# Making the Case for Source Water Protection

## Pedernales River Basin Evaluation

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# Executive Summary

**THIS CASE STUDY PRESENTS** multiple land conservation and source water protection programs, their successes and funding sources. Ultimately, the study suggests priority protection areas and a road map for implementing a successful source water protection program in the Pedernales River Basin.

A source water protection program protects critical water resources by working with private landowners who are interested in conserving, not developing, their lands and by providing compensation to the landowners for such conservation. The conserved land, in turn, provides critical natural infrastructure that filters and absorbs rainfall, replenishes groundwater, and provides source water for spring-fed creeks and rivers.

**Source water protection programs can provide numerous benefits:**

- Water supply security
- Water quality protection
- Managed water treatment costs
- Flood mitigation
- Habitat protection
- Ongoing operations of agricultural working lands

Source water protection programs have been implemented successfully across the United States, some for decades. These programs provide win-win-win outcomes for many stakeholders as water supplies are protected, ecosystems are preserved, and landowners with conservation easements retain their property for future generations.

With fee-simple purchases of development rights, the public gains lands for water quality and in some cases public parks. In addition, water providers and downstream users benefit from the source water protection program as it produces a clean abundant water supply and contributes to other important societal benefits, like recreation, tourism and economic development.

The Pedernales River Basin was evaluated through re-examination of existing studies and development of a new Geographic Information System (GIS) tool that analyzes available datasets, develops a ranking system, and geographically identifies high-value water resource lands. This GIS tool can be applied to other river basins throughout the Hill Country to help water providers in the planning and protection of high-value water resource areas.

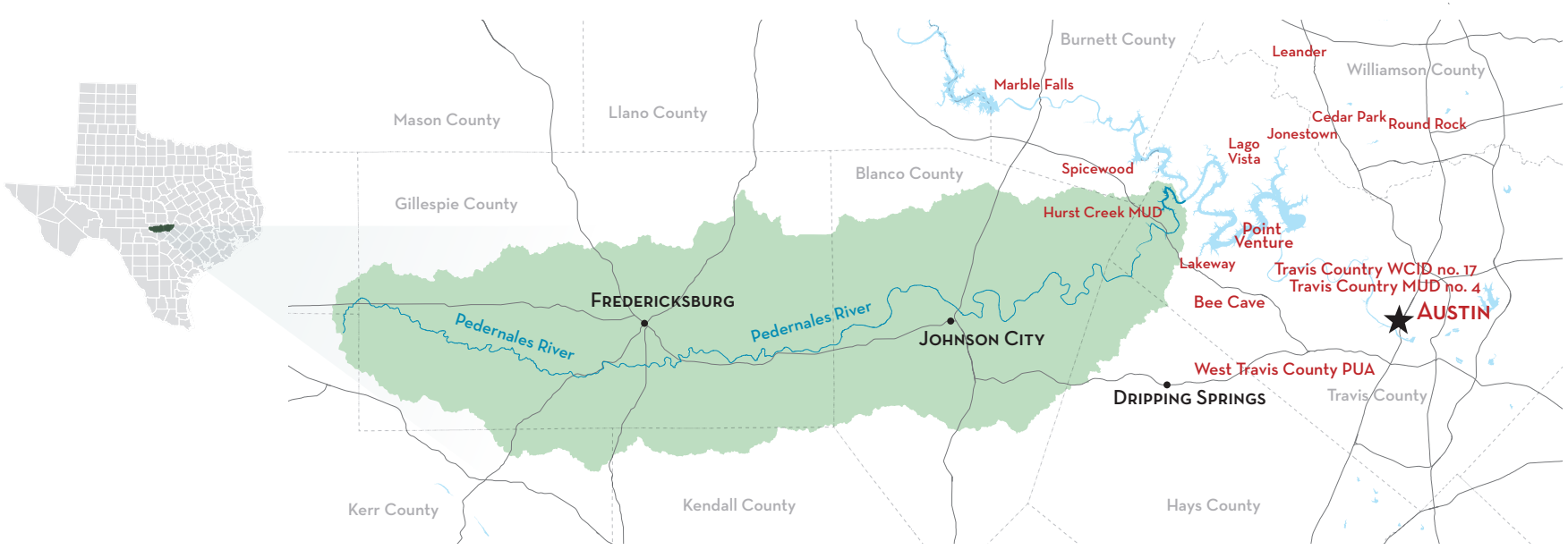
Protecting high-value water resource lands within rapidly growing areas in the Texas Hill Country is crucial to maintaining the region's high-quality ground and surface waters, which supply drinking water to downstream cities such as Austin, New Braunfels, San Marcos and San Antonio.

As part of the study, funding resources for source water protection programs were reviewed and discussed with numerous water providers. Their input underscored the value of a sustainable and reliable rate-based funding stream to implement a program that can leverage funding through the Texas Water Development Board's (TWDB) Clean Water State Revolving Fund (CWSRF) and other low-interest rate loans, grants, and non-government organization (NGO) resources. A base monthly water rate for utility customers provides long-term funding stability to support the continued acquisition, management and protection of high-value water resource protection lands.

FIGURE 1

**Pedernales River Basin and its Clean Water Beneficiaries**

Water provider entities noted in red text benefit from Pedernales River water quality.




Utility operators will reap many benefits like reduced water treatment requirements, decreased costs, and the ability to manage long-term rates. The Texas Land Trust Council notes that every $1 invested in land conservation for water protection can avoid $6 in water infrastructure costs for Texas taxpayers. In summary, healthy land equates to healthy, affordable water.

The Pedernales River provides about 25 percent of the water that flows into Lake Travis on an average annual basis and is noted as meeting all state water quality standards with no impairments. There are no known water providers that divert water from the river before it flows into Lake Travis. Utilities that withdraw water from Lake Travis and the Highland Lakes, shown in Figure 1, are beneficiaries of high-quality, clean water from the Pedernales River Basin.

# Key Findings

## Central Texas' water supply is under threat.

Explosive population growth, increasing groundwater extraction, expanding impervious cover, and more frequent climatic extremes jeopardize the quality and quantity of our region's rivers, creeks, aquifers and water resources.

## Successful models for source water protection exist in Central Texas and around the U.S.

Land conservation and source water protection programs are found throughout the country that provide water supply, water quality and flood management benefits, as well as cost avoidance for managed water treatment.

## Land conservation plays an essential cost-effective role in protecting source waters.

Promoting and preserving natural processes in key areas of the landscape substantially contributes to treatment and delivery of high yields of high-quality water to creeks, rivers and aquifers. In essence, natural lands function as low-cost water treatment facilities with numerous ecosystem service benefits.

## Lessons learned from others can guide Texas Hill Country programs.

When faced with similar challenges, other utilities and regions of the country have created source water protection programs. These existing land conservation programs benefit water quality and supply and are supported with a consistent funding stream.

## The Pedernales River Basin provides a compelling and timely reason for conservation.

The Pedernales River provides almost 25 percent of the average annual inflow for Lake Travis, which is the primary water supply reservoir for Austin and surrounding communities. This river basin plays a huge role in drinking water for millions.

## Public investment in land conservation programs reaps multiple public benefits.

Natural lands conservation in the Pedernales River Basin can improve water quality, diminish water treatment costs, preserve agricultural heritage, and provide recreational benefits in Lake Travis, Lake Austin and the Colorado River downstream.

### Water rates, service fees and/or sales taxes are proven approaches for publicly supported and sustainable source water protection funds.

These options can help finance a long-term land conservation program that targets high-value water resource areas to maximize the return on investment for landowners, utilities and communities.

### An established local or regional source water protection fund can be leveraged with state, federal and other grant or loan programs.

There are numerous opportunities in Texas to grow a local fund for source water protection, and land conservation is a proven and widely accepted use for such monies.

### A dedicated water rate fund is an optimum approach for a source water protection program.

With a reliable funding stream, communities can perform long-term planning and establish partnerships with neighboring communities and other water providers. Rate-based funds can be leveraged for loans and grants to yield high returns and allow providers to be more proactive in acquiring source water lands in a growing region.

### Multi-dimensional programs can function with land conservation efforts.

An active land conservation/source water protection program can cross-pollinate with other local and regional floodplain management, regulatory and agricultural programs to maximize land protection, inform appropriate land management practices, and benefit local and downstream water users.

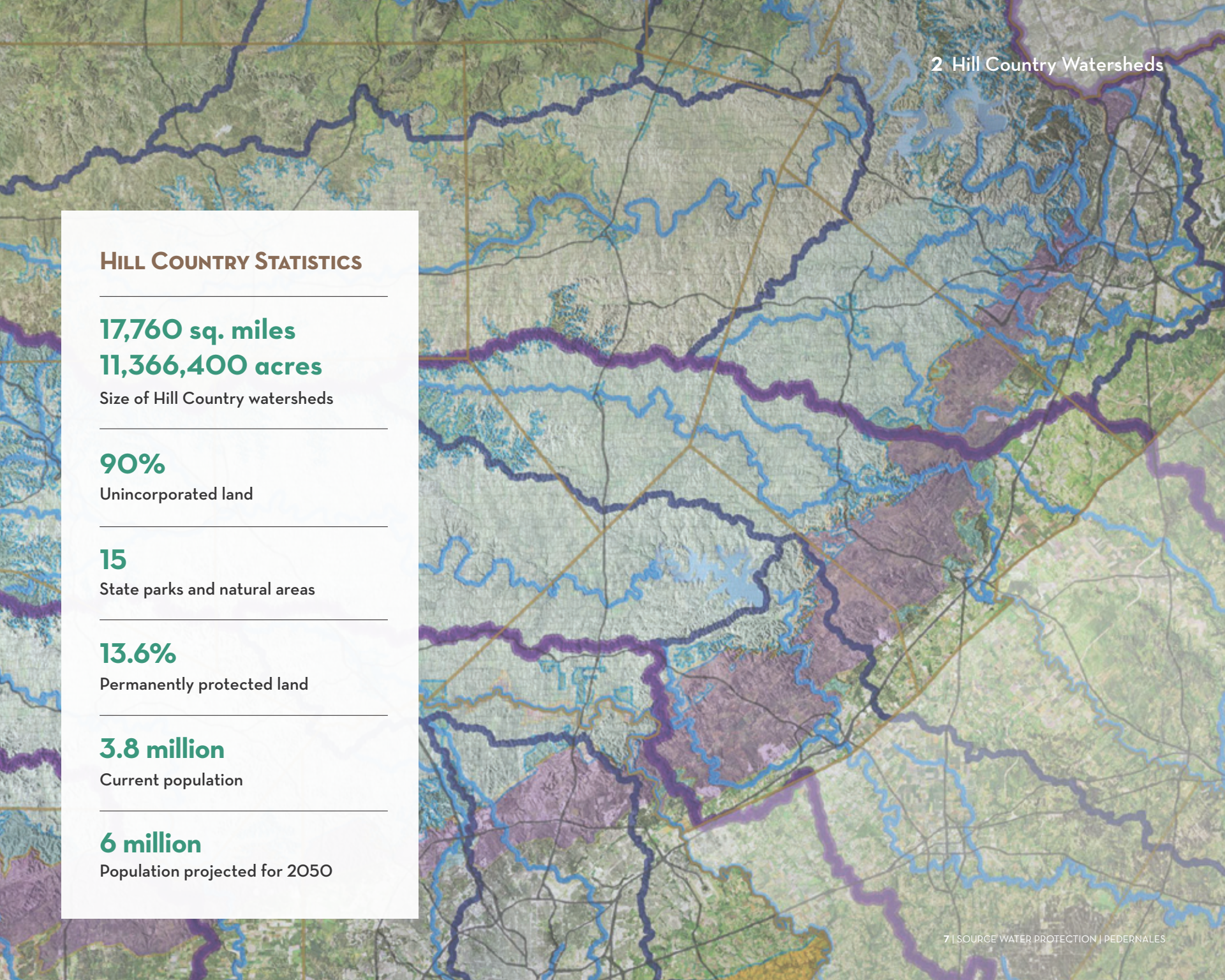
# Hill Country Watersheds

**The Texas Hill Country is more than** 11 million acres in area (17,760 square miles) encompassing 18 counties in Central Texas including those surrounding Austin and San Antonio. Much of the Hill Country is rural with rich biodiversity, natural heritage, unique ecological systems, vast open spaces, the Edwards Aquifer Recharge Zone, and the headwaters of 12 Texas rivers.

The rivers and connected aquifers provide water to ranches, growing cities and, ultimately coastal estuary habitats and communities. The Hill Country springs, streams, rivers and reservoirs are recognized as having some of the cleanest and clearest waters in the State which support a variety of ecologies and economies, as shown below.





2 Hill Country Watersheds

## Hill Country Statistics

**17,760 sq. miles**
**11,366,400 acres**
Size of Hill Country watersheds

**90%**
Unincorporated land

**15**
State parks and natural areas

**13.6%**
Permanently protected land

**3.8 million**
Current population

**6 million**
Population projected for 2050

# Threats to Land & Water

## The Hill Country is a region at a crossroads.

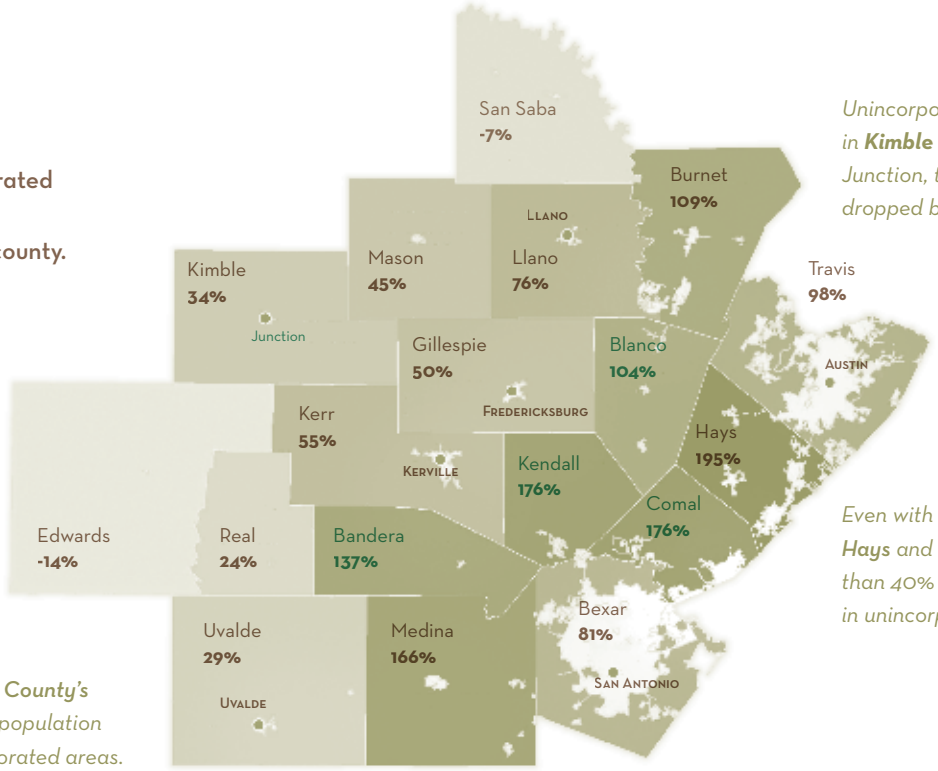
Its population is projected to grow from nearly four-million people today to about six-million people by 2050, resulting in increased water demands on Hill Country rivers, aquifers and reservoirs. While most of the growth is along the I-35 corridor from Austin to San Antonio, the adjacent counties of Bandera, Blanco, Burnet, Kendall, Llano and Medina are also experiencing rapid population growth. Generally speaking, rural communities tend to have fewer financial and technical resources, including codes and criteria, to guide growth that is protective of water resources. Texas counties have been given very limited authority to plan for and manage growth. There has been explosive population growth in unincorporated areas within counties (those areas outside of established municipal boundaries), and because counties lack land-use planning authority to guide this growth in sustainable ways, there are increasingly adverse effects on water resources.

FIGURE 2

**Population Growth in the Unincorporated Areas of the Texas Hill Country 1990 - 2020**

- The Texas Hill Country population in unincorporated areas has grown by 103% since 1990.
- Darker shades indicate faster growth rates by county.
- White spaces indicate incorporated areas.

Map courtesy Siglo Group




*Unincorporated population growth in **Kimble County** has grown while Junction, the county seat, has dropped by 8%.*

*Even with 19 municipalities in **Hays** and **Comal Counties**, more than 40% of their population lives in unincorporated areas.*

***Edwards County** and **San Saba County** are the two Hill Country counties losing population. Rocksprings, the county seat of Edwards County, is shrinking at a similar rate.*

***96% of Bandera County's** rapidly growing population lives in unincorporated areas.*

## Threats to Land & Water

With population growth comes the inevitable conversion of open spaces and ranch lands to subdivisions, roadways, shopping centers and aggregate operations. These land-use changes reduce groundwater recharge and increase pollution in surface water runoff which negatively affect aquifer levels and spring flows while generating additional flooding and poor water quality.

Further, these threats are compounded by highly variable weather patterns in the Hill Country—often described as extended drought broken occasionally by extreme floods—which bring potential water shortages and rising treatment costs.

Rapidly growing cities and new impervious cover

Loss of farmland and ranches

Sprawling development and associated land disturbance

Reduced infiltration and baseflow

Increased risk of flooding

Expanded turf and related water requirements and chemical inputs

*"In serious drought conditions, Texas does not and will not have enough water to meet the needs of its people, businesses, and agricultural enterprises."*

Texas State Water Plan

Natural vegetation loss

Degradation of ecological function

Increased wastewater discharges

Land fragmentation

Extensive groundwater pumping

Regulatory challenges

# Land Conservation for Clean Water

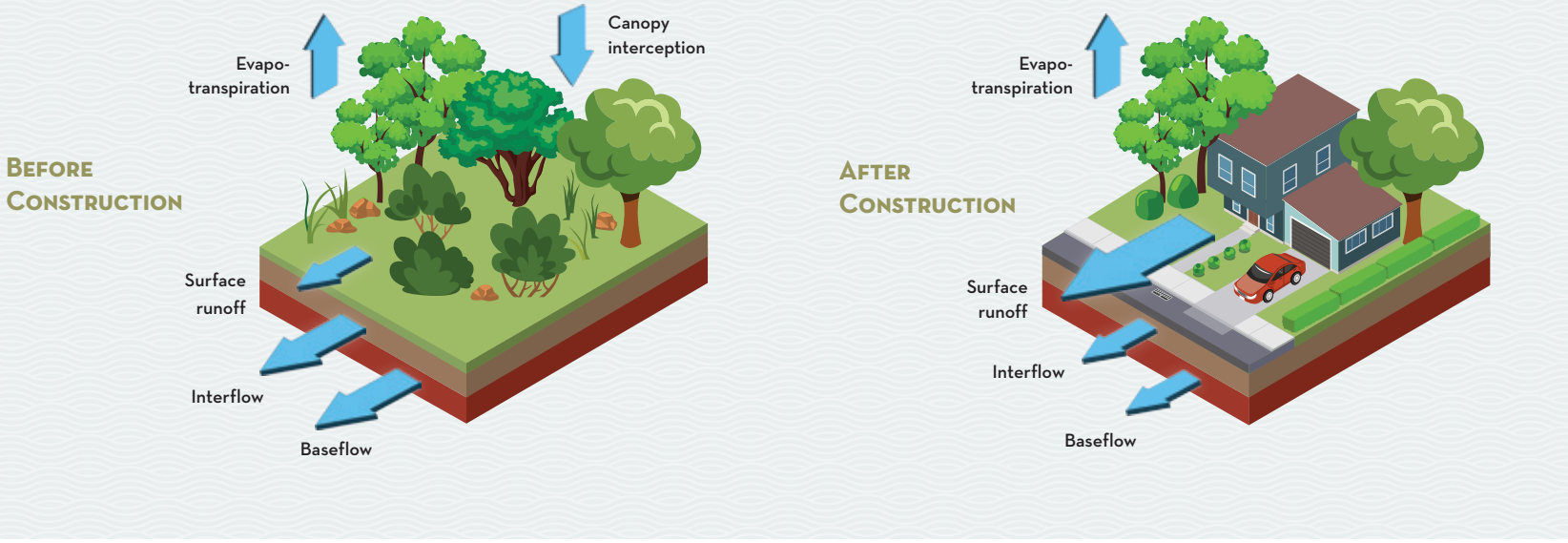
**Land conservation for source water protection** is the practice of leaving land in its natural condition to capture and filter rainfall, which promotes the slow release of clean, clear water to aquifers, creeks, rivers and lakes. This practice allows nature to do the water cleansing work for high-quality water supplies, while sustaining natural habitats, both aquatic and terrestrial.

Development pressures, changing land use, and increasing land costs are the driving forces behind land conservation programs that provide source water protection. Selection of lands for source water protection can be prioritized based on water resources including groundwater recharge, connectivity to rivers and reservoirs, and good natural vegetation cover for sediment and nutrient management.

FIGURE 3

**Comparison of natural lands and developed lands with regard to water management, runoff and groundwater recharge**

Impervious cover greatly increases surface water runoff and decreases groundwater recharge.



**There are many benefits from land conservation.**

- Clean water (pollution avoided from urbanization)
- Slow water movement and reduced erosion
- Lower water treatment costs
- Groundwater recharge
- Extended baseflow
- Reduced risk of flooding
- Reduced groundwater pumping
- Enhanced recreation and ecotourism
- Connectivity to local, state, national parks
- Community economic benefits
- Sustaining working agricultural lands
- Educational and land stewardship outreach opportunities
- Carbon management opportunities
- Aquatic and terrestrial habitat protection

## A Wise Investment

A study by the Texas Land Trust Council estimates that for every $1 invested in land conservation for water protection, Texans can avoid $6 in water infrastructure costs. At the same time, they note that conserved lands save about $480 million per year in construction replacement costs due to flood protection.

Since 1992, voters in the Hill Country region have approved $1.2 billion in funds to conserve land. These programs include the 2020 Hays County and 2017 Travis County Bond Fund programs and four San Antonio ballot propositions approving the allocation of sales tax revenue for land conservation.

Most of the funding focuses on water supply and water quality protection to sustain the Edwards Aquifer and creek and river flows that contribute to water supply reservoirs. Land conservation is a triple win water management approach benefiting the landowner, water providers/users, and Hill Country ecosystems.

To date, ballot measures have provided an essential funding source for land conservation and water protection in the Hill Country. However, these funding sources are typically one-time or short-term in nature, whereas a source water protection program seeks to secure long-term funding sources (e.g. a base water rate).

A compelling example of a successful out-of-state source water protection program is in New York City where the conservation of about 130,000 acres in upstate New York, more than 125 miles upstream from the City, provides for the treatment of drinking water with minimal filtration at a lower cost than other methods. The program is funded by water rates managed by the New York City Water Board and the protected watersheds are open for recreation, hiking, boating and fishing. The land conservation program was enhanced in the 1980s to avoid constructing a drinking water filtration plant that would have cost between $8 to $10 billion and approximately $1 million per day to operate the system. (See more about New York City's water supply system in Appendix 2, page 56).

## Conservation Easements

One of the most cost-effective ways to ensure land is managed and maintained for water resource benefits is through a conservation easement. This is a voluntary legal agreement between a willing landowner and a land trust or government entity that ensures a property will be conserved and maintained for specified conservation purposes for generations to come, generally in perpetuity.

Each conservation easement is individually crafted to provide the desired conservation benefits as well as meet the needs of the landowner for continued land use and stewardship while at the same time advancing regional goals to protect water quality, quantity and provide flood mitigation. The landowner may receive a financial benefit by selling the development rights and/or receiving Federal tax benefits, yet can continue to own, live on, and manage the land for ranching, hunting or other uses per the easement restrictions.

Conservation easements are popular in rapidly growing areas with escalating land costs. The easement allows the landowner to retain the land in its natural state without the pressure to develop the property to generate a financial windfall. The conservation easement can be passed to heirs or sold to another party with the same development restrictions.

The landowner voluntarily restricts certain uses of the property to protect natural, productive or cultural features. The holder of the conservation easement is generally a governmental entity or a qualified conservation organization, such as an accredited land trust. The landowner retains legal right to the property and grants the conservation easement holder the right to periodically assess the property's condition to ensure it's being maintained in accordance with the agreement terms. Once in place, the conservation easement is legally binding on all future landowners.

There are many successful conservation easement programs in Central Texas administered by local governments or accredited land trusts. To date, through conservation easements and property acquisitions, the City of San Antonio has protected more than 150,000 acres, and the City of Austin manages about 28,000 acres to enhance Edwards Aquifer water supplies. Conservation easements are a proven practice in Texas and across the nation to protect water supplies, habitat and natural resources.

## Conservation Development

Conservation development balances the demands of a growing population with the need to conserve natural resources and protect water supplies while preserving open space for future generations. Conservation development involves a voluntary agreement between the land developer and a local government entity or land trust and can be accomplished through a development agreement or in compliance with conservation development criteria.

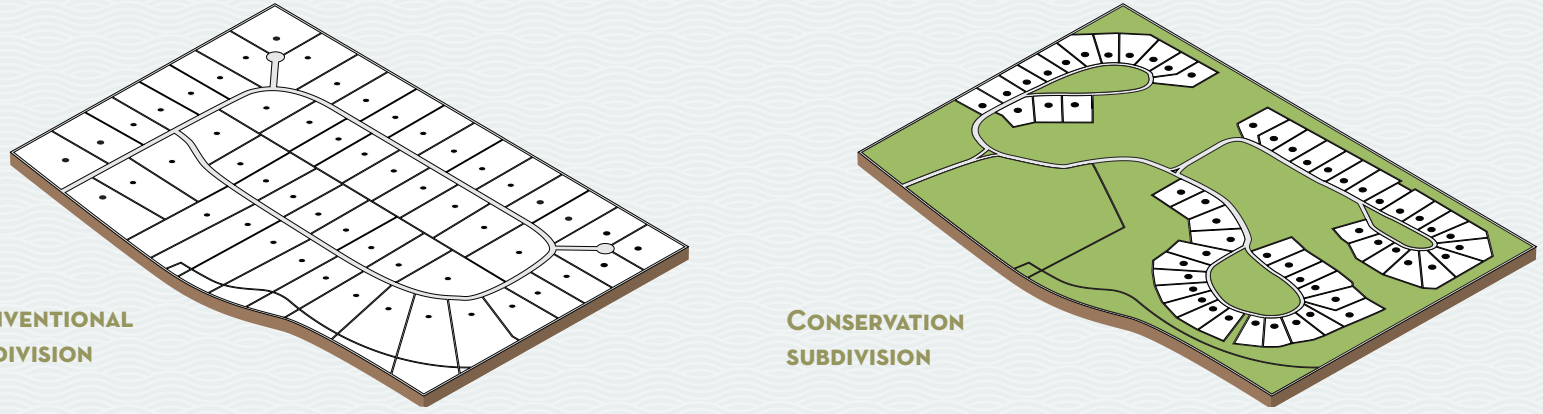
Because Texas counties do not have land-use planning authority, this provides an important option for a developer to create a development agreement and/or identify other incentives to shift a project from conventional development to one that is conservation-minded.

Typically, conservation development involves building homes and businesses in groups or clusters with smaller lot sizes at a similar total density, thus protecting a large open space area, usually a

FIGURE 4

**Conventional and Conservation Development**

Comparison using same number of building units. Conservation development provides same housing need while protecting open spaces and retaining natural drainage, infiltration and runoff processes.



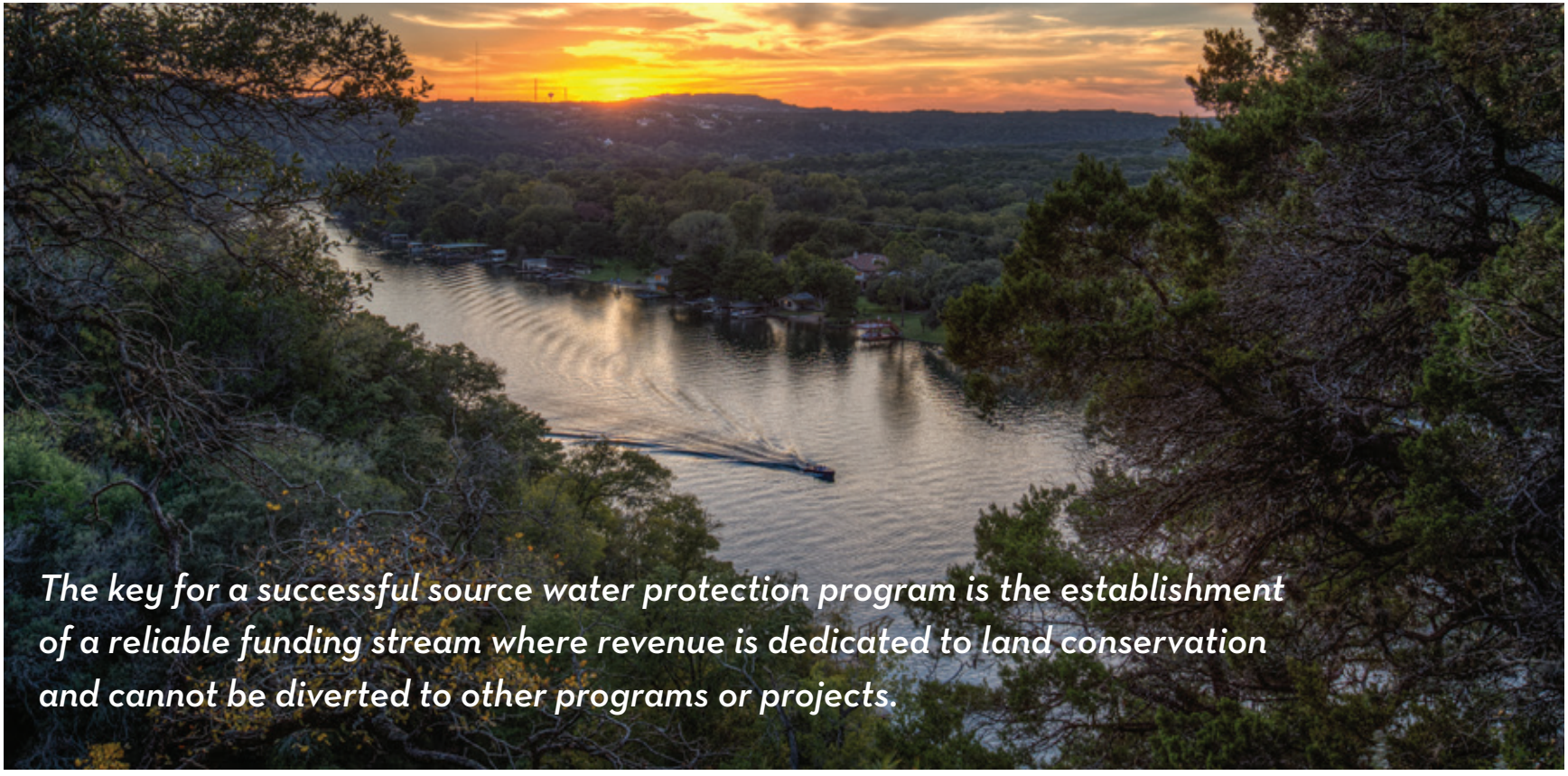

minimum of 50 percent of the total property. Often the open spaces are available for enjoyment by subdivision residents for hiking or other recreation.

With a smaller portion of the tract developed, less land and natural resources are disturbed, helping sustain ecosystem function. In addition, development costs can be considerably cut due to the reduced infrastructure need for roads and utilities. As noted by nationally recognized conservation development planner Randall Arendt, "conservation development is twice green—green environmentally and green economically".

From a local government perspective, the open space in a development increases the value of the homes and the tax revenue from the developed sections. The average cost of services per $1 of tax is $1.22 for residential development, but only $0.38 for open space according to a Lady Bird Johnson Wildflower Center report.

# Funding Mechanisms

**There are multiple options** to fund source water protection with the local government or water utility defining the best fit for their customers, water resources, and long-term program goals. National examples of rate-based source water protection programs include Central Arkansas Water that supplies a population of about 500,000 people and Raleigh Public Utilities which provides drinking water to more than 600,000 people. Both programs started after 2006 to preserve upstream priority lands, to protect their reservoir-based drinking water supplies, and to leverage the rate-based funding source. The rate-based funding mechanism allowed them to obtain low-cost loans and grants to expand land conservation efforts.



*The key for a successful source water protection program is the establishment of a reliable funding stream where revenue is dedicated to land conservation and cannot be diverted to other programs or projects.*

While voter-approved bonds and propositions can generate a large amount of revenue at one-time, once these funds are exhausted, the acquisition of additional land becomes challenging to non-existent. Thus, water rates or other permanent revenue stream funding sources provide the optimum approach to protect prioritized high-value water resource lands.

Water rate transparency is essential so that ratepayers understand how their dollars are being used. Including a line-item on the monthly water bill with a source water protection description is key to earning and continuing program support. Other water suppliers recommend simple but clear messaging such as "healthy forests/healthy water" and "From Forests to Faucets" are important in gaining program and rate support. In the end, maintaining stakeholder relationships and networking with landowners are critical activities for program success.

Source water protection programs funded by a reliable and dedicated rate-based funding source can allow the water provider to perform long-term planning and work proactively with neighboring communities and other water providers. The rate-based funds can leverage other funding sources to pursue grants and low-cost loans to initiate source water protection in developing communities.

An example is Central Arkansas Water which generates $2.2 million in annual revenue through its source water protection fund that yields a return of 5:1 to 6:1 on the dollar through loans, bonds, grants and refinancing. This allows the utility to move forward more aggressively to protect source water lands in a growing region.

## Texas Water Development Board Funding Opportunities

A water provider can use their rate-based funds to pursue grants and loans such as the TWDB Clean Water State Revolving Fund (CWSRF) and Drinking Water State Revolving Fund (DWSRF) to expand a source water protection program. These funds are administered through a federal-state partnership that provides communities with an independent source of low-cost financing for water resource projects, including land conservation.

The State of Texas recognizes the value of source water protection and funding through the CWSRF and DWSRF and offers these loans at near-zero interest rates which can include up to 50 percent loan forgiveness for projects complying with the "green" and "disadvantaged" criteria. For example, the City of San Marcos was recently awarded $3.2 million through the CWSRF for a property purchase and protection of local water resources with more than $1.2 million being forgivable. Other Central Texas counties, including Comal and Hays, are pursuing awards of up to $30 million to enhance land and habitat protection.

TABLE 1

**Source Water Protection Funding Sources**

| Funding Sources | Benefits | Challenges | Examples |
|---|---|---|---|
| **Monthly fee on water bill (dedicated water rate)** | Reliable, sustainable funding can be leveraged to obtain low-cost loans and grants and to support bonds | Rate approval, competition with traditional water and wastewater program needs | Central Arkansas Water, Raleigh Utilities, Denver Water, Salt Lake City Public Utilities, Santa Fe Water Utility, New York City Water Board |
| **General obligation bonds** | Can be a large sum at one time | Voter approved in election cycles | City of Austin, Travis County, Hays County |
| **Stormwater drainage utility fee (monthly fee)** | Reliable, sustainable funding | Rate approval, equity, competition with traditional stormwater program requirements | City of Austin, City of San Marcos, City of San Antonio |
| **Sales tax** | Sustainable funding, equitable | Voter approved, could be re-directed by local government | City of San Antonio |
| **Developer fees** | New development funding for mitigation measures | Economic development disincentives | Raleigh Utilities |
| **Regional Stormwater Management Programs, fee-in-lieu** | Public-private partnership to manage stormwater, land can be provided by the developer | Can have numerous conditions to demonstrate compliance | City of Austin, City of San Antonio |
| **Conservation development incentives** | Land can be conserved at little or no cost to the community | Providing appropriate incentives, development agreement approval, clear criteria | Hays County, Travis County |
| **NGO partnerships** | NGOs bring resources (land management and funding) | Limited resources | Hill Country Conservancy, The Nature Conservancy |
| **Grants, loans** | Reduce utility funding needs, stretch available resources | Limited grant funds, competition | Central Arkansas Water, TWDB Clean Water State Revolving Fund, TWDB Drinking Water State Revolving Fund |
| **Donations/fees** | Additional resources at limited cost to the utility, includes entrance, educational, public meeting fees | Unpredictable, could be small amounts and the land manager will need to operate any fee program | Santa Fe Water Utility, Central Arkansas Water |

# Model Programs

**TO GAIN PERSPECTIVES** on source water protection programs and to inform how this practice could be expanded and funded in Central Texas, the project team reviewed ongoing efforts and conducted interviews with several program managers across the nation. Below are snapshot summaries of several model programs.

TABLE 2

**Example Program Summaries**

| Water Provider | Year Fee Established | Population Served | Primary Purpose | Water Supply Resource | Revenue to Date | Funding Source | Fee Amount | Acreage Protected |
|---|---|---|---|---|---|---|---|---|
| **Central Arkansas Water (Little Rock, AR)** | 2007 | 500,000 | Water quality | Two reservoirs | $28 million | Water rate | $0.90/meter/ month | 14,000 |
| **Raleigh Public Utilities** | 2005 | 600,000 | Water quality | Two reservoirs | $8 million | Water rate | $0.15/1000 gal/ month | 11,000 |
| **Denver Water** | 2010 | 1.5M | Watershed health/ fire management | Rivers | $64 million | Water rate | $0.14/meter/ month | Not available |
| **Santa Fe Water Utility (Santa Fe, NM)** | 2013 | 78,000 | Water supply protection/wildfire management | Santa Fe River | $8 million | Water rate | $0.13/100 gal/ month | Not available |
| **New York City** | 1997 | 9M | Water quality/ water supply | 19 reservoirs, 3 controlled lakes | $2.5 billion (ecosystem protection) | Part of base rate, not separate | NA | 130,000 |
| **City of Austin** | 1998 | 1M | Water quality/ water supply | Edwards Aquifer, Barton Springs Zone | $155 million | Voter approved bonds | NA | >28,000 |
| **City of San Antonio** | 2000 | 1.9M | Water quality/ water supply | Edwards Aquifer Recharge Zone | $325 million | Voter approved propositions, sales tax | $0.00125 sales tax | 163,000 |

The project team interviewed the following entities to better understand their perspectives on existing source water protection programs and/or a community's interest in considering source water protection in their water planning efforts. In these conversations, we heard their goals, experiences and lessons learned from program inception to long-term land management.

**Communities or entities interviewed**

- Austin Water
- City of Bee Cave
- Central Arkansas Water
- Lower Colorado River Authority (LCRA)
- City of Marble Falls
- Cynthia and George Mitchell Foundation
- City of New Braunfels
- New Braunfels Utilities (NBU)
- Raleigh Public Utilities (North Carolina)
- City of San Antonio
- Texas State Soil and Water Conservation Board

From these discussions, a commonly heard theme was the importance of establishing a sustainable and reliable funding stream to implement and operate land conservation programs for source water protection. Sustainable funding can be achieved through the establishment of a rate-based financing structure as highlighted by Central Arkansas Water and Raleigh Public Utilities.

**Other lessons learned for implementing and operating a source water protection program.**

- Conduct an extensive stakeholder effort across a multi-year period to build support for water rate modifications.
- Establish a low water rate at program inception to gain community support.
- Implement policy and technical advisory committees for transparency and meaningful input.
- Ensure a dedicated funding structure is identified within the utility so that revenues cannot be diverted to other utility programs or projects, thus operations and maintenance must be met by other revenue streams.
- Coordinate on a frequent basis with other fund providers (TWDB, NGOs, local governments) to be aware of upcoming opportunities to extend land protection purchasing power.
- Establish a land conservation goal, such as Central Arkansas Water and Raleigh Public Utility's aim to protect about 50 percent of the watershed area draining to their water supply reservoirs.
- Go beyond land acquisition and provide workshops and training to guide customized land stewardship and grazing practices, tree planting, brush management where appropriate, and other practices which protect land and soil while enhancing water supplies.
- Provide public access to certain properties for hiking, biking, ecotourism, education and recreation opportunities.
- Promote/advertise public access opportunities including hosted events to illustrate source water protection benefits to the community and potentially gain support of future land conservation rate increases.

We heard from several smaller communities and water providers that purchase water from a larger water supplier such as the City of Austin, Lower Colorado River Authority (LCRA), and the Guadalupe Blanco River Authority (GBRA). These smaller entities are not normally invested in developing or protecting water supplies.

A primary opportunity at this level is expanded water conservation to minimize demand on the aquifers, rivers and reservoirs, thus keeping more water in the natural systems to benefit habitat and sustainable water supplies. These smaller utilities benefit from upstream land conservation through cleaner inflows and managed water treatment costs and could be a partner with the regional water suppliers in a source protection program.

There is the opportunity for development-type programs (fees, conservation development, fee-in-lieu, stormwater utility, parkland acquisition, etc.) to augment funding and promote land conservation at the local level.

With wastewater treatment costs increasing and water supplies challenged by rapid growth, reuse of treated effluent for beneficial purposes is encouraged and could be applied on appropriate conserved lands.

*Regional efforts, with local governments and water providers as partners, can connect programs and opportunities to achieve land conservation goals for source water protection.*

# Roadmap to Clean Water

**Based on project team research** and the shared experiences from program interviews, a roadmap for source water protection is presented here for water providers.

## Step 1: Existing Water Supply Assessment

- Review available data such as the Texas State Water Plan, Basin Highlights Reports, and local water utility information.
- Assess water quality, water quantity, future water demands, community growth, future water supply development, conservation efforts, reservoir service life, water rights, etc.
- Determine potential opportunities and challenges.
- Identify water treatment costs and the potential impacts of higher costs and associated rate increases if water quality were to degrade.

## Step 2: Land Prioritization

- Identify all watersheds contributing to your community's water supply.
- Identify high-value water resource protection land through a Geographic Information System (GIS) assessment.
- Evaluate existing surface and groundwater data.
- Locate and quantify target lands in watershed(s) to protect specific water supplies.
- Illustrate priority water resource lands at a broad scale, being careful not to identify individual land tracts and owners.
- Define potential land conservation goals, costs, partners and benefits.

## Step 3: Stakeholder Engagement

- Engage with the public and elected officials through community-wide processes to communicate source water protection program opportunities and benefits.
- Compare to other water supply programs.
- Underscore the value of land conservation, land stewardship, and recreation opportunities while extending water supply reservoir service life.
- Communicate long-term water supply cost savings.
- Educate landowners within priority water resource areas on the value and voluntary nature of conservation easements.
- Build a case for land conservation and source water protection as an important program in a water provider's water portfolio. For example, Central Arkansas Water hired a social media specialist to distribute educational messages on a frequent basis so customers were fully aware of the program's value to the community.

## Step 4: Partnership Development/Outreach

- Partners can help stretch resources and enhance program implementation.
- Connect and work with NGOs, state agencies and other communities. Typically, there are multiple source water protection beneficiaries, and all can have a role to play in contributing financial resources and/or shared programs, further enhancing the adoption of a regional water-rate based program.
- Identify land stewardship partners, organizations and agencies that may already be working with landowners. There is the potential to manage utility costs and operational impacts to further stretch financial resources.

## Step 5: Rate Adoption

- Consider a low source water protection rate initially to facilitate public support and adoption. Central Arkansas Water began their program with a $0.45/meter/month charge following an extensive, citizen-driven stakeholder process. Fifteen years later, their rate is $0.90 per residential meter per month with a higher monthly rate for larger meter sizes. An owner of a 10-inch meter pays $36/month.
- Coordinate across all community regions and economic levels to define an equitable source water protection rate. Consider a rate based on monthly water usage, meter size, or a flat charge to balance necessary fund generation while not adversely affecting low-income residents. Thus, those that use more water will pay more, similar to a water conservation rate structure.
- Maintain the public's trust through rate transparency during the adoption process and subsequent program operation. It is recommended to clearly label the source water protection rate on the customer's monthly water bills.

## Step 6: Program Structure

- Establish a source water protection department or division to manage and operate the program.
- It is recommended that funds from the source water protection rate are solely used to acquire and conserve land while operations are funded by the base water rate.
- Consider contracting the land conservation review and acquisition process to an accredited land trust entity with significant experience and relationships. Raleigh Public Utilities has had success with this approach.
- Perform scheduled conservation land inspections on a regular basis by an experienced staff member or partner with a land trust or a qualified land management consultant.

## Step 7: Program Financing

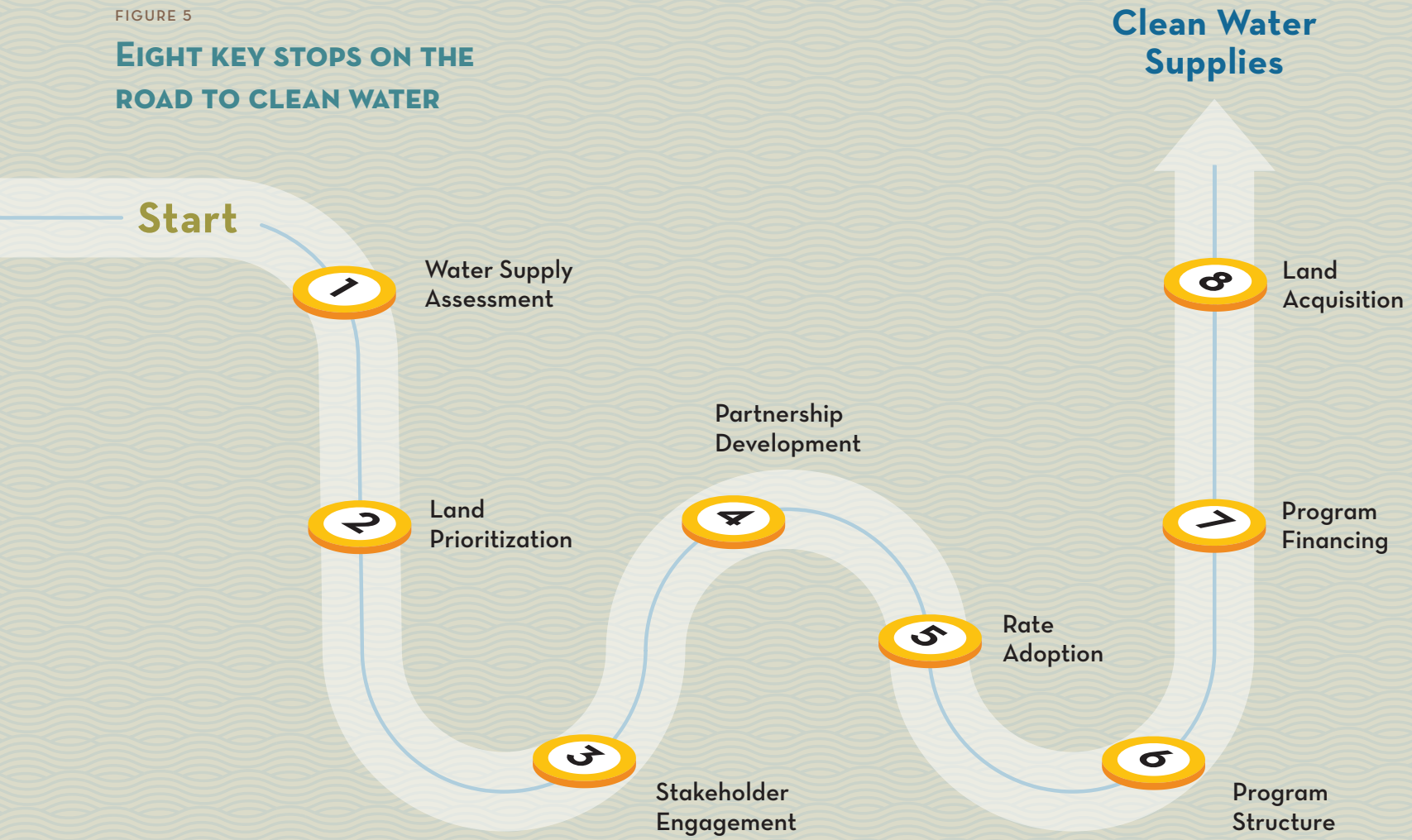
- Program and operational costs can be managed with existing financial staff of water provider or local government to avoid creating additional bureaucracy.
- Financial staff should be experienced in leveraging rate-based revenues in the pursuit of low-cost loans, bonds, grants and capital improvement funds to extend source water protection program reach.
- Financial staff should cultivate a solid relationship with state funding managers, fully understand the state funding requirements, and be aware of upcoming grant and loan opportunities.

## Step 8: Land Acquisition, Management and Monitoring

- Share program opportunities and initiate negotiations with landowners of high-value water resource properties by working with a land trust and/or your staff and real estate contracts division.
- Conduct on-the-ground review of priority tracts along with review of water well logs, water rights, and other natural features to verify that GIS-identified properties satisfy the source water protection criteria.
- Finalize conservation easements and begin the scheduled monitoring process to ensure contract conditions are being managed by the landowner.

FIGURE 5

## Eight key stops on the road to clean water



# Potential Supporting Programs

**Conservation easements and land acquisitions** are the foundation of an effective source water protection program. Protecting land from development and managing it wisely ensures that the natural processes of rainfall infiltration, runoff filtering, and water retention continue to generate clean water for aquifers, springs, rivers and reservoirs. To enhance a land conservation effort, other supporting programs, listed here, can be implemented to protect water supplies and natural habitats.

## Regional Habitat Conservation Plans

Regional Habitat Conservation Plans (RHCP), developed in accordance with the Federal Endangered Species Act, provide opportunities to generate funding for land conservation through the purchase of mitigation credits for land developed in endangered species habitat. The mitigation funds are used to acquire prime habitat areas and protect springs, aquifers and streams while providing flood management, watershed protection and public recreation.  Examples in Central Texas include the Balcones Canyonlands Conservation Plan (1996), the Hays County RHCP (2013), and the Edwards Aquifer HCP (2015). These plans have preserved tens of thousands of acres of prime habitat and source water areas.

## Wetland and Stream Mitigation Banking

A secondary type of mitigation bank or fund (outside of RHCPs) is a wetland and stream mitigation bank regulated by the U.S. Army Corps of Engineers (USACE). As with species conservation banks in the RHCP, wetland and stream mitigation banking values the natural resources in a "bank" or conservation area as "credits" which can be bought and sold to offset natural resources impacts on other lands. Mitigation banks can create and/or restore ecological functions of wetland and stream systems, and the program offers incentives to do so. Once a bank is created as a preserve, available credits to sell are established by the ecological value and are sold through the USACE Regulatory In-lieu fee and Bank Information Tracking System (RIBITS).

## 1-D-1 Open Space Agricultural Valuation Wildlife Management Plan as a Conservation Tool

The 1-D-1 Open Space Plan is a tool for landowners with an agricultural valuation to convert the land for wildlife management and keep the same tax valuation on the property. This program can be a benefit to land that has been historically overgrazed by cattle. Typical ag stocking rates are often higher than the carrying capacity of the land—a practice that often leaves the land overgrazed, over-browsed, highly eroded and susceptible to exotic invasive plants. It is especially devastating in riparian zones and around critical water quality features such as caves, seeps and springs.

Wildlife valuation can be used to restore and manage the land and is tailored to the specific needs of the landowner and the land. Several management techniques are allowed that improve the health and quality of the property while maintaining tax incentives.

The increased use of this tool can be an asset to the Hill Country conservation effort and is often achieved through landowner education. Land that may be otherwise developed due to past mismanagement or lower quality livestock forage could instead be managed for wildlife and remain undeveloped. This practice can

limit the burden landowners feel to engage in agricultural practices to sustain the tax value of their property.

Additionally, if a piece of land is purchased by a developer, the 1-D-1 open space valuation can be used as a tool to establish green space through riparian corridors and other sensitive habitat areas as an asset to homeowners or can be utilized in a conservation development with a cooperative agreement for smaller scale ranchettes.

Management practices qualifying for 1-D-1 valuation are plentiful and can include erosion control, site restoration, grassland management, wetland or stream feature restoration, supplemental food, water and shelter, grazing management, brush control, invasive species control, songbird management, prescribed burning, re-seeding, etc.

## Groundwater Conservation Districts

Groundwater Conservation Districts (GCDs) are responsible for the conservation, preservation, protection and recharge of groundwater and aquifers. To accomplish these goals, GCDs work to minimize the drawdown of the water table, prevent well interference, manage groundwater quality, promote the wise use of water resources, preserve historic use of groundwater, and consider the service needs of retail water utilities.

A GCD can work in partnership with a water provider to help manage groundwater pumping and land use practices to protect groundwater quality and quantity. In the Hill Country region, groundwater seepage and springs provide baseflow for creeks and rivers that fill reservoirs and become drinking water supplies. The following table shows the GCDs within the Pedernales Watershed.

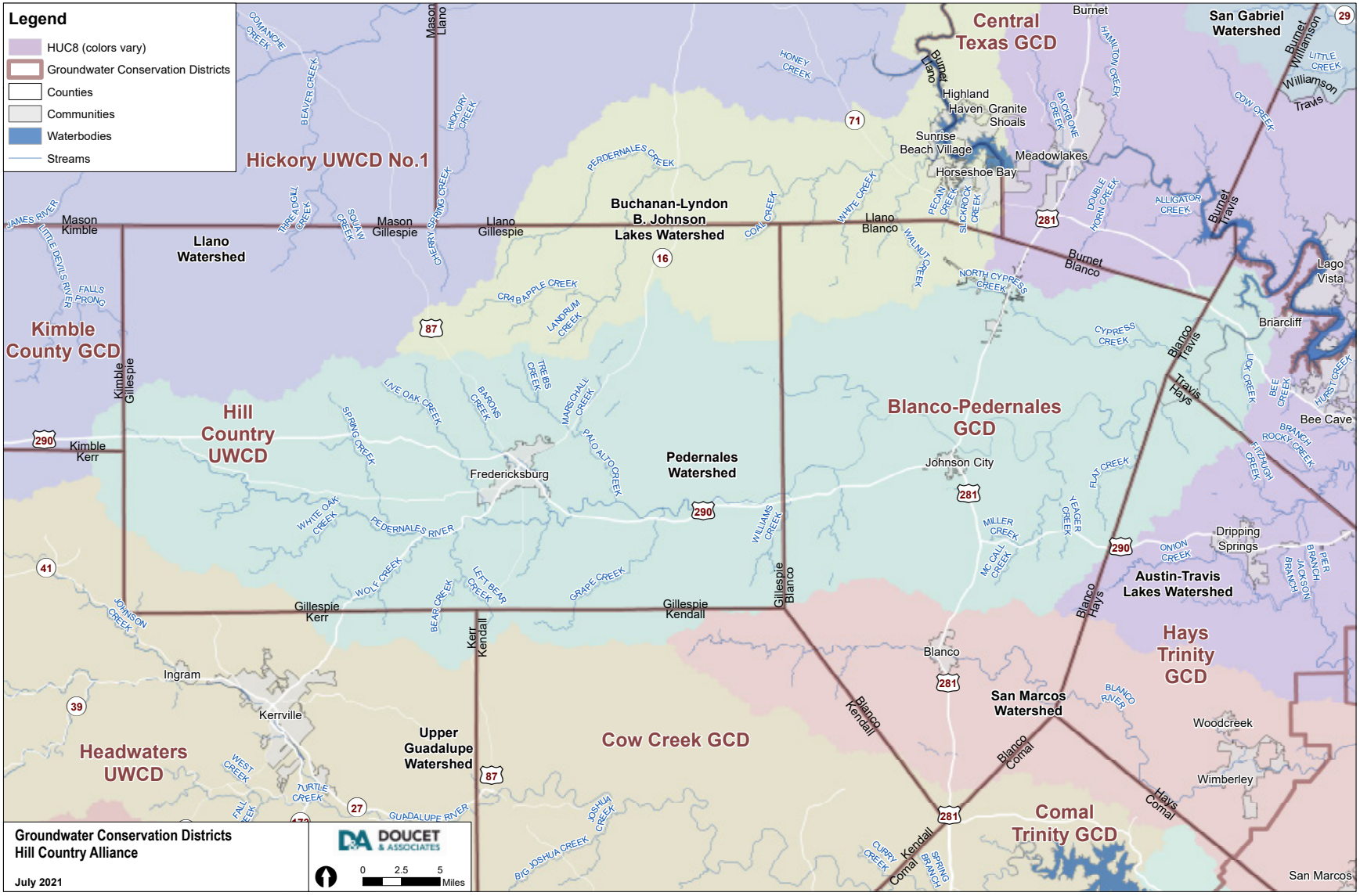
TABLE 3

**Groundwater Conservation Districts (GCDs) in the Pedernales River Basin**

| Districts | Year Founded |
|---|---|
| Blanco-Pedernales GCD | 2001 |
| Cow Creek GCD | 2002 |
| Hays Trinity GCD | 2003 |
| Headwaters Underground Water Conservation District | 1991 |
| Hill Country Underground Water Conservation District | 1987 |
| Kimble County GCD | 2002 |
| Southwestern Travis County GCD | 2019 |

FIGURE 6

## Groundwater Conservation District Boundaries across the Pedernales River Watershed



## LCRA Highland Lakes Watershed Ordinance – Buffer Zones

The LCRA Highland Lakes Watershed Ordinance (HLWO) was adopted in 2006 and manages stormwater runoff from new development in Travis, Burnet and Llano counties that drain to the Highland Lakes. Stormwater runoff from development can contain pollutants such as sediment, oil and grease, and nutrients. Through the ordinance, LCRA regulates development by incentivizing low impact development and encouraging low impervious cover practices to reduce runoff and pollution. Other features include water quality management measures (filter strips, water quality basins, rain gardens, etc.) to reduce pollutant discharge and downstream creek erosion– and most importantly buffer zones that connect directly with land conservation and source water protection.

The HLWO criteria in whole or in part could be adopted by local governments to manage runoff and protect riparian areas from development. If adopted by a local government, it would be administered by them, not the LCRA, to protect water quality and habitat. Through the Cypress Creek Watershed Protection Plan, the cities of Wimberley and Woodcreek adopted criteria based on the LCRA HLWO.

Buffer zones are a key practice in water quality protection and flood management. A buffer zone is the area of natural vegetation, which can include grass, shrubs and trees, adjacent to a river, creek or natural drainage way that separates the waterway from lawns, buildings, roads and driveways, grazing animals, and agriculturally managed fields. Without buffer zones, runoff containing sediment, fertilizers, pesticides, herbicides, metals, pet waste, oil and other vehicle fluids can pollute waterways and reservoirs.

FIGURE 7

**Benefits of Buffer Zones**

The wider the buffer zone, the greater the benefits.

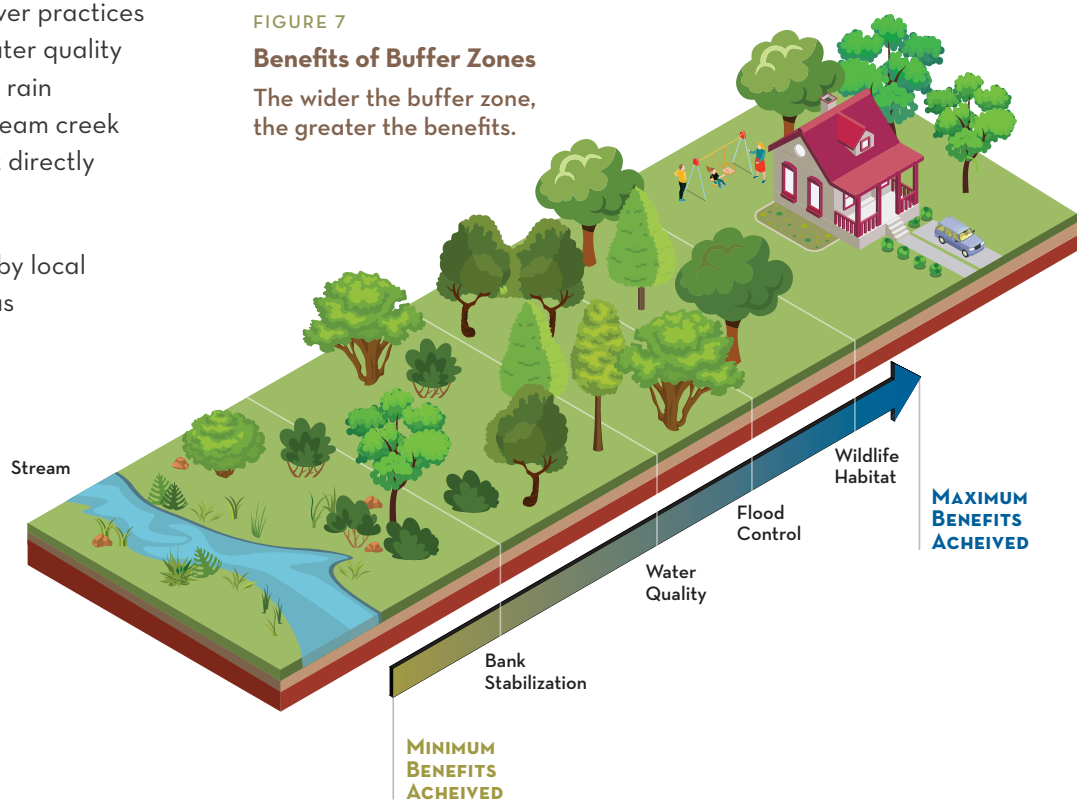
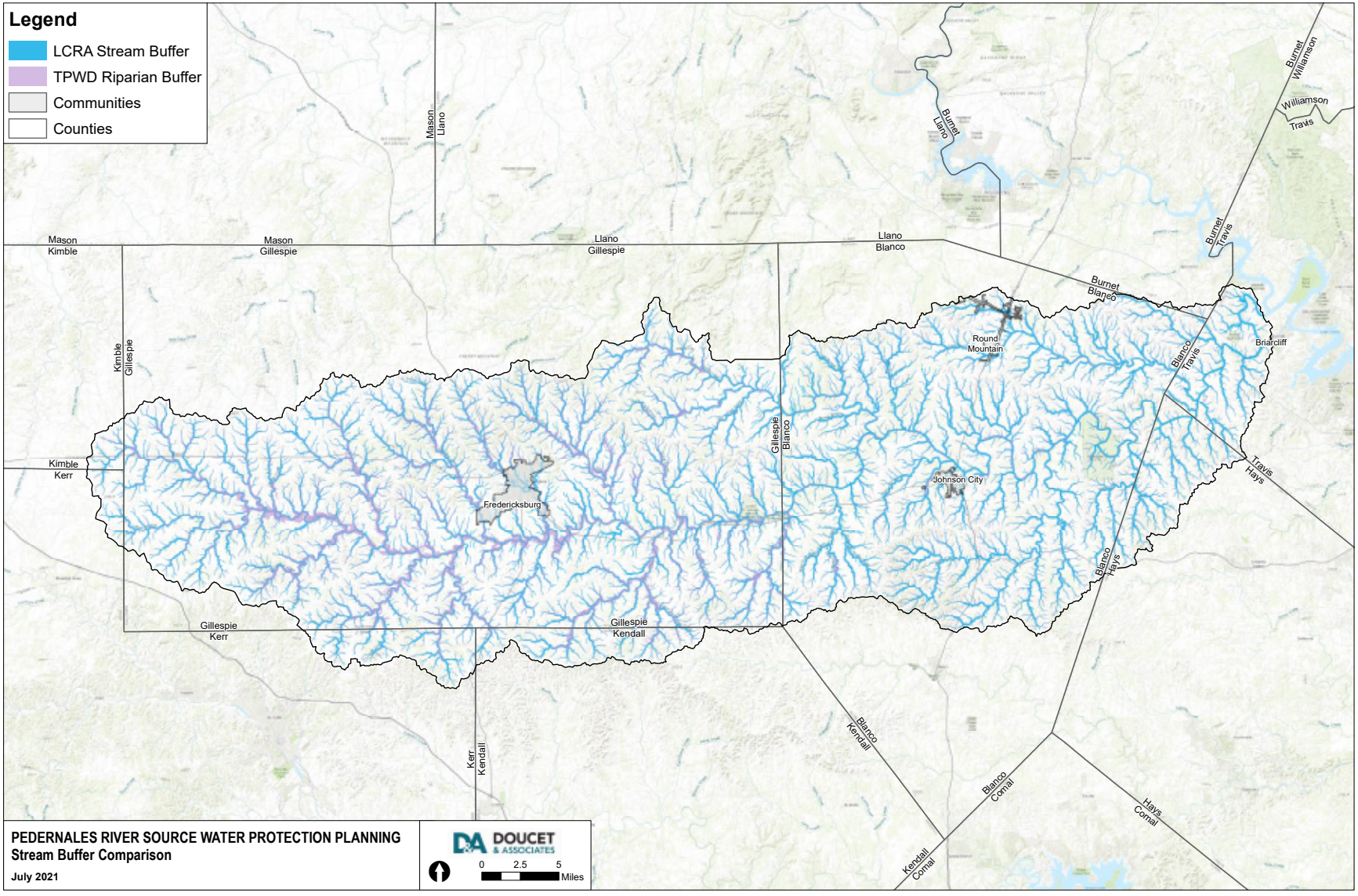


FIGURE 8

## Stream Buffers, LCRA and TPWD



LCRA HLWO buffer zones begin at a contributing drainage area of five acres and can be based on prescribed setbacks or the 100-year floodplain boundary. Thus, headwater/source water protection is achieved through this practice that directly connects small tributaries, streams and rivers such as the Pedernales River. Figure 8 illustrates potential buffer zones in the Pedernales watershed per LCRA and TPWD if they were in effect. The Highland Lakes Watershed Ordinance does not apply in Blanco and Gillespie Counties.

This practice is a no-cost land conservation method and keeps people, development and buildings out of harm's way during flooding. Buffer zones can be a part of a community's flood management program as noted in FEMA's Community Rating System (CRS) program.

## FEMA Community Rating System (CRS) and Hazard Mitigation Grant Program (HMGP)

The FEMA Community Rating System (CRS) is a voluntary incentive program that can be adopted by communities to implement floodplain management practices that exceed the minimum requirements of the National Flood Insurance Program (NFIP). The three main goals of the

program are to reduce and avoid flood damage to insurable property, strengthen and support the insurance aspects of the NFIP, and foster comprehensive floodplain management.

Flood insurance premium rates are discounted to reflect the community's effort in reducing flood risks. Nineteen creditable activities are organized into the following four categories: public information, mapping and regulations, flood damage reduction, and warning and response.

The more points a community scores through floodplain management practices the lower the cost of flood insurance for area residents. Open space protection is one of the highest scoring CRS practices. The Nature Conservancy advocates the implementation of the CRS program to improve floodplain management, conserve land, and provide source water protection.

Another FEMA program is the Hazard Mitigation Grant Program (HGMP) that can help local governments fund studies, watershed protection plans, and projects.

## Other State/Federal programs

The Natural Resources Conservation Service (NRCS), Texas Parks and Wildlife Department (TPWD), Soil and Water Conservation Districts, the U.S. Fish and Wildlife Service (USFWS), and the Texas A&M Forest Service help farmers, ranchers and forest landowners conserve the nation's soil, water, air and other natural resources. All programs can offer solutions that benefit both the environment and the landowner. An example includes providing incentives to landowners who place wetlands, agricultural land, grasslands, and forests under long-term easements.

A program just initiated by the Texas State Soil and Water Conservation Board (TSSWCB) is called "On-The-Ground Conservation Program" to assist landowners in managing soil health, erosion control, invasive species, habitat protection, and land restoration.

These agencies provide financial and technical assistance in implementing practices such as crop rotation, contour farming, filter strips, vegetative barriers, and many other practices. These efforts help landowners manage their ranches and conservation easements and remain in compliance with conservation easement requirements.

# Source Water Protection for the Pedernales

**The Pedernales River watershed** with an area of 819,370 acres (1,280 square miles) provides about 24 percent of the average annual inflow to the Highland Lakes system. The river, noted for its clean water is a primary contributor to Lake Travis, a reservoir frequently recognized as the clearest lake in Texas. With Lake Travis being the primary water supply for many local governments and water districts in Central Texas, maintaining high water quality in the Pedernales watershed helps manage water treatment costs and supports recreation and ecotourism activities in the region.

Over the next 50 years, the population is expected to double in the Pedernales River Basin. As the growth of the area continues, the quality and quantity of water and agricultural resources currently provided by the watershed could be negatively affected. Land conservation within the watershed can ensure continued clean water resources for growing local communities and urban populations downstream.

To assess land conservation priorities in the watershed, a Geographic Information System (GIS) assessment was performed to evaluate varying land and water resources and rank their potential conservation value from low to high. The GIS approach scored land parcels using publicly available data, maps and models—an approach that can be easily customized and scaled for other Hill Country watersheds. Lands identified as having a high-value water resources are considered priority land conservation areas.

The scoring system used five datasets found to have the greatest influence on water quality, quantity and efficient land conservation acquisition:

1) Land parcel size (the larger the parcel size the higher the score with the highest score for parcels greater than 500 acres);
2) Hensel sand geology (an aquifer formation recognized as potentially contributing recharge and surface water flows);
3) Stream and river buffers (based on the LCRA Highland Lakes Watershed Ordinance and Texas Parks and Wildlife data, Figure 8;
4) Spring buffers (based on USGS springs data and the Siglo Group's watershed prioritization report); and
5) Land slope.

The data is brought together using the Union tool in GIS to produce one shapefile and generate a map that illustrates the conservation value (low to high) of each parcel (see Figure 10).

TABLE 4

**Pedernales River Statistics**

| | |
|---|---|
| **Drainage Area** | 819,370 acres, 1,280 sq. mi. |
| **Counties** | Primary: Blanco, Gillespie, Hays, Travis<br>Other: Burnet, Kendall, Kerr, Kimble |
| **Cities** | Briarcliff, Fredericksburg, Johnson City, Round Mountain |
| **Average Flow/Yr.** | 281,059 ac-ft, Pedernales River at Johnson City* |
| **Highest Peak Flow** | 1952, 452,000 cfs at Hamilton Pool Crossing near Spicewood, TX |
| **Lowest Peak Flow** | 2011, 0 cfs |

**The United States Geological Survey flood gage is located in Johnson City.*

FIGURE 9

## Pedernales River Watershed

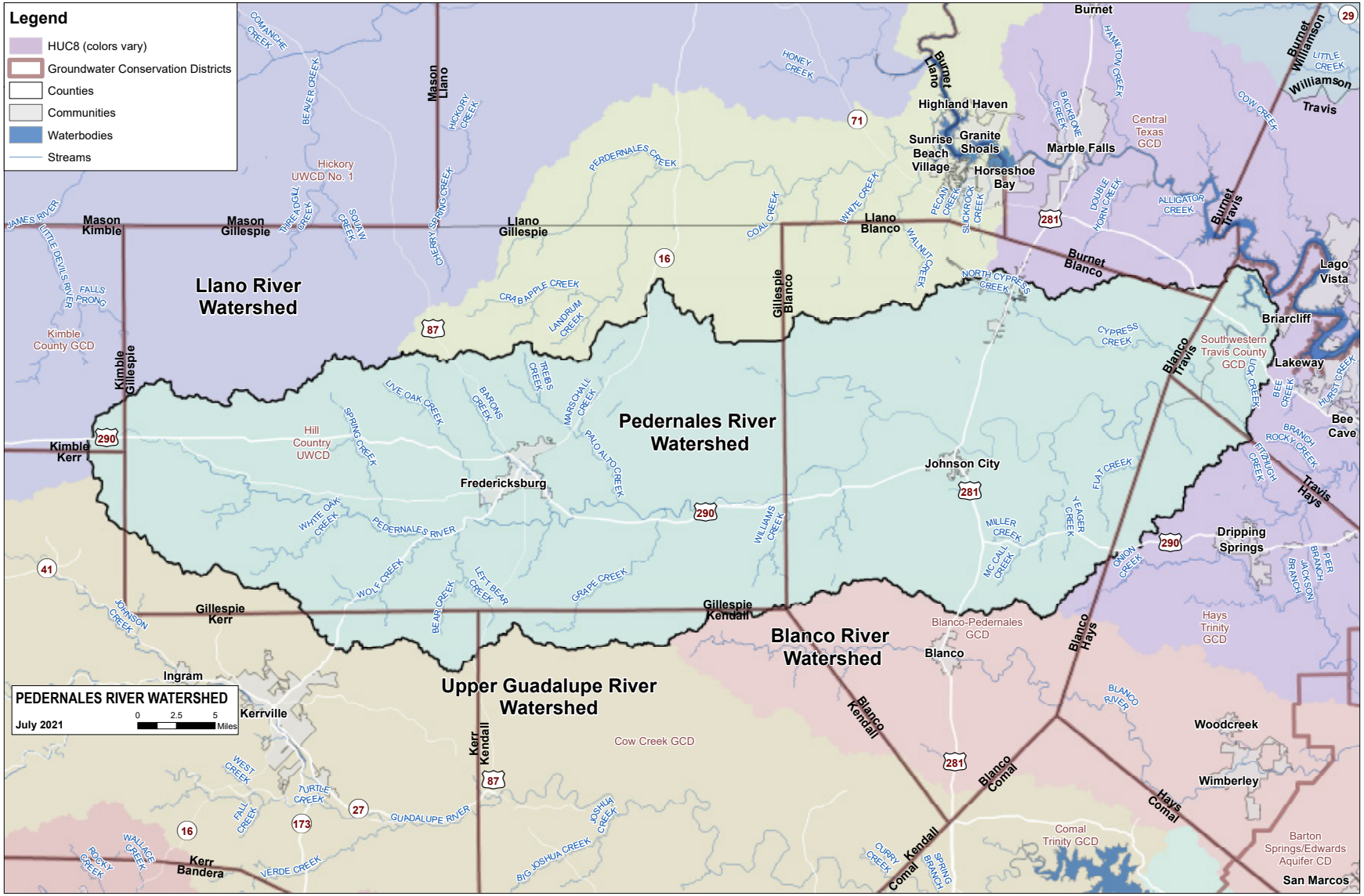
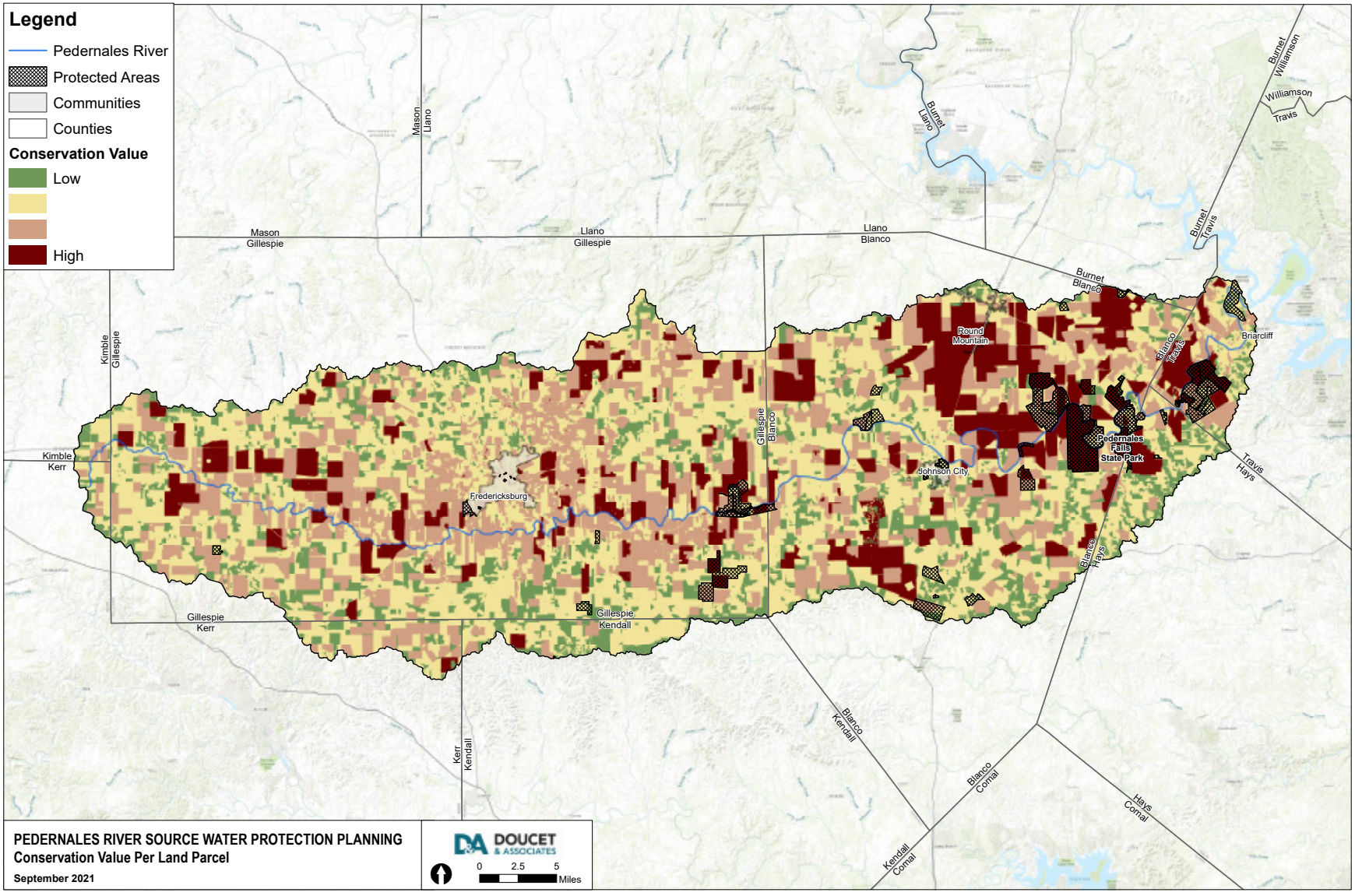


FIGURE 10

## Pedernales River Watershed – Conservation Values



The GIS analysis was compared with the 1962 and 2016 river gain-loss studies and a Meadows Center for Water and Environment hydrogeologic study and found that most high-value water resources are located east of Johnson City, where half of the Pedernales River flow originates. This area in Blanco County was further backed up by LCRA Pedernales River historical flow data and was prioritized for preservation.

TABLE 5

**Conservation Values by County in Acres**

| County | High-Value | Moderately High-Value |
|---|---|---|
| **Blanco** | 73,094 | 71,883 |
| **Burnet** | 0 | 534 |
| **Gillespie** | 44,480 | 132,892 |
| **Hays** | 3,339 | 2,957 |
| **Kendall** | 565 | 1,785 |
| **Kerr** | 505 | 7,878 |
| **Kimble** | 0 | 740 |
| **Travis** | 7,347 | 7,602 |
| **Total (Acres)** | **129,330** | **226,271** |

*Source: Doucet & Associates*

High-value conservation lands total about 130,000 acres and make up about 16 percent of the watershed. About 44 percent of the watershed scored as high or moderately high-value lands indicating that the Pedernales River Basin is an important watershed that delivers clean water to the Highland Lakes system and should be targeted for protection by water suppliers.

Currently, almost 46,000 acres of land in the Pedernales River Basin are conserved in parks, preserves and existing private conservation easements

Before acquiring conservation easements, the high priority lands identified in this process should be field verified as the datasets are large in scale and not defined to the site level, in part to protect landowner privacy. The field evaluation process includes reviewing well logs, onsite soils and vegetation, caves, springs, creeks, rivers, land management activities, and other features.

TABLE 6

**Existing Acres in Conservation**

| Type of conservancy | Total acres |
|---|---|
| **Parks/Preserves/Historic Sites** | 22,267 acres |
| **Private** | 23,372 acres |
| **Unspecified** | 34 acres |
| **Total** | 45,673 acres |
| **Percent of Watershed** | 5.6% |

*Source: Hill Country Conservancy*

This GIS process may also be replicated in the Colorado, Llano and San Saba River basins in the Highland Lakes system to pinpoint primary source water protection watersheds and areas.

## Potential Conservation Easement Cost

Using currently available cost data for conservation easements, it is estimated that in 2021, it would cost about $420M to protect the remaining high-value water resource lands via voluntary conservation easements. This figure does factor in the almost 46,000 acres in existing conservation easements or parkland (see Table 6).

## Land Conservation Organizations

Some of the active land trusts in the Pedernales River Basin include the Texas Land Conservancy, Hill Country Conservancy, Colorado River Land Trust, Texas Agricultural Land Trust and The Nature Conservancy.

Other conservation entities in the watershed include Westcave Outdoor Discovery Center, several chapters of the Native Plant Society of Texas and Texas Master Naturalists, the Meadows Center for Water & the Environment at Texas State University, Selah Bamberger Ranch Preserve, National Center for Appropriate Technology's Soil for Water program, and the Hill Country Alliance.

## A Plan for the Pedernales

Applying the study findings, funding opportunities, and lessons learned from other water providers, a plan for the Pedernales River Source Water Protection is suggested here:

- Work with interested landowners to conserve an additional 30,000 acres by 2030 so that more than half of the high-value water resource lands are placed in conservation. This involves water providers, NGOs, and local leaders working together to secure funding, close conservation easement contracts, and initiate long-term land management plans.
- Water providers and local governments should coordinate and establish a water-rate based funding source to purchase conservation easements. This effort will require leadership by a water provider or local government to inform and encourage the public, elected officials, and board members to consider and adopt an equitable source water protection rate as all utilities benefit from clean water supplies.
- The water providers should work together to pursue CWSRF loans and grants with emphasis on green and disadvantaged funds to maximize loan forgiveness.
- Local governments should evaluate and implement a FEMA Community Rating System program that features land conservation and creek buffer zones to enhance flood protection, reduce flood insurance rates, conserve high-value riparian lands, and protect water supplies.
- Local governments should adopt a creek buffer zone criterion that is aligned with the LCRA Highland Lakes Watershed Ordinance buffer zone standards that presently apply to Travis, Burnet and Llano Counties.
- Local governments and utilities should continue to participate in the regional water planning and flood management processes to ensure their priorities are addressed and to maximize the potential for other State and Federal funding sources to support land conservation efforts.

- NGOs should continue to work with landowners to inform and begin due diligence for conservation easements to protect their land and lifestyle for generations to come. This will pave the way so when conservation funds become available, the landowners will be able to participate in the program.
- To guide and coordinate the above efforts, a source water protection program manager should be identified and funded to begin the process of working with local governments and water providers to prioritize next steps, secure reliable funding streams, and initiate the long-term Pedernales River source water protection program.

# In Summary

**A GIS TOOL WAS DEVELOPED** for the Pedernales River Basin to assess and define high priority water resource lands. This approach used available datasets and can be easily and economically applied to other watersheds in the Hill Country region. The GIS analysis was compared with 1962 and 2016 gain-loss studies and a hydrogeologic study of the eastern river segment confirming that the majority of high priority water resources land is east of Johnson City. From this GIS assessment, a utility or group of water providers can prioritize land conservation efforts and begin the process of long-term water supply protection for the Pedernales River and Lake Travis water supplies.

In the Pedernales River Basin, about 130,000 acres were defined as high priority water resource land. Using the latest conservation easement cost information, the cost to protect this area would be about $420M. This accounts for about 46,000 acres already protected from development through parkland and existing conservation easements. To provide perspective on a potential land conservation target, Central Arkansas Water and Raleigh Public Utilities seek to protect about 50 percent of the watershed areas draining to their primary water supply reservoirs. Substantial benefits could still be accomplished with a lesser proportion of high priority land being protected.

Since all downstream water providers benefit from land conservation and management activities, utilities could work in partnership to fund and manage land conservation programs to manage water treatment costs and enhance water quality for recreation, tourism and economic development purposes. This plan for the Pedernales River Basin suggests a comprehensive approach to begin the source water protection process.

A monthly rate to utility customers provides the most stable funding stream to ensure reliable and sustainable long-term funding to achieve conservation goals. As an example, Central Arkansas Water has a rate of $0.90/month/residential customer to generate about $2.2M per year. They found that these funds can generate an additional $8M to $10M through low interest loans, bonds and grants.

To stretch financial and land conservation resources to expedite a source water protection program effort in the rapidly developing Central Texas region, any of the following opportunities can be implemented:

- Voter approved sales taxes and bonds
- Conservation development and development incentives
- Fee-in-lieu programs
- Stormwater drainage fees
- NGO partnerships
- NRCS and other state and federal land management programs
- Local and county criteria (buffer zones for water quality and floodplain protection)
- FEMA's Community Rating System for floodplain management and land conservation tools

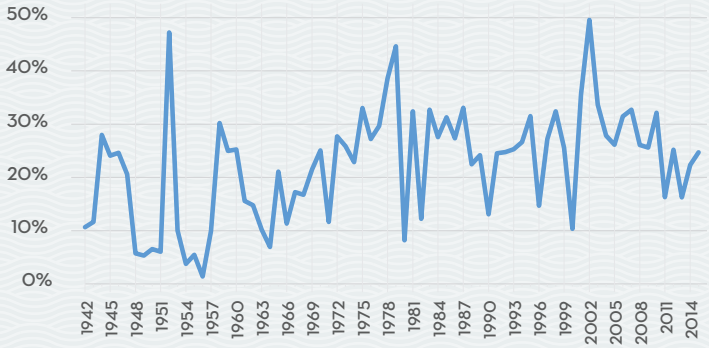
The above should be coordinated among utilities and local governments to leverage funds and provide numerous local benefits (where the conservation takes place) while preserving downstream water quality and supplies for all. To guide these numerous activities, the many partners in the Texas Hill Country Conservation Network or other entities may play an important role in developing and defining a program that can connect communities and utilities to lead this effort.

# Appendix 1 Pedernales River Watershed Land Prioritization Process

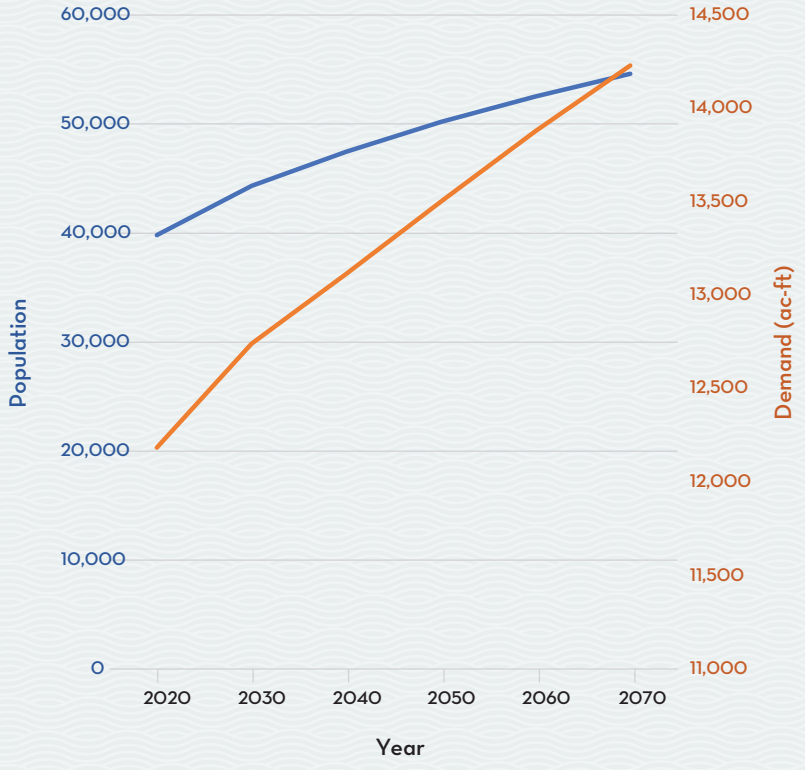
Charts, Maps, Data for the Assessment of the Pedernales River are found in this Appendix

The Region K Water Plan (2021) provided the following information on population growth and water demand increases in the Pedernales River basin.

**Percent Inflow to Lake Travis from the Pedernales River 1942 - 2015**




**Projected population growth and water demands in Blanco and Gillespie Counties combined**



## Gain/Loss Studies

Gain/loss studies were conducted on the Pedernales River in 1962 and more recently in 2016. Each gain/loss study acts as a baseline for future stream flow data for future comparison. During the study, a series of flow discharge measurements are acquired. The discharge data at the end of each reach is compared.

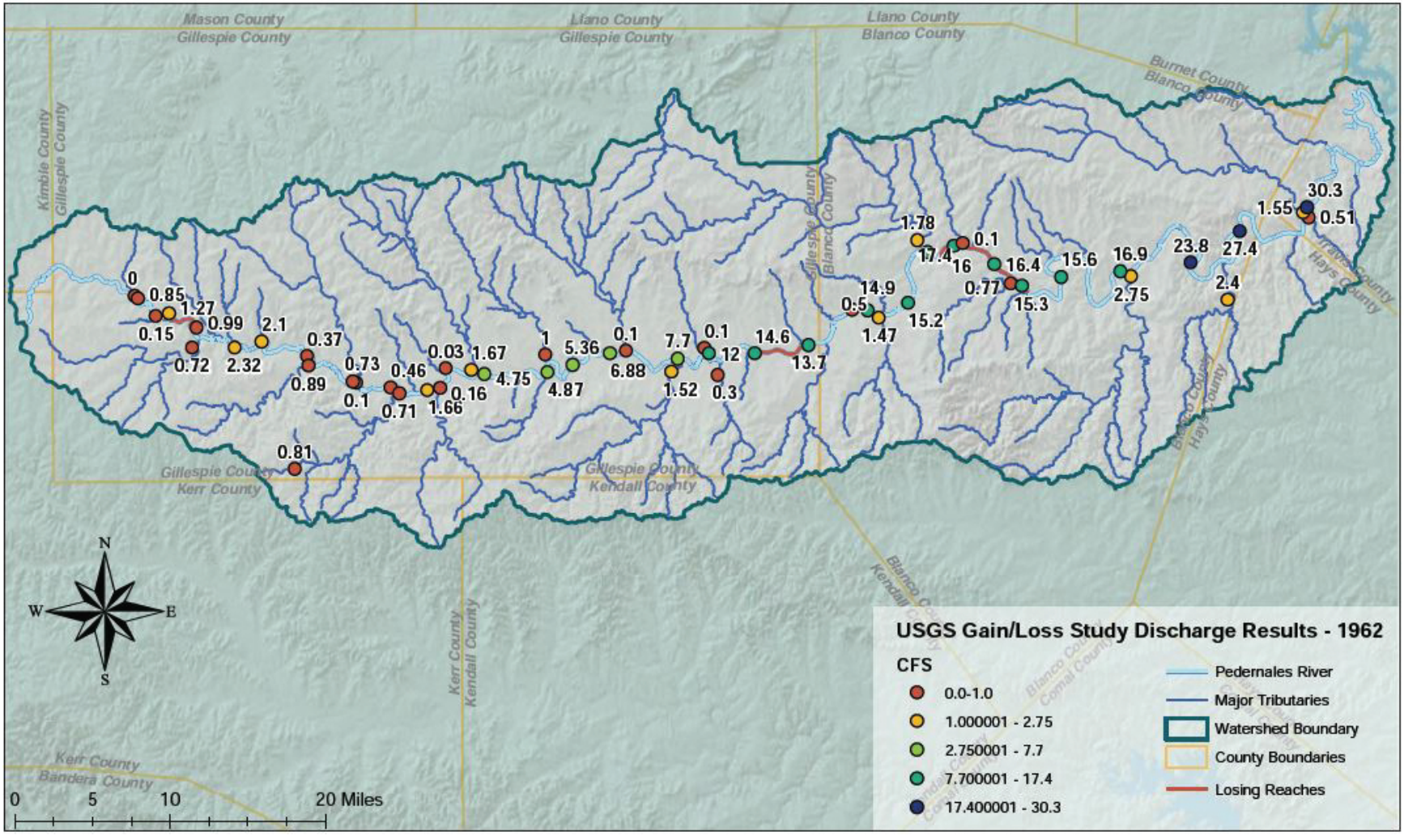
If the downstream measurement is greater than the upstream measurement, that section of stream is classified as a gaining reach. If the upstream measurement is greater than the downstream measurement, the reach is a losing reach. During baseflow conditions, gains are caused by groundwater discharge either through springs, seepage, or infiltration. Losses can be attributed to man-induced conditions such as increased pumping or to natural conditions such as local geology, transpiration or evaporation.

The few losing reaches south/southeast of Fredericksburg can be attributed to groundwater pumping since the city's well field is in that general location. The other various losing streams occur where surface water recharges the underlying aquifers through geologic recharge features.

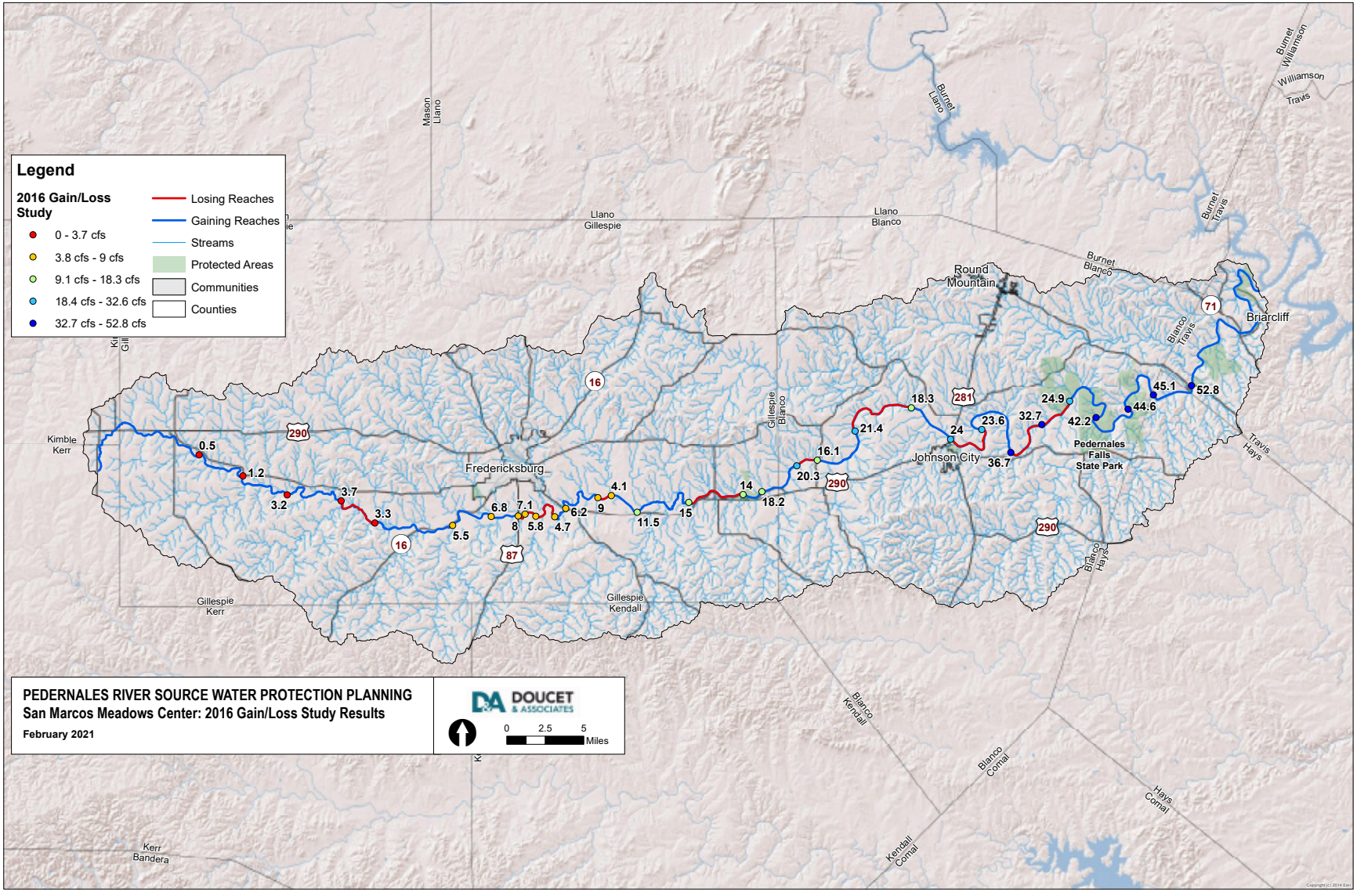
Significant gaining reaches are found east of Johnson City around Pedernales State Park and continue to Lake Travis. These are thought to be influenced by local geology, generally through spring flow. Overall, the Pedernales River is a gaining river. This study was critical in defining flow conditions in the watershed.

See Appendix 2: How Much Water Is in the Pedernales? Determining the Source of Base Flow to the Pedernales river in Northern Blanco, Hays, and Travis Counties, Meadows Center for Water and Environment at Texas State University, 2017

## 1962 USGS Gain/Loss Study Discharge Results



## 2016 Meadows Center for Water and the Environment Gain/Loss Study



## Appendix 1 Pedernales River Watershed Land Prioritization Process

### GIS Layer Scoring Weight

| Layer | Scenario | Pass/Fail | Importance | Weight |
|---|---|---|---|---|
| **Hensel Sands** | Pass/Fail based on C field | Pass: 5<br>Fail: 0 | High | 6 |
| **Land Parcel** | Land Parcel based on Area_ac_1 field | Parcel > 500 ac: 8<br>500 ac > Parcel > 200 ac: 4<br>Parcel < 200 ac: 0 | Moderate | 6 |
| **Stream Buffer** | Pass/Fail based on Area_sq_mi field | Pass: 5<br>Fail: 0 | Moderate | 6 |
| **Spring Buffer** | Pass/Fail based on dec_lat_va field | Pass: 5<br>Fail: 0 | Low-Moderate | 4 |
| **Slope** | Based on grid code field | Grid code 2: 16% – 78%; Slope: 5<br>Grid code 1: 0% – 15%; Slope: 0 | Low | 2 |

### LCRA Buffer Zones in Highland Lakes Watershed Ordinance

| Area Drained | Buffer Width (from centerline of stream) |
|---|---|
| 5 – 40 acres | 25 ft |
| 40 – 128 acres | 75 ft |
| 128 – 320 acres | 100 ft |
| 320 – 640 acres | 200 ft |
| Greater than 640 acres | 300 ft |

As an alternative to prescribed setbacks, the buffer can also be defined by the 100-year floodplain plus 25 feet on each side using fully-developed watershed conditions.

# Appendix 2 Reference Reports

The project team reviewed a number of reports and studies to inform this effort.
A listing of each study is provided below with the full summary following.

| Report/Study | Author/Date | Page |
|---|---|---|
| ***Advancing One Water in Texas*** | Cynthia and George Mitchell Foundation, 2018 | 52 |
| ***2020 Colorado River Basin Highlights Report: A Summary of Water Quality in the Colorado River Basin*** (Water Quality Summary) | Lower Colorado River Authority, 2020 | 52 |
| ***Beyond the Source: The Environmental, Economic and Community Benefits of Source Water Protection*** | The Nature Conservancy, 2017 | 52 |
| ***Ensuring One Water Delivers for Healthy Waterways: A Framework for Incorporating Healthy Waterways into One Water Plans and Projects*** | National Wildlife Federation, Meadows Center for Water and the Environment (MCWE), Pacific Institute, 2020 | 53 |
| ***How Much Water is in the Pedernales? Appendix A: Potential Conservation Strategies*** | Meadows Center for Water and the Environment at Texas State University (MCWE), 2015 | 53 |
| ***How Much Water is in the Pedernales? Appendix B: Pedernales Regional Sampling Information*** | MCWE, 2015 | 54 |
| ***How Much Water is in the Pedernales? Conservation Strategies, Management Approaches and Action Plan*** | MCWE, 2015 | 54 |
| ***How Much Water Is in the Pedernales? Determining the Source of Base Flow to the Pedernales river in Northern Blanco, Hays and Travis Counties*** | MCWE, 2017 | 54 |

| Report/Study | Author/Date | Page |
|---|---|---|
| *How Much Water Is in the Pedernales? Occurrence of Flowing Water and Water Quality During Base Flow Conditions in the Pedernales River Basin* | MCWE, 2015 | 55 |
| *Lakes Buchanan and Travis Water Management Plan and Drought Contingency Plan* | Lower Colorado River Authority, 2020 | 55 |
| *Linking Conservation and the FEMA Community Rating System: Tools to Protect Habitat, Enhance Coastal Resilience and Reduce Flood Insurance Rates* | The Nature Conservancy, 2021 | 55 |
| *New York City Drinking Water Supply and Water Quality Report* | New York City Department of Environmental Protection, 2019 | 56 |
| *Pedernales Watershed Strategic Conservation Prioritization* | Siglo Group, 2018 | 57 |
| *Region K Water Plan for the Lower Colorado Regional Water Planning Group, 2021* | Lower Colorado Regional Water Planning Group, AECOM, 2020 | 57 |
| *Toward a Regional Plan for the Texas Hill Country* | The University of Texas at Austin, Community and Regional Planning, 2016 | 58 |
| *Water Supply Resource Plan* | Lower Colorado River Authority, 2010 | 59 |

### *Advancing One Water in Texas*

**Cynthia and George Mitchell Foundation, 2018**

- One Water promotes the management of all water within a specific geography—e.g., drinking water, wastewater, stormwater, greywater—as a single resource that must be managed holistically, viably and sustainably.
- This report characterizes One Water, describes influencers of this water management shift, and outlines emerging challenges and opportunities.
- It also provides three "areas for action": promoting good policy, building across entities (or breaking them down), and mainstreaming successful pilots and demonstrations.

### *2020 Colorado River Basin Highlights Report: A Summary of Water Quality in the Colorado River Basin*

**Lower Colorado River Authority (LCRA), 2020**

- The Lake Travis Watershed is approximately 1,830 square miles comprised of the Pedernales River, Lakes Travis and Marble Falls. Growth and development have dramatically changed the landscape in the past 20 years. Despite this, water quality remains good and there are no impairments.
- Segment 1414 Pedernales River – The headwaters are located near Harper in Gillespie County. The river flows 125 miles through Fredericksburg, Stonewall and Johnson City before reaching Lake Travis. Data collected in 2019 shows the river meets all applicable water quality standards.

### *Beyond the Source: The Environmental, Economic and Community Benefits of Source Water Protection*

**The Nature Conservancy, 2017**

- Healthy source watersheds are vital natural infrastructure for most cities around the world. They collect, store and filter water, and provide benefits for biodiversity conservation, climate change adaptation and mitigation, food security, and human health and well-being. Unfortunately, 40 percent of source watershed areas show high to moderate levels of degradation. Nutrients and sediment from agricultural and other sources raise the cost of water treatment for users downstream, and loss of natural vegetation and land degradation can change water flow patterns leading to an unreliable water supply.
- Source water protection activities include targeted land protection (forests, grasslands, wetlands), revegetation (native plants), riparian restoration, agricultural and ranching best management practices (BMPs), fire risk management, wetland restoration and creation, and road management.
- Nature-based solutions used to improve water quality and quantity also maintain critical ecosystems and help reduce the carbon footprint of and build healthier, more resilient communities in the face of climate change.
- Generally, there is a lack of communication between urban water users and upstream landowners from where the water originates. The water fund, an institutional platform developed by cities and conservation practitioners, was developed to help resolve governance issues by bridging science, jurisdictional, financial and implementation gaps. It provides the framework for collective

action, connecting land stewards in rural areas and water users in urban areas to share in the value of healthy watersheds.

- The cost of source water protection could be covered by revealing benefits to diverse payers through the business case for water funds. The report analyzes the relative water treatment return on investment (ROI) for the roughly 4,000 cities in the source watershed model and compared them to relative values of co-benefits such as climate change mitigation, biodiversity, and human health and well-being. Public funding will continue to be critical to source water protection efforts.

### *Ensuring One Water Delivers for Healthy Waterways: A Framework for Incorporating Healthy Waterways into One Water Plans and Projects*

**National Wildlife Federation, Meadows Center for Water and the Environment (MCWE), Pacific Institute, 2020**

- To realize the full potential of the One Water approach, planners should explicitly acknowledge and quantitatively assess potential threats to healthy waterways and incorporate actions to protect river flows downstream for the benefit of people and the environment.
- Four steps to successfully implement One Water strategies include the following: 1) create a community vision for healthy waterways, 2) identify benefits and trade-offs of advancing healthy waterways locally, 3) evaluate key benefits and trade-offs of healthy waterways, and 4) use the healthy waterways framework to inform decision-making.

### *How Much Water Is in the Pedernales? Appendix A: Potential Conservation Strategies*

**Meadows Center for Water and Environment at Texas State University, 2015**

- Management Measures are categories that each contain conservation practices (also known as BMPs) that can be cooperatively implemented to achieve water quality and water quantity goals and standard. Agricultural Management Measures, for example, contain conservation strategies such as fencing riparian areas, grazing management strategies, etc.
- Each conservation strategy in the document includes descriptions, details, cost, pollutants treated, existing operational support, and complimentary strategies.
- The document also contains land management controls and ordinances, water use management, management of vegetation and invasive species, water and riparian area management, and educational and technical assistance.

### *How Much Water Is in the Pedernales? Appendix B: Pedernales Regional Sampling Information*

**Meadows Center for Water and Environment at Texas State University, 2015**

- Volunteers for a "hydro-blitz" were given regional maps and field sheets to record observations at various points where a road intersects any type of water body. This document contains the regional sampling information and data collected from the volunteers.
- Landowners across the region were contacted with requests to access any springs or wells on the property. This led to water quality samples being taken at multiple ranches, parks and private properties throughout the watershed.
- The information in this study provided the groundwork for the gain/loss study conducted in 2016.

### *How Much Water Is in the Pedernales? Conservation Strategies, Management Approaches, and Action Plan*

**Meadows Center for Water and Environment at Texas State University, 2015**

- This report outlines the various threats to the Pedernales watershed such as invasive species, wastewater discharges, sand and gravel operations along the river that impair water quality, land use, management practices, and construction methods that cause downstream water quality and sedimentation issues.
- To counter the threats, conservation and management measures are suggested as next steps to initiate activities that manage water use and natural resources to benefit the river.

### *How Much Water Is in the Pedernales? Determining the Source of Base Flow to the Pedernales River in Northern Blanco, Hays and Travis Counties*

**Meadows Center for Water and Environment at Texas State University, 2017**

- Stream flow gain/loss studies performed in 1962 and 2016 on the Pedernales River have indicated significant gains to base flow in the main channel along the reach from Johnson City to the confluence of the river with Lake Travis. A synoptic groundwater level measuring event was conducted to determine if groundwater inflows played a significant role contributing to the gains. If so, potential river management actions may be identified to maintain the current level of flow into the river.
- The study area included an area roughly bounded by Cypress Mill Road, Hammett's Crossing, County Road 2766 and State Highway (STH) 281 on the north, east, south and west, respectively. The reach encompasses approximately 32 miles of river, primarily in Blanco County.
- The results of this study confirm that the groundwater from the Paleozoic and Cretaceous Aquifers contribute significant base flow to the Pedernales River and Lake Travis in the study area. Approximately half of the inflow into Lake Travis from the Pedernales River originates in the study area, or approximately 12 percent of the total inflow into Lake Travis. Shallow depths to groundwater and apparently high-modeled recharge rates indicate the Paleozoic strata, primarily on the northern side of the river, contribute the majority of the inflow to the river. Future groundwater management actions in this area need to consider the importance of this area to maintaining adequate water supplies.

### *How Much Water Is in the Pedernales? Occurrence of Flowing Water and Water Quality During Base Flow Conditions in the Pedernales River Basin*

**Meadows Center for Water and Environment at Texas State University, 2015**

- Springs and streams originating in the Edwards and Glen Rose Aquifers appear to provide most of the main channel base flow in the western part of the Pedernales Basin. The Paleozoic and Trinity Aquifers contribute to base flow in the eastern basin area.
- Overall, the Pedernales is a gaining river though there are losing reaches where the surface water recharges the underlying aquifers.
- In general, water quality in the river under base flow conditions is good. While there have been changes in water quality, at least partly due to human impact, there have not been significant changes since a comparable study in the 1960s was performed.

### *Lakes Buchanan and Travis Water Management Plan (WMP) and Drought Contingency Plan*

**Lower Colorado River Authority, 2020**

- A framework created by LCRA to meet "firm" water needs (cities, businesses, industries, etc.), downstream "interruptible" agricultural demands, and environmental flow needs.
- The WMP determines when and how to cut back the available supply of interruptible stored water as needed to protect firm water demands through a repeat of the drought of record.
- Three sets of operating conditions are set to determine the availability of interruptible stored water which is used by agricultural customers in Colorado, Wharton and Matagorda counties. March 1 and July 1 are set to determine the amount of interruptible stored water available for first and second crops. Combined storage, recent inflows, and environmental flow criteria are all reevaluated on specific dates throughout the year as well.
- The WMP is updated periodically and reviewed and approved by the Texas Commission on Environmental Quality (TCEQ).

### *Linking Conservation and the FEMA Community Rating System: Tools to Protect Habitat, Enhance Coastal Resilience and Reduce Flood Insurance Rates*

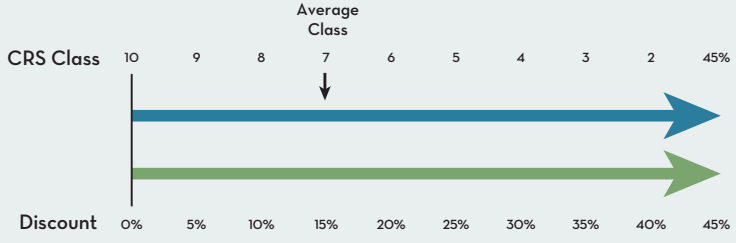
**The Nature Conservancy 2021**

- As Community Rating System (CRS) points and green spaces increase in a community, flood risks and flood insurance premiums decrease for the citizens in that community.
- CRS points can be earned by protecting any part of the floodplain as open space, which is defined as "free from buildings, filling, paving or other encroachment to flood flows." Bonus points are available for protecting areas of the floodplain that are currently or have been restored to predevelopment conditions (e.g., wetlands, riparian habitats, etc.).
- Five primary nature-based solutions are: open space protection, habitat restoration, species/habitat conservation plans, buyouts, and smart development.
- The open space protection option could be aligned with riparian buffer zones, floodplains and conservation easements to enhance the potential of local governments to consider the CRS as a floodplain management and water resource protection program and generate flood insurance savings.

### THE CRS CLASS SCALE

**Most CRS communities are rated Class 9 or 8, designations that provide a 5 or 10 percent discount, respectively, to their residents. The average number of total points awarded to a community is 1,947 out of a possible 12,304. However, a community needs just 4,500 points to qualify as Class 1 and receive the highest possible discount of 45 percent.**

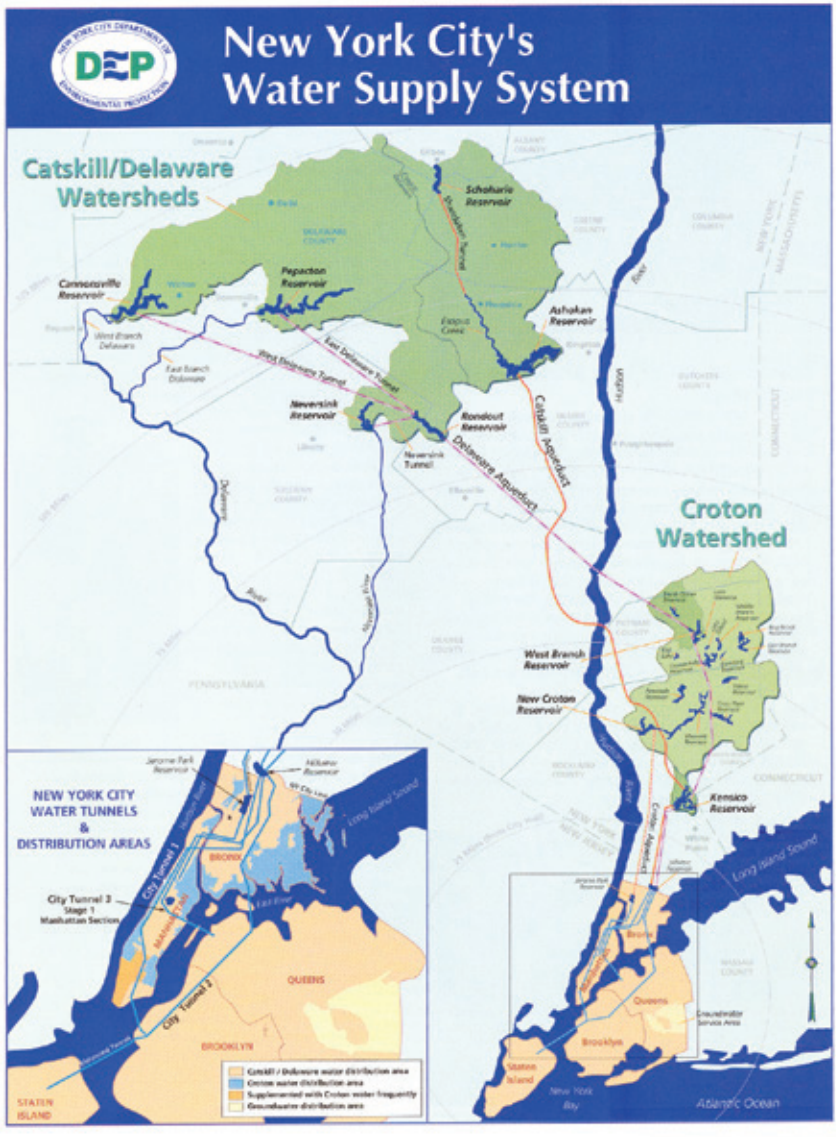
**Many communities do not apply for or receive credit for as many activities as they could to reduce flood hazards and reduce flood insurance premiums.**




## *New York City (NYC) Drinking Water Supply and Quality Report*

### New York City Department of Environmental Protection, 2019

- New York City's water supply system provides more than one billion gallons of safe drinking water every day to more than 8.4 million residents of New York City; one million people living in the counties of Westchester, Putnam, Orange and Ulster; and more than 60 million tourists and commuters who visit the five boroughs throughout the year. In all, the system provides high-quality drinking water to nearly half the population of New York State.
- NYC gets its drinking water from 19 reservoirs and three controlled lakes. Catskill/Delaware and Croton are the two primary sources of water supply.
- Due to the high quality of the Catskill/Delaware supply and land protection measures, NYC is one of five cities in the country that does not utilize filtration as a form of treatment for the surface drinking water supply.
- Although New York City has grown by more than one million people since 1980, demand for water has dropped by approximately 35 percent—making it one of the most water-efficient large cities in the country. New York City is committing more than $20 billion to upgrading infrastructure over the next decade.




## *Pedernales Watershed Strategic Conservation Prioritization*

### Siglo Group, 2018

- Identifies lands that will maximize the efficiency and success of conservation investments within the watershed.
- The prioritization in the report uses a repeatable, procedural model within Geographic Information System (GIS) to delineate the geographic distribution of conservation resources and their significance. The result is a set of prioritized areas that are suitable for immediate conservation action.
- The study evaluated 819,370 acres of the Pedernales Watershed for hydrological, ecological and cultural significance. The findings isolate 160,420 acres deemed to be of the highest conservation value.

## *Region K Water Plan for the Lower Colorado Regional Water Planning Group (2021)*

### Lower Colorado Regional Water Planning Group, AECOM, 2020

- The Plan includes a description of the region, population and water demand projections, water supply analyses, water management strategies for ensuring supplies during drought of record conditions, water conservation and drought management plans, consistency with the state's long-term resource protection goals, policy recommendations related to improving water management and preserving the environment, and public involvement activities.
- The scope of work in the water plan was prepared through a public process and is separated into 11 different tasks.
- Blanco County water demand is projected to increase from 2,123-acre feet per year (AFY) in 2020 to 2,370 AFY in 2070. Over the same time frame, the population is projected to increase

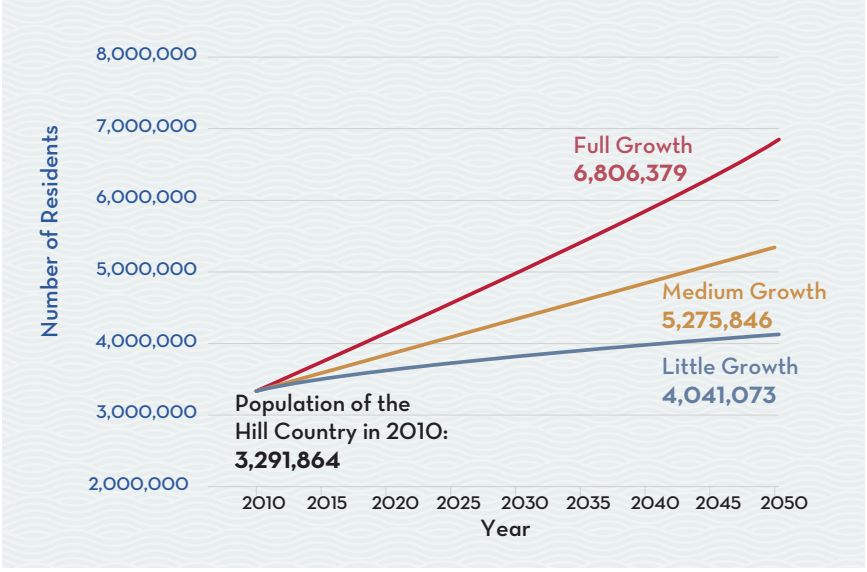
from 6,703 to 8,903. Recommended strategies include direct reuse, brush management and municipal conservation.

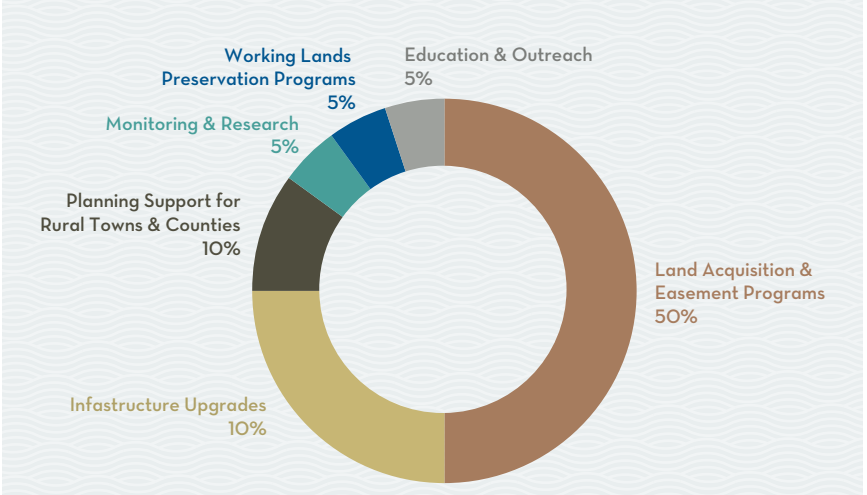
- Gillespie County water demand is projected to increase from 8,658 AFY in 2020 to 10,077 AFY in 2070. Over the same time frame, the population is projected to increase from 26,795 to 36,142. Recommended strategies include direct reuse, brush management, irrigation conservation and municipal conservation.
- The primary water supply is local groundwater from the Trinity and Ellenburger aquifers.

## *Toward a Regional Plan for the Texas Hill Country*

### The University of Texas at Austin, Community and Regional Planning, 2016

- The study notes that rapid population growth, land fragmentation and sprawling development are threatening the region's scenery, wildlife habitats, water supplies and natural resources.
- A new relationship is suggested between the Hill Country and the Austin-San Antonio corridor that could finance a program of land conservation, stewardship and resource protection in the Hill Country.
- As population and economic growth continue in the Austin-San Antonio corridor, a small portion of the increase in economic value, along with other funding sources (water rates, bonds, fees, sales taxes) could be used to finance key infrastructure investments as well as the land conservation measures in rural areas such as the purchase of conservation easements and the protection of water resources. Large and small cities would benefit through enhanced water supplies.




*Source: Toward a Regional Plan for the Texas Hill Country*

### *Water Supply Resource Plan*

**Lower Colorado River Authority, 2010**

- The purpose of the Water Supply Resource Plan (WSRP) is to establish an overview of possible strategies and options LCRA may choose to pursue in the future to help meet projected future firm water needs in the lower Colorado River basin through the year 2100.
- More than 20 water supply options were studied and are summarized in the report. Options range in price and time of implementation and from water conservation to major water supply reservoirs.
- Options investigated in the Pedernales River watershed included brush management/potential inflow to Lake Travis and brush management with groundwater recharge.
- The report also lays out next steps to take to meet water needs within LCRA's water planning area for the near-term (2010 – 2020) and for the mid- to long-term (2020 – 2100).

texas hill country
conservation network

This report is a product of the Texas Hill Country Conservation Network in association with these valued partners.

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