



Water Reuse in the Hill Country:

Analyzing Opportunities in Comal County, Texas

September 2023

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Executive Summary

The purpose of this report is to provide an argument for the development of water reuse districts in the Texas Hill Country by analyzing the status of water reuse in Comal County. The Hill Country is known for its many natural treasures, including springs, rivers, and underlying aquifers. These inviting waters serve as an attraction for people who want to live, work, and play surrounded by the beauty of the Hill Country. It is unsurprising then that development in the region is occurring at an unprecedented pace.¹ This development, however, is placing great strain on the natural resources for which the region is known and on which millions of people depend. The unique environment of Comal County and the Hill Country – overlying two karstic aquifers and subject to intense rainfalls and droughts – means water sources are highly vulnerable to shortages caused by drought and to contamination caused by wastewater disposal practices. Water reuse systems will allow the region to meet the challenges posed by population growth and water scarcity while preserving the quality and availability of existing water supplies.

Water reuse – using reclaimed and treated wastewater – is an integral step in ensuring Comal County will have the water supplies it needs to ensure the health, safety, and quality of life of its residents in the years to come. Water reuse systems protect the availability of groundwater by providing an alternative or supplement to existing water supplies. Using reclaimed and treated wastewater also protects the quality of existing water supplies by reducing groundwater drawdown and diverting wastewater effluent previously being disposed into sensitive waterways. Unfortunately, there is not currently in Comal County a comprehensive system in place for the reuse of treated wastewater, nor do there appear to be major efforts by water providers in the county to implement reuse systems within their boundaries. In fact, in 2020, reuse in Comal County accounted for just 1.5 percent of the total water use.

The status of water reuse in Comal County underscores both the long way Hill Country counties have to go in implementing water reuse systems and the unique opportunities present to do so within their boundaries. Examples from communities large and small across Texas show that water reuse systems can successfully be implemented; these case studies provide blueprints for how Comal County can move forward in realizing a more comprehensive water reuse system. In addition to these examples, this report highlights different methods for the authorization of water reuse districts or systems, multiple funding opportunities, and a unique opportunity for implementation within Comal County. These are by no means the only methods by which reuse districts or systems could be authorized, funded, or implemented, but hopefully will provide policymakers and residents with a solid foundation.

To build upon this foundation, the Greater Edwards Aquifer Alliance recommends that, in preparation for the 2025 legislative session, the Texas House of Representatives Natural Resources Committee conduct an interim study for the creation of wastewater reuse districts for irrigation and industrial use in the fast-growing areas of Comal County and the Texas Hill Country.

Table of Contents

EXECUTIVE SUMMARY.....	1
KEY WORDS	3
ACRONYMS AND ABBREVIATIONS	3
RECOMMENDATION	4
I. WATER MANAGEMENT CHALLENGES.....	5
A. POPULATION GROWTH	5
B. GEOGRAPHY AND CLIMATE	6
C. WATER SUPPLY SOURCES	10
D. CURRENT REUSE SYSTEMS	11
E. IMPACTS TO WATER RESOURCES	11
<i>1. Wastewater Impacts</i>	<i>12</i>
<i>2. Wastewater Administration</i>	<i>12</i>
II. WATER REUSE AND IMPLEMENTATION.....	15
A. NEED FOR WATER REUSE: WATER SUPPLY	15
B. NEED FOR WATER REUSE: WATER QUALITY	16
C. STATE-WIDE CASE STUDIES	16
<i>1. San Antonio, Texas</i>	<i>16</i>
<i>2. Big Spring, Texas</i>	<i>19</i>
<i>3. Boerne, Texas</i>	<i>19</i>
<i>4. El Paso, Texas.....</i>	<i>20</i>
<i>5. Round Rock, Texas.....</i>	<i>21</i>
<i>6. Lakeway, Texas</i>	<i>22</i>
<i>7. Fredericksburg, Texas.....</i>	<i>23</i>
D. LIMITATIONS	24
III. OPPORTUNITIES FOR ADVANCEMENT.....	26
A. AUTHORITY	26
<i>1. Distinct Water Reuse Districts.....</i>	<i>26</i>
<i>2. Guadalupe-Blanco River Authority Reuse Systems.....</i>	<i>26</i>
<i>3. Practicalities.....</i>	<i>27</i>
B. FUNDING	27
<i>1. State and Federal Grants and Loans</i>	<i>27</i>
<i>2. Rates and Taxes.....</i>	<i>29</i>
<i>3. Byproduct Sales.....</i>	<i>29</i>
C. IMPLEMENTATION.....	29
<i>1. Aggregate Production Operations</i>	<i>29</i>
REFERENCES.....	31

Key Words

Potable Water – Water treated to state and federal standards for direct human consumption, or drinking water. Non-potable water is not intended for direct human consumption. Non-potable *reuse* water is treated, but not to levels intended for direct human consumption.

Purple Pipe Infrastructure – Purple-colored pipes distinguish between non-potable and potable water lines to ensure these sources do not cross and are mandatory in non-potable reuse applications.

Texas Hill Country – A vernacular term referring to the 11-million-acre region encompassing 18 counties located in the central part of the State of Texas: Bandera, Bexar, Blanco, Burnet, Comal, Edwards, Gillespie, Hays, Kendall, Kerr, Kimble, Llano, Mason, Medina, Real, San Saba, Travis, and Uvalde.

Water Reuse – The terms reuse/reclaimed/recycled water should be treated as interchangeable within this report and refer to wastewater treated to an appropriate quality for beneficial reuse.

Acronyms and Abbreviations

Short name or acronym	Descriptive name
AWCRD:	Alamo Water Conservation and Reuse District
CRMWD:	Colorado River Municipal Water District
CWSRF:	Clean Water State Revolving Fund
DFund:	Texas Water Development Fund
EAA:	Edwards Aquifer Authority
EPA:	U.S. Environmental Protection Agency
EPW:	El Paso Water
GBRA:	Guadalupe-Blanco River Authority
MGD:	Million Gallons Per Day
MUD:	Municipal Utility District
NBU:	New Braunfels Utilities
SAWS:	San Antonio Water System
SPP:	State Participation Program
SWIFT:	State Water Implementation Fund for Texas
SWWC:	SouthWest Water Company
TAC:	Texas Administrative Code
TCEQ:	Texas Commission on Environmental Quality
TLAP:	Texas Land Application Permits
TPDES:	Texas Pollutant Discharge Elimination Systems
TWC:	Texas Water Company
TWDB:	Texas Water Development Board
USGS:	U.S. Geological Society
WIFIA:	Water Infrastructure Finance and Innovation Act

Recommendation

The Greater Edwards Aquifer Alliance recommends that, in preparation for the 2025 legislative session, the Texas House of Representatives Natural Resources Committee conduct an interim study for the creation of wastewater reuse districts for irrigation use in the fast-growing areas of Comal County and the Texas Hill Country and for industrial use at sites such as the aggregate production operations. The study should analyze the possibility of implementing multiple water reuse districts with flexible boundaries throughout the study area, given variations at different locations in the volume of potential reuse water generation and the need for that water. As evidenced by the state of water reuse in Comal County, this source of water is a vastly underutilized tool in the fight to manage the Hill Country's water supplies in the face of prolonged drought and presents a clear opportunity to better preserve the region's natural resources for the generations to come.

I. Water Management Challenges

A. Population Growth

Currently one of the fastest growing counties in the United States, Comal County is at the forefront of urban development, outpacing growth in the State of Texas and the nation as a whole.² Between 2010 and 2020, the county's population grew 48.9 percent. In comparison, over those same ten years, the population of the State of Texas grew 15 percent – roughly 34 percentage points less than Comal County. The population of the United States, meanwhile, grew just 7.35 percent.³

The Texas Water Development Board projected in 2017 that by 2030, Comal County would have a population of 178,399. As of July 2022, however, the U.S. Census Bureau estimated the population of Comal County to be 184,642, a 3.5 percent increase over the 2030 projection and eight years in advance. Water consumption in the county, meanwhile, has not only kept up with population growth but rather has outpaced it by 22 percentage points. In the last five years, from 2018 to 2022, the population of Comal County increased 24.4 percent.⁴ During this same time, Comal County itself saw a 46.5 percent increase in water consumption for its county operations and a 218.7 percent increase in the cost of this water consumption [Figure 1].⁵

This increase in water demand is not expected to slow in the coming decades. The TWDB now predicts that Comal County will have a population of 193,188 by 2030 and 357,464 by 2070, a 4.6 and 93.6 percent increase from 2022, respectively.⁶ According to the South Central Texas Regional Water Planning Group, between 2020 and 2070, Comal County is expected to have the second greatest growth in water demand volumes in the region, just behind Bexar County [Figure 2].⁷

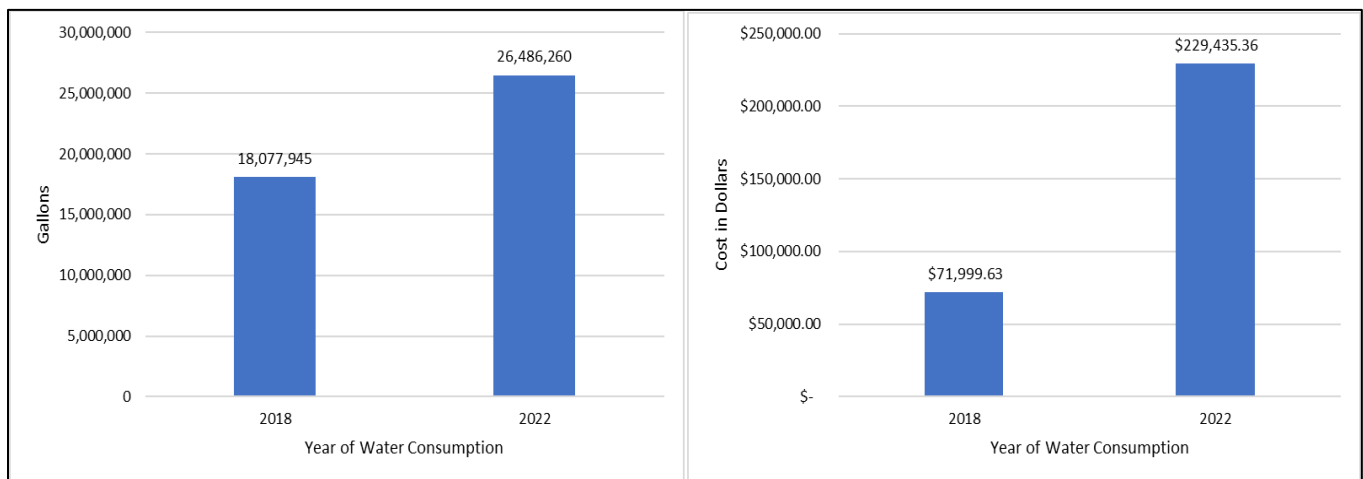


Figure 1. Charts showing the 46.5 percent increase in water consumption compared to the 218.7 percent increase in the cost of water consumption for county operations in Comal County from 2018 - 2022.

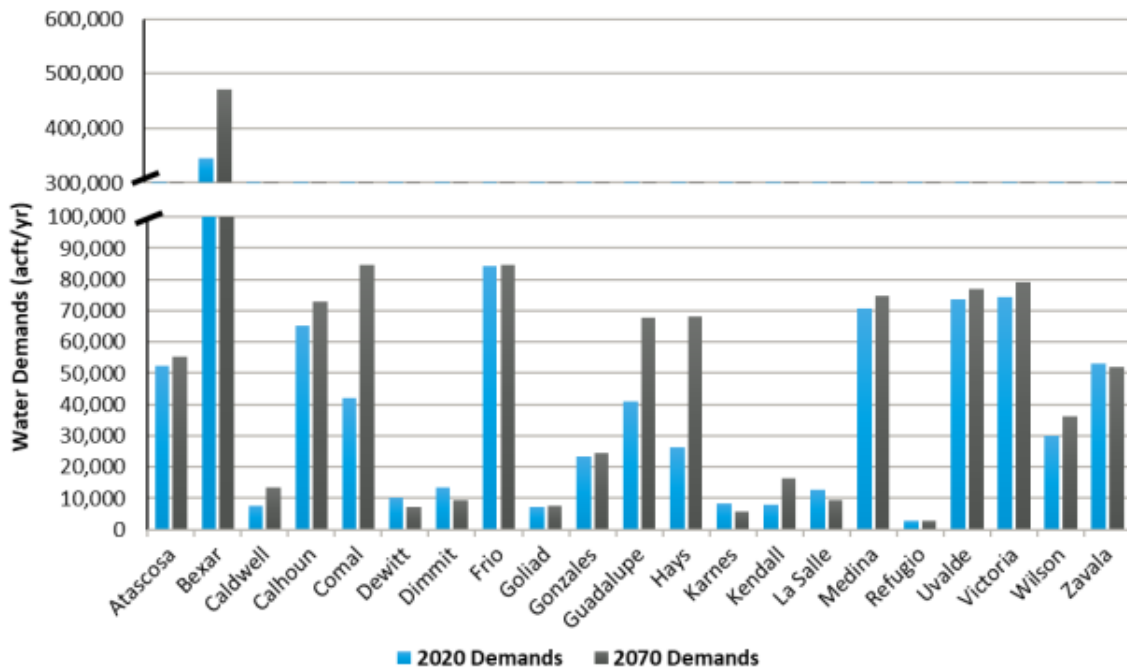


Figure 2-4 Water Demand Projections by County (2020 and 2070)

Figure 2. Chart from the Region L 2021 Water Plan showing Comal County projected to have the second highest water demand in the Region by 2070.

B. Geography and Climate

Comal County is located along the Balcones Escarpment in the Texas Hill Country, within the San Antonio River and Guadalupe River Basins, and overlaying both the Trinity and Edwards Aquifers [Figure 3]. The Trinity and Edwards Aquifers are at least partially hydrologically connected, and water from the Trinity Aquifer has been shown to contribute to some of the recharge of the Edwards Aquifer.⁸ The two major aquifers are also highly connected to surface water in the region. In the state as a whole, groundwater contributes to roughly 30 percent of surface water flows, and the greatest contributions from groundwater to surface water occur in the Hill Country.⁹ All three zones of the Edwards Aquifer – the contributing, recharge, and artesian – are present within the county’s borders [Figure 4].¹⁰ Comal Springs, the largest spring in the state, is fed by the Edwards Aquifer and located in Comal County.

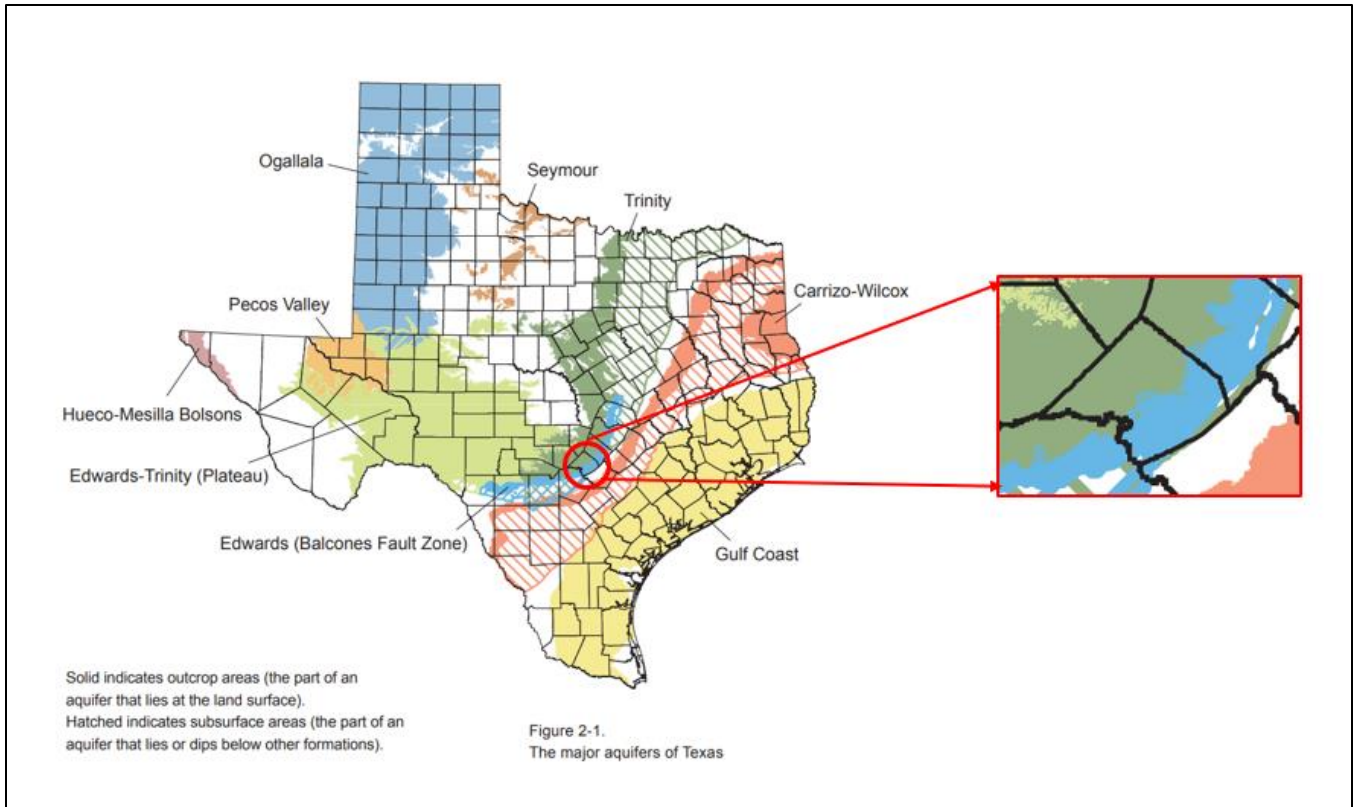


Figure 3. Map of the aquifers in the State of Texas with an addition (in red pop-out box) showing Comal County overlying the Edwards (blue) and Trinity (green) Aquifers.¹¹

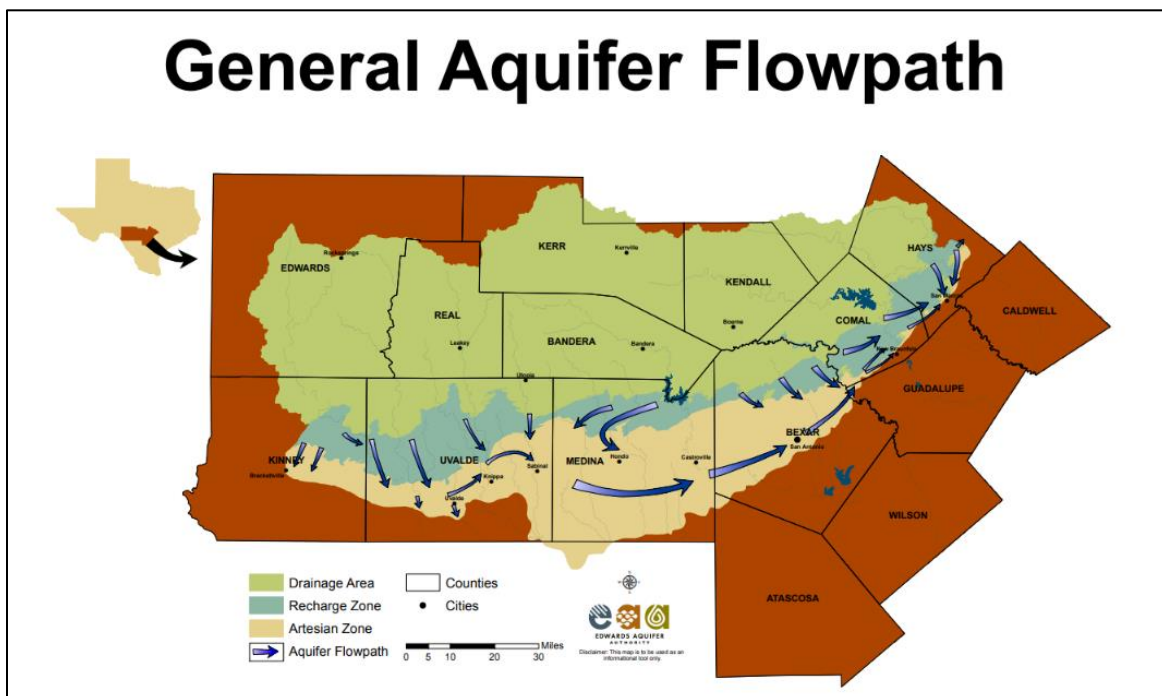


Figure 4. Map showing the three zones of the Edwards Aquifer and its flowpath underlying Comal County.¹²

The county sees an average annual precipitation of between 33 to 37 inches and is situated in the region known as Flash Flood Alley, which is “one of the most flood-prone regions in North America” due to heavy rains and efficient drainage.¹³ The region is just as well known, however, for its periods of intense drought. Flows in streams and rivers in the Texas Hill Country are characterized by similar extremes: short periods of high flow following heavy precipitation events and then longer periods of low flows in between.¹⁴

Precipitation is the primary source of recharge for the two main Hill Country aquifers. As such, spring flows and well elevation have been shown to decline during periods of drought in the Edwards and Trinity Aquifers, from both of which Comal County draws large portions of its water supply.¹⁵ While both aquifers are adversely affected by drought, long-term trends of the water levels specifically in the Trinity Aquifer show a limited ability to recover from drought even during very high rainfall events.¹⁶

The National Oceanic and Atmospheric Administration has categorized Comal County as being in Exceptional Drought in at least six of the last 20 years and in Moderate to Exceptional Drought more often than not [Figure 5 and 6].¹⁷ Over the same time period, from 2003 to 2023, Comal Springs has seen an overall declining trend in spring flows [Figure 7].¹⁸ As of September 2023, 100 percent of Comal County has been categorized as being in Moderate to Extreme Drought for over a year.¹⁹ Conditions such as these are unlikely to be rare occurrences in the coming years, as Texas is expected to experience more frequent drought. Unfortunately for a region experiencing rapid population growth, expected increases in temperature and frequency of drought are anticipated to lead to an increase in water demand while simultaneously lowering water supply.²⁰

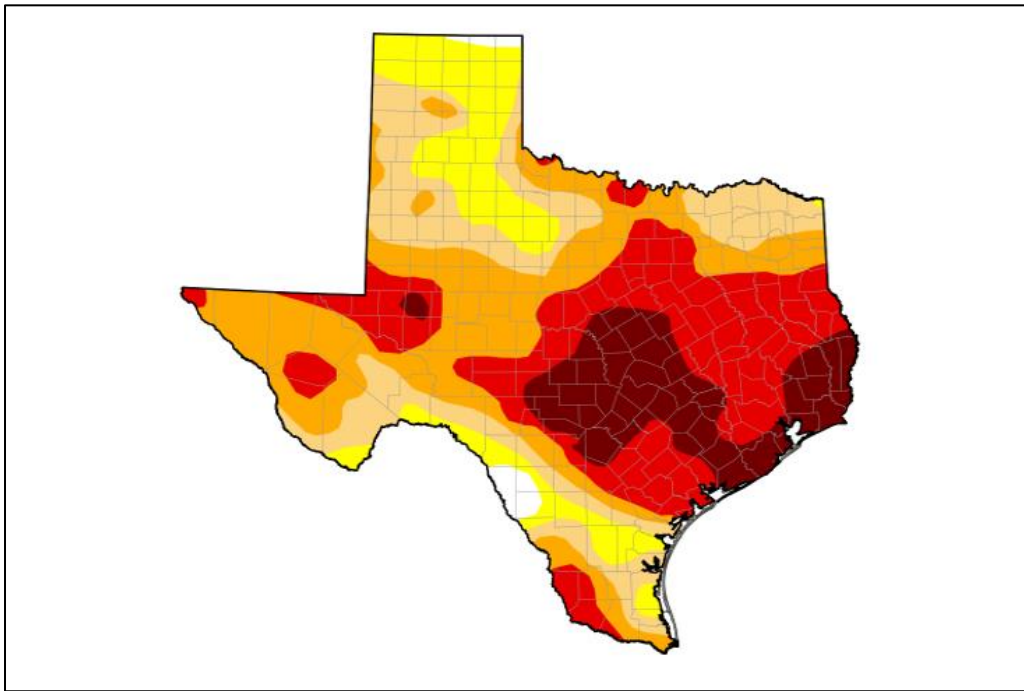


Figure 5. Picture showing the state of drought in Texas in September 2023 according to the Office of the Texas State Climatologist.

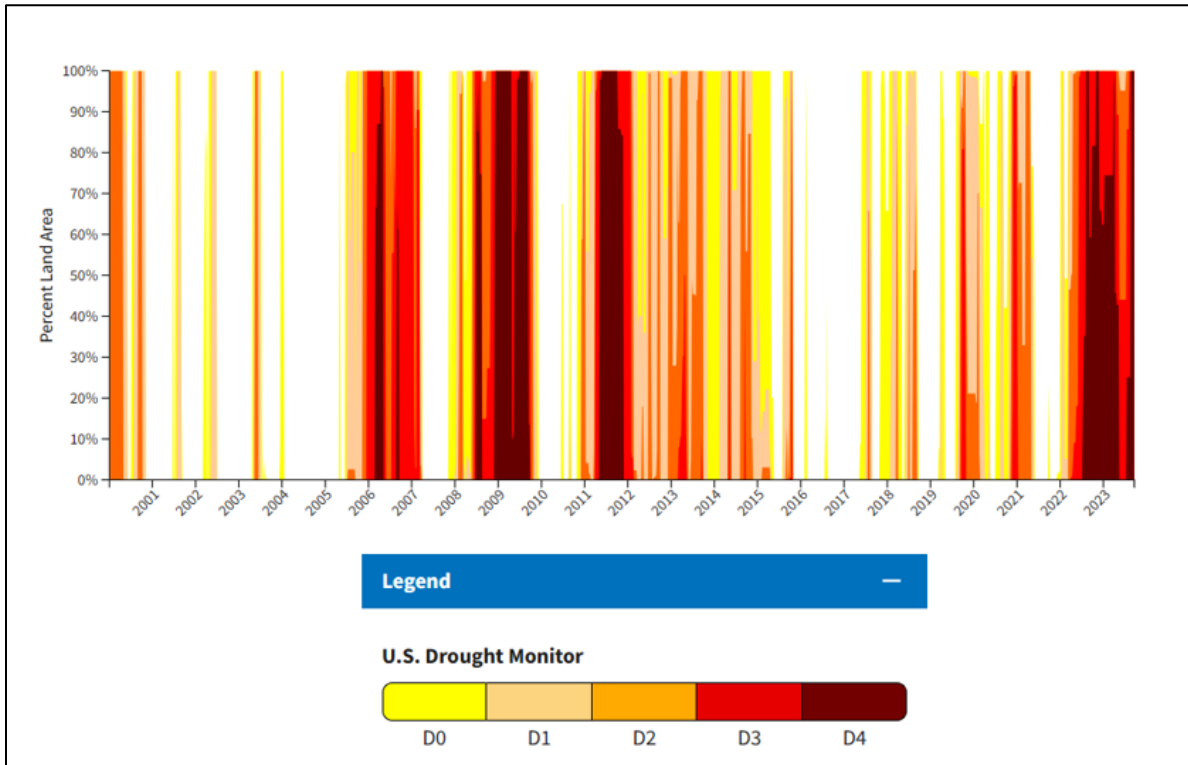


Figure 6. Picture showing years where land in Comal County was classified as being in drought from 2000-2023.

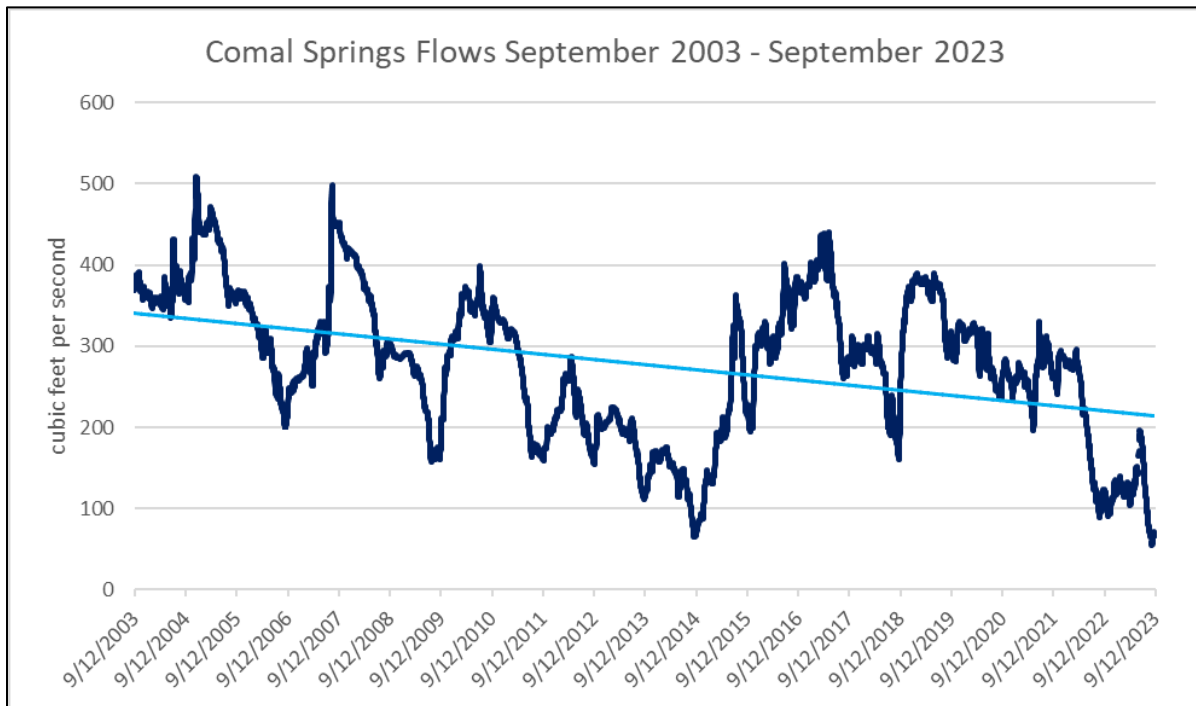


Figure 7. Spring flow data at Comal Springs showing a declining trend line between September 2003 through September 2023.

C. Water Supply Sources

There are three major utilities that serve customers in Comal County – New Braunfels Utilities; Texas Water Company, formerly the Canyon Lake Water Service Company; and SouthWest Water Company, formerly Water Services, Incorporated. NBU draws its water supplies from Guadalupe River surface water, Edwards Aquifer wells, and Trinity Aquifer wells. TWC and SWWC draw their water supplies from Canyon Lake surface water and Trinity Aquifer wells.²¹ The City of Garden Ridge has its own water system, for which it pumps water from the Edwards and Trinity Aquifers.²² Rural water users in the county draw their water supplies from onsite wells from the underlying aquifers, while residents not covered by the above utilities are served by several smaller local purveyors.²³

The majority of Comal County’s water supply is sourced from groundwater. In 2020, roughly 62.5 percent of the county’s total water use was groundwater, while surface water accounted for 36 percent, and reuse accounted for just 1.5 percent. In Comal County, groundwater makes up as much as 57 percent of municipal use.²⁴ Meanwhile, across the state as a whole, only around 33 percent of municipal water use was supplied by groundwater.²⁵

Water use for manufacturing, aggregate mining, power, and irrigation in Comal County is almost entirely sourced from groundwater. Groundwater made up 87.7 percent of water use for these combined categories in 2020, while 6.7 percent was sourced from surface water and just 5.6 percent from reuse [Table 1]. For aggregate mining water use alone, groundwater made up 100 percent of the supply, accounting for over one-fifth of the total groundwater use in the county [Table 2].²⁶

WATER USE SURVEY HISTORICAL SUMMARY ESTIMATES (INCLUDES REUSE) BY COUNTY (All volumes are in acre-feet unless otherwise noted. 1 Acre-Foot = 325,851 gallons) As of 6/27/2023 3:16:44 PM Revised as Additional or More Accurate Data Becomes Available Through Survey Responses Report Filename: SumFinal_CountyReportWithReuse								
Year	County	Population	Municipal	Manu- facturing	Mining	Power	Irrigation	Livestock
2020	COMAL	161,501	23,943	754	3,967	0	699	337
Type	Municipal			Mfr + Mining + Power + Irrigation				
Total	23,943	23,943	23,943		5,420	5,420	5,420	
Ground- water	13,704				4753			
Surface Water		10,095				365		
Reuse			144				302	
Percent of Total	57.2	42.2	0.60		87.7	6.7	5.6	

Table 1. Table showing 2020 water use data estimates for Comal County.

Comal County Total Water Use 2020 (acre-feet)*	29,700
Groundwater: Total Use (af)	18,558
Mining: Total Water Use (af)	3,967
Mining: Groundwater Supply (af)	3,967
Groundwater/Total Mining Water Use (%)	100
Mining Water/Total Groundwater Use (%)	21.4

Table 2. Table showing the percent of aggregate mining water use supplied by groundwater in Comal County in 2020.
(* 1 acre-foot is equivalent to 325,851 gallons.)

Across the state as a whole, between 2004 and 2011, 31 percent of municipal residential water use was estimated to be for outdoor water consumption. Around 90 percent of this outdoor water consumption was dedicated to purposes such as maintaining lawns and gardens. Though these are estimates, in Comal County, this percentage would translate to around 6,680 acre-feet dedicated each year to residential irrigation based on 2020 water use.

Between mining water use and estimated outdoor municipal water use, roughly 10,600 acre-feet of water use in Comal County could potentially be served by non-potable recycled water, over one-third of the county's total water use in 2020.²⁷

D. Current Reuse Systems

As of 2011, New Braunfels Utilities operated a reclaimed water system that provided water to one development for the irrigation of rights-of-way and common area landscaping.²⁸ The Texas Water Company, meanwhile, uses some effluent on irrigation fields within its service area, including a golf club, elementary school, and its office building.²⁹ As of the preparation of this report, these two instances appear to be the extent to which reclaimed wastewater has been used consistently as a water supply source within Comal County.

In the NBU 2021 Water Resources Plan Update, the utility service did not consider wastewater reuse a projected supply between 2021 and 2028, nor was wastewater reuse slated for further evaluation.³⁰ In the City of New Braunfels' One Water Roadmap, the city did, however, call for the development of a reclaimed or reuse water master plan and for the prioritization of reuse options as a method to provide a reliable water supply.³¹

E. Impacts to Water Resources

Portions of the Contributing and Recharge Zones of the Edwards Aquifer and portions of the Trinity Aquifer are present in Comal County. Water quality in the streams and creeks in the Contributing Zone directly impacts the water quality of the Edwards Aquifer, as these streams and creeks flow over and into the Recharge Zone. Furthermore, portions of creeks in the Edwards Aquifer Contributing Zone appear to provide some level of recharge to the Trinity Aquifer, meaning negative impacts to water quality from

wastewater disposal in the Edwards Aquifer Contributing and Recharge Zones may not be strictly limited to the Edwards Aquifer water supply.³²

As land in Comal County is developed and urbanized, less of that land is available to facilitate the recharge of integral groundwater supplies. Runoff that does recharge the aquifers is at greater risk of being contaminated after coming into contact with pollutants associated with increasing development, such as oil, pesticides, gasoline, and other chemicals. Surface water supplies are also at greater risk of degradation as they often act as receiving pools for polluted runoff and wastewater effluent.³³

1. Wastewater Impacts

Increases in population and water use inevitably lead to increases in wastewater. Investigations in the Barton Springs segment of the Edwards Aquifer show that increased wastewater disposal can be linked to increased nitrates in both surface and groundwater and that “this increase matches the timing of development.”³⁴ The unique environment of Comal County – overlying two karstic aquifers and subject to intense rainfall events and droughts – means water sources in the county, and the region as a whole, are highly vulnerable to contamination by wastewater disposal practices.³⁵

Even treated wastewater, or effluent, still contains pharmaceuticals, metals, chemicals, phosphorous, and nutrient nitrogen.³⁶ In waterways where they were not previously present in meaningful quantities, phosphates and nitrates can act similar to a fertilizer. This fertilization effect can lead to algae blooms and microbial growth, which can cause existing vegetation and aquatic life to sicken or die.³⁷

Rivers and creeks in the Texas Hill Country generally have very good water quality and clarity. Those that have not been impacted by wastewater effluent have low nutrient concentrations and are clear, with low levels of algae and high levels of dissolved oxygen.³⁸ On the other hand, rivers and creeks that have been impacted by development tend to show nutrient concentrations that far exceed natural levels, which can result in algae growth, “reduced clarity, foul odor, and bad taste.”³⁹

As early as 2006, the USGS published a report showing that Hill Country streams with wastewater present had five times more nitrate and 18 times more phosphate than in streams without detected wastewater.⁴⁰ Occasionally, bacteria, viruses, and other contaminants such as un-metabolized pharmaceuticals can be found in these water sources as well. Under the current permitting scheme for wastewater disposal, analysis has shown that increased development and increased wastewater discharge will result in greater negative impacts to the quality of groundwater recharge.⁴¹

2. Wastewater Administration

New municipal and industrial wastewater discharges into or adjacent to water that would create additional pollutant loading are prohibited by Texas Administrative Code Rule 213.8 within the Recharge Zone of the Edwards Aquifer. Wastewater discharge is permitted in the Contributing Zone, though, as detailed above, this does not necessarily reduce the risk of degradation in the aquifer. Land application systems that rely on percolation of wastewater for disposal are also prohibited in the Recharge Zone, under TAC

Rule 213.6. Wastewater disposal through land application methods – evaporation or irrigation – is not prohibited, but this method of disposal must be approved on a case-by-case basis.⁴²

The Texas Commission on Environmental Quality is the state’s environmental agency in charge of issuing permits for the disposal of wastewater effluent. There are two main permits that may be applied for with TCEQ for the disposal of wastewater effluent:

1. Texas Pollutant Discharge Elimination Systems: Permits for facilities in which effluent from wastewater treatment plants may be discharged into waterways, including surface waters and dry creek beds.
2. Texas Land Application Permits: Permits for facilities in which effluent may be disposed of by application to ground surface by way of subsurface or surface irrigation.⁴³

Comal County residents regularly contest TPDES permits due to concerns about the impacts of direct discharge of treated wastewater into Hill Country waterways and surface water sources. The rationale behind the TPDES permits is that vegetation and soils in waterways will help absorb and dilute excess nutrients. Waterways in the Hill Country – including in Comal County – however, have limestone stream beds with few methods of nutrient absorption, leading to excess nutrient buildup when wastewater effluent is disposed into them.⁴⁴

The absorption and dilution of contaminants is made even more difficult when these stream beds are dry, which they often are during the region’s frequent droughts.⁴⁵ Additionally, many of the streams in the Hill Country are the method by which water flows into the Edwards and Trinity Aquifers, as the stream beds are fractured and lay along faults that allow water to flow underground.⁴⁶ Once this water is in the underlying aquifer, it can move through the aquifer, potentially causing the contaminants to spread over a much larger area.⁴⁷

Recent data show that, within Comal County as a whole, there are TPDES permits for up to a combined effluent discharge of 27.66 million gallons per day from wastewater treatment plants [Figure 8]. Of this combined total, for sites within the Edwards Aquifer Zones, effluent discharge from TPDES sites is permitted for up to 8.86 mgd, and for sites just outside the Edwards Aquifer Zones, up to 18.8 mgd.⁴⁸ Many wastewater treatment plants can be converted to systems that allow for the creation of reuse water.⁴⁹

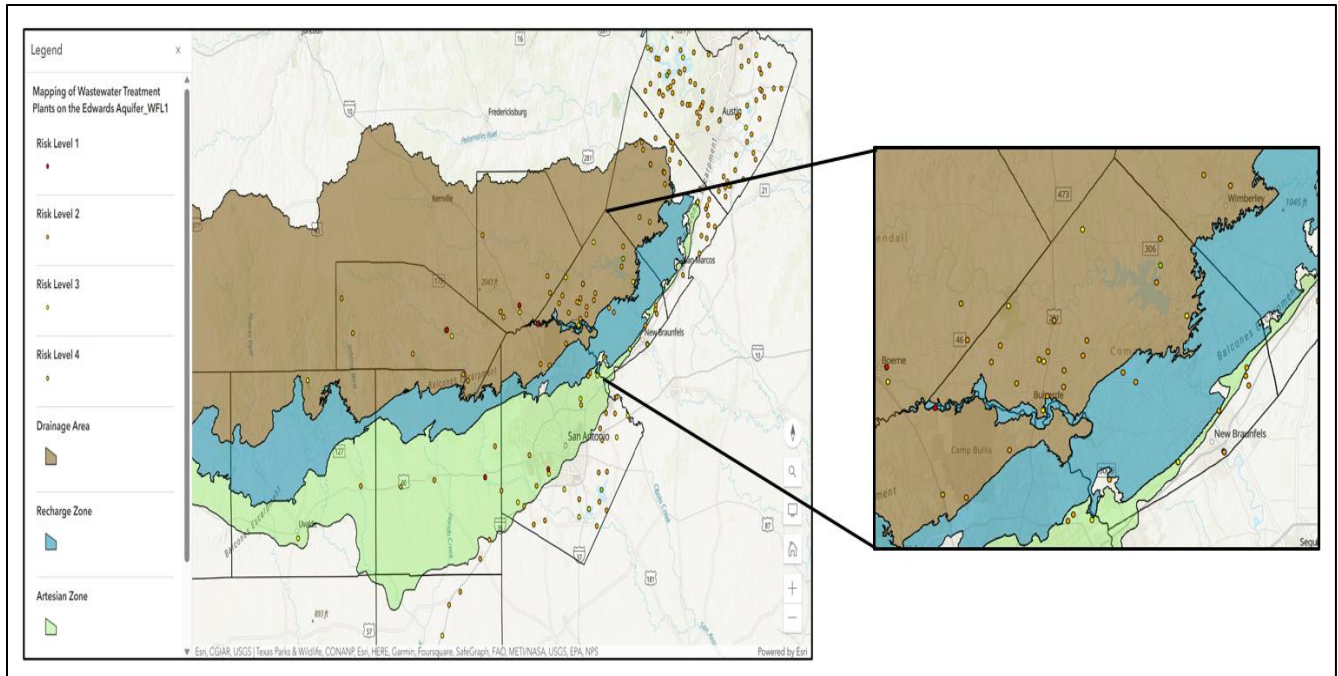


Figure 8. Map showing Wastewater Treatment Plants including those with TPDES permits in Comal County.⁵⁰

Of the two TCEQ permitting systems, TLAP provides a greater measure of assurance that contaminants from wastewater effluent will not reach water supplies. Land application allows an opportunity for “soil, sunlight, plants, and microbes to further reduce contaminants and nutrients in effluent before they come directly in contact” with streams and aquifers.⁵¹ Contaminants from effluent disposed through land application can make their way into water sources during heavy rainfall and runoff events, but this occurs sporadically, unlike effluent disposal directly into surface water and stream beds. Due to the sporadic occurrence of large runoff events and the ability of land application to provide better absorption and dilution of contaminants, effluent disposal under the TLAP system leads to a smaller risk of contaminant release into the aquifers than disposal under TPDES.⁵²

While generally more protective of water sources than TPDES, the TLAP system does not, however, eliminate the risk of contamination entirely. The thin soils, aquifer recharge features, and steep slopes of the Texas Hill Country can, at times, make it difficult to discharge effluent through land application in a manner that appropriately protects water quality.⁵³ Meanwhile, the beneficial reuse of wastewater for purposes such as municipal irrigation or as an industrial water supply can allow for greater oversight by water providers, reuse districts, or municipalities; may require wastewater to be treated to a higher standard; and allows for a targeted approach to land application.

In 2023, the Texas State Legislature passed Senate Bill 1289, which removes regulatory barriers to the onsite treatment and non-potable reuse of alternative water sources such as rainwater, stormwater, and wastewater within a building or across multiple buildings. Prior to the passage and implementation of this legislation, the TCEQ required owners of reuse systems to have either a TPDES or TLAP permit, which made the adoption of a wastewater reuse system difficult.⁵⁴ Now, onsite treatment and reuse of non-

potable water will be allowed without a TPDES or TLAP permit as long as the owner of the treatment system has a backup disposal method through a wastewater collection system and has the consent of the operator of that system and any other wastewater treatment facility that would further treat the water. The owner of the onsite system will also no longer be required to be the owner of an associated permitted domestic wastewater treatment facility.⁵⁵

II. Water Reuse and Implementation

A. Need for Water Reuse: Water Supply

For Texas to meet its future water demands, the Texas Water Development Board estimates that annual reuse supplies in the state will need to make up about 15 percent of the state's total water supply by 2070 [Figure 9]. In 2020, however, reuse supply made up just under 4 percent of Texas' total water supply but only 1.5 percent of Comal County's total.⁵⁶

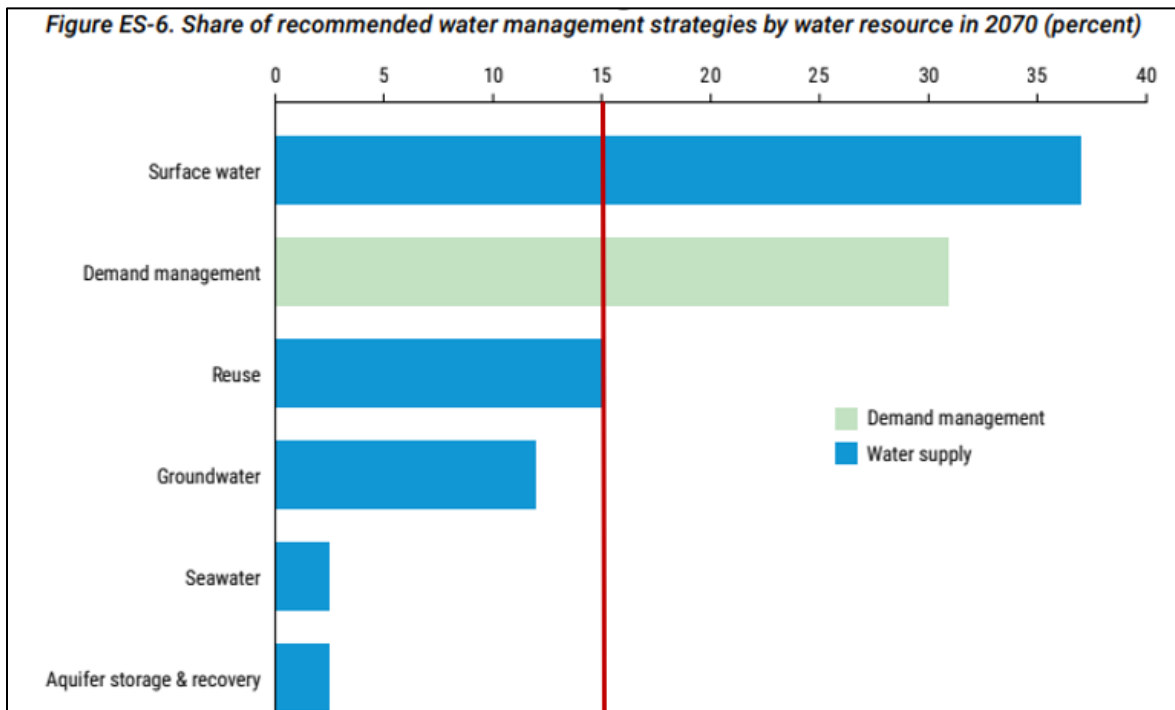


Figure 9. Graph showing the TWDB recommended reuse supply (percent) for the State of Texas by 2070, with reuse recommended to make up at least 15 percent of the expected water supply.⁵⁷

There is not currently in Comal County a comprehensive system in place for the reuse of treated wastewater, nor do there appear to be major efforts by water providers to implement reuse systems within their boundaries. Water reuse in the county, where it occurs, happens in a highly fragmented manner. As such, high quality potable water is often used in instances which do not require it, such as lawn and landscape irrigation, parks irrigation, manufacturing, mining, and power plant cooling. This scenario places greater than necessary strain on surface and groundwater supplies in the county, especially as

residents will continue to expect consistent water supplies even in the face of population growth and increasing aridification.

Water reuse is considered one of the leading solutions for safeguarding water supplies in the Hill Country.⁵⁸ Using reclaimed water allows for the conservation of potable water, thereby reducing the demand placed on groundwater and surface water while allowing communities to diversify and expand their water supplies at the same time.⁵⁹ Water reuse is integral to ensuring that Texas will have the water supplies it needs to ensure the health, safety, and quality of life of its residents in the future by providing alternatives to existing water supplies.

B. Need for Water Reuse: Water Quality

Water reuse also allows for a twofold protection of water quality in the Texas Hill Country. Spring flows are “a measurable indicator of the overall health of a region’s water supply.”⁶⁰ When groundwater is drawn down, spring flows are reduced or can even cease entirely. When wastewater effluent is then applied to dry or semi-dry stream beds, there is often a build-up of excess nutrients and a subsequent decline in water quality. The beneficial reuse of wastewater for non-potable water demands can help protect the quality of water sources by reducing the drawdown of groundwater supplies – thereby increasing spring flows – and by keeping wastewater effluent out of stream beds.

C. State-wide Case Studies

Communities large and small across the State of Texas have implemented water reuse systems in order to provide a sustainable supplemental water supply to their residents, including San Antonio, Big Spring, Boerne, El Paso, Round Rock, Lakeway, and Fredericksburg. These case studies provide examples of how to implement a more comprehensive water reuse system within Comal County to reduce demand that would otherwise be placed on the existing water supplies, primarily the vulnerable Edwards and Trinity Aquifers.

1. San Antonio, Texas

Comal County’s neighbor to the southwest, San Antonio, represents likely the most imitable example of a water reuse district. With Senate Bill 1667 in 1989, enacted by the Texas State Legislature after a request from the City of San Antonio, the Alamo Water Conservation and Reuse District became the state’s first municipal district charged with “controlling, conserving, protecting, preserving, distributing, and reusing wastewater.”⁶¹ While the City of San Antonio consolidated the AWCRD with the City Wastewater Department and City Water Board to form the San Antonio Water System in 1992, its brief history provides a helpful blueprint for the establishment of other water reuse districts within the State of Texas.⁶² As enumerated by SB 1667, the AWCRD had the power to:

1. Contract for the acquisition of wastewater from various parties, including individuals, private corporations, municipalities, and political subdivisions;
2. Accept wastewater from within and without the district boundaries;
3. Process and treat wastewater;

4. Sell treated wastewater as non-potable water to any individual, municipality, political subdivision, and private corporation within and without the district boundaries;
5. Construct, buy, own, lease, sell, and operate facilities to transport, store, and treat wastewater; and
6. Use banks and beds of any surface stream in the state to convey wastewater owned or controlled by the district.*

The legislation did not give the AWCRD the power to exclude any other party from using, controlling, or reusing wastewater within the district boundaries. The AWCRD was not allowed to deal in potable water in any manner, levy or collect taxes, or engage in solid waste collection and disposal. Senate Bill 1667 did, however, give the district authority to exercise the power of eminent domain within its boundaries for land, easements, and rights-of-way considered necessary, incident, or helpful to accomplish any of the purposes of the district.⁶³

In 1991, the AWCRD applied for a permit from the state to divert water from the City of San Antonio's Leon Creek Treatment Plan for reuse but was opposed by the City Water Board due to a potential impact on a separate permit for the Water Board. Because of "the controversy brought on by competing water agencies," San Antonio's City Council decided to merge the three water-related utilities within its boundaries into a single utility – the San Antonio Water System.⁶⁴ The merger did not, however, eliminate reuse within the City of San Antonio; reclaimed water is an integral part of San Antonio's water supply today.

In 1993, a federal district court ruled in *Sierra Club et al. v. Babbitt et al.* that, under the Endangered Species Act, minimum spring flows are required to protect listed endangered species in the Comal and San Marcos Springs. If the Texas Legislature did not adopt a management plan to limit withdrawals from the Edwards Aquifer by the end of that year's session, the court ruled the plaintiffs could request additional relief. The Texas Legislature subsequently adopted Senate Bill 1477, the Edwards Aquifer Authority Act, in 1993. This act tasked the newly created EAA with regulating groundwater withdrawals using a permit system for water users in the counties in its jurisdiction.⁶⁵ After solidifying its historical pumping rights under the EAA permit scheme, SAWS realized it did not have enough water to meet demand over the following 20 years. The water service took steps to both conserve water and build one of the largest recycling programs in the United States.⁶⁶

Twenty-seven years after committing to build the nation's largest direct recycled water system in 1996, SAWS has proven that water recycling is integral to its water diversification and conservation efforts. Through over 130 miles of "purple pipe," SAWS delivers treated recycled water to customers who use the water for landscaping, golf course irrigation, electrical generation, cooling towers, dust suppression, manufacturing, and perhaps most well-known, for augmenting flows on San Antonio's River Walk [Figure 10]. Through these efforts, 16.9 percent of water distributed by SAWS in 2022 was recycled water, around 115 million gallons per day.⁶⁷

* The sixth provision, "Use banks and beds of any surface stream in the state to convey wastewater owned or controlled by the district," should not be replicated for a water reuse district or system operating in Comal County.

In addition to treating and recycling wastewater, SAWS recycles the byproducts of its water recycling process. Biosolids generated during the treatment of wastewater are used to generate compost and are sold commercially at local retailers and nurseries, while the biogas generated is transferred to an energy company for sale on the natural gas market. Taking advantage of all aspects of the wastewater treatment and recycling process allows SAWs to continue to provide sustainable and affordable recycled water services [Table 3].⁶⁸

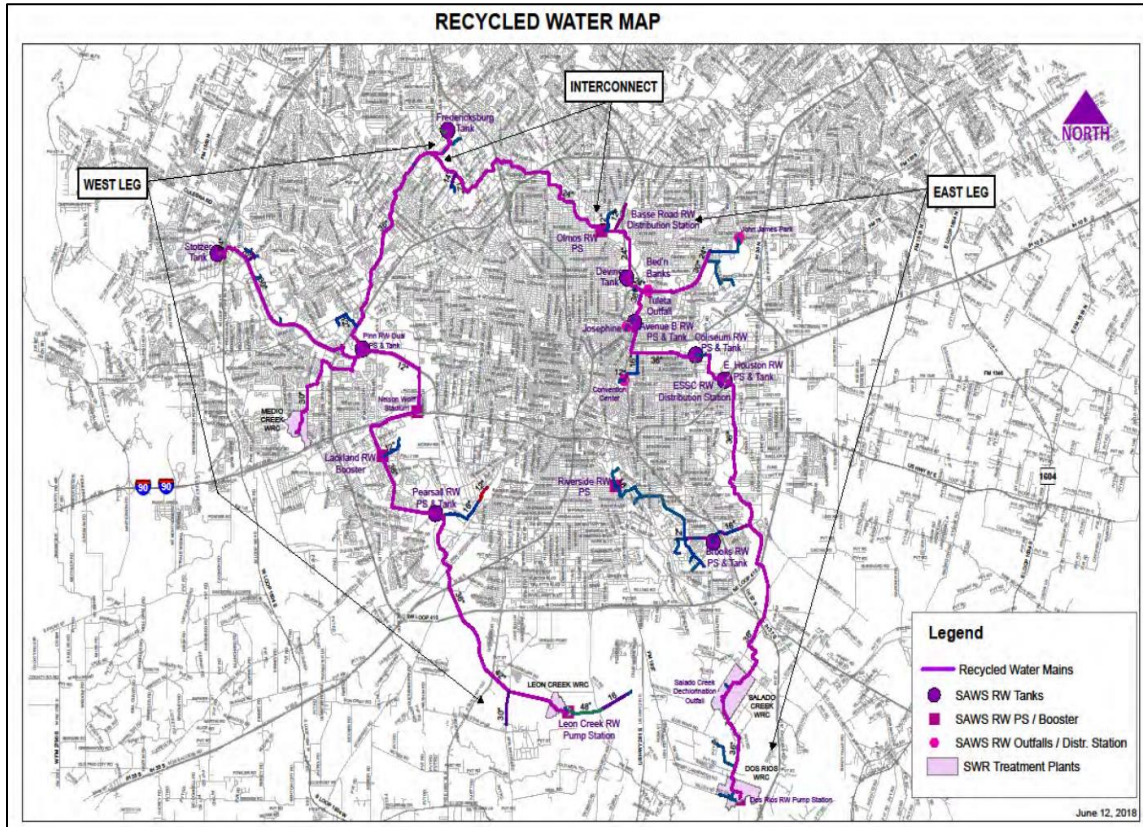


Figure 10. Map of SAWS' water recycling system and purple pipe system.⁶⁹

SAWS Water Service Rate Schedule		\$/Month Customer Fee	\$/1000 Gallons Volume Charge	Total Cost to Customer (1000 gallons/month)
Residential Water Service Inside City Limits				
	5/8" Meter	\$ 9.00	\$ 0.907	\$ 9.91
Residential Water Service Outside City Limits				
	5/8" Meter	\$ 11.70	\$ 1.180	\$ 12.88
Irrigation Water Service Inside City Limits				
	5/8" Meter	\$ 12.70	\$ 3.475	\$ 16.18
Irrigation Water Service Outside City Limits				
	5/8" Meter	\$ 16.00	\$ 4.518	\$ 20.52
Reclaimed Water Service*				
	5/8" Meter	\$ 16.92	\$ 0.446	\$ 17.37

* Based on recommendations by the Rates Advisory Committee, beginning in 2023, recycled water rate increases will begin to close the cost recovery gap over the next five years while still providing an affordable alternative to potable water.

Table 3. Table showing the total cost to SAWS customers for the first 1000 gallons a month for reclaimed water service is roughly on par with the total cost to customers for irrigation water service inside and outside city limits. Cheaper cost totals per 1000/gallons a month are shown in green and more expensive totals are shown in red.⁷⁰

2. Big Spring, Texas

In Big Spring, Texas, between Odessa-Midland and Abilene, the Colorado River Municipal Water District is considered a pioneer in recycled water use. The district constructed the nation's first direct potable reuse facility after two of its three reservoirs were declared effectively empty after a severe drought in 2011. Beginning operation in 2013, the Raw Water Production Facility reclaims and cleans water previously used for municipal use, producing around 1.5 million gallons of recycled potable water per day, which is around 2.6 percent of CRMWD's average daily water deliveries.⁷¹ The CRMWD and the State of Texas monitor drinking water quality levels, and the plant is considered highly effective in treating the water.

The CRMWD supports over 600,000 residents in West Texas. Unlike the SAWS system, the recycled water produced by CRMWD can be used for potable purposes, such as drinking water [Table 4]. Water from the Raw Water Production Facility in Big Spring is added to a raw water pipeline that mixes surface water from local reservoirs in a 50-50 mix and is then distributed to five water treatment plants in the region to be treated again before distribution to customers.⁷²

Big Spring Water Service Rate Schedule		\$/Month Customer Fee	\$/1000 Gallons Volume Charge	Total Cost to Customer (1000 gallons/month)
Residential Water Service Inside City Limits	5/8" Meter	\$ 30.00	\$ 1.50	\$ 31.50
Residential Water Service Outside City Limits	5/8" Meter	\$ 30.00	\$ 3.00	\$ 33.00
Commercial Water Service Inside City Limits	5/8" Meter	\$30.00	\$ 3.98	\$ 33.98
Commercial Water Service Outside City Limits	5/8" Meter	\$30.00	\$ 7.96	\$ 37.96

Reclaimed water in Big Spring is a direct potable reuse water sources and is not differentiated from other potable water supplies.

Table 4. Table showing the total cost to customers for the first 1000 gallons a month for water service both within and outside Big Spring city limits. Cheaper cost totals per 1000/gallons a month are shown in green and more expensive totals are shown in red.⁷³

3. Boerne, Texas

The City of Boerne, Texas, around 20 miles west of Comal County, has been using reclaimed water since 2016. Reclaimed water supplied by Boerne Utilities hovers around 10 percent of the daily total water supplied and is distributed through a separate purple pipe system [Figure 11]. Recycled water in the city is used for outdoor irrigation, soil compaction and dust control, and maintenance of off-channel water bodies.⁷⁴ The water utility's wastewater recycling system is permitted to produce around 1.4 million gallons per day of reclaimed water at its Wastewater Treatment and Recycling Center.

Boerne Utilities advertises that the benefits of customers using reclaimed water supplies are as follows:

1. "Save on your monthly water bill by not paying potable water prices for irrigation water;
2. Conserve precious drinking water supplies by reducing the amount of ground water pumped out of an aquifer for irrigation;
3. Reduce the costs associated with obtaining new sources of drinking water due to lessening demands on the drinking water supply" [Table 5].⁷⁵

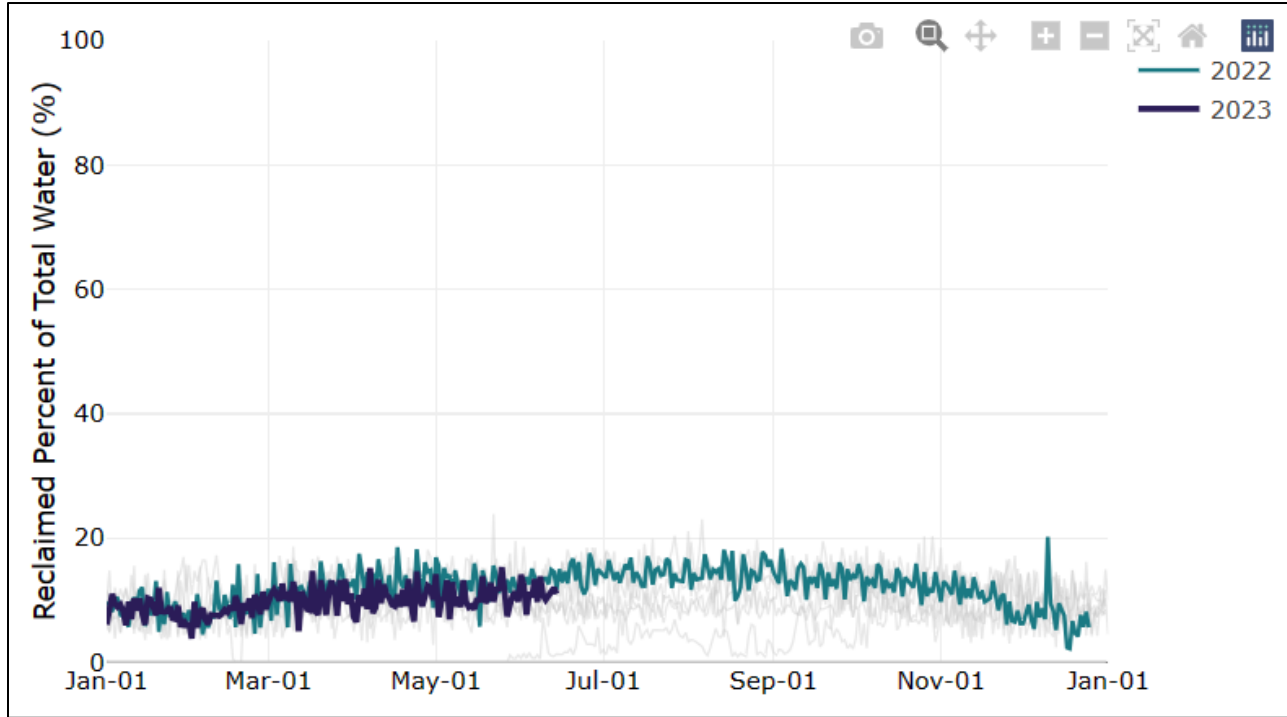


Figure 11. Graph showing the percent reclaimed water makes up of the total water supply delivered by Boerne Utilities, around 10 percent.⁷⁶

Boerne Utilities Water Service Rate Schedule		\$/Month Customer Fee	\$/1000 Gallons Volume Charge	Total Cost to Customer (1000 gallons/month)
Residential Water Service Inside City Limits				
	5/8" Meter	\$ 28.11	\$ 2.14	\$ 30.25
Residential Irrigation Water Service Inside City Limits				
	5/8" Meter	\$ 28.11	\$ 8.34	\$ 36.45
Commercial Irrigation Water Service Inside City Limits				
	5/8" Meter	\$ 28.11	\$ 5.90	\$ 34.01
Residential Water Service Outside City Limits				
	5/8" Meter	\$ 33.72	\$ 2.57	\$ 36.29
Residential Irrigation Water Service Outside City Limits				
	5/8" Meter	\$ 33.72	\$ 10.01	\$ 43.73
Commercial Irrigation Water Service Outside City Limits				
	5/8" Meter	\$ 33.72	\$ 7.08	\$ 40.80
Reclaimed Water Service				
	5/8" Meter	\$ 11.50	\$ 1.75	\$ 13.25

Table 5. Table showing the total cost to customers for the first 1000 gallons a month is much less for reclaimed water service than it is for residential and commercial water service both within and outside Boerne city limits. Cheaper cost totals per 1000/gallons a month are shown in green and more expensive totals are shown in red.⁷⁷

4. El Paso, Texas

El Paso, Texas, located in the Chihuahuan Desert in West Texas, has been delivering reclaimed water for reuse since 1963 through its water utility El Paso Water. The city now supplies nearly 6 million gallons per day of reclaimed water. The water utility operates four reclamation plants and distributes the reclaimed water through a roughly 40-mile purple pipe network. EPW's reuse water is distributed to parks, schools, golf courses, construction sites, industrial sites, and electric power plants [Table 6]. According to El Paso

Water, in their recycled water system, “every gallon of reclaimed water used to irrigate...or for construction or industrial use is one gallon of potable water that is saved. This means less pumping and preservation of our aquifers.”⁷⁸ The city also uses treated wastewater to augment its underlying aquifer, helping to stabilize aquifer levels.⁷⁹

El Paso Water piloted an Advanced Water Purification Facility – a direct potable reuse facility – in 2016. At this pilot facility, treated wastewater goes through an additional advanced water purification process to supplement El Paso’s drinking water supply. Preliminary designs on the full-scale facility are complete, and EPW expects the new facility will be completed and on-line by 2024, producing up to 10 million gallons per day. State and federal funding sources are expected to lessen the financial impact on ratepayers of constructing and operating the new completed Advanced Water Purification Facility.⁸⁰

El Paso Water Service Rate Schedule		\$/Month Customer Fee	\$/5 CCF* Volume Charge	Total Cost to Customer (1000 gallons/month)
Residential Water Service Inside City Limits				
	<1" Meter	\$ 9.48	\$ -	\$ 9.48
Residential Water Service Outside City Limits				
	<1" Meter	\$ 10.91	\$ -	\$ 10.91
Commercial Water Service Inside City Limits				
	<1" Meter	\$ 9.48	\$ 15.350	\$ 24.83
Commercial Water Service Outside City Limits				
	<1" Meter	\$ 10.91	\$ 23.025	\$ 33.94
Reclaimed Water Service Inside City Limits				
	<1" Meter	\$ 9.48	\$ 14.350	\$ 23.83
Reclaimed Water Service Outside City Limits				
	<1" Meter	\$ 10.01	\$ 14.350	\$ 24.36

* 1 CCF is 100 cubic feet of water, which is equivalent to 748 gallons. The volume charges shown here are for 500 cubic feet.

Table 6. Table showing the cost to customers for 500 cubic feet of water within and outside El Paso city limits. The total cost for reclaimed water service inside and outside city limits is cheaper than commercial water service. Cheaper cost totals per 500 cubic feet a month are shown in green and more expensive totals are shown in red.⁸¹

5. Round Rock, Texas

The City of Round Rock, north of Austin, has been using reuse water for irrigation since 1998 when it began supplying the Forest Creek Golf Club. Round Rock’s Water Reuse Program attempts to reduce potable water use by supplying reuse water for non-potable purposes, mainly irrigation. The city provides reuse water to sport complexes, golf clubs, educational campuses, parks, homeowner associations, and developments. Round Rock plans to supply reuse water to an athletic complex, two high schools, and two elementary schools for irrigation by the end of 2025.

Round Rock implements a cost-efficient reuse program by using abandoned wastewater force mains and locating new reuse projects near currently operational wastewater facilities. The program allows the city to conserve potable water supplies, delay surface water rights acquisitions – thereby saving millions of dollars – and optimize resources in the wastewater treatment process. Reuse water is a lower cost source of water both for the city and for users, and customers who use recycled water face no restrictions on their use even during drought and water rationing [Table 7].⁸²

Round Rock Utilities Water Service Rate Schedule		\$/Month Customer Fee	\$/1000 Gallons Volume Charge	Total Cost to Customer (1000 gallons/month)
Residential Water Service				
5/8" Meter	\$	16.52	\$ 2.56	\$ 19.08
Commercial Water Service				
5/8" Meter	\$	16.52	\$ 2.80	\$ 19.32
Irrigation Water Service < 15,000 gallons				
5/8" Meter	\$	16.52	\$ 2.56	\$ 19.08
Irrigation Water Service > 15,000 gallons				
5/8" Meter	\$	16.52	\$ 3.20	\$ 19.72
Reclaimed Water Service				
5/8" Meter	\$	16.52	\$ 1.92	\$ 18.44

Table 7. Table showing the total cost to customers for the first 1000 gallons a month is cheaper for reclaimed water service than it is for residential and commercial water service in Round Rock, Texas. Reclaimed water users also face no water use restrictions. Cheaper cost totals per 1000/gallons a month are shown in green and more expensive totals are shown in red.⁸³

6. Lakeway, Texas

The City of Lakeway, located 20 miles west of Austin, through the Lakeway Municipal Utility District, was one of the first utilities in the state of Texas to implement a water reuse system. The district began supplying the Yaupon Golf Course with reuse water for irrigation purposes in 1975 and became the first water provider in the state to use recycled water in a residential area for irrigation in 1994. The Lakeway MUD considers reuse water a safe and cost-effective way to expand the district's supply of non-potable water and is able to provide reuse water even during times of drought [Table 8].

Lakeway pulls its water from Lake Travis, one of the Texas Highland Lakes. In the 1980s, TCEQ issued the Highland Lakes discharge ban rule, prohibiting TPDES discharges into the lakes and leaving land application the only option for wastewater discharges for the district. Today, the Lakeway MUD stores more than 90 million gallons of reclaimed water and provides it for the irrigation of medians, city parks, golf courses, various commercial locations, and some residential locations, including the Estates of Lakeway Hills.⁸⁴

Lakeway Municipal Utilities District Water Service Rate Schedule		\$/Month Customer Fee	\$/1000 Gallons Volume Charge	Total Cost to Customer (1000 gallons/month)
Retail Water Service				
5/8" Meter	\$	22.00	\$ 2.50	\$ 24.50
Wholesale Water				
Meter size not specified	\$	-	\$ 4.96	\$ 4.96
Retail Reuse Water				
Meter size not specified	\$	-	\$ 2.50	\$ 2.50
Wholesale Reuse Water				
Meter size not specified	\$	-	\$ 1.50	\$ 1.50

Wholesale services means services provided by the District to a public water or wastewater supplier on terms and conditions set forth in a written contract between the District and said entity allowing said entity to provide retail water service to its customers

Table 8. Table showing the total cost to customers for the first 1000 gallons a month is cheaper for reclaimed water service than it is for potable water in Lakeway, Texas. Cheaper cost totals per 1000/gallons a month are shown in green and more expensive totals are shown in red.⁸⁵

7. Fredericksburg, Texas

The City of Fredericksburg, Texas, located within the Hill Country region, has a successful and imitable water reuse program which augments the city's water supply by easing demand on the potable water system. The Water and Wastewater Department provides non-potable water to the nearby Boot Ranch Development and to the Lady Bird Johnson Golf Course for irrigation. The city is authorized by the state to provide reuse water for the irrigation of golf courses, greenbelts and common areas, landscapes, public fields, and campuses [Table 9].⁸⁶ Reclaimed water may also be used for fire assistance and construction of roads and buildings.

Current peak hour demand for all water sources in the city is between 9 and 10 million gallons per day. Fredericksburg's Wastewater Treatment Plant is able to supply around 1 million gallons per day of reclaimed water and distributes to the current two users through a 16-mile purple pipe system [Figure 12]. In a report produced in 2017, the City of Fredericksburg was analyzing options to expand its reuse water system in order to decrease demands placed on its potable water system and to defer the need for an additional supply source.⁸⁷ Fredericksburg has instituted multiple incentives for reuse water users: 1) there is no volume restriction on recycled water use, and 2) monthly fixed customer fees do not apply in months when no recycled water is used.

Fredericksburg Water Service Rate Schedule		\$/Month Customer Fee	\$/1000 Gallons Volume Charge	Total Cost to Customer (1000 gallons/month)
Residential Water Service				
	5/8" Meter	\$ 11.60	\$ 2.45	\$ 14.05
Commercial Water Service				
	5/8" Meter	\$ 11.60	\$ 2.40	\$ 14.00
Industrial Water Service				
	5/8" Meter	\$ 294.40	\$ -	\$ 294.40
Reclaimed Water Service				
	5/8" Meter	\$ 20.00	\$ 1.50	\$ 21.50

For reclaimed water service users, the monthly customer fee does not apply during months in which no water is used.

Table 9. Table showing the total cost to customers for the first 1000 gallons in Fredericksburg, Texas. The reclaimed water service charges were provided by a utility department representative. Cheaper cost totals per 1000/gallons a month are shown in green and more expensive totals are shown in red.⁸⁸

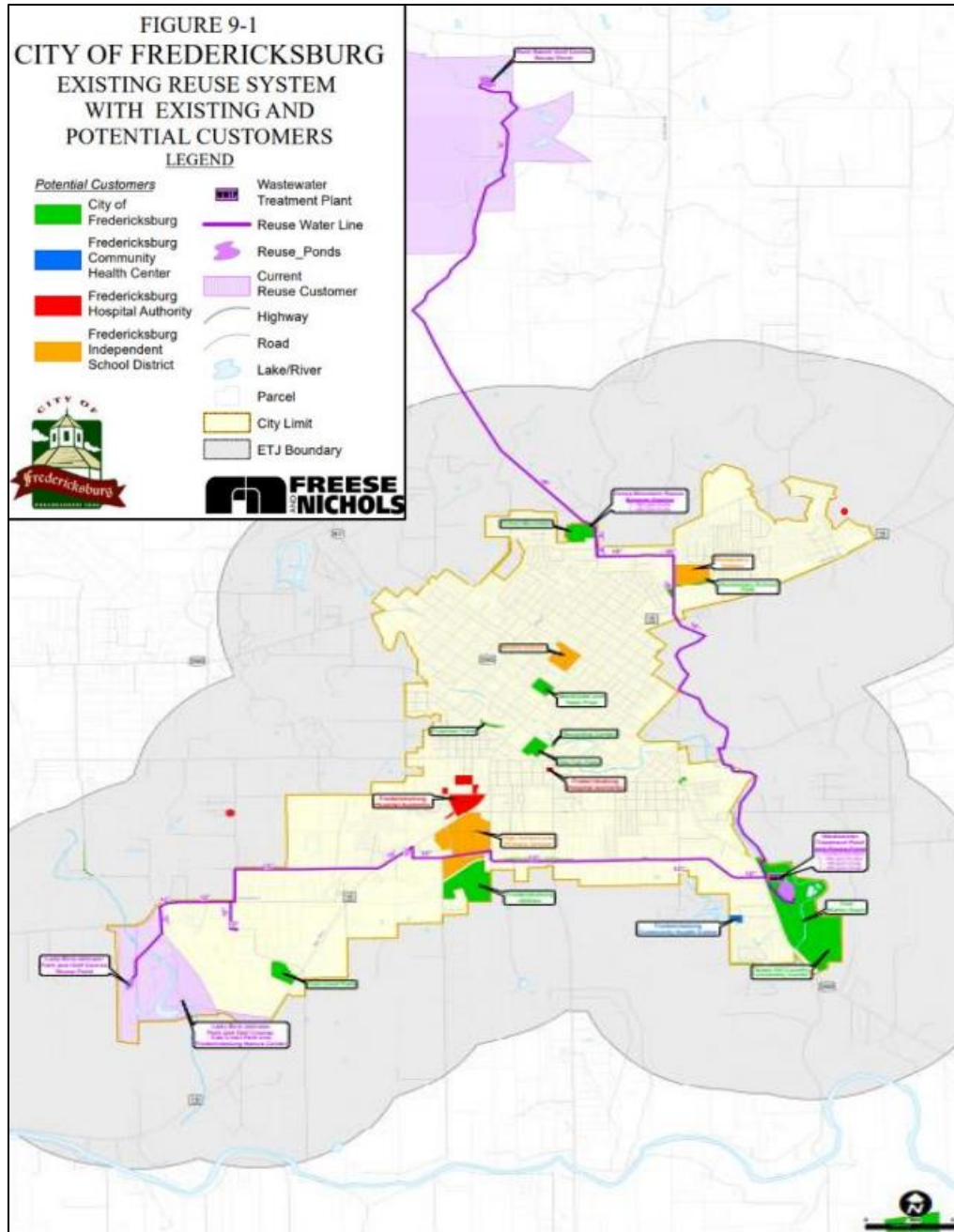


Figure 12. The City of Fredericksburg's purple pipe system in 2017.⁸⁹

D. Limitations

It is important to note that there are several limitations to the creation and implementation of water reuse systems in the state, especially over the Edwards Aquifer. Beneficial use of reclaimed water in the State of Texas is regulated by Texas Administrative Code Rule 210, *Use of Reclaimed Water*. For reuse water used for irrigation within the Recharge Zone, plans and specification for the disposal system must be submitted to the TCEQ Executive Director for approval prior to construction. Holding ponds containing

reclaimed water situated in the Recharge Zone must adhere to a variety of requirements outlined in TAC Rule 210, so as to prevent groundwater contamination. The irrigation of food crops and general irrigation practices using reclaimed water and the design of reclaimed water systems are also regulated by parameters set forth in this rule.⁹⁰

Various cities and authorities in the region have restrictions or guidelines on how reclaimed water can be used over the Recharge and Transition zones of the aquifer [Figure 13]:

- Edwards Aquifer Authority: To ensure groundwater quality, the use of reclaimed water on the Edwards Aquifer Recharge Zone is discouraged. Reclaimed water is, however, considered an alternative source of water and may be used without restriction during critical periods in other areas outside the Recharge Zone.⁹¹
- San Antonio: Within the San Antonio Water System boundaries, recycled water may not be used over the Edwards Aquifer Recharge and Transition Zones.⁹²
- Austin: If a wastewater treatment plant is going to discharge treated effluent over the Recharge Zone, it must instead dispose of the reclaimed water through irrigation.⁹³
- San Marcos: The city proposes that reclaimed water used in future irrigation projects should be limited to the Transition Zone and should not be used in the Recharge Zone. Reclaimed water is currently used at a power generating plant and a cement manufacturing plant in San Marcos.⁹⁴

Any reuse water provider should consider the location of their reuse treatment sites, infrastructure, and delivery points in relation to the Edwards Aquifer. If a provider decides to distribute reclaimed water within the Recharge or Transition Zones, that water should be held to higher treatment and water quality standards than reclaimed water distributed outside of these sensitive areas.

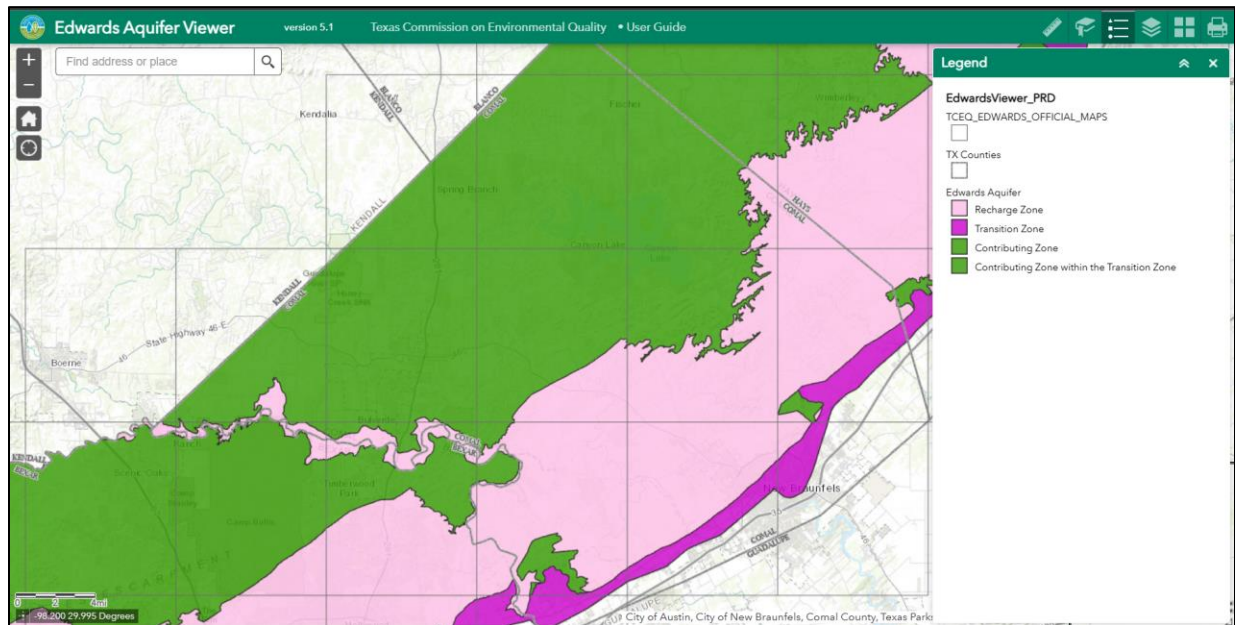


Figure 13. TCEQ map showing the zones of the Edwards Aquifer in Comal County. The Recharge Zone is the light pink area of the map.

III. Opportunities for Advancement

A. Authority

1. Distinct Water Reuse Districts

Perhaps the most obvious route for the creation of water reuse districts in Comal County is to model the authorization of the districts after the Alamo Water Conservation and Reuse District. The Texas State Legislature could authorize the creation of one or more water reuse districts within Comal County using a bill similar to Senate Bill 1667 in 1989. Doing so would allow the new district the authority to buy or collect wastewater, treat it, and then distribute it for reuse through a purple pipe network, selling it to any person, private corporation, city, town, municipal corporation, or political subdivision within or outside the district's boundaries. This would not prevent other corporations or political subdivisions from implementing a reuse system within Comal County but would allow the district to operate independently from other utility districts or political subdivisions.

A similar authorizing legislation to that which authorized the AWCRD would allow the new water reuse districts to construct their own facilities for the transportation, storage, and treatment of wastewater or allow them to lease or buy such facilities and would grant the districts the power of eminent domain. The district could construct, and later operate, purple pipe networks in the fast-growing areas of Comal County and the Hill Country before those areas are built up. The district could also locate its reuse infrastructure near large water demand industries, such as aggregate production operations. These scenarios would allow for the more responsible utilization of water sources to respond to and manage current and future growth.

As the state has authorized such a district before, there should be fewer legal challenges facing the creation of a water reuse district within the county. Logistical issues may create the bulk of challenges facing the authorization of such a district, but funding opportunities and opportunities for implementation are outlined in a later section.

2. Guadalupe-Blanco River Authority Reuse Systems

An alternative route for the creation of water reuse systems is to have the Guadalupe-Blanco River Authority implement more comprehensive reuse systems within its boundaries, for irrigation in fast-growing areas or for industrial sites. Established by Section 59, Article 16 of the Constitution of Texas in 1933 and reauthorized by an act of the Texas Legislature in 1935, the Guadalupe-Blanco River Authority is a 10-county statutory district that includes the entirety of Comal County. The Authority has prior experience in water reuse and could have support for a broader water reuse system.

The GBRA already operates multiple wastewater treatment plants, including one which produces reuse water for the City of Buda for irrigation of parks and city property. In its 2023-2028 Strategic Plan, the GBRA calls for the implementation of the first direct reuse facility in the Guadalupe River Basin, signaling existing support for water reuse within the authority's boundaries.⁹⁵ Here too, logistical issues may pose many of the challenges facing the creation or expansion of a water reuse system, but funding and implementation opportunities are outlined in a later section.

3. Practicalities

A water reuse district authorized to plan for and coordinate the treatment and distribution of recycled water in a region would allow for the more practicable and sustainable utilization of water sources. If recycled water systems are implemented in the Hill Country through one or more water reuse districts, these districts will need to reduce the risk of incurring the types of controversies that led to the dissolution of the AWCARD. The new districts could either operate outside of the boundaries of existing operators or, as recommended here, could incentivize collaboration and coordination between itself and existing operators.

Because there are many different and sometimes overlapping water and wastewater jurisdictions – municipal utility districts, water agencies, city water departments, etc. – in a region, the districts could facilitate water reuse by coordinating wastewater treatment and distribution across these various jurisdictions. The water reuse district could buy wastewater and lease existing treatment and storage facilities from current operators; undertake treatment costs; and undertake the planning and construction of recycled water infrastructure and delivery. This manner of operations could allow wastewater providers to continue to operate with a revenue stream without taking on the burden of coordinating wastewater reuse treatment or reuse infrastructure planning and construction, which the district would be authorized to handle.

B. Funding

1. State and Federal Grants and Loans

There are a variety of state and federal funding opportunities which could be available to supplement the funds needed for the creation of new water reuse districts or additional water reuse systems. Some of these funding opportunities may not be suitable for every iteration of a water reuse district or system. While this section should not be treated as an exhaustive list, it will provide a broad overview of some of the potential options. Further information for each funding opportunity can be found by clicking on the link associated with each category or by following the link in the associated reference. Some of the potential funding opportunities are:

- The [Clean Water State Revolving Fund](#): The CWSRF provides financial assistance for planning, acquisition, design, and construction of wastewater, reuse, or stormwater projects. Cities, counties, districts, river authorities, designated management agencies, and public and private entities are eligible to apply for below market interest rate loans and principal forgiveness after submitting a completed Project Information Form.⁹⁶
- The [State Water Implementation Fund for Texas](#): The SWIFT provides financial assistance for projects in the state water plan, including conservation, reuse, desalination, and new pipelines, and specifically encourages the funding of reuse projects. Cities, counties, river authorities, special law districts, groundwater conservation districts, and nonprofit water supply corporations are eligible to apply for a variety of loans and terms. Critically, the project must be a recommended water

management strategy in the regional water plan included in the most recently adopted state water plan prior to the project review year.⁹⁷

- The [State Participation Program](#): The SPP allows for the development of regional projects by funding excess capacity for future use where the development would be unaffordable without state participation. Eligible projects include planning design, acquisition, and construction for the “right sizing” of regional projects for water supply and wastewater to prepare for future use. Cities, counties, districts, river authorities, and nonprofit water supply corporations are eligible to apply for financing through a temporary Texas Water Development Board ownership interest in the regional facility with a 34-year repayment term.⁹⁸
- The [Texas Water Development Fund](#): The DFund provides financial assistance for planning, design, acquisition, and construction of water supply, conservation, and wastewater projects. Cities, counties, districts, river authorities, and nonprofit water supply corporations are eligible to apply for market interest rate loans after scheduling a pre-application conference with the relevant Regional Project Implementation Team.⁹⁹
- The U.S. Bureau of Reclamation’s [Title XVI Water Reclamation and Reuse Program](#) Grants: Under the authority of Title XVI of Public Law 102-575, the Bureau of Reclamation provides grant funding opportunities for the planning and design of water recycling and reuse projects in partnership with local government entities. Funding Group 1 applicants may request up to \$1 million in federal funding for projects under \$500 million, with a federal cost share of 50 percent. Funding Group 2 applicants may request up to \$5 million in federal funding for projects over \$500 million, with a federal cost share of 25 percent. Critically, projects are eligible to compete for these grants once Reclamation has reviewed the feasibility study submitted by the project sponsor.¹⁰⁰
- The U.S. Bureau of Reclamation’s [Large-Scale Water Recycling Program](#) Grant: Under the authority of the Bipartisan Infrastructure Law, the Bureau of Reclamation provides grant funding opportunities for projects that advance water recycling and reuse. The grant targets local government authorities or “water management agencies considering or planning larger water reuse projects as part of strategies to address projected water supply shortages.” There is no cap on the project size for which an applicant can request funding, and the federal cost share will be no more than 25 percent, up to \$180 million in federal funds. This funding opportunity will have multiple application deadlines in 2023 and 2024, and \$450 million will eventually be made available through this program.¹⁰¹
- The [Water Infrastructure Finance and Innovation Act](#) Loans: WIFIA loans are administered by the U.S. EPA and may be used for eligible water and wastewater infrastructure projects. Local and state government entities, partnerships and joint ventures, and corporations and trusts may apply for planning, design, acquisition, rehabilitation, replacement, and construction activities. Wastewater conveyance and treatment projects, alternative water supply projects, and water recycling projects may be eligible for WIFIA loans with a maximum federal cost share of 49 percent.¹⁰²

2. Rates and Taxes

If modeled after the Alamo Water Conservation and Reuse District, the governing board of a reuse district would be able to “establish and collect rates, charges, and fees for the sale of wastewater that are necessary to produce gross revenue that together with any other revenue is sufficient to: 1) pay all current operation and maintenance expenses of the district; and 2) produce an amount of revenue during each fiscal year at least equal to the principal and interest requirements for that fiscal year...”¹⁰³ Under the AWCRD model, a district would be able to issue bonds but would not be able to levy or collect taxes. The water reuse district would be authorized to enter into contracts for the purchase of wastewater and sale of the reclaimed wastewater.

If created under a political subdivision such as the Guadalupe-Blanco River Authority, the GBRA could use fees and funds from the sale of water, the treatment of water and wastewater, hydroelectric power, and recreation to implement the reuse system. The sale of reclaimed water would also then contribute to its revenues. The GBRA could not, however, levy or collect taxes.¹⁰⁴

In addition to establishing and collecting rates, charges, and fees for the sale of reuse water, the ability to levy and assess taxes would be instrumental in providing the districts or authority the financial flexibility to implement a reuse system. Amending GBRA’s authorizing legislation to include the power to levy and assess taxes – similar to the San Antonio River Authority’s ability to do so – or granting the new districts the authority to collect taxes in their authorizing legislation would go a long way towards the implementation and maintenance of any reuse system.¹⁰⁵

3. Byproduct Sales

The San Antonio Water System utilizes the byproducts of its wastewater treatment process to help provide affordable water services. Biosolids are used to generate compost and are sold commercially through local retailers and nurseries, while biogas – usually methane – is treated and sold by a partner energy company on the open market.¹⁰⁶ Following this example could help any new water reuse district or system offset costs or provide subsidized water rates to customers to influence the uptake of recycled water.

C. Implementation

1. Aggregate Production Operations

There are many different manners in which water reuse districts or systems can be implemented within Comal County, as evidenced by the seven case studies presented earlier in this report. In addition to these useful examples, there is another opportunity present for a water reuse district or system within the county. Due to the number and location of aggregate production operations (i.e., quarries) present within Comal County, there is a unique opportunity to implement a system wherein reclaimed wastewater can be provided to these quarries for their water use, thereby replacing groundwater use. Comal County has around 40,000 acres of aggregate production operations, roughly 11 percent of the county’s entire landmass. Eleven of these quarries are clustered along a 30-mile stretch of I-35 that runs through Comal County – this stretch is referred to as “Quarry Row.”¹⁰⁷

Comal County is one of the top three counties for water use by the aggregate mining industry in the State of Texas. These quarries use water – in Comal County, this water is solely groundwater – primarily for dust suppression and for washing the aggregate to clean and sort it.¹⁰⁸ A typical 800 ton-per-hour crusher uses the annual equivalent of the water used by around 1,920 single family homes.¹⁰⁹ While quarries make up 11 percent of Comal County’s land area, they use around 21 percent of the county’s groundwater, and annual water use by this industry is expected to increase around 10 percent per decade over the next 50 years.¹¹⁰ This represents a significant opportunity for the implementation of a water reuse district to immediately protect the groundwater supply.

The EPA recommends the construction of “intuitive projects” with strong potential for reuse and highlights both large water demand industries located next to a wastewater treatment plant and concentrations of reuse customers in an area.¹¹¹ The majority of the quarries in Comal County are linearly clustered along Quarry Row, some are already located next to existing wastewater treatment plants, and they use large amounts of groundwater [Figure 14]. Aggregate production operations provide a clear path forward for the development of a purple pipe network in the county.

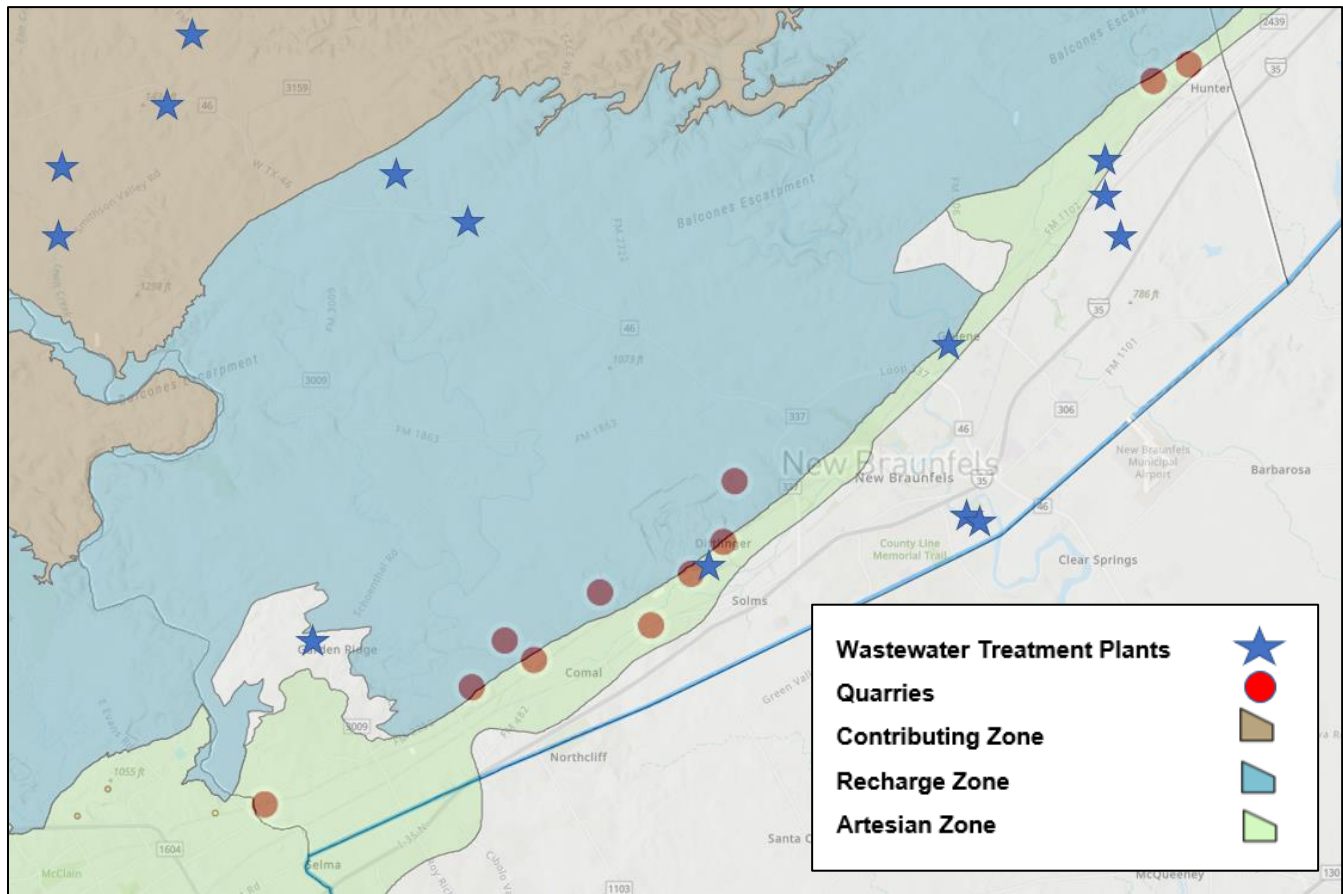


Figure 14. Map of Wastewater Treatment Plants (WWTPs) and limestone Aggregate Production Operations (Quarries) along Quarry Row in Comal County overlaid on the three layers of the Edwards Aquifer (see Figure 7).¹¹²

References

- ¹ Texas Water Development Board. (2023). *State of Texas Intended Use Plan Clean Water State Revolving Fund*. <https://www.twdb.texas.gov/financial/programs/CWSRF/doc/SFY2023/SFY2023-CWSRF-IUP.pdf>
- ² United States Census Bureau. (2020, March 26). *Most of the Counties with the Largest Population Gains Since 2010 are in Texas*. <https://www.census.gov/newsroom/press-releases/2020/pop-estimates-county-metro.html>; United States Census Bureau. (2023, March 30). *Growth in the Nation's Largest Counties Rebounds in 2022*. <https://www.census.gov/newsroom/press-releases/2023/population-estimates-counties.htm>
- ³ United States Census Bureau. (2022). *QuickFacts Comal County, Texas*. <https://www.census.gov/quickfacts/fact/table/comalcountytexas/PST045222#PST045222>
- ⁴ United States Census Bureau. (2018). *American FactFinder: Resident Population Estimates for the 100 Fastest Growing U.S. Counties with 10,000 or More Population in 2017: July 1, 2017 to July 1, 2018 – United States – County*. <https://www2.census.gov/programs-surveys/popest/tables/2010-2018/counties/totals/PEPANNGRC.pdf>
- ⁵ *QuickFacts Comal County, Texas*; Comal County Auditor. (2023). *Utilities for Comal County: 2012 thru 2023*. <https://www.co.comal.tx.us/AUD/Utilities.htm>
- ⁶ League of Women Voters of Comal Area. (2017). *Facts and Issues: Land-Use Planning in Comal County Impacts of Growth - Time for Action, An Update by the League of Women Voters of Comal Area 2017*. <https://my.lwv.org/sites/default/files/2017/land-useplanning.pdf>; *QuickFacts Comal County, Texas*; Texas Water Development Board. (2022). *Texas State Water Plan Comal County*. <https://www.texasstatewaterplan.org/county/Comal>
- ⁷ South Central Texas Regional Water Planning Group. (2020, November 5). *2021 South Central Texas Regional Water Plan Volume 1*. https://www.regionltexas.org/wp-content/uploads/2022/11/RegionL_2021RWP_V1.pdf
- ⁸ Eckhardt, G. (n.d.) *The Trinity Aquifer*. <http://www.edwardsaquifer.net/trinity.html>; Flores, M. E., et. al. (2020, July). *Comparative Evaluation of Wastewater Disposal Practices in the Contributing Zone of the Edwards Aquifer*. Southwest Research Institute. https://aquiferalliance.org/wp-content/uploads/2020/11/Final_Report_revised_102220.pdf
- ⁹ Siglo Group. (2022, February). *State of the Hill Country 8 Key Conservation and Growth Metrics for a Region at a Crossroads*. Texas Hill Country Conservation Network. https://hillcountryalliance.org/wp-content/uploads/State_of_the_Hill_Country-Network_REPORT_2022.pdf
- ¹⁰ *Comparative Evaluation of Wastewater Disposal Practices in the Contributing Zone of the Edwards Aquifer*.
- ¹¹ George, P.G., & Mace, R. E., & Petrossian, R. (2011, July). *Aquifers of Texas*. Texas Water Development Board. https://www.twdb.texas.gov/publications/reports/numbered_reports/index.asp
- ¹² Edwards Aquifer Authority. (n.d.). *Edwards Aquifer Maps and GIS*. <https://www.edwardsaquifer.org/science-maps/maps/>
- ¹³ *Facts and Issues: Land-Use Planning in Comal County Impacts of Growth - Time for Action, An Update by the League of Women Voters of Comal Area 2017*; San Antonio River Authority. (n.d.). *Be River Proud: Flood Risk*. www.sariverauthority.org/be-river-proud/flood-risk
- ¹⁴ Ross, D. L. (2011, November). *Land-Applied Wastewater Effluent Impacts on the Edwards Aquifer*. Greater Edwards Aquifer Alliance and Save Our Springs Alliance. <http://www.hillcountryalliance.org/uploads/HCA/EAWastewaterImpact.pdf>
- ¹⁵ Ding, J., & McCarl, B. A. (2019). *Economic and Ecological Impacts of Increased Drought Frequency in the Edwards Aquifer*. *Climate*, 8(1), 2. MDPI AG. Retrieved from <http://dx.doi.org/10.3390/cli8010002>; Edwards Aquifer Authority. (n.d.) *Historical Water Level Chart*. <https://www.edwardsaquifer.org/science-maps/aquifer-data/historical-water-level-chart/>; Smith, B., Hunt, B., Watson, J., & Camp, J. (2023). *Impacts of Recharge and Discharge of the Trinity Aquifers of Central Texas*. *Eurokarst* 2022. 17-24. <https://link.springer.com/book/10.1007/978-3-031-16879-6>
- ¹⁶ *Impacts of Recharge and Discharge of the Trinity Aquifers of Central Texas*.
- ¹⁷ Texas Water Development Board. (n.d.). *Water Data for Texas Drought Monitor*. <https://www.waterdatafortexas.org/drought/drought-monitor?period=2023-06-20&areaType=county&areaName=Comal>; Drought.gov. (n.d.). *Drought Conditions for Comal County*. <https://www.drought.gov/states/texas/county/comal>
- ¹⁸ U.S. Geological Survey. (n.d.). *USGS 08168710 Comal Spgs at New Braunfels, TX*. National Water Information System: Web Interface.

https://waterdata.usgs.gov/nwis/dv?cb_00060=on&format=gif_default&site_no=08168710&legacy=&referred_module=sw&period=&begin_date=2003-06-28&end_date=2023-06-25

- ¹⁹ *Water Data for Texas Drought Monitor.*
- ²⁰ Economic and Ecological Impacts of Increased Drought Frequency in the Edwards Aquifer.
- ²¹ Arcadis U.S., Inc. (2021, July). *2021 Water Resources Plan Update.* New Braunfels Utilities.
https://www.nbutexas.com/wp-content/uploads/2021/10/2021-WRP-Update-Final_9.1.21-Reduced.pdf; Texas Water Company. (n.d.). *Our Water Sources.* <https://www.txwaterco.com/water-quality-0/our-water-sources>; SouthWest Water Company. (n.d.). *Texas Water Quality.* <https://www.swwc.com/texas/water-quality/>
- ²² Garden Ridge Texas. (n.d.). *City of Garden Ridge Water Company.* <https://www.ci.garden-ridge.tx.us/105/Utilities>
- ²³ *Facts and Issues: Land-Use Planning in Comal County Impacts of Growth - Time for Action, An Update by the League of Women Voters of Comal Area 2017.*
- ²⁴ Texas Water Development Board. (n.d.). *Historical Water Use Estimates by County, 2015 and Later (Includes Reuse).* <https://www.twdb.texas.gov/waterplanning/waterusesurvey/estimates/>
- ²⁵ Texas Water Development Board. (2022, September 20). *Texas Water Use Estimates Summary for 2020.* <https://www.twdb.texas.gov/waterplanning/waterusesurvey/estimates/doc/2020TexasWaterUseEstimatesSummary.pdf>
- ²⁶ *Historical Water Use Estimates, Historical Water Use Estimates by County, 2015 and Later (Includes Reuse).*
- ²⁷ Hermitte, S. M., & Mace, R. E. (2012, November). *Technical Note 12-01 The Grass is Always Greener... Outdoor Residential Water Use in Texas.* Texas Water Development Board.
https://www.twdb.texas.gov/publications/reports/technical_notes/doc/SeasonalWaterUseReport-final.pdf#:~:text=Outdoor%20usage%20and%20lot%20size%2C%20another%20possible%20standard-of-living,more%20water%20than%20homes%20without%20installed%20irrigation%20systems
- ²⁸ Espey Consultants, Inc. (2011, July). *City of New Braunfels Parks Reclaimed Water Irrigation Feasibility Study.* City of New Braunfels.
http://www.twdb.texas.gov/publications/reports/contracted_reports/doc/1004831078_newbraunfels.pdf
- ²⁹ Texas Water Company. (n.d.). *Wastewater: Treatment and Water Quality.* <https://www.txwaterco.com/wastewater-treatment-and-water-quality>
- ³⁰ *2021 Water Resources Plan Update.*
- ³¹ One Water Working Group. (2021, June 1). *One Water Roadmap Report.* Headwaters at the Comal.
https://headwatersatthecomal.com/wp-content/uploads/2022/04/Roadmap-Report_FINAL-DRAFT-6.1.2021.pdf
- ³² Hunt, B., & Smith, B. (2016, September 24). *Study: Surface and Groundwater Interactions in Onion Creek and Blanco River.* Barton Springs Edwards Aquifer Conservation District. https://bseacd.org/2016/09/onionblanco_flowstudy/
- ³³ *Facts and Issues: Land-Use Planning in Comal County Impacts of Growth - Time for Action, An Update by the League of Women Voters of Comal Area 2017.*
- ³⁴ *Comparative Evaluation of Wastewater Disposal Practices in the Contributing Zone of the Edwards Aquifer.*
- ³⁵ Texas Commission on Environmental Quality. (n.d.). *Edwards Aquifer Protection Program.*
<https://www.tceq.texas.gov/permitting/eapp/>
- ³⁶ *Land-Applied Wastewater Effluent Impacts on the Edwards Aquifer.*
- ³⁷ Mabe, J. A. (2007). *Nutrient and Biological Conditions of Selected Small Streams in the Edwards Plateau, Central Texas, 2005-06, and Implications for Development of Nutrient Criteria.* US Department of the Interior, US Geological Survey Scientific Investigations Report 2007-5195. U.S. Geological Survey.
<https://pubs.usgs.gov/sir/2007/5195/pdf/sir2007-5195.pdf>
- ³⁸ *Land-Applied Wastewater Effluent Impacts on the Edwards Aquifer.*
- ³⁹ *Comparative Evaluation of Wastewater Disposal Practices in the Contributing Zone of the Edwards Aquifer; Hill Country Alliance.* (n.d.). *Pristine Streams.* <https://hillcountryalliance.org/our-work/water-resources/pristine-streams/>
- ⁴⁰ *Nutrient and Biological Conditions of Selected Small Streams in the Edwards Plateau, Central Texas, 2005-06, and Implications for Development of Nutrient Criteria*
- ⁴¹ *Comparative Evaluation of Wastewater Disposal Practices in the Contributing Zone of the Edwards Aquifer.*
- ⁴² Edwards Aquifer, 30 T.A.C. §213.1 - 213.14 (2008).
<https://www.tceq.texas.gov/assets/public/legal/rules/rules/pdf/lib/213a.pdf>
- ⁴³ Ibid.

- ⁴⁴ Clifford, M. (n.d.). *Solving Two Problems with One Solution – Beneficial Reuse of Wastewater*. Sierra Club for the Greater Edwards Aquifer Alliance. <https://aquiferalliance.org/waste-water-discharge-resources/>
- ⁴⁵ Peace, A. (2018, July). *Wastewater Discharge Regulations and Impacts on Surface Waters and Edwards Aquifer Recharge in the Texas Hill Country*. Greater Edwards Aquifer Alliance. <https://aquiferalliance.org/wp-content/uploads/2018/07/NoDischargeBill-FactSheet.pdf>
- ⁴⁶ *Solving Two Problems with One Solution – Beneficial Reuse of Wastewater*.
- ⁴⁷ Slade Jr., R. (2018, October). *Talking Points: Arguments against effluent discharges in the Hill Country*. Hill Country Alliance. https://www.hillcountryalliance.org/wp-content/uploads/2018/10/DD_Talking-points_2018_Slade.pdf
- ⁴⁸ Greater Edwards Aquifer Alliance. (2023, June 22). *Continued Partnership with Texas State University Students Expands GEAA's Wastewater Project Efforts*. <https://aquiferalliance.org/2023/06/continued-partnership-with-texas-state-university-students-expands-geaas-wastewater-project-efforts/>
- ⁴⁹ Nelson, R. (2018, November 22). Meyer Ranch to add 1,600 homes in rural northwest. *Community Impact*. <https://communityimpact.com/development-construction/2018/11/21/meyer-ranch-to-add-1600-homes-in-rural-northwest/>; Foglia, A., & Gonzalez-Camejo, J., et. al. (2023). Transforming wastewater treatment plants into reclaimed water facilities in water-unbalanced regions. An overview of possibilities and recommendations focusing on the Italian case. *Journal of Cleaner Production*, 410, 137264. <https://doi.org/10.1016/j.jclepro.2023.137264>
- ⁵⁰ *Continued Partnership with Texas State University Students Expands GEAA's Wastewater Project Efforts*.
- ⁵¹ Hill Country Alliance. (2019, December). *Issue: Discharging Treated Effluent into Hill Country Streams and Creeks Myths and Truths*. https://www.hillcountryalliance.org/wp-content/uploads/2019/12/THC_DischargeMyths_Paper2019.pdf
- ⁵² Ibid; *Comparative Evaluation of Wastewater Disposal Practices in the Contributing Zone of the Edwards Aquifer*.
- ⁵³ *Land-Applied Wastewater Effluent Impacts on the Edwards Aquifer*.
- ⁵⁴ Wright, W. G. (2023, June 5). Disposal of Reclaimed Wastewater to Wastewater Collection System: Texas Legislation Introduced Addressing the Treatment and Non-Potable Reuse of Water. *Mitchell Williams Law Firm*. <https://www.mitchellwilliamslaw.com/disposal-of-reclaimed-wastewater-to-wastewater-collection-system-texas-legislation-introduced-addressing-the-treatment-and-non-potable-reuse-of-water/>; WaterReuse. (2023, May 8). *Water Reuse Advances in the 88th Texas Legislative Session* [Press Release]. <https://watereuse.org/88th-tx-legislative/>
- ⁵⁵ An Act Relating to the Disposal of Reclaimed Water, S.B. 1289, 88 Leg. (2023). <https://legiscan.com/TX/text/SB1289/2023>
- ⁵⁶ Texas Water Development Board. (2022). *2022 State Water Plan Water for Texas*. <https://www.twdb.texas.gov/waterplanning/swp/2022/docs/SWP22-Water-For-Texas.pdf>
- ⁵⁷ Ibid.
- ⁵⁸ *State of the Hill Country 8 Key Conservation and Growth Metrics for a Region at a Crossroads*.
- ⁵⁹ Boerne Utilities. (n.d.). *Reclaimed Water*. <https://www.ci.boerne.tx.us/1948/Reclaimed-Water>
- ⁶⁰ *State of the Hill Country 8 Key Conservation and Growth Metrics for a Region at a Crossroads*.
- ⁶¹ Alamo Conservation & Reuse District, S.B. 1667, 71 Leg. (1989). <https://capitol.texas.gov/BillLookup/History.aspx?LegSess=71R&Bill=SB1667>
- ⁶² San Antonio Water System. (n.d.). *History & Chronology*. <https://www.saws.org/about-saws/history-chronology/>
- ⁶³ Alamo Conservation & Reuse District, S.B. 1667.
- ⁶⁴ *History and Chronology*; San Antonio Water System. (n.d.). *Recycled Water Program*. <https://www.saws.org/your-water/management-sources/recycled-water-program/>
- ⁶⁵ Votteler, T.H. (2023). Hands across the Water: How the 57-Year Dispute over the Edwards Aquifer Began, Persisted, and Was Resolved. *Water*, 15(10), 1835. MDPI AG. Retrieved from <http://dx.doi.org/10.3390/w15101835>
- ⁶⁶ Texas Stream Team. (2021, May). Pumping Up Progress. *EAHCP Steward News from the Edwards Aquifer Habitat Conservation Plan*. <https://www.edwardsaquifer.org/wp-content/uploads/2021/05/Pumping-Up-Progress-5-21.pdf>
- ⁶⁷ *Recycled Water Program*; Ameresco. (2020, April). *Project Highlight San Antonio Water System, TX*. <https://www.ameresco.com/wp-content/uploads/2020/04/san-antonio-water-system-tx.pdf>
- ⁶⁸ San Antonio Water System. (n.d.). *Water Recycling*. <https://www.saws.org/your-water/water-recycling/>
- ⁶⁹ Eckhardt, G. (n.d.). *Water Recycling and Reuse*. <http://www.edwardsaquifer.net/waterrecycling.html>
- ⁷⁰ San Antonio Water System. (2023). *Water & Sewer Rates*. <https://www.saws.org/service/water-sewer-rates/>
- ⁷¹ Colorado River Municipal Water District. (n.d.). *Chief Financial Officer*. <https://www.governmentresource.com/home/showpublisheddocument/2261/637920998733970000#:~:text=CRMW>

- [D%20delivers%20an%20average%20of%2058%20million%20gallons,100%20million%20gallons%20per%20day%20during%20the%20summer](#)
- ⁷² Colorado River Municipal Water District. (n.d.). *Reclaimed Water*. <https://www.crmwd.org/water-sources/reuse/>
- ⁷³ Big Spring Texas. (2023). *New Customer Information*. <https://www.mybigspring.com/DocumentCenter/View/233/New-Customer-Information-PDF>
- ⁷⁴ “City of Boerne. (2023, August 28). *Boerne Water Dashboard*. Internet of Water. <https://boerne-water-dashboard.internetofwater.app/>; *Reclaimed Water*. Boerne Utilities.
- ⁷⁵ City of Boerne. (2023, July). *City of Boerne Utilities Residential Reclaimed Water Notification and Information*. <https://www.ci.boerne.tx.us/DocumentCenter/View/17924/Reclaimed-Water-Notification-and-Information-Revised-July-2023?bidId=>
- ⁷⁶ *Boerne Water Dashboard*.
- ⁷⁷ City of Boerne. (2023). *Rates*. <https://www.ci.boerne.tx.us/271/Rates>
- ⁷⁸ El Paso Water. (n.d.). *Reclaimed Water*. <https://www.epwater.org/cms/One.aspx?portalId=6843488&pageId=7416458>
- ⁷⁹ Alley, W. M., & Alley, R. (2022). *The Water Recycling Revolution: Tapping into the Future*. Rowman & Littlefield Publishers, Incorporated. <https://doi.org/10.1111/gwat.13243>
- ⁸⁰ El Paso Water. (2019, April 12). *El Paso Water leads in water reuse technology* [Press release]. <https://www.epwater.org/cms/one.aspx?portalId=6843488&pageId=15507283>
- ⁸¹ El Paso Water. (n.d.). *Rates and Fees*. https://www.epwater.org/customer_service/rates_and_fees
- ⁸² Round Rock Texas. (n.d.). *About Your Water*. <https://www.roundrocktexas.gov/city-departments/utilities-and-environmental-services/water/about-your-water/>
- ⁸³ Round Rock Texas. (n.d.). *Water, Sewer and Garbage Rates*. <https://www.roundrocktexas.gov/city-departments/utility-billing/water-sewer-and-garbage-rates/>
- ⁸⁴ Foster, E. (2021, August 27). Lakeway MUD: Beneficial reuse prevents wastewater discharge, promotes conservation. *Austin-American Statesman*. <https://www.statesman.com/story/news/2021/08/27/lakeway-mud-beneficial-reuse-prevents-wastewater-discharge-promotes-conservation/5615510001/>; Lakeway Municipal Utility District. (n.d.). *Water Reuse*. <https://lakewaymud.org/about-us/services/water-reuse/>
- ⁸⁵ Lakeway Municipal Utility District. (2023, April 12). *FY 2022 Rate Order: Third Amendment*. <https://lakewaymud.org/wp-content/uploads/2022LMUDRateOrder4-12-2023.pdf>
- ⁸⁶ Freese and Nichols, Inc. (2017, February). *Water, Wastewater, and Reuse System Master Plan*. <https://www.fbgtx.org/DocumentCenter/View/2343/City-of-Fredericksburg-Water-Wastewater-and-Reuse-Master-Plan>
- ⁸⁷ Ibid
- ⁸⁸ The City of Fredericksburg Texas. (2019, November 1). *Water Rates*. <https://www.fbgtx.org/302/Water-Rates>
- ⁸⁹ *Water, Wastewater, and Reuse System Master Plan*.
- ⁹⁰ Use of Reclaimed Water, 30 T.A.C. §210.1 – 210.85. (2016). <https://www.tceq.texas.gov/rules/indxpathdf.html#210>
- ⁹¹ Edwards Aquifer Authority. (2014, November). *Groundwater Conservation Plan*. https://www.edwardsaquifer.org/wp-content/uploads/2019/04/Groundwater_Conservation_Plan_Nov2014.pdf
- ⁹² Plants and Major Projects Department. (2020, December). *SAWS Recycled Water User Handbook*. San Antonio Water System. https://apps.saws.org/your_water/recycling/handbook/docs/Recycled%20Water%20User%20Handbook%20-%20December%202020.pdf.
- ⁹³ Article 4 – Reclaimed Water, Title 25 Austin TX Land Development Code Ch. 25-9. https://library.municode.com/tx/austin/codes/land_development_code?nodeId=TIT25LADE_CH25-9WAWA_ART4REWA_S25-9-399BI
- ⁹⁴ Texas Water Development Board. (2014, January 7). *Direct Water Reuse Expansion Feasibility Study*. <https://sanmarcostx.gov/DocumentCenter/View/4700/Direct-Water-Reuse-Expansion-Feasability-Study-PDF?bidId=>
- ⁹⁵ Guadalupe-Blanco River Authority. (n.d.). *About Us*. <https://www.gbra.org/about/>
- ⁹⁶ Texas Water Development Board. (2022, November). *Clean Water State Revolving Fund (CWSRF) Loan Program*. <https://www.twdb.texas.gov/financial/programs/CWSRF/>
- ⁹⁷ Texas Water Development Board. (2022, November). *State Water Implementation Fund for Texas (SWIFT)*. <http://www.twdb.texas.gov/financial/programs/SWIFT/index.asp>

- ⁹⁸ Texas Water Development Board. (2022, November). *State Participation*. <http://www.twdb.texas.gov/financial/programs/SPP/index.asp>
- ⁹⁹ Texas Water Development Board. (2022, November). *Texas Water Development Fund (DFund)*. <http://www.twdb.texas.gov/financial/programs/TWDF/index.asp>
- ¹⁰⁰ Bureau of Reclamation. (2023, September 27). *Title XVI – Water Reclamation and Reuse*. <https://www.usbr.gov/watersmart/title/index.html>
- ¹⁰¹ Bureau of Reclamation. (2023, September 27). *Large-Scale Water Recycling Program*. <https://www.usbr.gov/watersmart/largescale/index.html>
- ¹⁰² United States Environmental Protection Agency. (2023, June 27). *What is WIFIA?* <https://www.epa.gov/wifia/what-wifia>
- ¹⁰³ An Act Relating to the Disposal of Reclaimed Water, S.B. 1289.
- ¹⁰⁴ Guadalupe-Blanco River Authority. (n.d.). *Financial Transparency*. <https://www.gbra.org/about/transparency/>
- ¹⁰⁵ San Antonio River Authority. (2023). *Current Facts*. <https://www.sariverauthority.org/about/current-facts#:~:text=The%20River%20Authority%20has%20the%20statutory%20authority%20to,property%20valuation.%20The%20average%20annual%20tax%20is%20%2440.20>
- ¹⁰⁶ *Water Recycling*.
- ¹⁰⁷ Public Citizen. (2018, July 23). *The Texas Aggregate Industry is Crushing Hill Country Dreams*. <https://www.citizen.org/news/the-texas-aggregate-industry-is-crushing-hill-country-dreams/>
- ¹⁰⁸ Reedy, R. C., & Scanlon, B. R. (2022, August). *Water Use by the Mining Industry in Texas*. Texas Water Development Board. <https://www.twdb.texas.gov/waterplanning/data/projections/MiningStudy/doc/Final%20TWDB%20Mining%20Water%20Use%20Report.PDF>
- ¹⁰⁹ Texans for Responsible Aggregate Mining. (2019, August 25). *Total Annual Water Consumption 4 Person Residence Vs. 800TPH Crusher* [Infographic]. <https://www.tramtexas.org/wp-content/uploads/2020/06/20190825-Water-Consumption-Slide-Residence-vs.-Crusher.pdf>
- ¹¹⁰ *Water Use by the Mining Industry in Texas*.
- ¹¹¹ Camp Dresser & McKee, Inc. (2004, September). *2004 Guidelines for Water Reuse*. U.S. Environmental Protection Agency. <https://www.epa.gov/sites/default/files/2019-08/documents/2004-guidelines-water-reuse.pdf>
- ¹¹² Texas Hearst Data Visualization Team. (2021, October 6). Do you live near a quarry? Use the map below to see how close you live to a quarry site. *San Antonio Express-News*. <https://www.expressnews.com/projects/2021/texas-quarry-map/>. Texas Hearst Data Visualization Map is overlaid on GEAA-produced map.