

51.56% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070
L	County Line SUD	Guadalupe	Canyon Lake/Reservoir	403	403	371	340	306	270
L	County-Other, Caldwell	Guadalupe	Guadalupe Run-of-River	0	0	0	0	0	0
L	Gonzales County WSC	Guadalupe	Canyon Lake/Reservoir	9	10	11	12	12	13
L	Livestock, Caldwell	Colorado	Colorado Livestock Local Supply	15	15	15	15	15	15
L	Livestock, Caldwell	Guadalupe	Guadalupe Livestock Local Supply	243	243	243	243	243	243
L	Martindale WSC	Guadalupe	Canyon Lake/Reservoir	226	224	222	220	218	218
L	Martindale WSC	Guadalupe	Guadalupe Run-of-River	11	11	11	11	11	11
L	Maxwell WSC	Guadalupe	Canyon Lake/Reservoir	694	710	720	724	727	727
L	Maxwell WSC	Guadalupe	Guadalupe Run-of-River	9	10	10	10	10	10
L	San Marcos	Guadalupe	Canyon Lake/Reservoir	2	2	2	3	3	3
L	Tri Community WSC	Guadalupe	Guadalupe Run-of-River	492	490	490	491	490	490
	Sum of Projected Surface Water Supplies (acre-feet)			**2,104**	**2,118**	**2,095**	**2,069**	**2,035**	**2,000**

HAYS COUNTY

9.11% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070
K	Austin	Colorado	Colorado Run-of-River	188	827	1,304	2,063	3,025	4,357
K	Buda	Colorado	Canyon Lake/Reservoir	1,381	1,292	1,181	1,041	882	701
K	Deer Creek Ranch Water	Colorado	Highland Lakes Lake/Reservoir System	125	125	125	125	125	125
K	Dripping Springs WSC	Colorado	Highland Lakes Lake/Reservoir System	1,632	1,632	1,632	1,632	1,632	1,632
K	Hays County WCID 1	Colorado	Highland Lakes Lake/Reservoir System	821	808	801	798	717	717
K	Hays County WCID 2	Colorado	Highland Lakes Lake/Reservoir System	580	593	600	603	684	684
K	Livestock, Hays	Colorado	Colorado Livestock Local Supply	20	20	20	20	20	20
K	Steam-Electric Power, Hays	Colorado	Canyon Lake/Reservoir	127	127	127	127	127	127

K	West Travis County Public Utility Agency	Colorado	Highland Lakes Lake/Reservoir System	4,349	4,349	4,349	4,349	4,349	4,349
L	Buda	Guadalupe	Canyon Lake/Reservoir	299	388	499	639	798	979
L	County Line SUD	Guadalupe	Canyon Lake/Reservoir	905	905	937	968	1,002	1,038
L	County-Other, Hays	Guadalupe	Canyon Lake/Reservoir	64	0	84	140	364	365
L	Crystal Clear WSC	Guadalupe	Canyon Lake/Reservoir	323	317	319	329	340	354
L	Goforth SUD	Guadalupe	Canyon Lake/Reservoir	4,186	4,186	4,186	4,186	4,186	4,186
L	Irrigation, Hays	Guadalupe	Guadalupe Run-of-River	2	2	2	2	2	2
L	Kyle	Guadalupe	Canyon Lake/Reservoir	5,443	5,443	5,443	5,443	5,443	5,443
L	Livestock, Hays	Guadalupe	Guadalupe Livestock Local Supply	69	69	69	69	69	69
L	Maxwell WSC	Guadalupe	Canyon Lake/Reservoir	194	178	168	164	161	161
L	Maxwell WSC	Guadalupe	Guadalupe Run-of-River	3	2	2	2	2	2
L	San Marcos	Guadalupe	Canyon Lake/Reservoir	9,998	9,998	9,998	9,997	9,997	9,997
	Sum of Projected Surface Water Supplies (acre-feet)			**30,709**	**31,261**	**31,846**	**32,697**	**33,925**	**35,308**

Projected Water Demands
TWDB 2022 State Water Plan Data

Please note that the demand numbers presented here include the plumbing code savings found in the Regional and State Water Plans.

CALDWELL COUNTY

51.56% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
L	Aqua WSC	Colorado	43	51	59	68	77	86
L	Aqua WSC	Guadalupe	241	288	336	384	434	483
L	County Line SUD	Guadalupe	226	318	384	436	468	480
L	County-Other, Caldwell	Colorado	13	7	7	8	9	11
L	County-Other, Caldwell	Guadalupe	60	30	32	34	43	50
L	Creedmoor-Maha WSC	Colorado	167	186	207	231	257	283
L	Creedmoor-Maha WSC	Guadalupe	15	17	18	21	23	25
L	Goforth SUD	Guadalupe	45	43	43	43	42	42
L	Gonzales County WSC	Guadalupe	54	65	76	87	98	110
L	Irrigation, Caldwell	Colorado	12	12	12	12	12	12
L	Irrigation, Caldwell	Guadalupe	401	401	401	401	401	401
L	Livestock, Caldwell	Colorado	29	29	29	29	29	29
L	Livestock, Caldwell	Guadalupe	377	377	377	377	377	377
L	Lockhart	Guadalupe	2,258	2,683	3,114	3,557	4,021	4,477
L	Luling	Guadalupe	956	1,131	1,309	1,493	1,688	1,879
L	Manufacturing, Caldwell	Guadalupe	3	3	3	3	3	3
L	Martindale WSC	Guadalupe	361	453	529	626	747	894
L	Maxwell WSC	Guadalupe	428	503	579	659	745	829
L	Mining, Caldwell	Colorado	6	5	3	2	1	1
L	Mining, Caldwell	Guadalupe	58	46	34	22	9	4
L	Polonia WSC	Colorado	285	338	391	447	505	562
L	Polonia WSC	Guadalupe	605	717	831	948	1,071	1,193
L	San Marcos	Guadalupe	1	2	3	4	5	6
L	Tri Community WSC	Guadalupe	174	206	239	272	308	343
	Sum of Projected Water Demands (acre-feet)		**6,818**	**7,911**	**9,016**	**10,164**	**11,373**	**12,580**

HAYS COUNTY

9.11% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
K	Austin	Colorado	188	827	1,304	2,063	3,025	4,357
K	Buda	Colorado	1,768	2,508	3,419	4,563	5,860	7,338
K	Cimarron Park Water	Colorado	244	236	230	226	225	225
K	County-Other, Hays	Colorado	123	95	141	176	205	284
K	Deer Creek Ranch Water	Colorado	26	29	33	35	38	41

K	Dripping Springs WSC	Colorado	1,930	3,190	4,103	5,278	6,716	7,476
K	Goforth SUD	Colorado	153	196	249	317	395	484
K	Hays	Colorado	183	235	294	348	435	533
K	Hays County WCID 1	Colorado	821	808	801	798	797	797
K	Hays County WCID 2	Colorado	285	369	464	551	688	844
K	Irrigation, Hays	Colorado	48	48	48	48	48	48
K	Livestock, Hays	Colorado	2	2	2	2	2	2
K	Manufacturing, Hays	Colorado	25	30	30	30	30	30
K	Mining, Hays	Colorado	77	98	124	132	151	172
K	Steam-Electric Power, Hays	Colorado	108	108	108	108	108	108
K	West Travis County Public Utility Agency	Colorado	4,499	5,590	6,273	7,711	9,151	10,593
L	Buda	Guadalupe	298	388	499	639	797	978
L	County Line SUD	Guadalupe	508	714	971	1,241	1,532	1,842
L	County-Other, Hays	Guadalupe	119	45	138	194	604	1,077
L	Creedmoor-Maha WSC	Guadalupe	7	8	9	10	11	12
L	Crystal Clear WSC	Guadalupe	632	716	827	973	1,143	1,338
L	Goforth SUD	Guadalupe	2,605	3,871	5,136	6,415	7,712	9,015
L	Irrigation, Hays	Guadalupe	14	14	14	14	14	14
L	Kyle	Guadalupe	4,898	7,680	9,133	9,118	9,108	9,104
L	Livestock, Hays	Guadalupe	254	254	254	254	254	254
L	Manufacturing, Hays	Guadalupe	4	5	5	5	5	5
L	Maxwell WSC	Guadalupe	120	126	135	149	165	184
L	San Marcos	Guadalupe	10,901	12,713	14,968	17,746	21,136	25,193
L	South Buda WCID 1	Guadalupe	214	275	345	409	510	626
L	Texas State University	Guadalupe	928	911	902	898	897	896
L	Wimberley WSC	Guadalupe	1,015	1,399	1,889	2,503	3,197	3,988
	Sum of Projected Water Demands (acre-feet)		**32,997**	**43,488**	**52,848**	**62,954**	**74,959**	**87,858**

Projected Water Supply Needs
TWDB 2022 State Water Plan Data

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

CALDWELL COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
L	Aqua WSC	Colorado	51	43	35	26	17	8
L	Aqua WSC	Guadalupe	290	243	195	147	97	48
L	County Line SUD	Guadalupe	227	135	33	-54	-124	-177
L	County-Other, Caldwell	Colorado	203	216	215	214	211	207
L	County-Other, Caldwell	Guadalupe	1,112	1,170	1,165	1,162	1,145	1,131
L	Creedmoor-Maha WSC	Colorado	0	0	0	0	0	0
L	Creedmoor-Maha WSC	Guadalupe	0	0	0	0	0	0
L	Goforth SUD	Guadalupe	-16	-23	-27	-25	-20	-18
L	Gonzales County WSC	Guadalupe	32	31	28	24	16	9
L	Irrigation, Caldwell	Colorado	0	0	0	0	0	0
L	Irrigation, Caldwell	Guadalupe	0	0	0	0	0	0
L	Livestock, Caldwell	Colorado	0	0	0	0	0	0
L	Livestock, Caldwell	Guadalupe	0	0	0	0	0	0
L	Lockhart	Guadalupe	817	392	-39	-482	-946	-1,402
L	Luling	Guadalupe	127	-49	-226	-411	-606	-796
L	Manufacturing, Caldwell	Guadalupe	0	0	0	0	0	0
L	Martindale WSC	Guadalupe	-124	-218	-296	-395	-518	-665
L	Maxwell WSC	Guadalupe	445	391	328	253	170	86
L	Mining, Caldwell	Colorado	3	2	2	1	1	0
L	Mining, Caldwell	Guadalupe	0	0	0	0	0	0
L	Polonia WSC	Colorado	508	455	398	340	276	213
L	Polonia WSC	Guadalupe	1,078	963	846	720	587	451
L	San Marcos	Guadalupe	1	0	0	0	-1	-2
L	Tri Community WSC	Guadalupe	318	284	251	219	182	147
	Sum of Projected Water Supply Needs (acre-feet)		**-140**	**-290**	**-588**	**-1,367**	**-2,215**	**-3,060**

HAYS COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
K	Austin	Colorado	0	0	0	0	0	0
K	Buda	Colorado	1,411	582	-440	-1,724	-3,180	-4,839
K	Cimarron Park Water	Colorado	47	55	61	65	66	66
K	County-Other, Hays	Colorado	966	1,279	764	388	72	-801
K	Deer Creek Ranch Water	Colorado	99	96	92	90	87	84
K	Dripping Springs WSC	Colorado	727	-533	-1,446	-2,621	-4,059	-4,819

K	Goforth SUD	Colorado	-60	-113	-168	-232	-308	-393
K	Hays	Colorado	0	-55	-114	-168	-255	-353
K	Hays County WCID 1	Colorado	0	0	0	0	-80	-80
K	Hays County WCID 2	Colorado	295	224	136	52	-4	-160
K	Irrigation, Hays	Colorado	257	257	257	257	257	257
K	Livestock, Hays	Colorado	903	903	903	903	903	903
K	Manufacturing, Hays	Colorado	191	144	144	144	144	144
K	Mining, Hays	Colorado	-531	-761	-1,047	-1,131	-1,340	-1,579
K	Steam-Electric Power, Hays	Colorado	511	511	511	511	511	511
K	West Travis County Public Utility Agency	Colorado	128	-963	-1,646	-3,084	-4,524	-5,966
L	Buda	Guadalupe	1	0	0	0	1	1
L	County Line SUD	Guadalupe	509	303	82	-153	-406	-675
L	County-Other, Hays	Guadalupe	0	106	0	0	-2,029	-7,220
L	Creedmoor-Maha WSC	Guadalupe	0	0	0	0	0	0
L	Crystal Clear WSC	Guadalupe	-35	61	-45	-168	-310	-472
L	Goforth SUD	Guadalupe	3,175	1,928	669	-608	-1,906	-3,212
L	Irrigation, Hays	Guadalupe	349	349	349	349	349	349
L	Kyle	Guadalupe	1,375	-1,407	-2,860	-2,845	-2,835	-2,831
L	Livestock, Hays	Guadalupe	0	0	0	0	0	0
L	Manufacturing, Hays	Guadalupe	502	494	494	494	494	494
L	Maxwell WSC	Guadalupe	125	98	76	57	38	19
L	San Marcos	Guadalupe	2,181	369	-1,887	-4,666	-8,056	-12,113
L	South Buda WCID 1	Guadalupe	436	375	305	241	140	24
L	Texas State University	Guadalupe	202	219	228	232	233	234
L	Wimberley WSC	Guadalupe	137	-247	-737	-1,351	-2,045	-2,836
	Sum of Projected Water Supply Needs (acre-feet)		**-626**	**-4,079**	**-10,390**	**-18,751**	**-31,337**	**-48,349**

Projected Water Management Strategies
TWDB 2022 State Water Plan Data

CALDWELL COUNTY

WUG, Basin (RWPG)

All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
Aqua WSC, Guadalupe (L)							
Municipal Water Conservation	DEMAND REDUCTION [Caldwell]	0	0	0	1	1	1
		0	**0**	**0**	**1**	**1**	**1**
County Line SUD, Guadalupe (L)							
ARWA - Phase 2	Carrizo-Wilcox Aquifer [Caldwell]	0	0	190	174	157	138
ARWA - Phase 3	Direct Reuse [Hays]	0	0	0	0	42	37
ARWA Shared Project (Phase 1)	Carrizo-Wilcox Aquifer [Caldwell]	148	148	135	124	112	99
County Line SUD - Brackish Edwards Wellfield	Edwards-BFZ Aquifer [Hays]	0	0	0	130	234	310
County Line SUD - Trinity Wellfield	Trinity Aquifer [Hays]	0	0	0	130	173	153
Reuse - County Line SUD	Direct Reuse [Hays]	172	345	476	582	655	695
		320	**493**	**801**	**1,140**	**1,373**	**1,432**
Goforth SUD, Guadalupe (L)							
Drought Management – Goforth SUD	DEMAND REDUCTION [Caldwell]	2	0	0	0	0	0
GBRA Shared Project (Phase 1)	Carrizo-Wilcox Aquifer [Caldwell]	32	20	15	12	10	9
GBRA Shared Project (Phase 1)	Carrizo-Wilcox Aquifer [Gonzales]	32	21	16	13	10	9
		66	**41**	**31**	**25**	**20**	**18**
Gonzales County WSC, Guadalupe (L)							
Municipal Water Conservation	DEMAND REDUCTION [Caldwell]	3	9	16	24	34	45
		3	**9**	**16**	**24**	**34**	**45**
Lockhart, Guadalupe (L)							
GBRA Shared Project (Phase 1)	Carrizo-Wilcox Aquifer [Caldwell]	1,489	1,489	1,489	1,489	1,489	1,489
GBRA Shared Project (Phase 1)	Carrizo-Wilcox Aquifer [Gonzales]	1,511	1,511	1,511	1,511	1,511	1,511
Municipal Water Conservation	DEMAND REDUCTION [Caldwell]	0	0	0	0	0	71
		3,000	**3,000**	**3,000**	**3,000**	**3,000**	**3,071**
Luling, Guadalupe (L)							
Local Carrizo Aquifer Development	Carrizo-Wilcox Aquifer [Caldwell]	0	349	350	702	702	1,056
Municipal Water Conservation	DEMAND REDUCTION [Caldwell]	0	0	0	0	0	2

		0	**349**	**350**	**702**	**702**	**1,058**
Martindale WSC, Guadalupe (L)							
CRWA - Wells Ranch (Phase 3)	Carrizo-Wilcox Aquifer [Guadalupe]	0	61	131	231	484	779
Drought Management - Martindale	DEMAND REDUCTION [Caldwell]	20	0	0	0	0	0
FE - CRWA Hays Caldwell WTP Expansion	Guadalupe Run-of-River [Hays]	242	241	238	235	233	233
Martindale WSC - Alluvial Well	San Marcos River Alluvium Aquifer [Caldwell]	0	226	224	222	219	219
		262	**528**	**593**	**688**	**936**	**1,231**
Maxwell WSC, Guadalupe (L)							
Maxwell WSC - Trinity Well Field	Trinity Aquifer [Hays]	0	0	187	188	188	188
		0	**0**	**187**	**188**	**188**	**188**
Polonia WSC, Colorado (L)							
Municipal Water Conservation	DEMAND REDUCTION [Caldwell]	0	0	0	0	0	1
		0	**0**	**0**	**0**	**0**	**1**
Polonia WSC, Guadalupe (L)							
Municipal Water Conservation	DEMAND REDUCTION [Caldwell]	0	0	0	0	0	3
		0	**0**	**0**	**0**	**0**	**3**
San Marcos, Guadalupe (L)							
ARWA - Phase 2	Carrizo-Wilcox Aquifer [Caldwell]	0	0	2	2	2	2
ARWA - Phase 3	Direct Reuse [Hays]	0	0	0	0	1	1
ARWA Shared Project (Phase 1)	Carrizo-Wilcox Aquifer [Caldwell]	0	1	1	1	1	1
FE - CRWA Hays Caldwell WTP Expansion	Direct Reuse [Hays]	0	0	0	0	0	0
Reuse - San Marcos (Non-Potable)	Direct Reuse [Hays]	0	0	0	0	0	0
Reuse - San Marcos (Potable)	Direct Reuse [Hays]	0	0	0	1	1	1
		0	**1**	**3**	**4**	**5**	**5**
Tri Community WSC, Guadalupe (L)							
Municipal Water Conservation	DEMAND REDUCTION [Caldwell]	0	0	0	0	0	2
		0	**0**	**0**	**0**	**0**	**2**
Sum of Projected Water Management Strategies (acre-feet)		**3,651**	**4,421**	**4,981**	**5,772**	**6,259**	**7,055**

HAYS COUNTY

WUG, Basin (RWPG)

All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
Austin, Colorado (K)							
Drought Management	DEMAND REDUCTION [Hays]	9	38	59	94	137	198
		9	**38**	**59**	**94**	**137**	**198**
Buda, Colorado (K)							

ARWA - Phase 2	Carrizo-Wilcox Aquifer [Caldwell]	0	0	1,067	1,067	1,067	1,067
ARWA - Phase 3	Direct Reuse [Hays]	0	0	0	0	157	157
ARWA Shared Project (Phase 1)	Carrizo-Wilcox Aquifer [Caldwell]	762	762	762	762	762	762
Direct Potable Reuse - Buda	Direct Reuse [Hays]	0	2,240	2,240	2,240	2,240	2,240
Direct Reuse - Buda	Direct Reuse [Hays]	0	920	520	520	880	680
Drought Management	DEMAND REDUCTION [Hays]	322	443	607	813	1,045	1,309
Edwards/Middle Trinity ASR	Trinity Aquifer ASR [Hays]	150	600	600	600	600	600
Municipal Conservation - Buda	DEMAND REDUCTION [Hays]	159	292	382	499	636	793
Municipal Water Conservation	DEMAND REDUCTION [Hays]	11	42	61	90	126	172
Saline Edwards Desalination and ASR (Storage)	Edwards-BFZ Aquifer (Saline Portion) ASR [Travis]	0	0	800	800	800	800
		1,404	**5,299**	**7,039**	**7,391**	**8,313**	**8,580**
Cimarron Park Water, Colorado (K)							
Drought Management	DEMAND REDUCTION [Hays]	18	12	12	11	11	11
		18	**12**	**12**	**11**	**11**	**11**
County-Other, Hays, Colorado (K)							
Brush Management	Trinity Aquifer [Hays]	0	83	83	83	83	83
Drought Management	DEMAND REDUCTION [Hays]	158	103	132	155	176	243
Edwards/Middle Trinity ASR	Trinity Aquifer ASR [Hays]	0	289	289	289	289	289
Expansion of Current Groundwater Supplies - Trinity Aquifer	Trinity Aquifer [Hays]	0	0	0	0	0	200
GBRA - MBWSP - Surface Water w/ASR	Carrizo-Wilcox Aquifer ASR [Gonzales]	0	1,000	1,000	1,000	1,000	1,000
Rainwater Harvesting - Hays County-Other	Rainwater Harvesting [Hays]	0	16	24	31	36	50
Saline Edwards Desalination and ASR (Storage)	Edwards-BFZ Aquifer (Saline Portion) ASR [Travis]	0	0	500	500	500	500
		158	**1,491**	**2,028**	**2,058**	**2,084**	**2,365**
Deer Creek Ranch Water, Colorado (K)							
Drought Management	DEMAND REDUCTION [Hays]	1	1	2	2	2	2
		1	**1**	**2**	**2**	**2**	**2**
Dripping Springs WSC, Colorado (K)							
Direct Potable Reuse - Dripping Springs WSC	Direct Reuse [Hays]	0	560	560	560	560	560
Direct Reuse - Dripping Springs WSC	Direct Reuse [Hays]	0	390	460	531	601	672
Drought Management	DEMAND REDUCTION [Hays]	351	580	753	972	1,239	1,380
Expansion of Current Groundwater Supplies - Trinity Aquifer	Trinity Aquifer [Hays]	0	0	300	300	300	300
LCRA - Mid Basin Reservoir	LCRA New Off-Channel Reservoir (2030 Decade) [Reservoir]	0	0	0	1,000	2,000	2,000

Municipal Conservation - Dripping Springs WSC	DEMAND REDUCTION [Hays]	174	289	339	417	522	576
Rainwater Harvesting - Dripping Springs WSC	Rainwater Harvesting [Hays]	0	34	44	57	73	81
		525	**1,853**	**2,456**	**3,837**	**5,295**	**5,569**
Goforth SUD, Colorado (K)							
Drought Management	DEMAND REDUCTION [Hays]	8	10	12	16	20	24
Drought Management – Goforth SUD	DEMAND REDUCTION [Hays]	6	0	0	0	0	0
GBRA Shared Project (Phase 1)	Carrizo-Wilcox Aquifer [Caldwell]	108	95	91	122	191	264
GBRA Shared Project (Phase 1)	Carrizo-Wilcox Aquifer [Gonzales]	110	96	92	94	97	102
Municipal Water Conservation	DEMAND REDUCTION [Hays]	0	0	0	0	0	3
		232	**201**	**195**	**232**	**308**	**393**
Hays, Colorado (K)							
Development of New Groundwater Supplies - Trinity Aquifer	Trinity Aquifer [Hays]	0	100	100	100	100	100
Drought Management	DEMAND REDUCTION [Hays]	37	47	59	70	87	107
Edwards/Middle Trinity ASR	Trinity Aquifer ASR [Hays]	0	146	146	146	146	146
New Water Purchase - Hays	Edwards-BFZ Aquifer [Hays]	0	0	0	0	70	140
Rainwater Harvesting - Hays	Rainwater Harvesting [Hays]	0	3	4	4	6	7
		37	**296**	**309**	**320**	**409**	**500**
Hays County WCID 1, Colorado (K)							
Drought Management	DEMAND REDUCTION [Hays]	149	134	121	114	114	114
Municipal Conservation - Hays County WCID 1	DEMAND REDUCTION [Hays]	74	136	196	226	225	225
		223	**270**	**317**	**340**	**339**	**339**
Hays County WCID 2, Colorado (K)							
Drought Management	DEMAND REDUCTION [Hays]	52	61	70	76	95	117
Municipal Conservation - Hays County WCID 2	DEMAND REDUCTION [Hays]	26	62	114	169	211	259
		78	**123**	**184**	**245**	**306**	**376**
Mining, Hays, Colorado (K)							
Direct Reuse - Buda	Direct Reuse [Hays]	0	200	600	600	800	1,000
Expansion of Current Groundwater Supplies - Trinity Aquifer	Trinity Aquifer [Hays]	600	600	600	600	600	600
		600	**800**	**1,200**	**1,200**	**1,400**	**1,600**
West Travis County Public Utility Agency, Colorado (K)							
Direct Reuse - West Travis County PUA	Direct Reuse [Travis]	0	97	99	104	111	116
Drought Management	DEMAND REDUCTION [Hays]	819	921	933	1,033	1,104	1,151
GBRA - MBWSP - Surface Water w/ASR	Carrizo-Wilcox Aquifer ASR [Gonzales]	0	3,000	3,000	3,000	3,000	3,000
LCRA - Excess Flows Reservoir	LCRA New Off-Channel	0	1,400	1,400	2,500	2,500	3,300

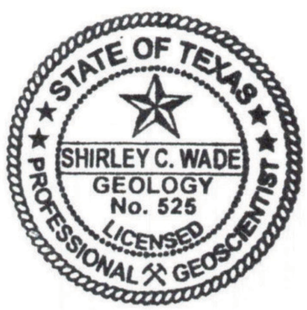
	Reservoir (2030 Decade) [Reservoir]						
Municipal Conservation - West Travis County PUA	DEMAND REDUCTION [Hays]	405	984	1,610	2,546	3,631	4,840
		1,224	**6,402**	**7,042**	**9,183**	**10,346**	**12,407**
Buda, Guadalupe (L)							
ARWA - Phase 3	Direct Reuse [Hays]	0	0	0	0	21	21
Municipal Water Conservation	DEMAND REDUCTION [Hays]	2	6	9	13	17	23
		2	**6**	**9**	**13**	**38**	**44**
County Line SUD, Guadalupe (L)							
ARWA - Phase 2	Carrizo-Wilcox Aquifer [Caldwell]	0	0	479	495	512	531
ARWA - Phase 3	Direct Reuse [Hays]	0	0	0	0	136	141
ARWA Shared Project (Phase 1)	Carrizo-Wilcox Aquifer [Caldwell]	330	330	343	354	366	379
County Line SUD - Brackish Edwards Wellfield	Edwards-BFZ Aquifer [Hays]	0	0	0	370	766	1,190
County Line SUD - Trinity Wellfield	Trinity Aquifer [Hays]	0	0	0	370	567	587
Reuse - County Line SUD	Direct Reuse [Hays]	388	775	1,204	1,658	2,145	2,665
		718	**1,105**	**2,026**	**3,247**	**4,492**	**5,493**
County-Other, Hays, Guadalupe (L)							
GBRA - MBWSP - Surface Water w/ASR	Carrizo-Wilcox Aquifer ASR [Gonzales]	0	0	0	0	2,029	7,220
Municipal Water Conservation	DEMAND REDUCTION [Hays]	0	0	0	0	0	232
		0	**0**	**0**	**0**	**2,029**	**7,452**
Crystal Clear WSC, Guadalupe (L)							
ARWA - Phase 2	Carrizo-Wilcox Aquifer [Caldwell]	0	0	929	957	989	1,029
ARWA - Phase 3	Direct Reuse [Hays]	0	0	0	0	263	274
ARWA Shared Project (Phase 1)	Carrizo-Wilcox Aquifer [Caldwell]	671	659	663	683	707	735
Drought Management - Crystal Clear WSC	DEMAND REDUCTION [Hays]	24	0	0	0	0	0
Municipal Water Conservation	DEMAND REDUCTION [Hays]	0	0	0	0	0	22
		695	**659**	**1,592**	**1,640**	**1,959**	**2,060**
Goforth SUD, Guadalupe (L)							
Drought Management – Goforth SUD	DEMAND REDUCTION [Hays]	101	0	0	0	0	0
GBRA Shared Project (Phase 1)	Carrizo-Wilcox Aquifer [Caldwell]	1,837	1,863	1,872	1,842	1,770	1,694
GBRA Shared Project (Phase 1)	Carrizo-Wilcox Aquifer [Gonzales]	1,866	1,892	1,901	1,902	1,902	1,897
Municipal Water Conservation	DEMAND REDUCTION [Hays]	0	0	0	0	0	50
		3,804	**3,755**	**3,773**	**3,744**	**3,672**	**3,641**
Kyle, Guadalupe (L)							
ARWA - Phase 2	Carrizo-Wilcox Aquifer [Caldwell]	0	0	5,916	5,916	5,916	5,916

ARWA - Phase 3	Direct Reuse [Hays]	0	0	0	0	1,573	1,573
ARWA Shared Project (Phase 1)	Carrizo-Wilcox Aquifer [Caldwell]	4,225	4,225	4,225	4,225	4,225	4,225
Municipal Water Conservation	DEMAND REDUCTION [Hays]	0	0	0	52	266	480
		4,225	**4,225**	**10,141**	**10,193**	**11,980**	**12,194**
Maxwell WSC, Guadalupe (L)							
Maxwell WSC - Trinity Well Field	Trinity Aquifer [Hays]	0	0	43	42	42	42
		0	**0**	**43**	**42**	**42**	**42**
San Marcos, Guadalupe (L)							
ARWA - Phase 2	Carrizo-Wilcox Aquifer [Caldwell]	0	0	7,528	7,528	7,528	7,528
ARWA - Phase 3	Direct Reuse [Hays]	0	0	0	0	2,001	2,001
ARWA Shared Project (Phase 1)	Carrizo-Wilcox Aquifer [Caldwell]	2,594	5,379	5,379	5,379	5,379	5,379
FE - CRWA Hays Caldwell WTP Expansion	Direct Reuse [Hays]	1,288	1,288	1,288	1,288	1,288	1,288
Municipal Water Conservation	DEMAND REDUCTION [Hays]	0	0	54	395	949	1,706
Reuse - San Marcos (Non-Potable)	Direct Reuse [Hays]	1,826	1,971	1,971	1,971	1,971	1,971
Reuse - San Marcos (Potable)	Direct Reuse [Hays]	0	0	0	3,807	3,807	3,807
		5,708	**8,638**	**16,220**	**20,368**	**22,923**	**23,680**
South Buda WCID 1, Guadalupe (L)							
Municipal Water Conservation	DEMAND REDUCTION [Hays]	4	6	12	21	38	60
		4	**6**	**12**	**21**	**38**	**60**
Texas State University, Guadalupe (L)							
Municipal Water Conservation	DEMAND REDUCTION [Hays]	33	101	153	167	185	201
		33	**101**	**153**	**167**	**185**	**201**
Wimberley WSC, Guadalupe (L)							
GBRA - MBWSP - Surface Water w/ASR	Carrizo-Wilcox Aquifer ASR [Gonzales]	0	262	752	1,366	2,060	2,851
		0	**262**	**752**	**1,366**	**2,060**	**2,851**
Sum of Projected Water Management Strategies (acre-feet)		**19,698**	**35,543**	**55,564**	**65,714**	**78,368**	**90,058**

APPENDIX A

GAM RUN 21-018 MAG:
MODELED AVAILABLE GROUNDWATER FOR THE CARRIZO-WILCOX, QUEEN CITY, SPARTA, AND YEGUA-JACKSON AQUIFERS IN GROUNDWATER MANAGEMENT AREA 13

Shirley C. Wade, Ph.D., P.G.
Texas Water Development Board
Groundwater Division
Groundwater Availability Modeling Department
(512) 936-0883
July 25, 2022



Shirley C. Wade
7/25/22

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GAM RUN 21-018 MAG: MODELED AVAILABLE GROUNDWATER FOR THE CARRIZO-WILCOX, QUEEN CITY, SPARTA, AND YEGUA-JACKSON AQUIFERS IN GROUNDWATER MANAGEMENT AREA 13

Shirley C. Wade, Ph.D., P.G.
Texas Water Development Board
Groundwater Division
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(512) 936-0883
July 25, 2022

EXECUTIVE SUMMARY:

The modeled available groundwater for Groundwater Management Area 13 for the Carrizo-Wilcox, Queen City, Sparta, and Yegua-Jackson aquifers is summarized by decade for the groundwater conservation districts (Tables 1 through 4 respectively) and for use in the regional water planning process (Tables 5 through 8 respectively). The modeled available groundwater estimates for the Carrizo-Wilcox Aquifer range from approximately 470,000 acre-feet per year in 2020 to approximately 575,000 acre-feet per year in 2080 (Table 1). The modeled available groundwater estimates for the Queen City Aquifer range from approximately 23,000 acre-feet per year in 2020 to approximately 18,000 acre-feet per year in 2080 (Table 2). The modeled available groundwater estimates for the Sparta Aquifer range from approximately 6,000 acre-feet per year in 2020 to approximately 4,000 acre-feet per year in 2080 (Table 3). The estimates for the Carrizo-Wilcox, Queen City, and Sparta Aquifers were extracted from the results of a model run using the groundwater availability model for the southern part of the Carrizo-Wilcox, Queen City, and Sparta aquifers (version 2.01). The modeled available groundwater estimates for the Yegua-Jackson Aquifer are approximately 6,700 acre-feet per year from 2020 to 2080 (Table 4). The estimates for the Yegua-Jackson Aquifer were extracted from the results of a model run using the groundwater availability model for the Yegua-Jackson Aquifer (version 1.01). The explanatory report and other materials submitted to the TWDB were determined to be administratively complete on April 15, 2022.

REQUESTOR:

Ms. Kelley Cochran, coordinator of Groundwater Management Area 13.

DESCRIPTION OF REQUEST:

The desired future conditions for the Carrizo-Wilcox, Queen City, and Sparta aquifers described in Resolution 21-02 from Groundwater Management Area 13, adopted November 19, 2021, are:

- *"The first desired future condition for the Carrizo-Wilcox, Queen City and Sparta aquifers in Groundwater Management Area 13 is that 75 percent of the saturated thickness in the outcrop at the end of 2012 remains in 2080. Due to the limitations of the current Groundwater Availability Model, this desired future condition cannot be simulated as documented during 2016 Joint Planning in GMA 13 Technical Memorandum 16-08 (Hutchison, 2017a)."*
- *"In addition, a secondary proposed desired future condition for the Carrizo-Wilcox, Queen City, and Sparta aquifers in Groundwater Management Area 13 is an average drawdown of 49 feet (+/- 5 feet) for all of GMA 13. The drawdown is calculated from the end of 2012 conditions to the year 2080. This desired future condition is consistent with simulation "GMA13_2019_001" summarized during a meeting of Groundwater Management Area 13 members on March 19, 2021."*

The desired future conditions for the Yegua-Jackson Aquifer described in Resolution 21-03 from Groundwater Management Area 13, adopted November 19, 2021 are:

- *"For Gonzales County, the average drawdown from 2010 to 2080 is 3 feet (+/- 1 foot)."*
- *"For Karnes County, the average drawdown from 2010 to 2080 is 1 foot (+/- 1 foot)."*
- *"For all other counties in GMA 13, the Yegua-Jackson is classified as not relevant for purposes of joint planning."*

The Edwards (Balcones Fault Zone), Gulf Coast, and Trinity aquifers were declared not relevant for purposes of joint planning by Groundwater Management Area 13 in Resolution 21-01 (Groundwater Management Area 13 Joint Planning Committee and others, 2022; Appendix B).

On January 14, 2022, Dr. Jordan Furnans, on behalf of Groundwater Management Area 13, submitted the Desired Future Conditions Packet to the TWDB. TWDB staff reviewed the model files associated with the desired future conditions and received clarifications on procedures and assumptions from the Groundwater Management Area 13 Technical Coordinator on March 3, 2022, and on March 7, 2022. Groundwater Management Area 13 adopted two desired future conditions for the Carrizo-Wilcox, Queen City, and Sparta Aquifers and they were not mutually compatible in the groundwater availability model. The technical coordinator for the groundwater management area confirmed that their intention was for the modeled available groundwater values to be based on the secondary desired future condition and MODFLOW pumping simulation GMA13_2019_001 (Groundwater Management Area 13 Joint Planning Committee and others, 2022; Appendix 2). The first proposed desired future condition was not intended for the calculation of modeled available groundwater.

The model run pumping file, which meets the secondary desired future condition adopted by district representatives of Groundwater Management Area 13 for the Carrizo-Wilcox, Queen City, and Sparta Aquifers, was submitted to the TWDB as supplemental information for the original submittal on February 9, 2022. The model run files, which meet the desired future conditions adopted by district representatives of Groundwater Management Area 13 for the Yegua-Jackson Aquifer, were submitted to the TWDB on January 14, 2022, as part of the Desired Future Conditions Explanatory Report for Groundwater Management Area 13.

In an email dated March 3, 2022, the Technical Coordinator and consultant for Groundwater Management Area 13 confirmed that they intended to use the end of 2011 as the reference year for the drawdown calculations for the Carrizo-Wilcox, Queen City, and Sparta aquifers and they intended to use the end of 2009 as the reference year for the Yegua-Jackson Aquifer. In an email dated March 7, 2022, they also confirmed that the confining unit model layers representing the Reklaw and Weches formations should be included in the desired future condition calculation of average drawdown for the combined Carrizo-Wilcox, Queen City, and Sparta aquifers.

All clarifications are included in the Parameters and Assumptions Section of this report.

METHODS:

The groundwater availability model for the southern part of the Carrizo-Wilcox, Queen City, and Sparta aquifers (Figures 1 through 3) was run using the model files submitted with the explanatory reports (Groundwater Management Area 13 Joint Planning Committee and others, 2022) on January 14 and February 9, 2022. Model-calculated water levels were extracted for the years 2011 (stress period 12) and 2080 (stress period 81). An overall drawdown average was calculated for the entire Groundwater Management Area 13 using all model layers in the average. As described in the Technical Memorandum submitted with the Explanatory Report on January 14, 2022 (Furnans, 2022) drawdowns for cells that became dry during the simulation (water level dropped below the base of the cell) were calculated as the reference year water level elevation minus the elevation of the model cell bottom. The calculated drawdown average was compared with the desired future condition of 49 feet to verify that the pumping scenario achieved the desired future conditions within the stated tolerance of five feet.

The groundwater availability model for the Yegua-Jackson Aquifer (Figure 4) was run using the model files submitted on January 14, 2022. Model-calculated water levels were extracted for the years 2009 (stress period 39) and 2080 (stress period 110). County-wide average drawdowns were calculated for Gonzales and Karnes counties within Groundwater Management Area 13 by averaging the drawdown values for all model layers. There were no dry cells in Karnes County or Gonzales County, so no additional dry cell calculations were needed. The calculated drawdown averages were compared with the desired future conditions for Gonzales and Karnes counties to verify that the pumping scenario achieved the desired future conditions within the stated tolerance of one foot.

The modeled available groundwater values were determined by extracting pumping rates by decade from the model results using ZONEBUDGET Version 3.01 (Harbaugh, 2009). Annual pumping rates by aquifer are presented by county and groundwater conservation district, subtotaled by groundwater conservation district, and then summed for Groundwater Management Area 13 (Tables 1 through 4). Annual pumping rates by aquifer are also presented by county, river basin, and regional water planning area within Groundwater Management Area 13 (Tables 5 through 8) in order to be consistent with the format used in the regional water planning process.

Modeled Available Groundwater and Permitting

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

PARAMETERS AND ASSUMPTIONS:

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

Carrizo-Wilcox, Queen City, and Sparta aquifers

- We used Version 2.01 of the groundwater availability model for the southern part of the Carrizo-Wilcox, Queen City, and Sparta aquifers. See Deeds and others (2003) and Kelley and others (2004) for assumptions and limitations of the groundwater availability model for the southern part of the Carrizo-Wilcox, Queen City, and Sparta aquifers.
- This groundwater availability model includes eight layers, which generally represent the Sparta Aquifer (Layer 1), the Weches Confining Unit (Layer 2), the Queen City Aquifer (Layer 3), the Reklaw Confining Unit (Layer 4), the Carrizo (Layer 5), the Upper Wilcox (Layer 6), the Middle Wilcox (Layer 7), and the Lower Wilcox (Layer 8). Since the model extends beyond the official TWDB aquifer extents, please note that model layers 1 and 3 instead represent geologic units equivalent to the Sparta and Queen City aquifers, respectively, in those areas falling outside of the official aquifer extents.
- The model was run with MODFLOW-96 (Harbaugh and McDonald, 1996).
- Although the original groundwater availability model was only calibrated to 1999, an analysis during the second round of joint planning (Hutchison, 2017b) verified that the model satisfactorily matched measured water levels for the period from 1999 to 2011. For this reason, TWDB considers it acceptable to use the end of 2011 as the reference year for drawdown calculations.
- Drawdown averages and modeled available groundwater values were based on the TWDB defined aquifer boundaries rather than the model extent.
- Drawdowns for cells that became dry during the simulation (water level dropped below the base of the cell) were calculated as the reference year water level elevation minus the elevation of the model cell bottom. Pumping in dry cells was excluded from the modeled available groundwater calculations for the decades after the cell went dry.
- A tolerance of five feet was assumed when comparing desired future conditions to modeled drawdown results. This tolerance was specified by the GMA in their definition of the desired future conditions.
- Estimates of modeled available groundwater from the model simulation were rounded to the nearest whole number.
- The verification calculation for the desired future conditions is based on an average of all model layers (Layers 1 through 8). The modeled available groundwater

calculations are based on Layer 1 for the Sparta Aquifer, Layer 3 for the Queen City Aquifer, and the sum of Layers 5 through 8 for the Carrizo-Wilcox Aquifer.

Yegua-Jackson Aquifer

- We used version 1.01 of the groundwater availability model for the Yegua-Jackson Aquifer. See Deeds and others (2010) for assumptions and limitations of the groundwater availability model.
- This groundwater availability model includes five layers which represent the outcrop of the Yegua-Jackson Aquifer and younger overlying units—the Catahoula Formation (Layer 1), the upper portion of the Jackson Group (Layer 2), the lower portion of the Jackson Group (Layer 3), the upper portion of the Yegua Group (Layer 4), and the lower portion of the Yegua Group (Layer 5).
- The model was run with MODFLOW-2000 (Harbaugh and others, 2000).
- Although the original groundwater availability model was only calibrated to 1997, a TWDB analysis (Oliver, 2010) verified that the model satisfactorily matched measured water levels for the period from 1997 to 2009. For this reason, TWDB considers it acceptable to use the end of 2009 as the reference year for drawdown calculations.
- Drawdown averages and modeled available groundwater values were based on the TWDB-defined aquifer boundaries rather than the model extent.
- No dry cells occurred in the simulation in Gonzales County or Karnes County. As these were the only counties with defined desired future conditions, no dry cell considerations were required during the verification calculation for the desired future conditions. Pumping in dry cells was excluded from the modeled available groundwater calculations for the decades after the cell went dry.
- A tolerance of one foot was assumed when comparing desired future conditions to modeled drawdown results. This tolerance was specified by the GMA in their definition of the desired future conditions.
- Estimates of modeled available groundwater from the model simulation were rounded to the nearest whole number.
- The verification calculation for the desired future conditions is based on an average of all model layers representing the Yegua or Jackson formations (Layers 1 through 5). The modeled available groundwater calculations are the sum of all model layers representing the Yegua or Jackson formations (Layers 1 through 5).

RESULTS:

The modeled available groundwater estimates for the Carrizo-Wilcox Aquifer range from approximately 470,000 acre-feet per year in 2020 to approximately 575,000 acre-feet per year in 2080 (Table 1). The modeled available groundwater estimates for the Queen City Aquifer range from approximately 23,000 acre-feet per year in 2020 to approximately 18,000 acre-feet per year in 2080 (Table 2). The modeled available groundwater estimate for the Sparta Aquifer ranges from approximately 6,000 acre-feet per year in 2020 to approximately 4,000 acre-feet per year in 2080 (Table 3). The modeled available groundwater is summarized by groundwater conservation district and county for the Carrizo-Wilcox, Queen City, and Sparta aquifers (Tables 1, 2, and 3 respectively). The modeled available groundwater has also been summarized by county, river basin, and regional water planning area for use in the regional water planning process for the Carrizo-Wilcox, Queen City, and Sparta aquifers (Tables 5, 6, and 7 respectively). Small differences in values between table summaries are due to rounding.

The modeled available groundwater estimate for the Yegua-Jackson Aquifer is approximately 7,000 acre-feet per year from 2020 to 2080 (Table 4). The modeled available groundwater for the Yegua-Jackson Aquifer is summarized by groundwater conservation district and county (Table 4) and by county, river basin, and regional water planning area for use in the regional water planning process (Table 8). Small differences of values between table summaries are due to rounding.

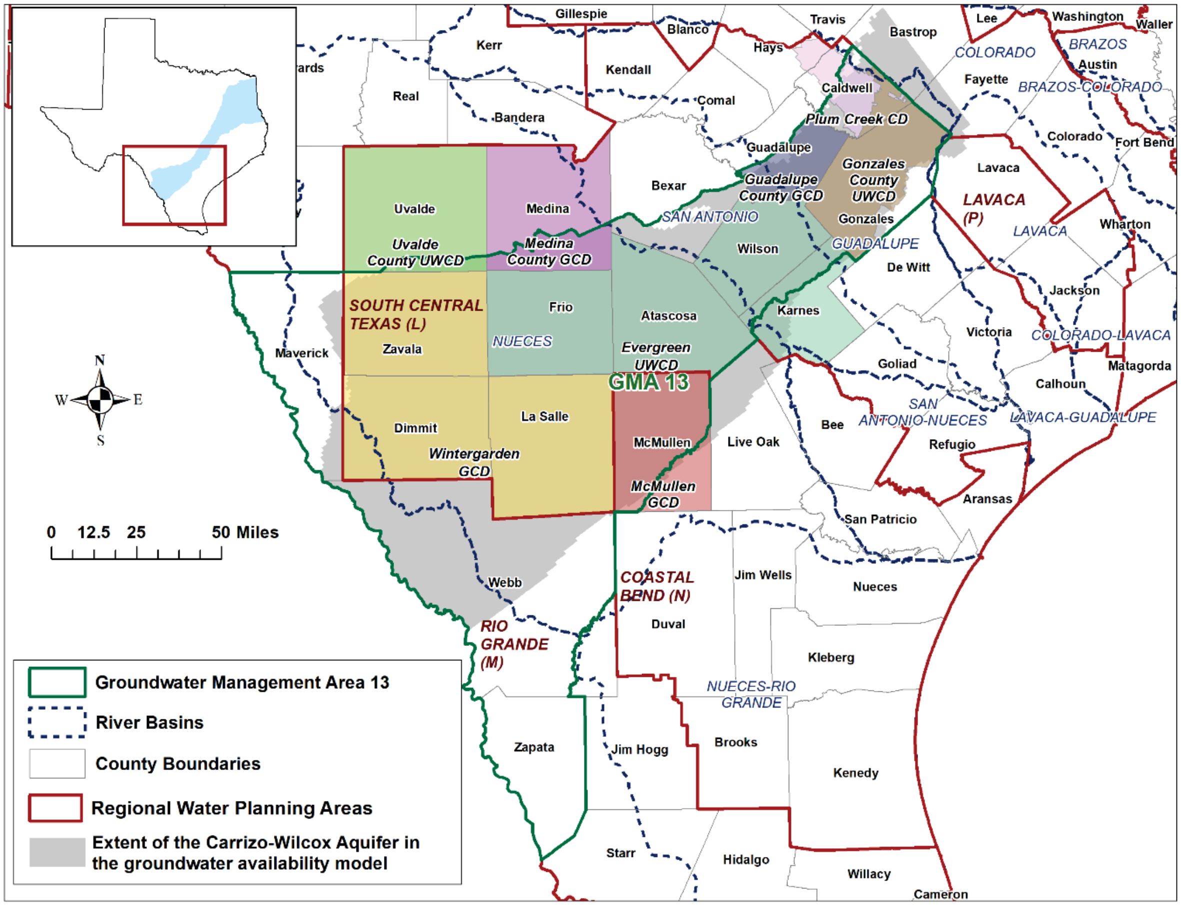

FIGURE 1. GROUNDWATER MANAGEMENT AREA (GMA) 13 BOUNDARY, REGIONAL WATER PLANNING AREAS (RWPAS), RIVER BASINS, GROUNDWATER CONSERVATION DISTRICTS (GCDS), AND COUNTIES OVERLAIN ON THE EXTENT OF THE CARRIZO-WILCOX AQUIFER.

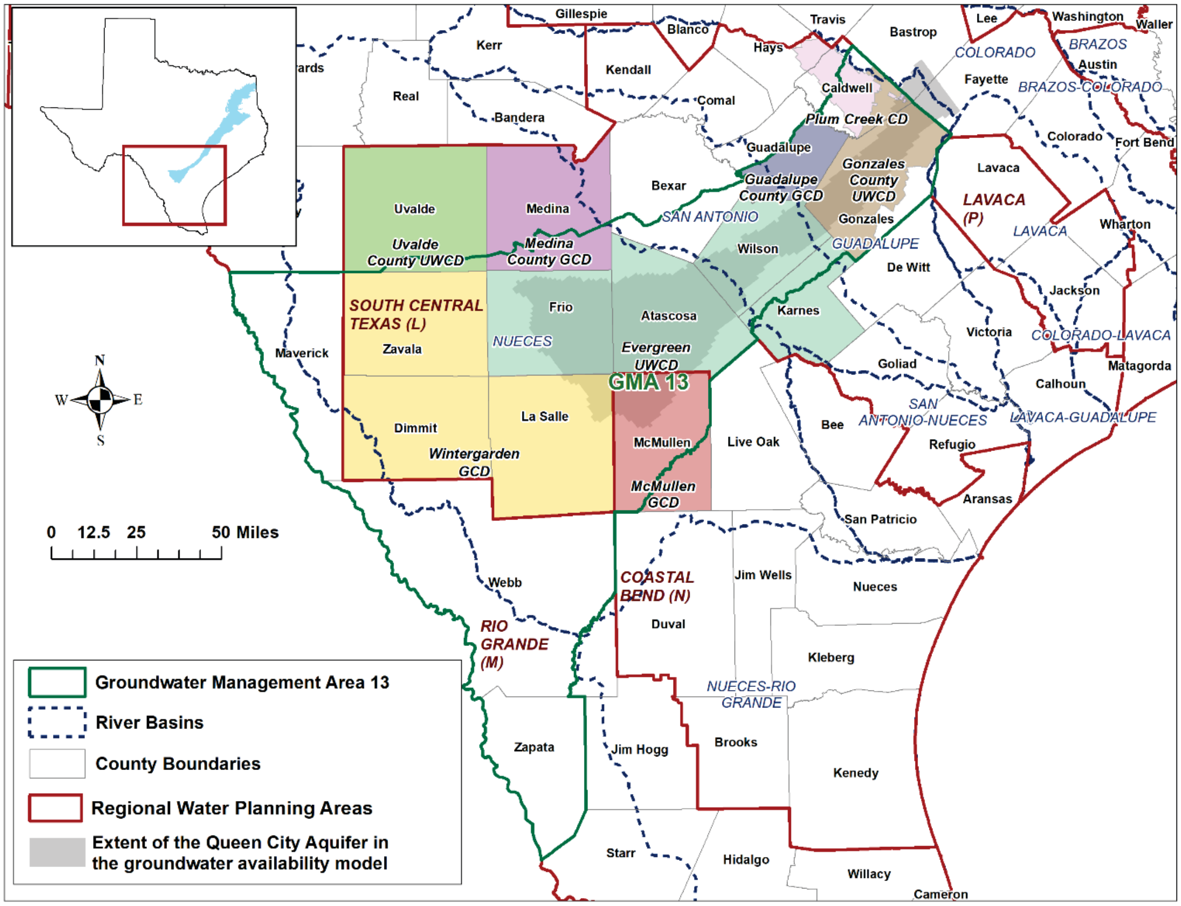

FIGURE 2. GROUNDWATER MANAGEMENT AREA (GMA) 13 BOUNDARY, REGIONAL WATER PLANNING AREAS (RWPAS), RIVER BASINS, GROUNDWATER CONSERVATION DISTRICTS (GCDS), AND COUNTIES OVERLAIN ON THE EXTENT OF THE QUEEN CITY AQUIFER.

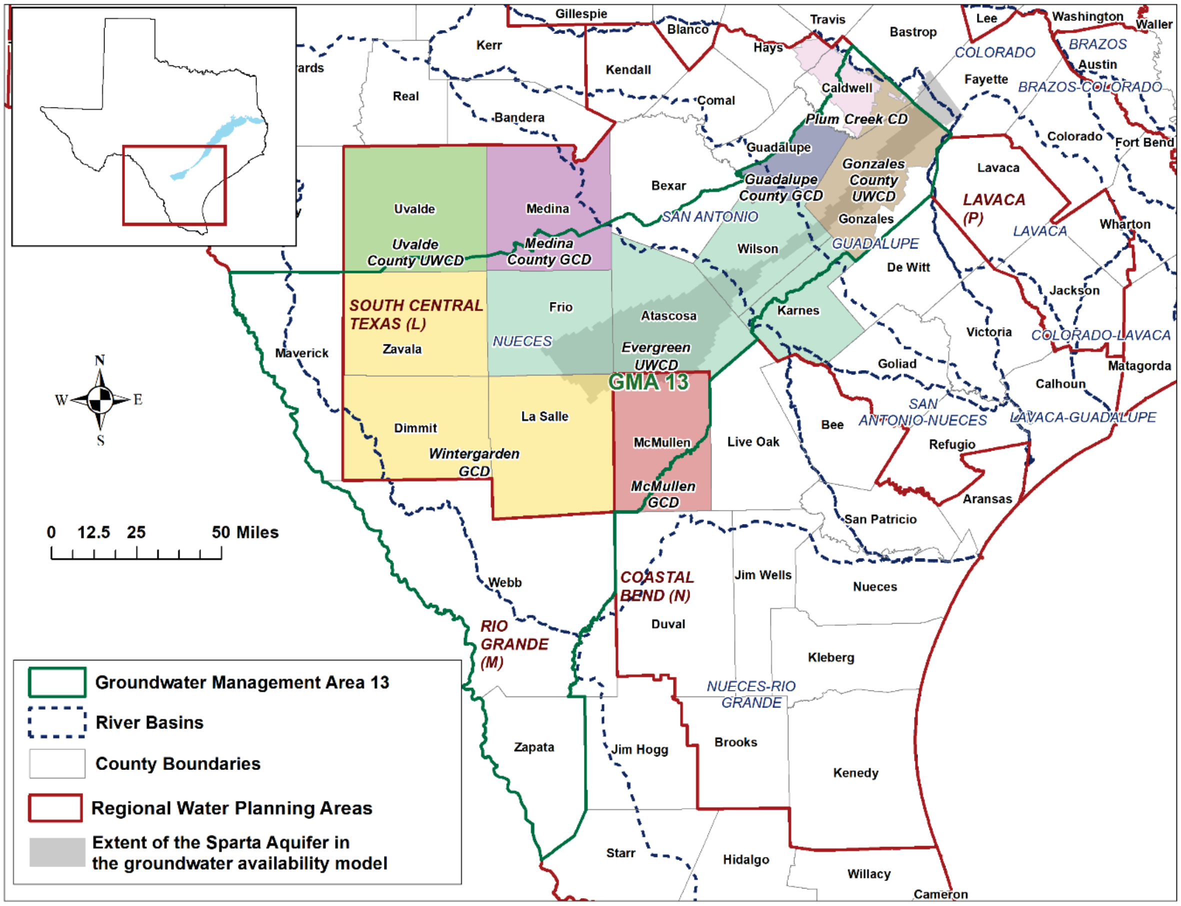

FIGURE 3. GROUNDWATER MANAGEMENT AREA (GMA) 13 BOUNDARY, REGIONAL WATER PLANNING AREAS (RWPAS), RIVER BASINS, GROUNDWATER CONSERVATION DISTRICTS (GCDS), AND COUNTIES OVERLAIN ON THE EXTENT OF THE SPARTA AQUIFER.

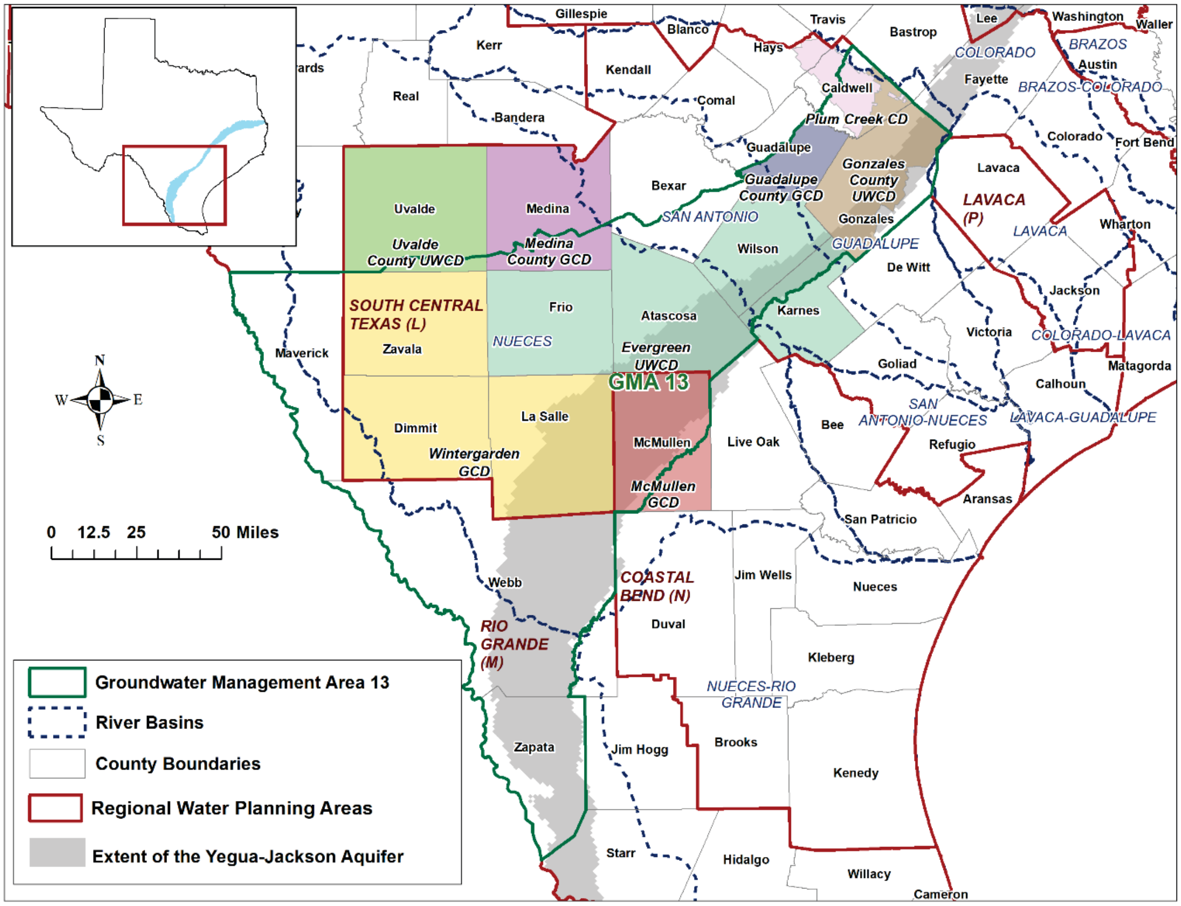

FIGURE 4. GROUNDWATER MANAGEMENT AREA (GMA) 13 BOUNDARY, REGIONAL WATER PLANNING AREAS (RWPAS), RIVER BASINS, GROUNDWATER CONSERVATION DISTRICTS (GCDS), AND COUNTIES OVERLAIN ON THE EXTENT OF THE YEGUA-JACKSON AQUIFER.

TABLE 1. MODELED AVAILABLE GROUNDWATER FOR THE CARRIZO-WILCOX AQUIFER IN GROUNDWATER MANAGEMENT AREA 13 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2080. VALUES ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District	County	Aquifer	2020	2030	2040	2050	2060	2070	2080
Evergreen UWCD	Atascosa	Carrizo-Wilcox	51,924	54,397	55,329	56,828	58,406	59,982	59,982
Evergreen UWCD	Frio	Carrizo-Wilcox	114,827	86,995	85,143	82,950	81,018	79,131	79,131
Evergreen UWCD	Karnes	Carrizo-Wilcox	693	758	843	931	1,001	1,043	1,043
Evergreen UWCD	Wilson	Carrizo-Wilcox	38,229	38,284	43,604	68,609	105,947	125,670	125,670
Evergreen UWCD Total		**Carrizo-Wilcox**	**205,673**	**180,434**	**184,919**	**209,318**	**246,372**	**265,826**	**265,826**
Gonzales County UWCD	Caldwell	Carrizo-Wilcox	468	9,472	16,401	25,510	30,087	30,087	30,087
Gonzales County UWCD	Gonzales	Carrizo-Wilcox	60,431	76,265	90,788	102,373	102,747	103,707	96,161
Gonzales County UWCD Total		**Carrizo-Wilcox**	**60,899**	**85,737**	**107,189**	**127,883**	**132,834**	**133,794**	**126,248**
Guadalupe County GCD	**Guadalupe**	**Carrizo-Wilcox**	**55,637**	**39,563**	**41,668**	**43,315**	**42,118**	**42,199**	**41,659**
McMullen GCD	**McMullen**	**Carrizo-Wilcox**	**7,789**	**7,768**	**4,867**	**4,854**	**4,854**	**4,854**	**4,854**
Medina County GCD	**Medina**	**Carrizo-Wilcox**	**2,635**	**2,628**	**2,635**	**2,628**	**2,628**	**2,628**	**2,628**
Plum Creek CD	**Caldwell**	**Carrizo-Wilcox**	**17,673**	**15,366**	**16,335**	**16,965**	**15,562**	**19,509**	**19,468**
Uvalde County UWCD	**Uvalde**	**Carrizo-Wilcox**	**0**[1]	**0**	**0**	**0**	**0**	**0**	**0**

[1] A zero value indicates the groundwater availability model pumping scenario did not include any pumping in the aquifer.

TABLE 1 (CONTINUED)

Groundwater Conservation District	County	Aquifer	2020	2030	2040	2050	2060	2070	2080
Wintergarden GCD	Dimmit	Carrizo-Wilcox	**3,895**	**3,885**	**3,895**	**3,885**	**3,885**	**3,885**	**3,885**
Wintergarden GCD	La Salle	Carrizo-Wilcox	**6,554**	**6,536**	**6,554**	**6,536**	**6,536**	**6,536**	**6,536**
Wintergarden GCD	Zavala	Carrizo-Wilcox	**38,303**	**36,675**	**35,399**	**35,204**	**35,006**	**34,831**	**34,540**
Wintergarden GCD Total		**Carrizo-Wilcox**	**48,752**	**47,096**	**45,848**	**45,625**	**45,427**	**45,252**	**44,961**
No District-County	Bexar	Carrizo-Wilcox	69,727	68,451	68,928	68,739	67,653	67,849	67,849
No District-County	Caldwell	Carrizo-Wilcox	39	39	39	39	39	39	39
No District-County	Gonzales	Carrizo-Wilcox	0[2]	0	0	0	0	0	0
No District-County	Maverick	Carrizo-Wilcox	547	545	547	545	545	276	276
No District-County	Webb	Carrizo-Wilcox	912	910	912	910	910	910	910
No District-County Total		**Carrizo-Wilcox**	**71,225**	**69,945**	**70,426**	**70,233**	**69,147**	**69,074**	**69,074**
Total for GMA 13		**Carrizo-Wilcox**	**470,283**	**448,537**	**473,887**	**520,821**	**558,942**	**583,136**	**574,718**

[2] A zero value indicates the groundwater availability model pumping scenario did not include any pumping in the aquifer.

TABLE 2. MODELED AVAILABLE GROUNDWATER FOR THE QUEEN CITY AQUIFER IN GROUNDWATER MANAGEMENT AREA 13 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2080. VALUES ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District	County	Aquifer	2020	2030	2040	2050	2060	2070	2080
Evergreen UWCD	Atascosa	Queen City	4,070	4,525	4,537	4,495	4,390	4,285	4,285
Evergreen UWCD	Frio	Queen City	6,702	4,533	4,380	4,231	4,066	3,927	3,927
Evergreen UWCD	Wilson	Queen City	2,631	1,423	1,267	1,123	1,000	892	892
Evergreen UWCD Total		**Queen City**	**13,403**	**10,481**	**10,184**	**9,849**	**9,456**	**9,104**	**9,104**
Gonzales County UWCD	Caldwell	Queen City	4,842	4,829	4,557	4,545	4,545	3,977	3,977
Gonzales County UWCD	Gonzales	Queen City	4,973	4,960	4,973	4,960	4,960	4,500	4,500
Gonzales County UWCD Total		**Queen City**	**9,815**	**9,789**	**9,530**	**9,505**	**9,505**	**8,477**	**8,477**
Guadalupe County GCD	**Guadalupe**	**Queen City**	**0**[3]	**0**	**0**	**0**	**0**	**0**	**0**
McMullen GCD	**McMullen**	**Queen City**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
Plum Creek CD	**Caldwell**	**Queen City**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Wintergarden GCD	**La Salle**	**Queen City**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
Total for GMA 13		**Queen City**	**23,222**	**20,274**	**19,718**	**19,358**	**18,965**	**17,585**	**17,585**

[3] A zero value indicates the groundwater availability model pumping scenario did not include any pumping in the aquifer.

TABLE 3. MODELED AVAILABLE GROUNDWATER FOR THE SPARTA AQUIFER IN GROUNDWATER MANAGEMENT AREA 13 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2080. VALUES ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District	County	Aquifer	2020	2030	2040	2050	2060	2070	2080
Evergreen UWCD	Atascosa	Sparta	1,218	1,187	1,043	998	961	932	932
Evergreen UWCD	Frio	Sparta	897	623	603	576	557	534	534
Evergreen UWCD	Wilson	Sparta	335	182	163	144	128	114	114
Evergreen UWCD Total		**Sparta**	**2,450**	**1,992**	**1,809**	**1,718**	**1,646**	**1,580**	**1,580**
Gonzales County UWCD	**Gonzales**	**Sparta**	**3,524**	**2,451**	**2,457**	**2,451**	**2,451**	**2,451**	**2,451**
McMullen GCD	**McMullen**	**Sparta**	**0**[4]	**0**	**0**	**0**	**0**	**0**	**0**
Wintergarden GCD	**La Salle**	**Sparta**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Total for GMA 13		**Sparta**	**5,974**	**4,443**	**4,266**	**4,169**	**4,097**	**4,031**	**4,031**

TABLE 4. MODELED AVAILABLE GROUNDWATER FOR THE YEGUA-JACKSON AQUIFER IN GROUNDWATER MANAGEMENT AREA 13 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2080. VALUES ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District	County	Aquifer	2020	2030	2040	2050	2060	2070	2080
Evergreen UWCD	Karnes	Yegua-Jackson	2,013	2,013	2,013	2,013	2,013	2,013	2,013
Gonzales County UWCD	Gonzales	Yegua-Jackson	4,155	4,155	4,155	4,155	4,155	4,155	4,155
No District-County	Gonzales	Yegua-Jackson	573	573	573	573	573	573	573
Total for GMA 13		**Yegua-Jackson**	**6,741**	**6,741**	**6,741**	**6,741**	**6,741**	**6,741**	**6,741**

[4] A zero value indicates the groundwater availability model pumping scenario did not include any pumping in the aquifer.

TABLE 5. MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE CARRIZO-WILCOX AQUIFER IN GROUNDWATER MANAGEMENT AREA 13. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), RIVER BASIN, AND AQUIFER.

County	RWPA	River Basin	Aquifer	2030	2040	2050	2060	2070	2080
Atascosa	L	Nueces	Carrizo-Wilcox	54,310	55,241	56,739	58,316	59,890	59,890
Atascosa	L	San Antonio	Carrizo-Wilcox	87	88	89	90	92	92
Bexar	L	Nueces	Carrizo-Wilcox	38,762	38,993	39,134	39,134	39,287	39,287
Bexar	L	San Antonio	Carrizo-Wilcox	29,689	29,935	29,605	28,519	28,562	28,562
Caldwell	L	Colorado	Carrizo-Wilcox	0[5]	0	0	0	0	0
Caldwell	L	Guadalupe	Carrizo-Wilcox	24,877	32,775	42,514	45,688	49,635	49,594
Dimmit	L	Nueces	Carrizo-Wilcox	3,765	3,775	3,765	3,765	3,765	3,765
Dimmit	L	Rio Grande	Carrizo-Wilcox	120	120	120	120	120	120
Frio	L	Nueces	Carrizo-Wilcox	86,995	85,143	82,950	81,018	79,131	79,131
Gonzales	L	Guadalupe	Carrizo-Wilcox	76,265	90,788	102,373	102,747	103,707	96,161
Gonzales	L	Lavaca	Carrizo-Wilcox	0	0	0	0	0	0
Guadalupe	L	Guadalupe	Carrizo-Wilcox	32,400	34,200	35,631	34,655	34,736	34,345
Guadalupe	L	San Antonio	Carrizo-Wilcox	7,163	7,468	7,684	7,463	7,463	7,314
Karnes	L	Guadalupe	Carrizo-Wilcox	0	0	0	0	0	0
Karnes	L	Nueces	Carrizo-Wilcox	0	0	0	0	0	0
Karnes	L	San Antonio	Carrizo-Wilcox	758	843	931	1,001	1,043	1,043
La Salle	L	Nueces	Carrizo-Wilcox	6,536	6,554	6,536	6,536	6,536	6,536
Medina	L	Nueces	Carrizo-Wilcox	2,623	2,630	2,623	2,623	2,623	2,623

[5] A zero value indicates the groundwater availability model pumping scenario did not include any pumping in the aquifer.

TABLE 5 (CONTINUED)

County	RWPA	River Basin	Aquifer	2030	2040	2050	2060	2070	2080
Medina	L	San Antonio	Carrizo-Wilcox	5	5	5	5	5	5
Uvalde	L	Nueces	Carrizo-Wilcox	0[6]	0	0	0	0	0
Wilson	L	Guadalupe	Carrizo-Wilcox	443	653	762	3,870	3,982	3,982
Wilson	L	Nueces	Carrizo-Wilcox	10,774	11,171	11,578	12,027	12,546	12,546
Wilson	L	San Antonio	Carrizo-Wilcox	27,067	31,780	56,269	90,050	109,142	109,142
Zavala	L	Nueces	Carrizo-Wilcox	36,675	35,399	35,204	35,006	34,831	34,540
Maverick	M	Nueces	Carrizo-Wilcox	542	544	542	542	273	273
Maverick	M	Rio Grande	Carrizo-Wilcox	3	3	3	3	3	3
Webb	M	Nueces	Carrizo-Wilcox	890	892	890	890	890	890
Webb	M	Rio Grande	Carrizo-Wilcox	20	20	20	20	20	20
McMullen	N	Nueces	Carrizo-Wilcox	7,768	4,867	4,854	4,854	4,854	4,854
GMA 13 Total			**Carrizo-Wilcox**	**448,537**	**473,887**	**520,821**	**558,942**	**583,136**	**574,718**

[6] A zero value indicates the groundwater availability model pumping scenario did not include any pumping in the aquifer.

TABLE 6. MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE QUEEN CITY AQUIFER IN GROUNDWATER MANAGEMENT AREA 13. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), RIVER BASIN, AND AQUIFER.

County	RWPA	River Basin	Aquifer	2030	2040	2050	2060	2070	2080
Atascosa	L	Nueces	Queen City	4,525	4,537	4,495	4,390	4,285	4,285
Caldwell	L	Guadalupe	Queen City	4,829	4,557	4,545	4,545	3,977	3,977
Frio	L	Nueces	Queen City	4,533	4,380	4,231	4,066	3,927	3,927
Gonzales	L	Guadalupe	Queen City	4,960	4,973	4,960	4,960	4,500	4,500
Guadalupe	L	Guadalupe	Queen City	0[7]	0	0	0	0	0
La Salle	L	Nueces	Queen City	1	1	1	1	1	1
Wilson	L	Guadalupe	Queen City	106	95	84	75	67	67
Wilson	L	Nueces	Queen City	181	161	143	127	114	114
Wilson	L	San Antonio	Queen City	1,136	1,011	896	798	711	711
McMullen	N	Nueces	Queen City	3	3	3	3	3	3
GMA 13 Total			**Queen City**	**20,274**	**19,718**	**19,358**	**18,965**	**17,585**	**17,585**

[7] A zero value indicates the groundwater availability model pumping scenario did not include any pumping in the aquifer.

TABLE 7. MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE SPARTA AQUIFER IN GROUNDWATER MANAGEMENT AREA 13. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), RIVER BASIN, AND AQUIFER.

County	RWPA	River Basin	Aquifer	2030	2040	2050	2060	2070	2080
Atascosa	L	Nueces	Sparta	1,187	1,043	998	961	932	932
Frio	L	Nueces	Sparta	623	603	576	557	534	534
Gonzales	L	Guadalupe	Sparta	2,451	2,457	2,451	2,451	2,451	2,451
La Salle	L	Nueces	Sparta	0[8]	0	0	0	0	0
Wilson	L	Guadalupe	Sparta	12	11	10	9	8	8
Wilson	L	Nueces	Sparta	19	17	15	13	12	12
Wilson	L	San Antonio	Sparta	151	135	119	106	94	94
McMullen	N	Nueces	Sparta	0	0	0	0	0	0
GMA 13 Total			**Sparta**	**4,443**	**4,266**	**4,169**	**4,097**	**4,031**	**4,031**

[8] A zero value indicates the groundwater availability model pumping scenario did not include any pumping in the aquifer.

TABLE 8. MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE YEGUA-JACKSON AQUIFER IN GROUNDWATER MANAGEMENT AREA 13. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), RIVER BASIN, AND AQUIFER.

County	RWPA	River Basin	Aquifer	2030	2040	2050	2060	2070	2080
Atascosa	L	Nueces	Yegua-Jackson	NR	NR	NR	NR	NR	NR
Frio	L	Nueces	Yegua-Jackson	NR	NR	NR	NR	NR	NR
Gonzales	L	Guadalupe	Yegua-Jackson	4,709	4,709	4,709	4,709	4,709	4,709
Gonzales	L	Lavaca	Yegua-Jackson	19	19	19	19	19	19
Karnes	L	Guadalupe	Yegua-Jackson	292	292	292	292	292	292
Karnes	L	Nueces	Yegua-Jackson	91	91	91	91	91	91
Karnes	L	San Antonio	Yegua-Jackson	1,630	1,630	1,630	1,630	1,630	1,630
La Salle	L	Nueces	Yegua-Jackson	NR	NR	NR	NR	NR	NR
Wilson	L	Guadalupe	Yegua-Jackson	NR	NR	NR	NR	NR	NR
Wilson	L	Nueces	Yegua-Jackson	NR	NR	NR	NR	NR	NR
Wilson	L	San Antonio	Yegua-Jackson	NR	NR	NR	NR	NR	NR
Webb	M	Nueces	Yegua-Jackson	NR	NR	NR	NR	NR	NR
Webb	M	Rio Grande	Yegua-Jackson	NR	NR	NR	NR	NR	NR
Zapata	M	Rio Grande	Yegua-Jackson	NR	NR	NR	NR	NR	NR
McMullen	N	Nueces	Yegua-Jackson	NR	NR	NR	NR	NR	NR
GMA 13 Total			**Yegua-Jackson**	**6,741**	**6,741**	**6,741**	**6,741**	**6,741**	**6,741**

NR: Groundwater Management Area 13 declared the Yegua-Jackson Aquifer not relevant in these areas.

LIMITATIONS:

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

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

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

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

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

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APPENDIX A

Total Pumping Associated with Modeled Available Groundwater Run for the Carrizo-Wilcox Aquifer Split by Model Layers for Groundwater Management Area 13

TABLE A.1. TOTAL PUMPING SPLIT BY MODEL LAYERS FROM THE MODELED AVAILABLE GROUNDWATER RUN FOR THE CARRIZO-WILCOX AQUIFER IN GROUNDWATER MANAGEMENT AREA 13. THE VALUES ARE SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2080. VALUES ARE IN ACRE-FEET PER YEAR.

GCD	County	Aquifer	2020	2030	2040	2050	2060	2070	2080
Evergreen UWCD	Atascosa	Carrizo	50,266	52,745	53,671	55,176	56,754	58,330	58,330
Evergreen UWCD	Atascosa	Upper Wilcox	250	249	250	249	249	249	249
Evergreen UWCD	Atascosa	Middle Wilcox	224	223	224	223	223	223	223
Evergreen UWCD	Atascosa	Lower Wilcox	1,184	1,180	1,184	1,180	1,180	1,180	1,180
Evergreen UWCD	Frio	Carrizo	114,827	86,995	85,143	82,950	81,018	79,131	79,131
Evergreen UWCD	Frio	Upper Wilcox	0[9]	0	0	0	0	0	0
Evergreen UWCD	Frio	Middle Wilcox	0	0	0	0	0	0	0
Evergreen UWCD	Frio	Lower Wilcox	0	0	0	0	0	0	0
Evergreen UWCD	Karnes	Carrizo	693	758	843	931	1,001	1,043	1,043
Evergreen UWCD	Karnes	Upper Wilcox	0	0	0	0	0	0	0
Evergreen UWCD	Karnes	Middle Wilcox	0	0	0	0	0	0	0
Evergreen UWCD	Karnes	Lower Wilcox	0	0	0	0	0	0	0
Evergreen UWCD	Wilson	Carrizo	36,086	32,648	34,096	35,482	36,994	38,730	38,730
Evergreen UWCD	Wilson	Upper Wilcox	125	125	125	125	125	125	125
Evergreen UWCD	Wilson	Middle Wilcox	125	125	125	125	125	125	125
Evergreen UWCD	Wilson	Lower Wilcox	1,893	5,386	9,258	32,877	68,703	86,690	86,690
Evergreen UWCD Total		**Carrizo-Wilcox**	**205,673**	**180,434**	**184,919**	**209,318**	**246,372**	**265,826**	**265,826**

[9] A zero value indicates the groundwater availability model pumping scenario did not include any pumping in the aquifer.

TABLE A.1. (CONTINUED)

GCD	County	Aquifer	2020	2030	2040	2050	2060	2070	2080
Gonzales County UWCD	Caldwell	Carrizo	453	9,457	16,386	25,495	30,072	30,072	30,072
Gonzales County UWCD	Caldwell	Upper Wilcox	15	15	15	15	15	15	15
Gonzales County UWCD	Caldwell	Middle Wilcox	0[10]	0	0	0	0	0	0
Gonzales County UWCD	Caldwell	Lower Wilcox	0	0	0	0	0	0	0
Gonzales County UWCD	Gonzales	Carrizo	47,131	51,908	55,242	55,832	56,206	57,166	49,620
Gonzales County UWCD	Gonzales	Upper Wilcox	0	0	0	0	0	0	0
Gonzales County UWCD	Gonzales	Middle Wilcox	11,096	15,563	20,114	24,556	24,556	24,556	24,556
Gonzales County UWCD	Gonzales	Lower Wilcox	2,204	8,794	15,432	21,985	21,985	21,985	21,985
Gonzales County UWCD Total		**Carrizo-Wilcox**	**60,899**	**85,737**	**107,189**	**127,883**	**132,834**	**133,794**	**126,248**
Guadalupe County GCD	Guadalupe	Carrizo	28,943	14,834	14,627	14,532	14,224	14,624	14,624
Guadalupe County GCD	Guadalupe	Upper Wilcox	0	0	0	0	0	0	0

[10] A zero value indicates the groundwater availability model pumping scenario did not include any pumping in the aquifer.

TABLE A.1 (CONTINUED)

GCD	County	Aquifer	2020	2030	2040	2050	2060	2070	2080
Guadalupe County GCD	Guadalupe	Middle Wilcox	6,609	6,373	7,926	9,428	9,207	9,075	8,986
Guadalupe County GCD	Guadalupe	Lower Wilcox	20,085	18,356	19,115	19,355	18,687	18,500	18,049
Guadalupe County GCD Total		**Carrizo-Wilcox**	**55,637**	**39,563**	**41,668**	**43,315**	**42,118**	**42,199**	**41,659**
McMullen County GCD	McMullen	Carrizo	7,789	7,768	4,867	4,854	4,854	4,854	4,854
McMullen County GCD	McMullen	Upper Wilcox	0[11]	0	0	0	0	0	0
McMullen County GCD	McMullen	Middle Wilcox	0	0	0	0	0	0	0
McMullen County GCD	McMullen	Lower Wilcox	0	0	0	0	0	0	0
McMullen County GCD Total		**Carrizo-Wilcox**	**7,789**	**7,768**	**4,867**	**4,854**	**4,854**	**4,854**	**4,854**
Medina County GCD	Medina	Carrizo	517	515	517	515	515	515	515
Medina County GCD	Medina	Upper Wilcox	0	0	0	0	0	0	0
Medina County GCD	Medina	Middle Wilcox	1,252	1,249	1,252	1,249	1,249	1,249	1,249
Medina County GCD	Medina	Lower Wilcox	866	864	866	864	864	864	864
Medina County GCD Total		**Carrizo-Wilcox**	**2,635**	**2,628**	**2,635**	**2,628**	**2,628**	**2,628**	**2,628**
Plum Creek CD	Caldwell	Carrizo	0	1,990	5,048	5,709	6,046	9,993	9,993
Plum Creek CD	Caldwell	Upper Wilcox	0	0	0	0	0	0	0
Plum Creek CD	Caldwell	Middle Wilcox	5,733	5,717	5,733	5,717	3,977	3,977	3,936
Plum Creek CD	Caldwell	Lower Wilcox	11,940	7,659	5,554	5,539	5,539	5,539	5,539
Plum Creek CD Total		**Carrizo-Wilcox**	**17,673**	**15,366**	**16,335**	**16,965**	**15,562**	**19,509**	**19,468**

[11] A zero value indicates the groundwater availability model pumping scenario did not include any pumping in the aquifer.

TABLE A.1 (CONTINUED)

GCD	County	Aquifer	2020	2030	2040	2050	2060	2070	2080
Uvalde County GCD	Uvalde	Carrizo	0[12]	0	0	0	0	0	0
Uvalde County GCD	Uvalde	Upper Wilcox	0	0	0	0	0	0	0
Uvalde County GCD	Uvalde	Middle Wilcox	0	0	0	0	0	0	0
Uvalde County GCD	Uvalde	Lower Wilcox	0	0	0	0	0	0	0
Uvalde County GCD Total		**Carrizo-Wilcox**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Wintergarden GCD	Dimmit	Carrizo	2,722	2,715	2,722	2,715	2,715	2,715	2,715
Wintergarden GCD	Dimmit	Upper Wilcox	993	990	993	990	990	990	990
Wintergarden GCD	Dimmit	Middle Wilcox	142	142	142	142	142	142	142
Wintergarden GCD	Dimmit	Lower Wilcox	38	38	38	38	38	38	38
Wintergarden GCD	La Salle	Carrizo	4,597	4,584	4,597	4,584	4,584	4,584	4,584
Wintergarden GCD	La Salle	Upper Wilcox	1,957	1,952	1,957	1,952	1,952	1,952	1,952
Wintergarden GCD	La Salle	Middle Wilcox	0	0	0	0	0	0	0
Wintergarden GCD	La Salle	Lower Wilcox	0	0	0	0	0	0	0
Wintergarden GCD	Zavala	Carrizo	27,969	26,368	25,065	24,897	24,699	24,524	24,233
Wintergarden GCD	Zavala	Upper Wilcox	6,329	6,312	6,329	6,312	6,312	6,312	6,312
Wintergarden GCD	Zavala	Middle Wilcox	3,683	3,673	3,683	3,673	3,673	3,673	3,673
Wintergarden GCD	Zavala	Lower Wilcox	322	322	322	322	322	322	322
Wintergarden GCD Total		**Carrizo-Wilcox**	**48,752**	**47,096**	**45,848**	**45,625**	**45,427**	**45,252**	**44,961**
No District-County	Bexar	Carrizo	43,057	42,939	43,346	43,227	43,227	43,423	43,423
No District-County	Bexar	Upper Wilcox	10	10	10	10	10	10	10
No District-County	Bexar	Middle Wilcox	58	58	58	58	58	58	58
No District-County	Bexar	Lower Wilcox	26,602	25,444	25,514	25,444	24,358	24,358	24,358

[12] A zero value indicates the groundwater availability model pumping scenario did not include any pumping in the aquifer.

TABLE A.1 (CONTINUED)

GCD	County	Aquifer	2020	2030	2040	2050	2060	2070	2080
No District-County	Caldwell	Carrizo	NP[13]	NP	NP	NP	NP	NP	NP
No District-County	Caldwell	Upper Wilcox	NP	NP	NP	NP	NP	NP	NP
No District-County	Caldwell	Middle Wilcox	39	39	39	39	39	39	39
No District-County	Caldwell	Lower Wilcox	0[14]	0	0	0	0	0	0
No District-County	Gonzales	Carrizo	0	0	0	0	0	0	0
No District-County	Gonzales	Upper Wilcox	0	0	0	0	0	0	0
No District-County	Gonzales	Middle Wilcox	0	0	0	0	0	0	0
No District-County	Gonzales	Lower Wilcox	0	0	0	0	0	0	0
No District-County	Maverick	Carrizo	543	541	543	541	541	272	272
No District-County	Maverick	Upper Wilcox	0	0	0	0	0	0	0
No District-County	Maverick	Middle Wilcox	2	2	2	2	2	2	2
No District-County	Maverick	Lower Wilcox	2	2	2	2	2	2	2
No District-County	Web	Carrizo	898	896	898	896	896	896	896
No District-County	Web	Upper Wilcox	13	13	13	13	13	13	13
No District-County	Web	Middle Wilcox	1	1	1	1	1	1	1
No District-County	Web	Lower Wilcox	0	0	0	0	0	0	0
No District-County Total		**Carrizo-Wilcox**	**71,225**	**69,945**	**70,426**	**70,233**	**69,147**	**69,074**	**69,074**
Total for GMA 13		**Carrizo-Wilcox**	**470,283**	**448,537**	**473,887**	**520,821**	**558,942**	**583,136**	**574,718**

[13] NP: The aquifer is not present in this part of the county.
[14] A zero value indicates the groundwater availability model pumping scenario did not include any pumping in the aquifer.

APPENDIX B

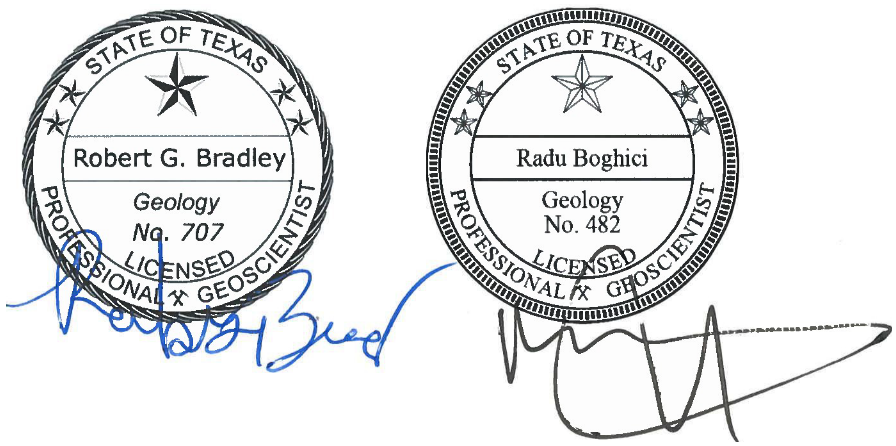
Summary of Modeled Available Groundwater for the Plum Creek Conservation District (complete set of values is available in the appendix)

GMA	Aquifers	MAG (acre-ft/ per year)	TWDB MAG Report
10	Trinity Group	276	GAM Run 16-033 MAG
10	Saline Edwards	812	GAM Run 16-033 MAG
13	Carrizo-Wilcox	Year 2020 = 17,673 Year 2080 = 19,468	GAM Run 21-018 MAG (Date issued: 7/25/2022)
13	Carrizo	Year 2030 = 1,990 Year 2080 = 9,993	GAM Run 21-018 MAG Appendix A (Date issued: 7/25/2022)
13	Wilcox Group (Upper, Middle & Lower)	Year 2020 =17,673 Year 2080 = 9,475	GAM Run 21-018 MAG Appendix A (Date issued: 7/25/2022)
13	Queen City	0	GAM Run 21-018 MAG (Date issued: 7/25/2022)

APPENDIX B

GAM RUN 16-033 MAG: MODELED AVAILABLE GROUNDWATER FOR THE AQUIFERS IN GROUNDWATER MANAGEMENT AREA 10

Robert G. Bradley, P.G. and Radu Boghici, P.G.
Texas Water Development Board
Groundwater Division
(512) 463-5808
July 20, 2018



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GAM RUN 16-033 MAG: MODELED AVAILABLE GROUNDWATER AQUIFERS IN GROUNDWATER MANAGEMENT AREA 10

Robert G. Bradley, P.G. and Radu Boghici, P.G.
Texas Water Development Board
Groundwater Division
(512) 463-5808
July 20, 2018

EXECUTIVE SUMMARY:

The modeled available groundwater for the relevant aquifers of Groundwater Management Area 10—the Austin Chalk-Buda Limestone (relevant in Uvalde County), Barton Springs segment of the Edwards (Balcones Fault Zone), saline portion of the Barton Springs segment of the Edwards (Balcones Fault Zone), western portion of the San Antonio segment of the Edwards (Balcones Fault Zone) in Kinney County, Leona Gravel (relevant in Uvalde County), and Trinity—are summarized for the groundwater conservation districts (Tables 1, 3, 5, and 8) and by decade for use in the regional water planning process (Tables 2, 4, 6, and 9) . The modeled available groundwater estimates are 2,935 acre-feet per year in the Austin Chalk Aquifer (Uvalde County); 758 acre-feet per year in the Buda Limestone Aquifer (Uvalde County); 11,557 acre-feet per year in the Barton Springs segment of the Edwards (Balcones Fault Zone) Aquifer during average recharge conditions (3,765 acre-feet per year during drought conditions); 8,564 acre-feet per year in the saline portion of the Barton Springs segment of the Edwards (Balcones Fault Zone) Aquifer; 6,321 acre-feet per year in the freshwater portion of the western part of the San Antonio segment of the Edwards (Balcones Fault Zone) Aquifer; 9,385 acre-feet per year in the Leona Gravel Aquifer (Uvalde County); and 46,481 acre-feet per year in the Trinity Aquifer. Appropriate groundwater availability models were used to determine the modeled available groundwater for the Kinney County area of the Edwards (Balcones Fault Zone) Aquifer and to determine average recharge conditions for the Barton Springs segment of the Edwards (Balcones Fault Zone) Aquifer. Water budget methods were used to calculate the modeled available groundwater for the rest of the relevant aquifers in Groundwater Management Area 10. The Texas Water Development Board (TWDB) determined that the explanatory report and other materials were administratively complete on February 12, 2018.

REQUESTOR:

Mr. John Dupnik, Chair of Groundwater Management Area 10.

DESCRIPTION OF REQUEST:

In a letter dated November 3, 2017, Mr. John Dupnik provided the TWDB with the desired future conditions of the relevant aquifers in Groundwater Management Area 10. The desired future conditions, adopted June 26, 2017, by the groundwater conservation districts within Groundwater Management Area 10, are reproduced below:

Austin [Chalk-]Buda Limestone Aquifer(s), relevant in Uvalde County only:

- Buda Limestone: no drawdown (including exempt and non-exempt use); and
- Austin Chalk: no drawdown (including exempt and non-exempt use).

Freshwater Edwards Aquifer in the Northern [Groundwater Management Area 10] Subdivision

- Springflow at Barton Springs during average recharge conditions shall be no less than 49.7 [cubic feet per second] averaged over an 84-month (7-year) period; and,
- Springflow of Barton Springs during extreme drought conditions, including those as severe as a recurrence of the 1950s drought of record, shall be no less than 6.5 [cubic feet per second] average on a monthly basis.

Saline Edwards Aquifer in the Northern [Groundwater Management Area 10] Subdivision

- No more than 75 feet of regional average potentiometric surface drawdown due to pumping when compared to pre-development.

Freshwater Edwards Aquifer in the Western [Groundwater Management Area 10] Subdivision

- The water level in well 70-38-902 shall not fall below 1,184 [feet above] mean sea level.

Leona Gravel Aquifer, relevant in Uvalde County only:

- No drawdown (including exempt and non-exempt use).

Trinity Aquifer, in hydrologically confined zone downdip of the Trinity outcrop:

- Outside of Uvalde and Bexar counties: average regional well drawdown not exceeding 25 feet during average recharge conditions (including exempt and non-exempt use);
- In Uvalde County: no (zero) regional well drawdown (including exempt and non-exempt use); [and]
- In Bexar County: non-relevant for joint planning purpose.

In response to a request for clarifications from the TWDB on December 14, 2017, and January 29, 2018 Mr. John Dupnik indicated the following preferences for calculating modeled available groundwater volumes in Groundwater Management Area 10:

Austin Chalk-Buda Limestone aquifers (only in Uvalde County)

The TWDB will use the methods and assumptions from AA 10-26 MAG and AA 10-27 MAG, with a planning period from 2010 to 2060.

Freshwater Edwards, Northern Subdivision

The TWDB will use the methods and assumptions from GAM Run 10-059 MAG Version 2, with a planning period from 2010 to 2060. Groundwater Management Area 10 specified two desired future conditions for this aquifer. We will provide only the drought conditions modeled available groundwater for regional water planning purposes because this corresponds to the methods used in regional water planning (planning for water in times of drought). We will provide both the average recharge conditions and the drought conditions modeled available groundwater in the final report. The modeled available groundwater values will be unchanged from the previous planning cycle.

Saline Edwards, Northern Subdivision

The TWDB will use aquifer parameters from AA 10-35 MAG, with a planning period from 2010 to 2060, but we will recalculate with a simple water budget as outlined in Table 1 of the Saline Edwards explanatory report, instead of the method used in AA 10-35 MAG. On January 29, 2018, we received Technical Memo 2017-1221 from the Barton Springs/ Edwards Aquifer Conservation District, which outlines the technical clarification on the method to use for this aquifer.

Freshwater Edwards, Western Subdivision (only in Kinney County)

The TWDB will use the methods and assumptions from GAM Run 12-002 MAG, with a planning period from 2010 to 2060. The modeled available groundwater values will be unchanged from the previous planning cycle.

Leona Gravel (only in Uvalde County)

The TWDB will use the methods and assumptions from AA 10-28 MAG, with a planning period from 2010 to 2060.

Trinity (downdip of recharge zone)

The TWDB will use the methods and assumptions from AA 10-06 with a planning period from 2010 to 2060. The changes in groundwater district boundaries since AA 10-06 will require reapportionment of the modeled available groundwater.

METHODS:

The desired future conditions for the Austin Chalk-Buda Limestone aquifers (relevant in Uvalde County), Leona Gravel Aquifer (relevant in Uvalde County), Barton Springs segment of the Edwards (Balcones Fault Zone) Aquifer, saline portion of the Barton Springs segment of the Edwards (Balcones Fault Zone) Aquifer, Trinity Aquifer, and western portion of the San Antonio segment of the Edwards (Balcones Fault Zone) Aquifer in Kinney County are identical to the ones adopted in 2010. The applicable water budget methodologies to calculate modeled available groundwater are unchanged except for the saline Edwards (Balcones Fault Zone) and Trinity aquifers.

Therefore, the modeled available groundwater volumes presented for most of the aquifers are the same as those shown in the previous water budget assessments and model runs. These reports are AA 10-26 MAG (Thorkildsen and Backhouse, 2011a), AA 10-27 MAG (Thorkildsen and Backhouse, 2011b), GAM Run 10-059 MAG Version 2 (Hutchison and Oliver, 2011), GAM Run 12-002 MAG (Shi, 2012), and AA 10-28 MAG (Bradley, 2013).

The modeled available groundwater numbers were recalculated for the Trinity Aquifer to incorporate changes in the Groundwater Management Area 10 and groundwater conservation district boundaries. Additionally, a change in methodology required the recalculation of the Saline Edwards (Balcones Fault Zone) Aquifer modeled available groundwater, however, aquifer parameters from AA 10-35 MAG (Bradley, 2011) were incorporated into this assessment.

For the water budget approaches, modeled available groundwater volumes were determined by summing estimates of effective recharge and the change in aquifer storage. The water budget for these analyses were a simplified version of one found in Freeze and Cherry (1979, p.365).

This was the best method to calculate a modeled available groundwater estimate at this time; however, this method has limitations and should be replaced with better tools, including groundwater models and additional data as they become available. These analyses assume homogeneous and isotropic aquifers; however, real aquifer conditions do not satisfy these assumptions. These analyses further assume that precipitation is the only source of aquifer recharge, that lateral inflow to the aquifer is equal to lateral outflow from the aquifer, and that future pumping will not alter this balance. In addition, certain assumptions have been made regarding future precipitation, recharge, and streamflow in developing these estimates. Those assumptions also need to be considered and compared to actual future data when evaluating achievement of the desired future condition.

Estimates of modeled available groundwater volumes from the numerical flow models were determined by extracting pumping rates by decade from the model results using ZONEBUDGET Version 3.01 (Harbaugh, 2009). Annual pumping rates were divided by county, river basin, regional water planning area, and groundwater conservation district within Groundwater Management Area 10 (Figures 1 through 7 and Tables 1 through 9).

Modeled Available Groundwater and Permitting

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

PARAMETERS AND ASSUMPTIONS:

Austin Chalk-Buda Limestone Aquifers

- All parameters and assumptions for the Austin Chalk Aquifer are described in AA 10-26 MAG (Thorkildsen and Backhouse, 2011a) and for the Buda Limestone in AA 10-27 MAG (Thorkildsen and Backhouse, 2011b). Both reports assumed a planning period from 2010 to 2060.
- The Austin Chalk Aquifer in Uvalde County is in a state of dynamic equilibrium and the 2008 estimated pumpage of 2,935 acre-feet (Green and others, 2009) achieves the adopted desired future condition.

- The Buda Limestone Aquifer in Uvalde County is in a state of dynamic equilibrium and the 2008 estimated pumpage of 758 acre-feet (Green and others, 2009) achieves the adopted desired future condition.
- Conditions are physically possible across the management area and a water-level decline of 0 feet is uniform across the aquifer(s).

Freshwater Edwards (Balcones Fault Zone) Aquifer

NORTHERN SUBDIVISION OF GROUNDWATER MANAGEMENT AREA 10

- All parameters and assumptions for the freshwater portion of the Edwards (Balcones Fault Zone) Aquifer in the northern subdivision of Groundwater Management Area 10 are described in GAM Run 10-059 MAG Version 2 (Hutchison and Oliver, 2011). Both approaches discussed below assumed a 50-year planning period. From clarifications we received from Mr. John Dupnik, we assume a 50-year planning period from 2010 to 2060.
- A water balance approach was used to estimate modeled available groundwater during extreme drought conditions[1] based on information provided by Barton Springs/Edwards Aquifer Conservation District. See Hunt and others (2011) for additional details on the methods and assumptions for this approach.
- The total amount of water available for discharge by both springs and pumping during extreme drought conditions (11.7 cubic feet per second or 8,470 acre-feet per year) was estimated using information from the 1950's drought of record as described in Hunt and (2011).
- The water balance approach does not contain information about the spatial distribution of pumping. For the purposes of regional water planning, the estimated total pumping available during extreme drought conditions was divided by county, regional water planning area, river basin, and groundwater conservation district based on the distribution of pumping in the modeled approach under average recharge conditions (Hutchison and Oliver, 2011).
- For average recharge conditions, we used the numerical groundwater flow model that was recalibrated to include the 1950s drought for the Barton Springs segment of the Edwards (Balcones Fault Zone) Aquifer. See Hutchison and Hill (2011a) for assumptions and limitations of the numerical flow model.

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[1] The desired future conditions statement adopted by the district representatives in GMA 10 uses the term "extreme drought conditions" to include the drought of record.

- The model does not cover the Edwards Aquifer (Balcones Fault Zone) in the southernmost Barton Springs/Edwards Aquifer Conservation District jurisdiction (see Figure 4). However, given that, during average recharge conditions, the contributing zone for the flow at Barton Springs does not extend this far south, we deemed the use of the model appropriate for this purpose.
- Similar to GAM Run 09-019 (Hutchison and Hill, 2011b), the simulations consisted of 342 7-year simulations extending from 1648 through 1995 based on a tree-ring dataset from Cleaveland (2006). Each 7-year simulation consisted of 84 monthly stress periods.
- Model simulations indicated that, during average recharge conditions, an average springflow of 49.7 cubic feet per second could be maintained by allowing 11,557 acre-feet per year pumping.

KINNEY COUNTY

- All parameters and assumptions for the freshwater portion of the Edwards (Balcones Fault Zone) Aquifer in the western subdivision of Groundwater Management Area 10 (Kinney County) are described in GAM Run 12-002 MAG (Shi, 2012). We used a 50-year planning period from 2010 to 2060.
- We used version 1.01 of the numerical groundwater flow model of the Kinney County Area. See Hutchison and others (2011) for assumptions and limitations of the numerical groundwater flow model. The model was run with MODFLOW-2000 (Harbaugh and others, 2000).
- The model has four layers: layer 1 represents the Carrizo-Wilcox and associated aquifers, layer 2 represents the upper Cretaceous formations that yield groundwater, layer 3 represents the Edwards (Balcones Fault Zone) Aquifer and the Edwards Group of the Edward-Trinity (Plateau) Aquifer, and layer 4 represents the Trinity Aquifer.

Saline Edwards (Balcones Fault Zone) Aquifer

- A detailed description of all parameters is available for the saline portion of the Edwards (Balcones Fault Zone) Aquifer in the northern subdivision of Groundwater Management Area 10 in AA 10-35 MAG (Bradley, 2011). Table 1 from Barton Springs/Edwards Aquifer Conservation District Technical Memo 2017-1221 (Hunt, 2017) outlines the approach used to estimate modeled available groundwater. We used a 50-year planning period from 2010 to 2060.

- Map areas (Figure 5) from AA 10-35 MAG (Bradley, 2011) were used to calculate volumes based on a storage coefficient of 7.0 X 10^{-4} (Hunt and others, 2010) and a desired future condition of 75 feet of drawdown. Map areas are designated as Plum Creek Conservation District only where their jurisdiction does not overlap with the Barton Springs/Edwards Aquifer Conservation District.
- A water-level decline of 75 feet is uniform across the aquifer for the 50-year planning period.
- The aquifer is homogeneous and isotropic, lateral inflow to the aquifer is equal to lateral outflow from the aquifer, and future pumping will not alter this balance.

Leona Gravel Aquifer

- A detailed description of all parameters and assumptions is available for the Leona Gravel Aquifer in Uvalde County in AA 10-28 MAG (Bradley, 2013). We used a 50-year planning period from 2010 to 2060.
- See George (2010) for assumptions and parameters used to estimate effective recharge. Recharge is received mainly from inflow from the Edwards Aquifer (Green and others, 2008) with additional recharge from direct precipitation. The period 1996 to 2011 was selected for analysis of J-27 water levels due to the start of mandated management of the Edwards Aquifer in 1996.

Trinity Aquifer

- A detailed description of all parameters and assumptions is available in AA 10-06 (Thorkildsen and Backhouse, 2010b). We used a 50-year planning period from 2010 to 2060.
- The methods and assumptions used to estimate modeled available groundwater for the Trinity Aquifer remain unchanged from AA 10-06 (Thorkildsen and Backhouse, 2010b). Because the Groundwater Management Area 10 boundary was adjusted since the last round of joint planning, this required a reapportionment of the modeled available groundwater as estimated in the original aquifer assessment. First, changes were made to the Groundwater Management Area 10 boundary to exclude the Guadalupe County, Hays Trinity, and Trinity Glen Rose groundwater conservation districts. There were also changes in to the Barton Springs/Edwards Aquifer Conservation District boundary to include a portion of the Trinity Aquifer in Hays County.

- Bexar County is excluded from the modeled available groundwater calculations because the groundwater management area designated the Trinity Aquifer in Bexar County not relevant for joint planning.
- Outcrop areas are calculated as unconfined areas of the aquifer and subcrop areas are calculated as confined areas of the aquifer. Map areas 1-10 represent outcrop areas, and map areas 11-31 are subcrop areas (see Figure 8 and Table 7).
- Recharge is assigned only to the outcrop areas. The average annual precipitation for outcrop map areas was determined from the Texas Climatic Atlas (Narasimhan and others, 2008), which is the average for years 1971 to 2000; the values range from 29 to 36 inches per year. The effective recharge rate is estimated to be 4 percent. The effective recharge calculation is the map area, in acres, multiplied by the estimated average annual precipitation, in feet, and the effective recharge rate, in percent.
- Lateral inflow to the Trinity Aquifer in Groundwater Management Area 10 is estimated to be 46,018 acre-feet per year based on the average outflow across the Balcones Fault Zone results (Scenario 6) from GAM Task 10-005 (Hutchison, 2010). This volume was apportioned across each county by aquifer map areas. GAM Task 10-005 does not include inflows to Uvalde County, so a proportional amount based on inflow to Medina County was used to estimate the inflow to Uvalde County.
- The storage coefficient for the Trinity Aquifer subcrop is assumed to be 1×10^{-5} derived from aquifer tests of the Trinity Aquifer subcrop in Travis and Hays counties (Hunt and others, 2010). The storage coefficient for the Trinity Aquifer subcrop in the remaining counties is assumed to be 5×10^{-5} as derived from the calibrated groundwater availability model for the Hill Country portion of the Trinity Aquifer system in Texas (Jones and others, 2009). The average specific yield of the Trinity Aquifer outcrop is estimated to be 5×10^{-2} (Ashworth, 1983).
- Water-level drawdowns are uniform across the aquifer. Annual volumes from drawdowns are calculated by dividing the total volume by 50 years.
- Modeled available groundwater estimates are the sum of the effective recharge, lateral inflow, and volume from water-level decline.

RESULTS:

Tables 1 through 6 and 8 through 9 show the combination of modeled available groundwater summarized (1) by groundwater conservation district and county; and (2) by county, river basin, and regional water planning area for use in the regional water planning process. The modeled available groundwater results for the groundwater conservation districts (Tables 1, 3, 5, and 8), reflect the ending year discussed in the Parameters and Assumption Section of this report. For purposes of planning (Tables 2, 4, 6, and 9), the values may have been populated past the dates noted in Parameters and Assumption Section using the trend of results.

The modeled available groundwater estimates are 2,935 acre-feet per year in the Austin Chalk Aquifer (Uvalde County); 758 acre-feet per year in the Buda Limestone Aquifer (Uvalde County); 11,557 acre-feet per year in the Barton Springs segment of the Edwards (Balcones Fault Zone) Aquifer during average recharge conditions (3,765 acre-feet per year during drought conditions); 8,564 acre-feet per year in the saline portion of the Barton Springs segment of the Edwards (Balcones Fault Zone) Aquifer; 6,321 acre-feet per year in the freshwater portion of the western part of the San Antonio segment of the Edwards (Balcones Fault Zone) Aquifer; 9,385 acre-feet per year in the Leona Gravel Aquifer (Uvalde County); and 46,481 acre-feet per year in the Trinity Aquifer.

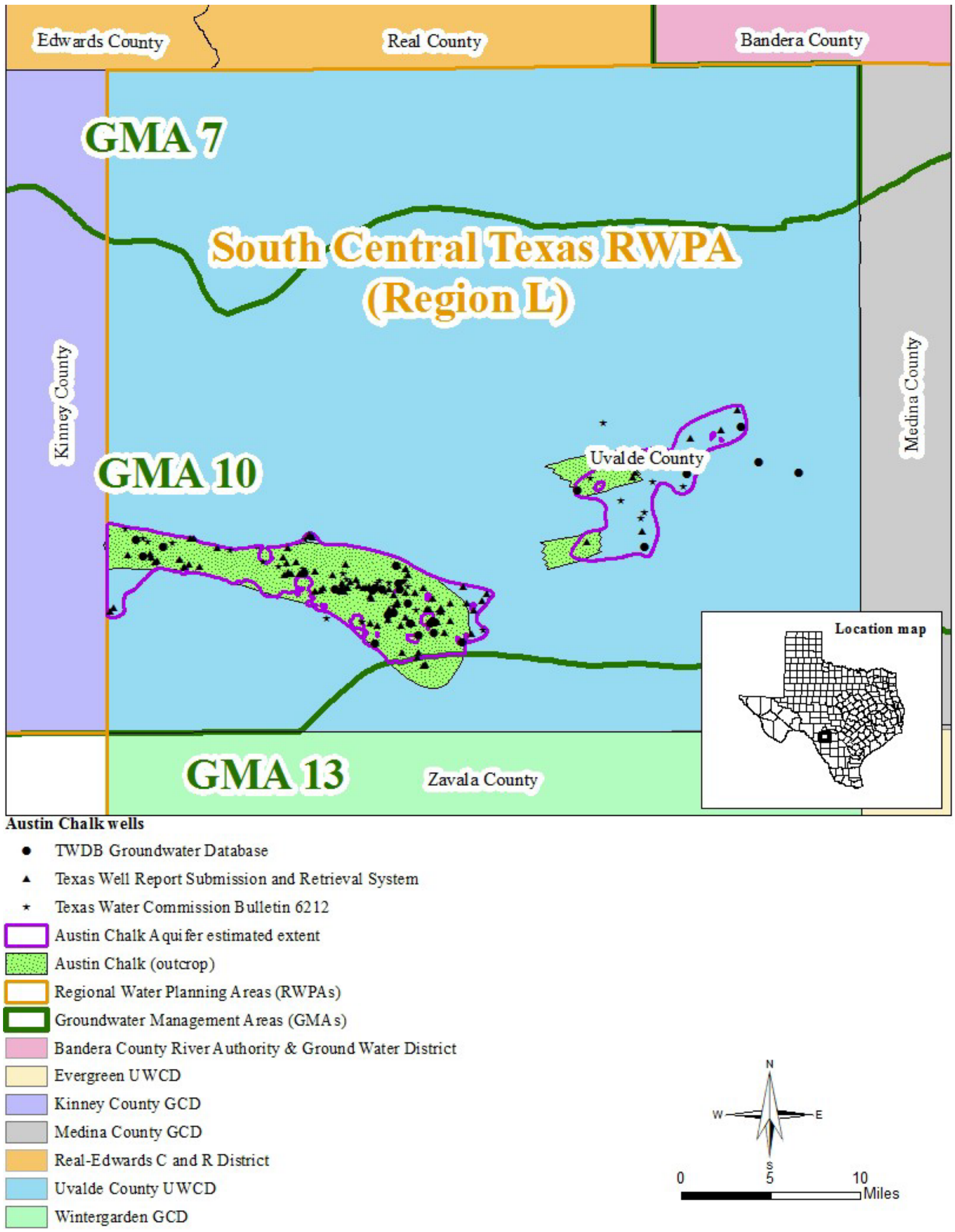

FIGURE 1. MAP SHOWING REGIONAL WATER PLANNING AREAS (RWPAS), GROUNDWATER CONSERVATION DISTRICTS (GCDS), AND COUNTIES IN THE VICINITY OF THE AUSTIN CHALK AQUIFER IN UVALDE COUNTY.

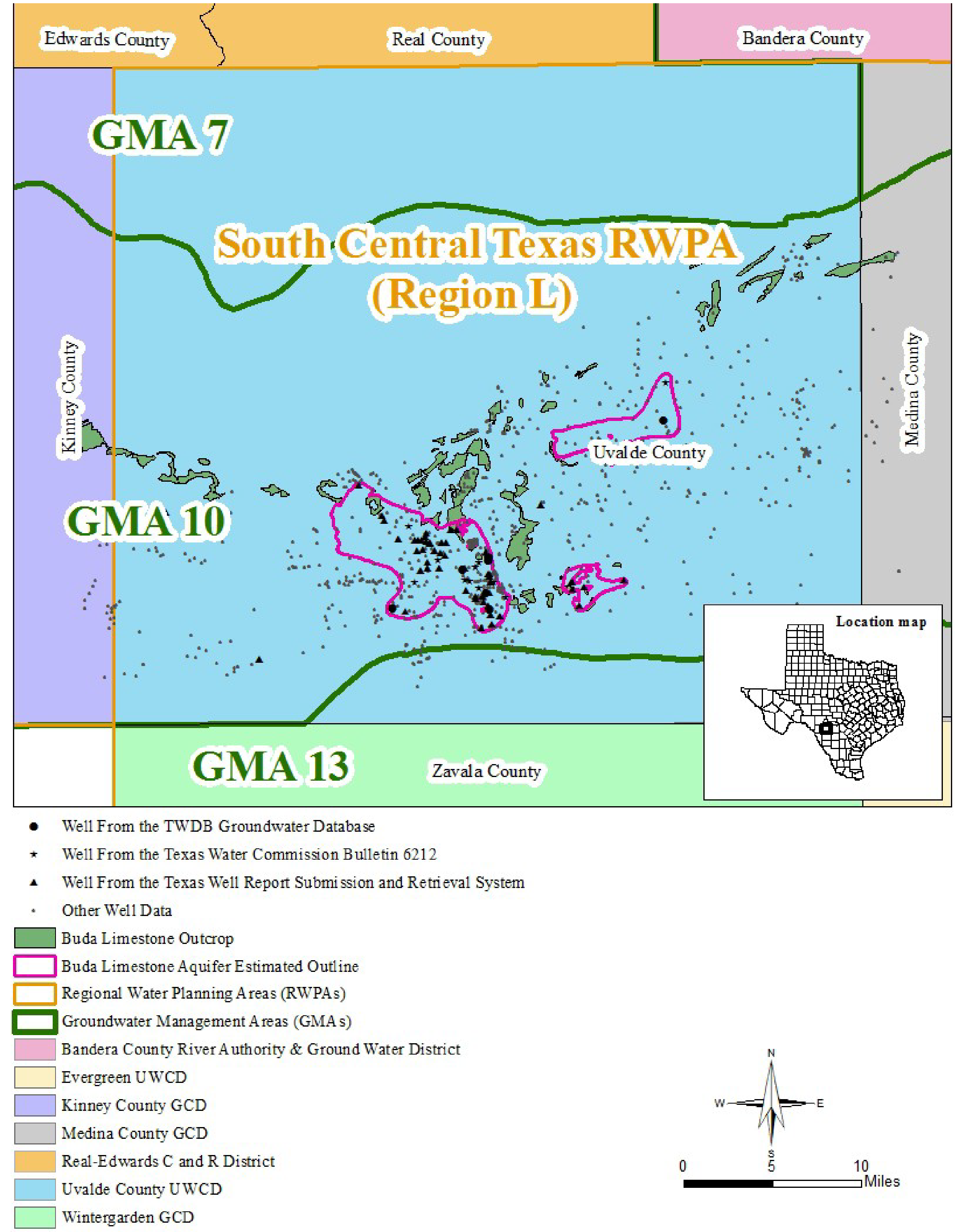

FIGURE 2. MAP SHOWING REGIONAL WATER PLANNING AREAS (RWPAS), GROUNDWATER CONSERVATION DISTRICTS (GCDS), AND COUNTIES IN THE VICINITY OF THE BUDA LIMESTONE AQUIFER IN UVALDE COUNTY.

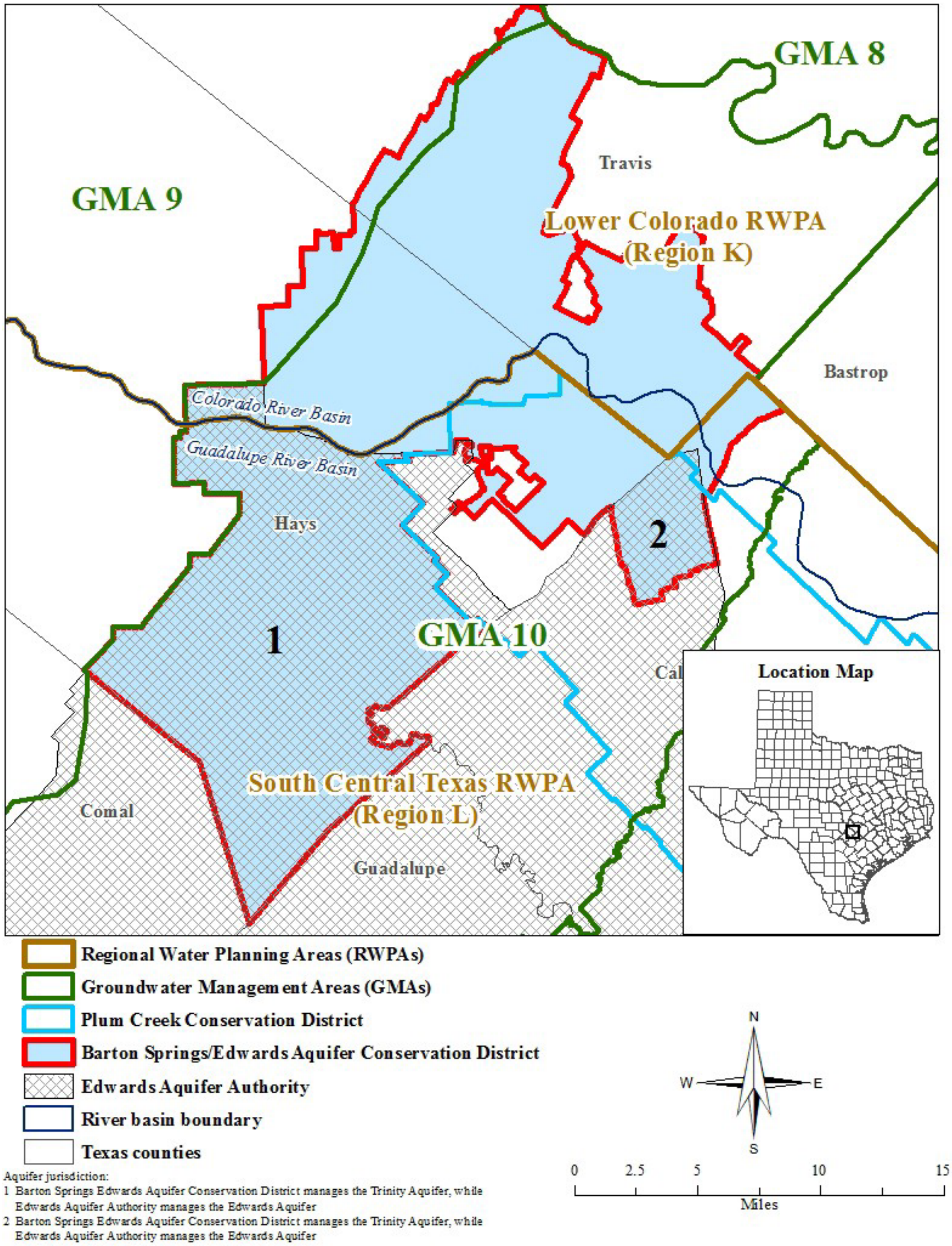

FIGURE 3. **MAP SHOWING REGIONAL WATER PLANNING AREAS (RWPAS), GROUNDWATER CONSERVATION DISTRICTS (GCDS), AND COUNTIES IN THE VICINITY OF THE FRESHWATER AND SALINE EDWARDS (BALCONES FAULT ZONE) AQUIFER IN THE NORTHERN SUBDIVISION OF GROUNDWATER MANAGEMENT AREA 10.**

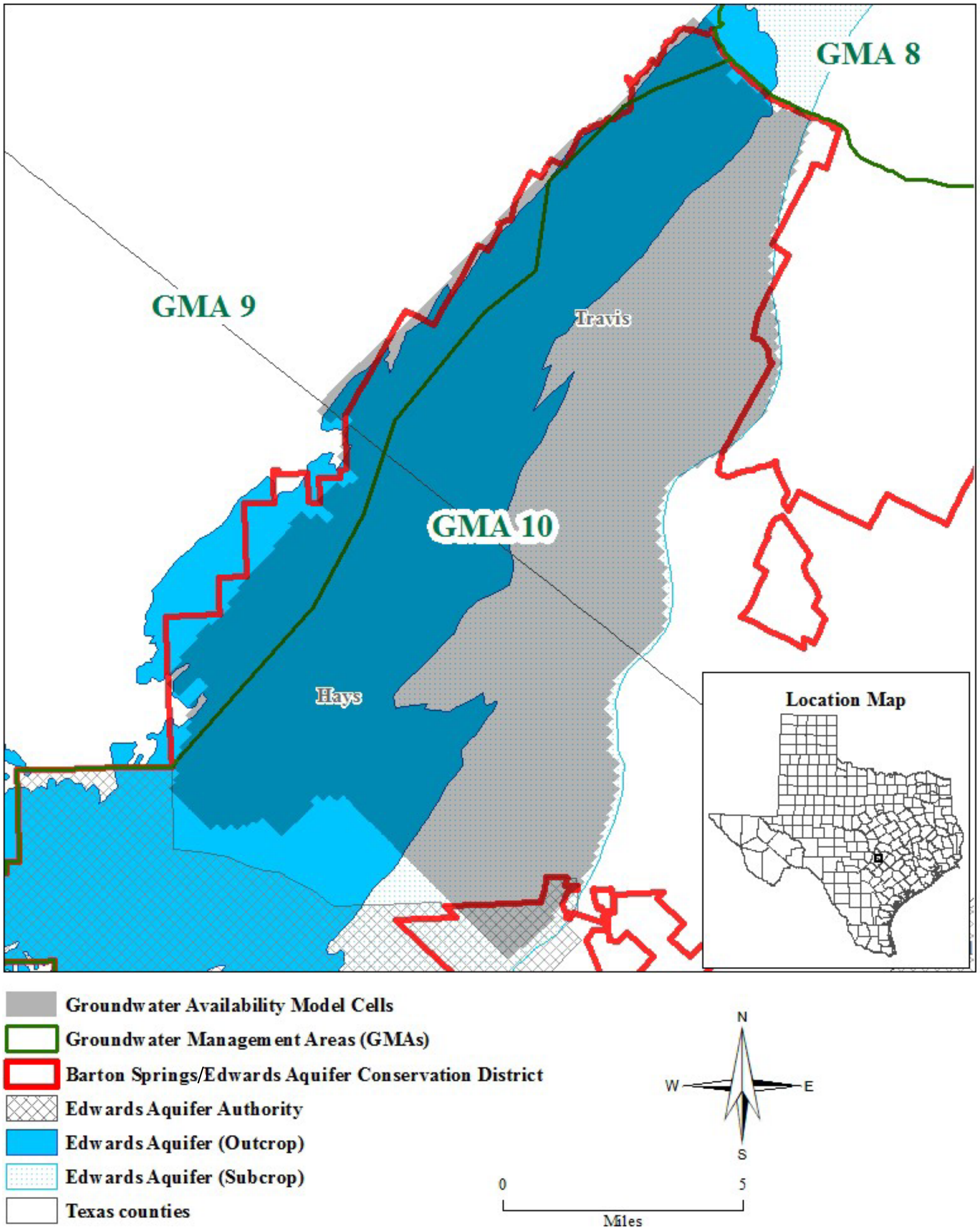

FIGURE 4. MAP SHOWING GROUNDWATER AVAILABILITY MODEL EXTENT, EDWARDS (BALCONES FAULT ZONE) AQUIFER, AND ADMINISTRATIVE BOUNDARIES IN THE NORTHERN PART OF THE BARTON SPRINGS/EDWARDS AQUIFER CONSERVATION DISTRICT IN THE NORTHERN SUBDIVISION OF GROUNDWATER MANAGEMENT AREA 10.

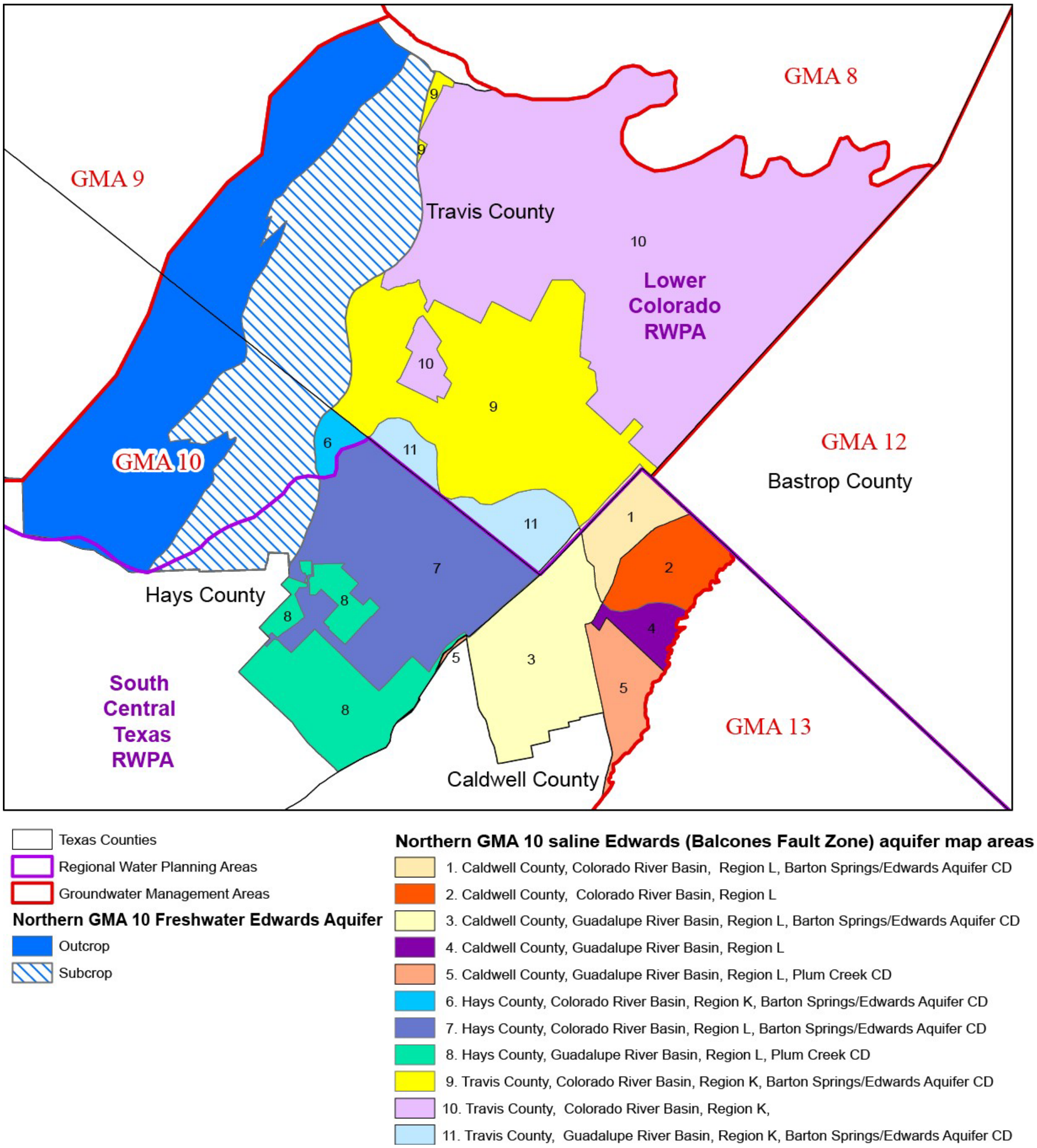

FIGURE 5. MAP SHOWING AREAS USED FOR ESTIMATING THE SALINE, EDWARDS (BALCONES FAULT ZONE) AQUIFER, MODELED AVAILABLE GROUNDWATER IN THE NORTHERN SUBDIVISION OF GROUNDWATER MANAGEMENT AREA 10, (MODIFIED FROM BRADLEY,2011) .

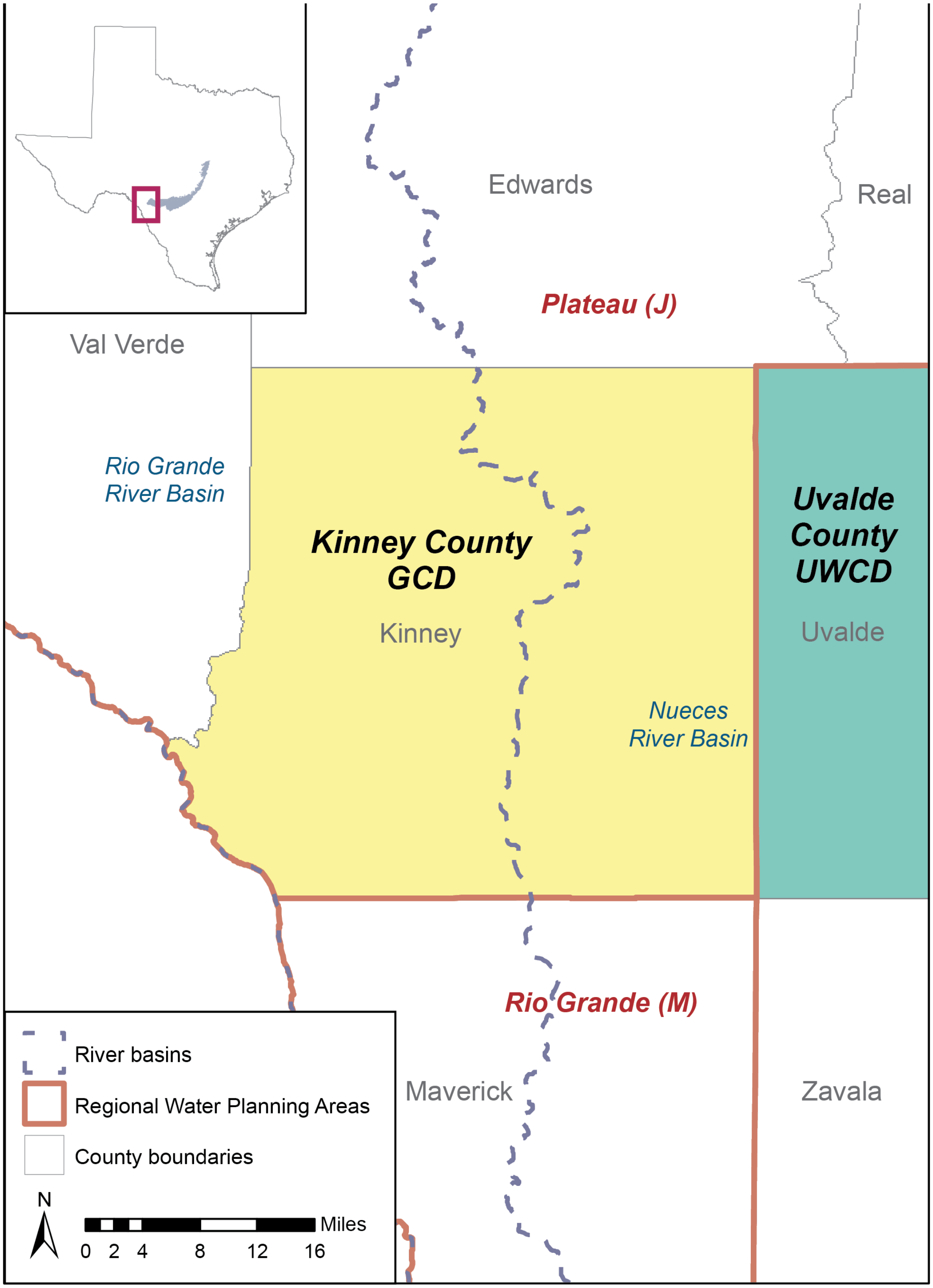

FIGURE 6. MAP SHOWING REGIONAL WATER PLANNING AREAS (RWPAS), GROUNDWATER CONSERVATION DISTRICTS (GCDS), AND COUNTIES IN THE VICINITY OF THE FRESHWATER EDWARDS (BALCONES FAULT ZONE) AQUIFER IN THE WESTERN SUBDIVISION OF GROUNDWATER MANAGEMENT AREA 10 (KINNEY COUNTY).

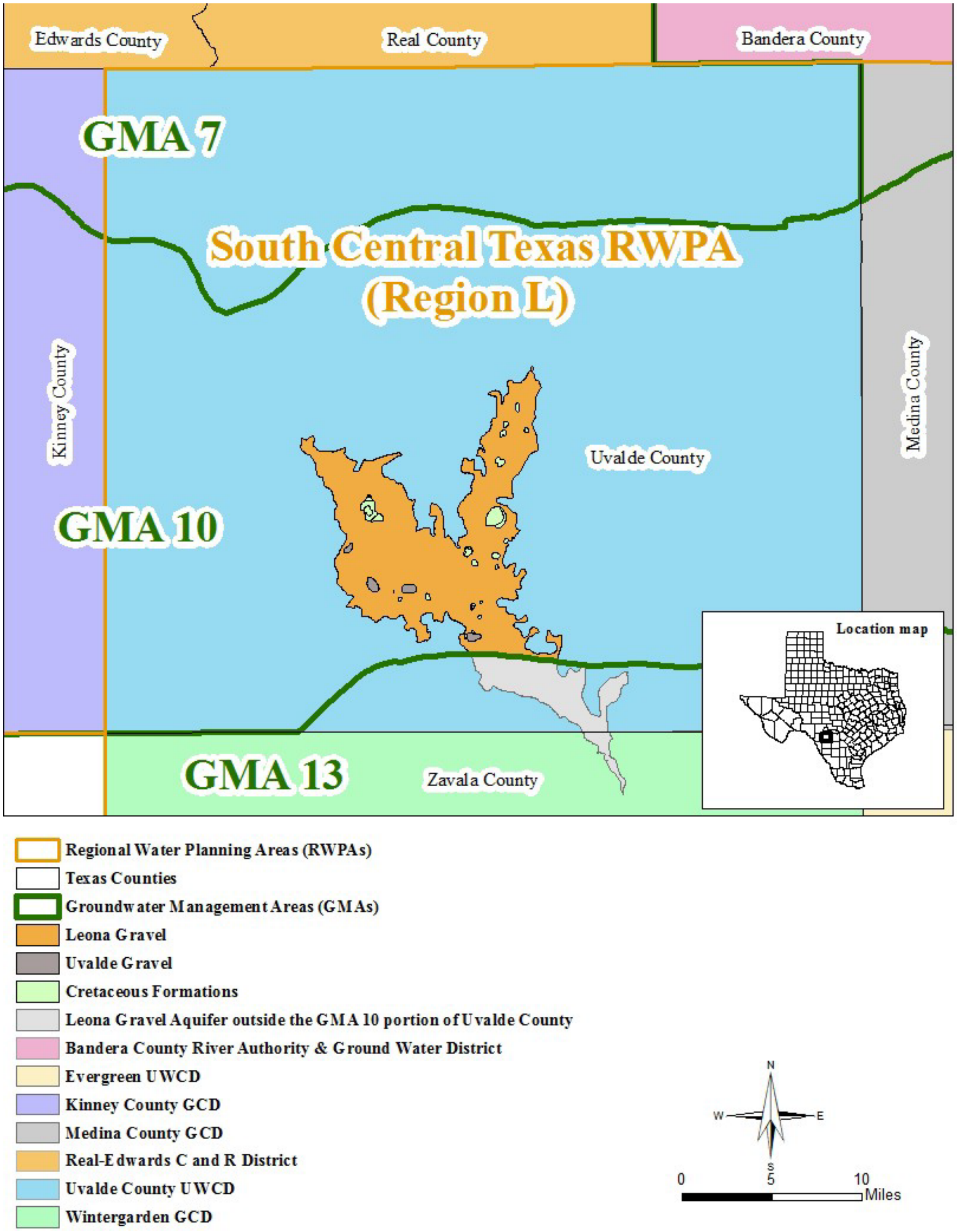

FIGURE 7. MAP SHOWING REGIONAL WATER PLANNING AREAS (RWPAS), GROUNDWATER CONSERVATION DISTRICTS (GCDS, UWCDS), AND COUNTIES IN THE VICINITY OF THE LEONA GRAVEL AQUIFER IN GROUNDWATER MANAGEMENT AREA 10 (UVALDE COUNTY).

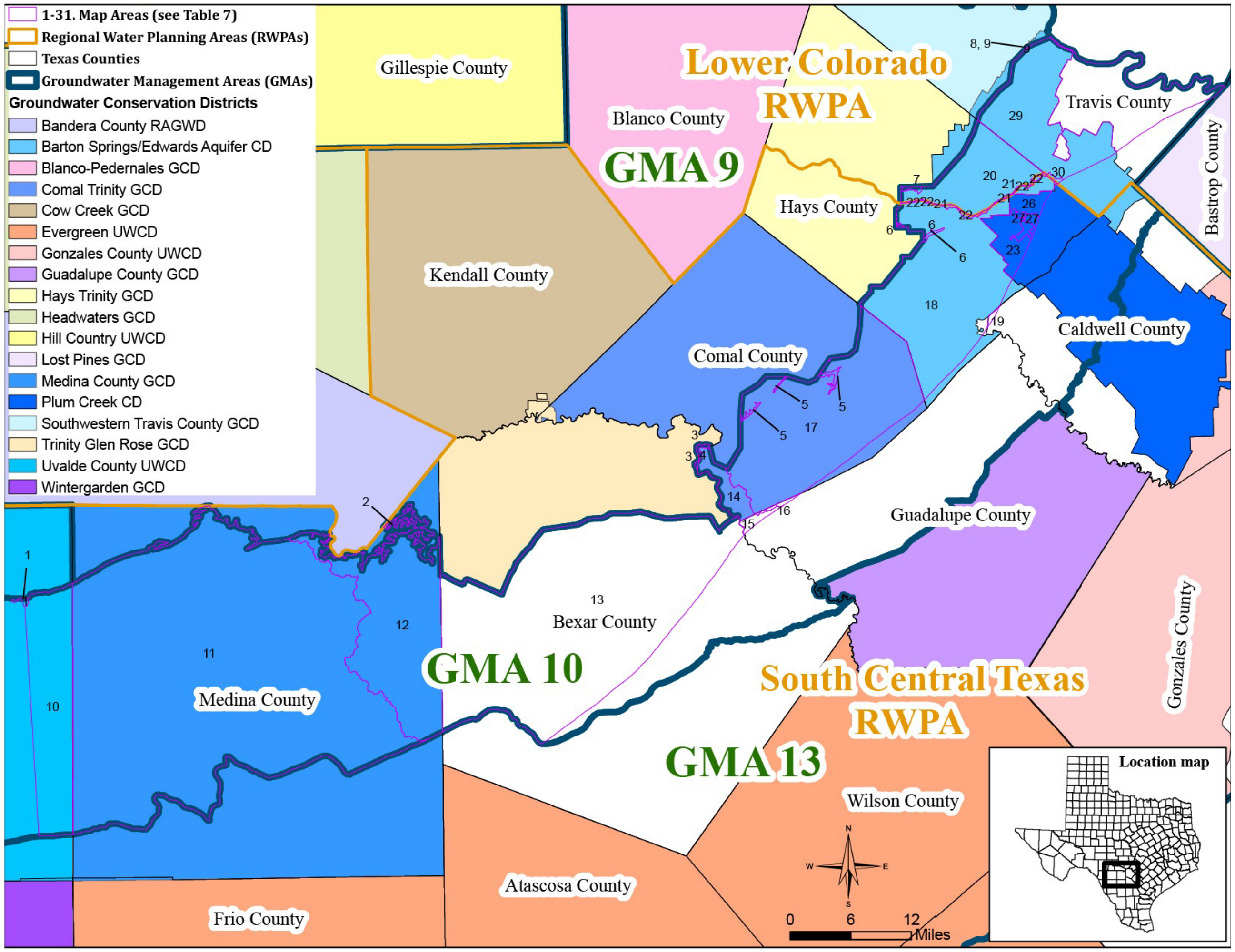

FIGURE 8 MAP SHOWING REGIONAL WATER PLANNING AREAS (RWPAS), GROUNDWATER CONSERVATION DISTRICTS (GCDS), AND COUNTIES IN THE VICINITY OF THE TRINITY AQUIFER IN GROUNDWATER MANAGEMENT AREA 10.

TABLE 1. MODELED AVAILABLE GROUNDWATER FOR THE AUSTIN CHALK, BUDA LIMESTONE, AND LEONA GRAVEL AQUIFERS IN UVALDE COUNTY IN GROUNDWATER MANAGEMENT AREA 10 FOR EACH DECADE BETWEEN 2010 AND 2060. VALUES ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District	County	Aquifer	2010	2020	2030	2040	2050	2060
Uvalde County Underground Water Conservation District	Uvalde	Austin Chalk	2,935	2,935	2,935	2,935	2,935	2,935
		Buda Limestone	758	758	758	758	758	758
		Leona Gravel	9,385	9,385	9,385	9,385	9,385	9,385
Total			**16,013**	**16,013**	**16,013**	**16,013**	**16,013**	**16,013**

TABLE 2. MODELED AVAILABLE GROUNDWATER FOR THE AUSTIN CHALK, BUDA LIMESTONE, AND LEONA GRAVEL AQUIFERS IN UVALDE COUNTY IN GROUNDWATER MANAGEMENT AREA 10 SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN FOR EACH DECADE BETWEEN 2020 AND 2070. VALUES ARE IN ACRE-FEET PER YEAR.

County	RWPA	River Basin	Aquifer	2020	2030	2040	2050	2060	2070
Uvalde	L	Nueces	Austin Chalk	2,935	2,935	2,935	2,935	2,935	2,935
			Buda Limestone	758	758	758	758	758	758
			Leona Gravel	9,385	9,385	9,385	9,385	9,385	9,385
Total				**16,013**	**16,013**	**16,013**	**16,013**	**16,013**	**16,013**

TABLE 3. MODELED AVAILABLE GROUNDWATER FOR THE FRESHWATER PORTION OF THE EDWARDS (BALCONES FAULT ZONE) AQUIFER IN GROUNDWATER MANAGEMENT AREA 10 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2010 AND 2060. VALUES ARE IN ACRE-FEET PER YEAR.

Recharge Condition	Groundwater Conservation District	County	2010	2020	2030	2040	2050	2060
Average	Barton Springs/Edwards Aquifer Conservation District	Hays	7,950	7,950	7,950	7,950	7,950	7,950
		Travis	3,578	3,578	3,578	3,578	3,578	3,578
	Non-District Areas	Hays	29	29	29	29	29	29
Total for average recharge conditions			**11,557**	**11,557**	**11,557**	**11,557**	**11,557**	**11,557**
Drought	Barton Springs/Edwards Aquifer Conservation District	Hays	2,590	2,590	2,590	2,590	2,590	2,590
		Travis	1,166	1,166	1,166	1,166	1,166	1,166
	Non-District Areas	Hays	9	9	9	9	9	9
Total for drought recharge conditions			**3,765**	**3,765**	**3,765**	**3,765**	**3,765**	**3,765**
Kinney County Groundwater Conservation District		Kinney	6,321	6,321	6,321	6,321	6,321	6,321

TABLE 4. MODELED AVAILABLE GROUNDWATER FOR THE FRESHWATER PORTION OF THE EDWARDS (BALCONES FAULT ZONE) AQUIFER IN GROUNDWATER MANAGEMENT AREA 10 SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN FOR EACH DECADE BETWEEN 2020 AND 2070. VALUES ARE IN ACRE-FEET PER YEAR.

Recharge Condition	County	RWPA	River Basin	2020	2030	2040	2050	2060	2070
Average	Hays	K	Colorado	7,037	7,037	7,037	7,037	7,037	7,037
	Hays	L	Guadalupe	942	942	942	942	942	942
	Travis	K	Colorado	3,578	3,578	3,578	3,578	3,578	3,578
	Total for average recharge conditions			**11,557**	**11,557**	**11,557**	**11,557**	**11,557**	**11,557**
Drought	Hays	K	Colorado	2,292	2,292	2,292	2,292	2,292	2,292
	Hays	L	Guadalupe	307	307	307	307	307	307
	Travis	K	Colorado	1,166	1,166	1,166	1,166	1,166	1,166
	Total for drought recharge conditions			**3,765**	**3,765**	**3,765**	**3,765**	**3,765**	**3,765**
Not applicable	Kinney	J	Nueces	6,319	6,319	6,319	6,319	6,319	6,319
			Rio Grande	2	2	2	2	2	2

TABLE 5. MODELED AVAILABLE GROUNDWATER FOR THE SALINE PORTION OF THE EDWARDS (BALCONES FAULT ZONE) AQUIFER IN GROUNDWATER MANAGEMENT AREA 10 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2010 AND 2060. VALUES ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District	County	2010	2020	2030	2040	2050	2060
Barton Springs/Edwards Aquifer Conservation	Caldwell	858	858	858	858	858	858
	Hays	1,171	1,171	1,171	1,171	1,171	1,171
	Travis	1,770	1,770	1,770	1,770	1,770	1,770
Non-District Areas	Caldwell	369	369	369	369	369	369
	Travis	3,583	3,583	3,583	3,583	3,583	3,583
Plum Creek Conservation District	Caldwell	210	210	210	210	210	210
	Hays	602	602	602	602	602	602
Total		**8,563**	**8,563**	**8,563**	**8,563**	**8,563**	**8,563**

TABLE 6. MODELED AVAILABLE GROUNDWATER FOR THE SALINE PORTION OF THE EDWARDS (BALCONES FAULT ZONE) AQUIFER IN GROUNDWATER MANAGEMENT AREA 10 SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN FOR EACH DECADE BETWEEN 2020 AND 2070. VALUES ARE IN ACRE-FEET PER YEAR

County	RWPA	River Basin	2020	2030	2040	2050	2060	2070
Caldwell	L	Colorado	469	469	469	469	469	469
		Guadalupe	968	968	968	968	968	968
Hays	K	Colorado	66	66	66	66	66	66
	L	Guadalupe	1,707	1,707	1,707	1,707	1,707	1,707
Travis	K	Colorado	5,073	5,073	5,073	5,073	5,073	5,073
		Guadalupe	280	280	280	280	280	280
Total			**8,563**	**8,563**	**8,563**	**8,563**	**8,563**	**8,563**

TABLE 7. INPUTS TO CALULATE MODELED AVAILABLE GROUNDWATER FOR THE TRINITY AQUIFER IN GROUNDWATER MANAGEMENT AREA 10, SUMMARIZED BY MAP AREA REPRESENTING EACH GROUNDWATER CONSERVATION DISTRICT (GCD), COUNTY, RIVER BASIN, AND REGIONAL WATER PLANNING AREA (RWPA) COMBINATIONS. AREA VALUES ARE IN ACRES, AND OTHER VALUES ARE IN ACRE-FEET PER YEAR.

Map area[1,2,3]	GCD	County	River Basin	RWPG	Areal extent	Estimated annual effective recharge	Estimated annual lateral inflow	Estimated annual volume from water-level decline	Modeled available groundwater
1	Uvalde County UWCD	Uvalde	Nueces	L	372	36	4	0	40
2	Medina GCD	Medina	San Antonio	L	1	0	0	0	0
3	No GCD	Bexar	San Antonio	L	N/A	N/A	N/A	N/A	N/A
4	Comal Trinity GCD	Comal	San Antonio	L	594	67	147	15	229
5	Comal Trinity GCD	Comal	Guadalupe	L	1,282	149	318	32	499
6	Barton Springs/ Edwards Aquifer Conservation District	Hays	Guadalupe	L	505	61	13	13	87
7	Barton Springs/ Edwards Aquifer Conservation District	Hays	Colorado	K	494	57	12	12	81
8	Barton Springs/ Edwards Aquifer Conservation District	Travis	Colorado	K	3	0	0	0	0
9	Southwestern Travis County GCD	Travis	Colorado	K	11	1	0	0	1
10	Uvalde County UWCD	Uvalde	Nueces	L	63,464	N/A	755	0	755
11	Medina GCD	Medina	Nueces	L	459,975	N/A	5,470	12	5,482
12	Medina GCD	Medina	San Antonio	L	98,983	N/A	1,177	2	1,179

1. Map areas 1-10 represent outcrop areas and were assumed to be under unconfined aquifer conditions.
2. Map areas 11-31 represent subcrop areas and were assumed to be under confined aquifer conditions.
3. Map areas 24-26 cover the Barton Springs/Edwards Aquifer Conservation District and Plum Creek Conservation District where the two districts overlap. These values are assigned to the Barton Springs/Edwards Aquifer Conservation District.

Map area[1,2,3]	GCD	County	River basin	RWPG	Areal extent	Estimated annual effective recharge	Estimated annual lateral inflow	Estimated annual volume from water-level decline	Modeled available groundwater
13	No GCD	Bexar	San Antonio	L	N/A	N/A	N/A	N/A	N/A
14	Comal Trinity GCD	Comal	San Antonio	L	9,243	N/A	2,290	0	2,290
15	No GCD	Guadalupe	San Antonio	L	1,907	N/A	472	0	472
16	No GCD	Guadalupe	Guadalupe	L	757	N/A	188	0	188
17	Comal Trinity GCD	Comal	Guadalupe	L	123,232	N/A	30,533	3	30,536
18	Barton Springs/ Edwards Aquifer Conservation District	Hays	Guadalupe	L	104,045	N/A	2,597	3	2,600
19	No GCD	Caldwell	Guadalupe	L	420	N/A	10	0	10
20	Barton Springs/ Edwards Aquifer Conservation District	Hays	Colorado	K	36,033	N/A	899	0	899
21	Barton Springs/ Edwards Aquifer Conservation District	Hays	Guadalupe	K	354	N/A	9	0	9
22	Barton Springs/ Edwards Aquifer Conservation District	Hays	Colorado	L	1,286	N/A	32	0	32
23	Plum Creek CD	Hays	Guadalupe	L	9,934	N/A	248	0	248

1. Map areas 1-10 represent outcrop areas and were assumed to be under unconfined aquifer conditions.
2. Map areas 11-31 represent subcrop areas and were assumed to be under confined aquifer conditions.
3. Map areas 24-26 cover the Barton Springs/Edwards Aquifer Conservation District and Plum Creek Conservation District where the two districts overlap. These values are assigned to the Barton Springs/Edwards Aquifer Conservation District.

Map area[1,2,3]	GCD	County	River basin	RWPG	Areal extent	Estimated annual effective recharge	Estimated annual lateral inflow	Estimated annual volume from water-level decline	Modeled available groundwater
24	Barton Springs/ Edwards Aquifer Conservation District[3]	Hays	Guadalupe	K	17	N/A	0	0	0
25	Barton Springs/ Edwards Aquifer Conservation District[3]	Hays	Colorado	K	1	N/A	0	0	0
26	Barton Springs/ Edwards Aquifer Conservation District[3]	Hays	Guadalupe	L	5,864	N/A	146	0	146
27	Plum Creek CD	Hays	Guadalupe	L	1,108	N/A	28	0	28
28	Southwestern Travis County GCD	Travis	Colorado	K	18	N/A	0	0	0
29	Barton Springs/ Edwards Aquifer Conservation District	Travis	Colorado	K	55,223	N/A	339	0	339
30	Barton Springs/ Edwards Aquifer Conservation District	Travis	Guadalupe	K	396	N/A	2	0	2
31	No GCD	Travis	Colorado	K	53,547	N/A	329	0	329

1. Map areas 1-10 represent outcrop areas and were assumed to be under unconfined aquifer conditions.
2. Map areas 11-31 represent subcrop areas and were assumed to be under confined aquifer conditions.
3. Map areas 24-26 cover the Barton Springs/Edwards Aquifer Conservation District and Plum Creek Conservation District where the two districts overlap. These values are assigned to the Barton Springs/Edwards Aquifer Conservation District.

TABLE 8. MODELED AVAILABLE GROUNDWATER FOR THE TRINITY AQUIFER IN GROUNDWATER MANAGEMENT AREA 10 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2010 AND 2060. VALUES ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District	County	2010	2020	2030	2040	2050	2060
Barton Springs/ Edwards Aquifer Conservation District	Hays	3,854	3,854	3,854	3,854	3,854	3,854
	Travis	341	341	341	341	341	341
Comal Trinity GCD	Comal	33,554	33,554	33,554	33,554	33,554	33,554
Medina County GCD	Medina	6,661	6,661	6,661	6,661	6,661	6,661
Non-District Areas	Caldwell	10	10	10	10	10	10
	Guadalupe	660	660	660	660	660	660
	Travis	329	329	329	329	329	329
Plum Creek Conservation District	Hays	276	276	276	276	276	276
Southwestern Travis County GCD	Travis	1	1	1	1	1	1
Uvalde County UWCD	Uvalde	795	795	795	795	795	795
Total		**46,481**	**46,481**	**46,481**	**46,481**	**46,481**	**46,481**

TABLE 9. MODELED AVAILABLE GROUNDWATER FOR THE TRINITY AQUIFER IN GROUNDWATER MANAGEMENT AREA 10 SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN FOR EACH DECADE BETWEEN 2020 AND 2070. VALUES ARE IN ACRE-FEET PER YEAR.

County	RWPA	River Basin	2020	2030	2040	2050	2060	2070
Caldwell	L	Guadalupe	10	10	10	10	10	10
Comal	L	Guadalupe	31,035	31,035	31,035	31,035	31,035	31,035
		San Antonio	2,519	2,519	2,519	2,519	2,519	2,519
Guadalupe	L	Guadalupe	188	188	188	188	188	188
		San Antonio	472	472	472	472	472	472
Hays	K	Colorado	980	980	980	980	980	980
		Guadalupe	9	9	9	9	9	9
	L	Colorado	32	32	32	32	32	32
		Guadalupe	3,109	3,109	3,109	3,109	3,109	3,109
Medina	L	Nueces	5,482	5,482	5,482	5,482	5,482	5,482
		San Antonio	1,179	1,179	1,179	1,179	1,179	1,179
Travis	K	Colorado	669	669	669	669	669	669
		Guadalupe	2	2	2	2	2	2
Uvalde	L	Nueces	795	795	795	795	795	795

LIMITATIONS:

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

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

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

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

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

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APPENDIX C

GAM Run 12-001: Plum Creek Conservation District Management Plan

by William Kohlrenken
Texas Water Development Board
Groundwater Resources Division
Groundwater Availability Modeling Section
(512) 463-8279
July 2, 2012

Cynthia K. Ridgeway is the Manager of the Groundwater Availability Modeling Section and is responsible for oversight of work performed by William Kohlrenken under her direct supervision. The seal appearing on this document was authorized by Cynthia K. Ridgeway, P.G. 471 on July 2, 2012.

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GAM RUN 12-001: PLUM CREEK CONSERVATION DISTRICT MANAGEMENT PLAN

by William Kohlrenken
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Groundwater Availability Modeling Section
(512) 463-8279
July 2, 2012

EXECUTIVE SUMMARY:

Texas State Water Code, Section 36.1071, Subsection (h), states that, in developing its groundwater management plan, a groundwater conservation district shall use groundwater availability modeling information provided by the executive administrator of the Texas Water Development Board (TWDB) together with any available site-specific information provided by the district for review and comment to the executive administrator. Information derived from groundwater availability models that shall be included in the groundwater management plan includes:

- the annual amount of recharge from precipitation to the groundwater resources within the district, if any;
- for each aquifer within the district, the annual volume of water that discharges from the aquifer to springs and any surface water bodies, including lakes, streams, and rivers; and
- the annual volume of flow into and out of the district within each aquifer and between aquifers in the district.

The purpose of this report is to provide Part 2 of a two-part package of information from the TWDB to Plum Creek Conservation District management plan to fulfill the requirements noted above. The groundwater management plan for Plum Creek Conservation District is due for approval by the executive administrator of the TWDB before January 29, 2013.

This report discusses the method, assumptions, and results from model runs using the groundwater availability model for the southern portions of the Carrizo-Wilcox, Queen City, and Sparta aquifers. Tables 1 and 2 summarize the groundwater availability model data required by the statute, and Figures 1 and 2 show the area of the model from which the values in the tables were extracted. This model run replaces the results of GAM Run 06-18. GAM Run 12-001 meets current standards set after the release of GAM Run 06-18 and it is based on the most current groundwater district boundaries. If after review of the figures, Plum Creek Conservation District determines that the district boundaries used in the assessment do not reflect current conditions, please notify the TWDB immediately.

METHODS:

The groundwater availability model for the southern portion of the Carrizo-Wilcox, Queen City, and Sparta aquifers was run for this analysis. Water budgets for each year of 1980 through 1999 were extracted and the average annual water budget values for recharge, surface water outflow, inflow to the district, outflow from the district, net inter-aquifer flow (upper), and net inter-aquifer flow (lower) for the portions of the aquifers located within the district are summarized in this report.

PARAMETERS AND ASSUMPTIONS:

Carrizo-Wilcox and Queen City Aquifers

- Version 2.01 of the groundwater availability model for the southern part of the Carrizo-Wilcox, Queen City, and Sparta aquifers was used for this analysis. See Deeds and others (2003) and Kelley and others (2004) for assumptions and limitations of the groundwater availability model for the southern part of the Carrizo-Wilcox, Queen City, and Sparta aquifers.

- This groundwater availability model includes eight layers, which generally correspond to (from top to bottom):

    1. the Sparta Aquifer,

    2. the Weches Confining Unit,

    3. the Queen City Aquifer,

    4. the Reklaw Confining Unit,

    5. the Carrizo Aquifer,

6. the Upper Wilcox Aquifer,
7. the Middle Wilcox Aquifer, and
8. the Lower Wilcox Aquifer.

- Of the eight layers listed above, individual water budgets for the district were determined for the Queen City Aquifer (Layer 3), and the combined layers of the Carrizo-Wilcox Aquifer (Layers 5 through 8). Budget terms were not determined for the Sparta Aquifer because it is not present in the Plum Creek Conservation District.
- The root mean square error (a measure of the difference between simulated and actual water levels during model calibration) in the groundwater availability model is 23 feet for the Sparta Aquifer, 18 feet for the Queen City Aquifer, and 33 feet for the Carrizo Aquifer for the calibration period (1980 to 1990) and 19, 22, and 48 feet for the same aquifers, respectively, in the verification period (1991 to 1999) (Kelley and others, 2004). These root mean square errors are between seven and ten percent of the range of measured water levels (Kelley and others, 2004).
- Groundwater in the Carrizo-Wilcox, Queen City, and Sparta aquifers ranges from fresh to brackish in composition (Kelley and others, 2004). Groundwater with total dissolved solids concentrations of less than 1,000 milligrams per liter (mg/l) are considered fresh and total dissolved solids concentrations of 1,000 to 10,000 mg/l are considered brackish.

RESULTS:

A groundwater budget summarizes the amount of water entering and leaving the aquifer according to the groundwater availability model. Selected groundwater budget components listed below were extracted from the model results for the aquifers located within the district and averaged over the duration of the calibration and verification portion of the model runs in the district, as shown in Tables 1 and 2. The components of the modified budget shown in Tables 1 and 2 include:

- Precipitation recharge—The areally distributed recharge sourced from precipitation falling on the outcrop areas of the aquifers (where the aquifer is exposed at land surface) within the district.
- Surface water outflow—The total water discharging from the aquifer (outflow) to surface water features such as streams, reservoirs, and drains (springs).
- Flow into and out of district—The lateral flow within the aquifer between the district and adjacent counties.
- Flow between aquifers—The net vertical flow between aquifers or confining units. This flow is controlled by the relative water levels in each aquifer or confining unit and aquifer properties of each aquifer or confining unit that define the amount of leakage that occurs. "Inflow" to an aquifer from an overlying or underlying aquifer will always equal the "Outflow" from the other aquifer.

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

TABLE 1: SUMMARIZED INFORMATION FOR THE QUEEN CITY AQUIFER THAT IS NEEDED FOR PLUM CREEK CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT. THESE FLOWS INCLUDE BRACKISH WATERS.

Management Plan requirement	*Aquifer or confining unit*	*Results*
Estimated annual amount of recharge from precipitation to the district	Queen City Aquifer	119
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Queen City Aquifer	41
Estimated annual volume of flow into the district within each aquifer in the district	Queen City Aquifer	66
Estimated annual volume of flow out of the district within each aquifer in the district	Queen City Aquifer	159
Estimated net annual volume of flow between each aquifer in the district	From Queen City Aquifer into the underlying Reklaw Formation confining unit	10

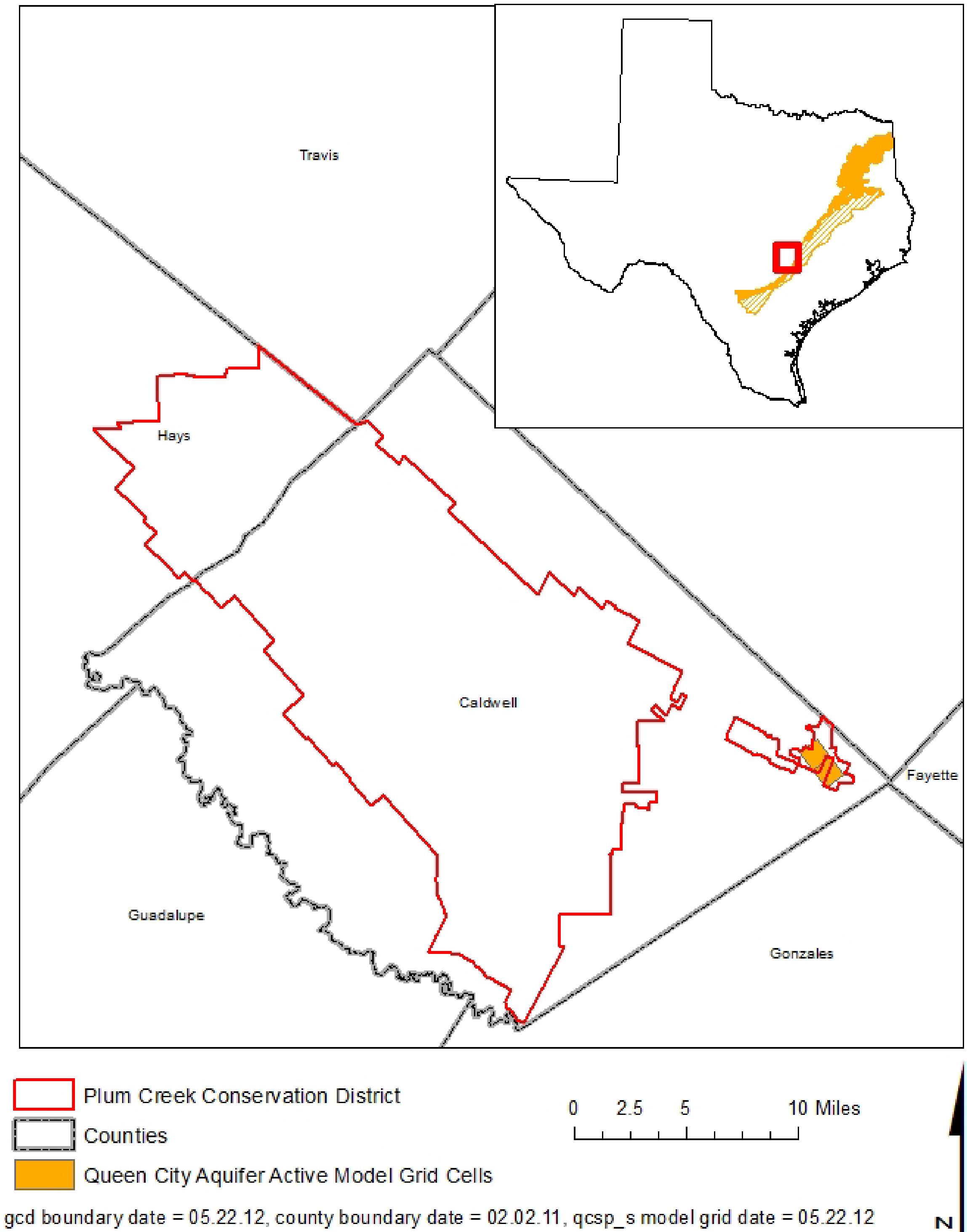

FIGURE 1: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE SOUTHERN PORTION OF THE CARRIZO -WILCOX, QUEEN CITY, AND SPARTA AQUIFERS FROM WHICH THE INFORMATION IN TABLE 1 WAS EXTRACTED (THE AQUIFER EXTENT OF THE QUEEN CITY AQUIFER WITHIN THE DISTRICT BOUNDARY).

TABLE 2: SUMMARIZED INFORMATION FOR THE CARRIZO-WILCOX AQUIFER THAT IS NEEDED FOR PLUM CREEK CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT. THESE FLOWS MAY INCLUDE FRESH AND BRACKISH WATERS.

Management Plan requirement	*Aquifer or confining unit*	*Results*
Estimated annual amount of recharge from precipitation to the district	Carrizo-Wilcox Aquifer	5,743
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Carrizo-Wilcox Aquifer	6,847
Estimated annual volume of flow into the district within each aquifer in the district	Carrizo-Wilcox Aquifer	4,043
Estimated annual volume of flow out of the district within each aquifer in the district	Carrizo-Wilcox Aquifer	3,616
Estimated net annual volume of flow between each aquifer in the district	From the Reklaw Formation confining unit into the Carrizo-Wilcox Aquifer	58

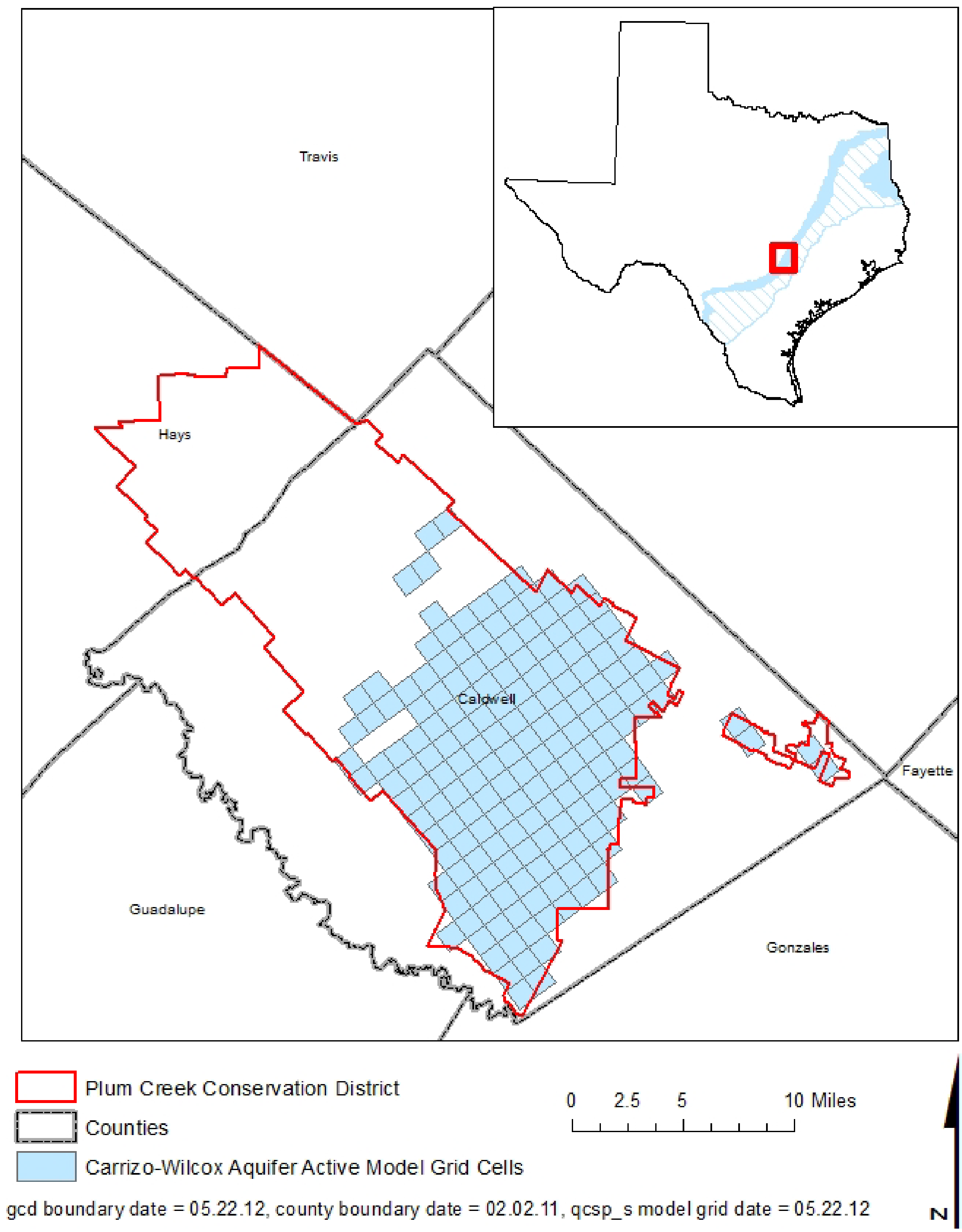

FIGURE 2: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE SOUTHERN PORTION OF THE CARRIZO-WILCOX, QUEEN CITY, AND SPARTA AQUIFERS FROM WHICH THE INFORMATION IN TABLE 2 WAS EXTRACTED (THE AQUIFER EXTENT OF THE CARRIZO-WILCOX AQUIFER WITHIN THE DISTRICT BOUNDARY).

LIMITATIONS

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

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

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

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

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

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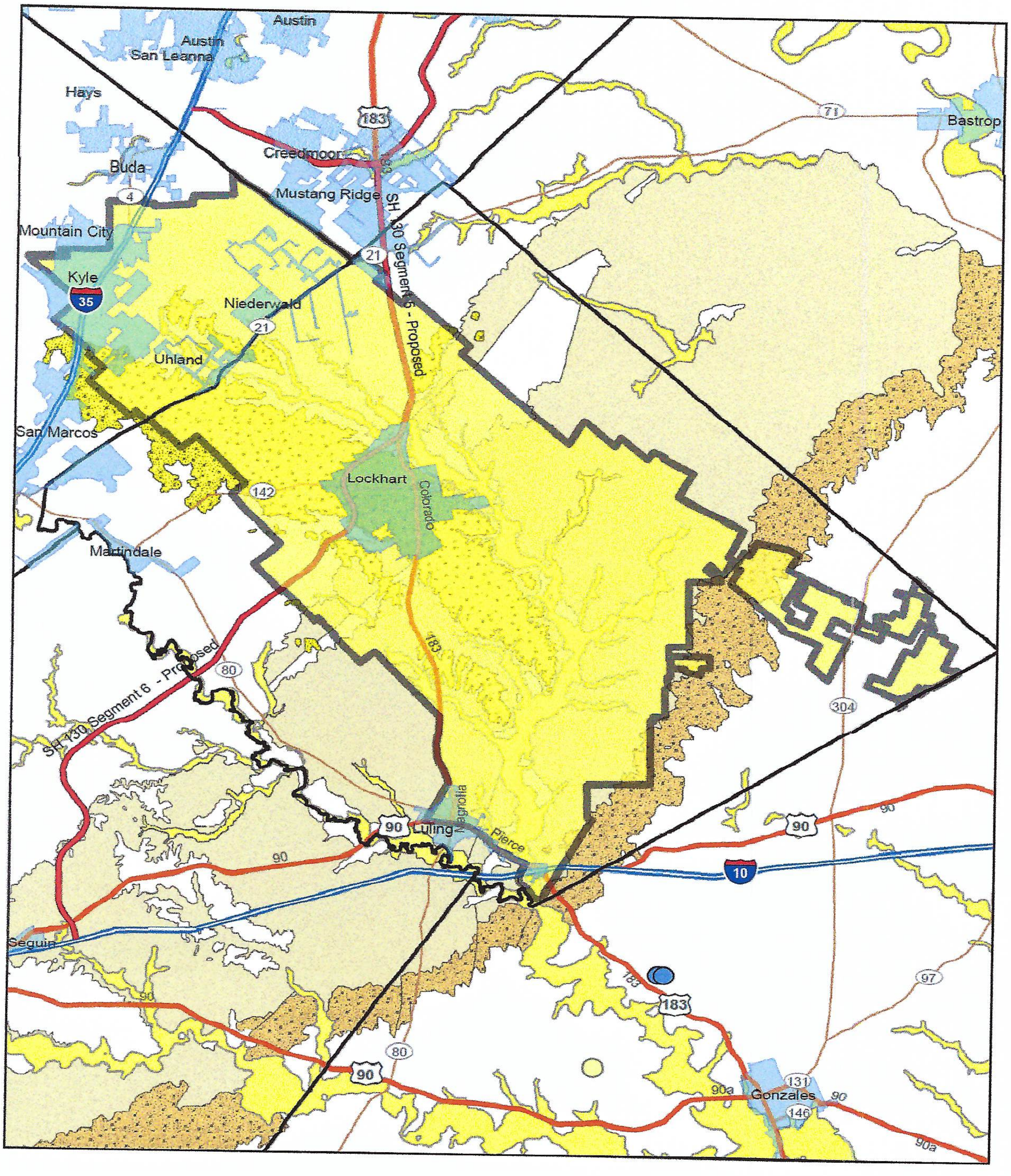
APPENDIX D



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PCCD GEOLOGY

1 in = 5 miles

STATE OF TEXAS
WM. FEATHERGAIL WILSON
GEOLOGY
21
LICENSED
PROFESSIONAL GEOSCIENTIST

April 16, 2015

William Feathergail Wilson PG 21